MESOZOIC INVERTEBRATE FAUNAS OF PERU

PART 1. GENERAL INTRODUCTION
PART 2. LATE TRIASSIC GASTROPODS FROM CENTRAL PERU

OTTO HAAS

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MESOZOIC INVERTEBRATE FAUNAS OF PERU

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OTTO HAAS

Associate Curator of Fossil Invertebrates
Department of Geology and Paleontology

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PART 1. GENERAL INTRODUCTION

THE RESEARCH PROJECT

THE RESEARCH PROJECT here under consideration originated in 1941, when Dr. William F. Jenks, now of Rochester University, entrusted, on the recommendation of Prof. Percy E. Raymond of Harvard University, rich collections of fossils from the Cerro de Pasco and adjacent areas of central Peru to this writer for study. Dr. Jenks, then a geologist with the Cerro de Pasco Copper Corporation, had collected the fossils in the course of his geologic field work in central Peru, supported by a grant from the American Philosophical Society. He later donated them to the American Museum of Natural History, and they are hereinafter named the Jenks Collection.

Further field work carried out from 1943 to 1947 in various parts of Peru by Dr. Norman D. Newell, of the American Museum of Natural History and Columbia University, and some of his students, by Dr. Jenks, and by Dr. Bernhard Kummel, Jr., now of the University of Illinois, yielded more fossil materials that greatly increased the American Museum's collections from Peru (Dr. Kummel's as a permanent loan). Some valuable specimens were, furthermore, added to these collections through the courtesy of Dr. Jorge Broggi, Director of the Instituto Geologico del Perú.

A considerable part of the fossils collected by Newell are Paleozoic in age; those collected in 1947 have separately been published (Newell, Chronic, and Roberts, 1949). Some Tertiary fossils (from the Calera limestone) are included in the Jenks Collection, but most of it is of Mesozoic age, as are Kummel's collections from northern Peru (Kummel, 1950), Newell's from the Lake Titicaca region (Newell, 1949), and Jenks' from the Arequipa region of southern Peru (Jenks, 1948). It is these collections that come within the scope of the present project.[1]

Work on these collections has been, and is still to be, divided up among several specialists. Kummel will concentrate on Triassic cephalopods. Newell has taken charge of the pelecypods, and John W. Wells of Cornell University will study the Anthozoa and Porifera. The writer has studied the post-Triassic cephalopods[2] and the late Triassic gastropods from central Peru (published simultaneously as Part 2 of this series) and hopes to finish the study of those from Suta in northern Peru. Dr. G. A. Cooper has been requested to take charge of the brachiopods which are, at least within the Jenks Collection, second only to the mollusks in abundance and importance, but has not yet felt in a position definitely to accept.[3] The crinoids, echinoids, and other echinoderms are still awaiting a specialist to undertake their study. The plan is to publish the results of the respective studies, preferably in the Bulletin of the American Museum of Natural History, as a series of monographs and shorter papers.

Preliminary notes on the subject of this General Introduction were published some years ago in Nature and Science (Haas, 1947, 1947a). Some recent publications on the geology of Peru, connected in one way or another with the present project, are mentioned above and are listed in the Literature Cited. To them and to Steinmann (1929) reference may be made for previous geologic literature. Previous geologic and paleontologic work relating to individual areas and faunas is to be dealt with in the following parts of this series. However, Knechtel, Richards, and Rathbun's (1947) publication should here be mentioned, if for no other reason than the similarity between its title (which would perfectly cover the Jenks Collection) and that of the present series. However, the two publications are by no means coextensive. Cretaceous invertebrates dominate in the Johns Hopkins publication; Triassic and, to a somewhat lesser extent, Jurassic, in the collections here dealt with.

The present writer is responsible for the English versions of quotations from French, German, and Italian.

[1] Some late Cretaceous and early Cenozoic Charophyta collected by Newell in the Lake Titicaca region have since been published by Peck and Reker (1947).

[2] Their identifications have been utilized by Newell (1949, p. 44) and indirectly by Jenks (1948, p. 145).

[3] A preliminary paper on the occurrence of the interesting genus *Spondylospira* has been published by Vokes and Haas (1944).

THE JENKS COLLECTION

Fossil Localities

THE IMPORTANT RESULTS of the geologic work, in the course of which Jenks collected these fossils, were published recently (Jenks, 1951). Reference is made to his paper for the geology of the region and for its bibliography which is of course the most up to date of all those available.

Originally the Jenks Collection consisted of altogether 96 lots, 87 of which reached the American Museum of Natural History. Of the latter, one contains a single plant, believed to be Cretaceous in age, and four[1] are from the Tertiary Calera limestone; these five lots thus do not come within the scope of this series. Another lot contains no fossils worthy of study. Deduction of these six lots leaves 81 of the 87 received. In addition, a boulder from the Shuco limestone conglomerate contains important fossils; these are designated no. 49 by Jenks, as distinct from his lot 49. Thus fossils from altogether 82 localities of central Peru can be expected to be dealt with in this series.

On the writer's request, Dr. Jenks most kindly undertook the insertion of the numbers of the fossil lots in his Geologic Map of the Region around Cerro de Pasco (Jenks, 1951, pl. 1; map 1 of this paper). Localities within the limits of his Geologic Map (scale 1:100,000) are found in this map; localities beyond those limits, including the important lots 48 and 92 and no. 49, can be found in his Index Map (scale 1:2,000,000) only. However, lot 61, collected 8 kilometers northeast of Tingo Maria, a town about 190 kilometers north-northeast of Cerro de Pasco, is far beyond the boundaries even of the Index Map. We are greatly indebted to Dr. Jenks and to the Geological Society of America for permission to reproduce the map and to Dr. Jenks in particular for the insertion of the numbers of the fossil localities. The elevation of most of these localities is about 4000 meters.

Stratigraphy

The vertical sequence of the various lots, most of which were collected from the Pucará group, is not recognizable in map 1.[2] I am indebted to Dr. Jenks also for data on the superposition of the various lots.

Lithologic and Faunistic Characteristics of Lots

Although from one stratigraphic unit, the Pucará group, the lots vary widely both in lithologic facies and faunistically. In the former respect Jenks' characterizations of the various lots could in most cases be corroborated in the laboratory, especially in the course of the chemical preparation.

Lithologically, the following groups of lots are distinguishable:

Dark gray, on fresh fractures nearly black, "*Myophoria*"[3] limestones, with fossils only partly silicified.[4] In Jenks' eastern facies they are typically represented by lots 2, 3, 19 to 21, 28, and 81 to 83; among the lots of the western facies lot 37, and among those of the eastern facies lot 40, may also belong here.

Dark gray, mostly bituminous limestones,[5] with fossils silicified; they sometimes contain "*Myophoria*," but seem faunistically to be best characterized by the brachiopod genus

[1] However, one of these (lot 1) may be of late Triassic age as well.

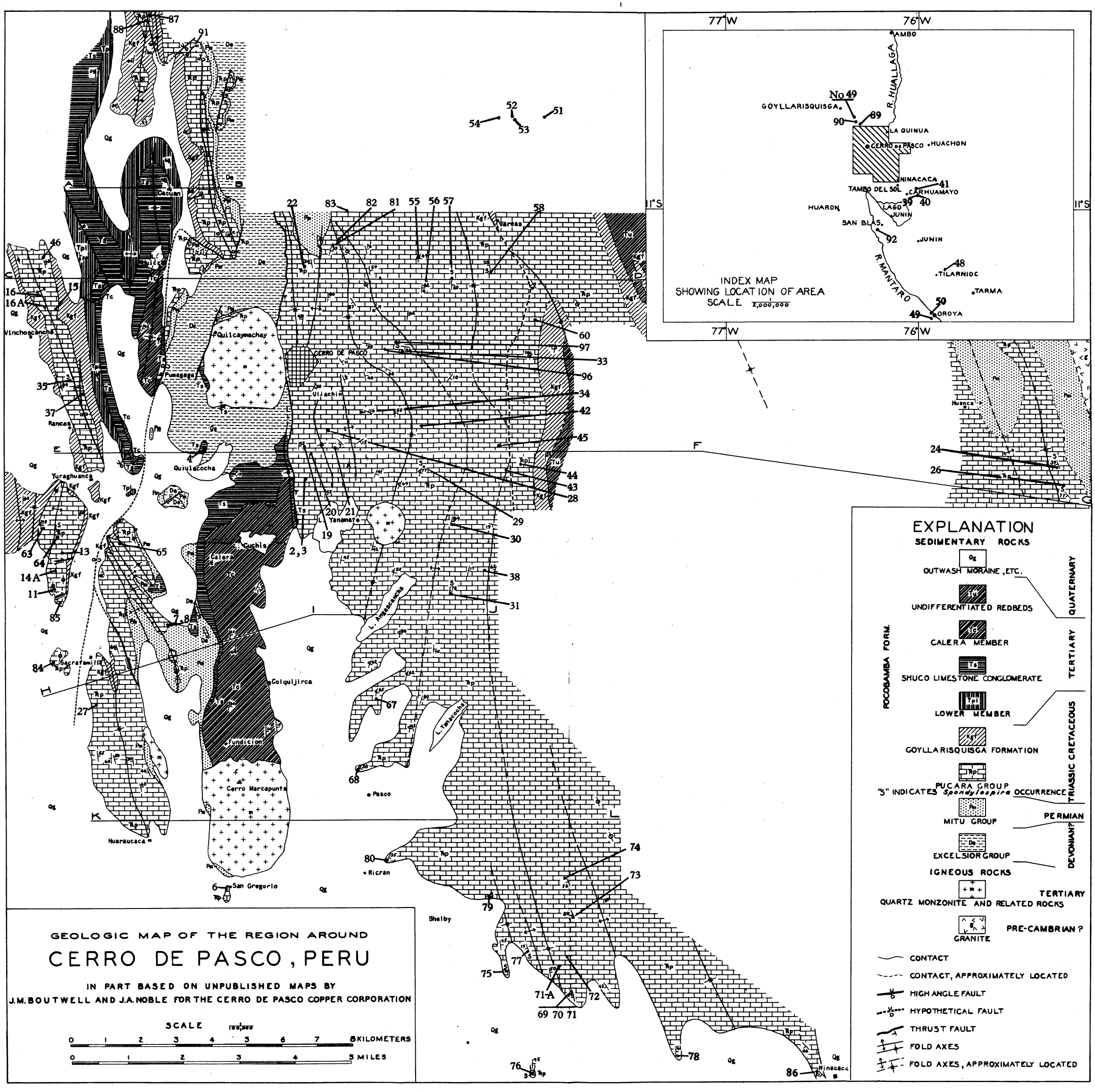
[2] The following two groups of lots are for all practical purposes from the same location each: 7 and 8; 69, 70, and 71. The following groups comprise lots topographically close to one another: 11, 13, and 14A; 15, 16, and 16A; 24 and 26; 39 and 40; 43 and 44; 52 and 53; 71A and 72; 87 and 88. However, this does not necessarily mean that all the lots collected at the same locality or at adjacent localities are also from the same horizon.

[3] It may be doubted if the pelecypods so designated throughout the previous literature are not *Trigoniae* instead. A decision whether they should be referred to *Myophoria*, to *Trigonia*, to a subgenus of one or the other, or to a new genus may be expected from Newell's forthcoming report on the pelecypods of the Jenks Collection. In the meantime, the generic name *Myophoria* is used in quotation marks throughout this report.

Addition, February, 1952: Since the above was written, the new generic name *Myophorigonia* (type species, *Myophoria paucicostata* Jaworski, 1922, p. 126, pl. 5, figs. 9–11) has been proposed for these forms by Cox (1952, Proc. Malacol. Soc. London, vol. 29, pts. 2, 3, p. 52).

[4] In the attempt at chemical preparation the matrix was readily dissolved by the (diluted) hydrochloric acid, but after some time the fossils, too, were attacked by it.

[5] Probably identical with the "very dark bituminous limestones" stated by Boit (1949, pp. 2, 12) to overlie the Norian limestones.



MAP 1. Geologic map of the region around Cerro de Pasco, Peru. After Jenks (1951), supplemented by fossil localities.

Spondylospira and the gastropod genera *Chartroniella* and *Sororcula*. Typical representatives of this group are lots 29, 33, 67, 96, 97, and no. 49. In the eastern facies lots 22, 31, 34, 38, 42, ?45, 51 to 53, and 56 to 58 may also belong to this group, and the same may tentatively be assumed for lots 15, 35, 89, and 91 of Jenks' western facies. In the course of chemical preparation, lots 29, 33, 67, and no. 49, especially, emanated a strong bituminous odor.

Lighter, more or less pure limestones whose color may be gray, light buff, gray buff, or brown[1] but which are by no means uniform lithologically. This group includes among others those lots from the Shelby-Ninacaca-Tambo del Sol area which have yielded the richest gastropod assemblages (Jenks, 1951, p. 208), namely, 70, 71, 78, and 86.

In abundance and composition of the gastropod fauna lot 48 from 4 kilometers east of Tilarnioc (about 80 kilometers from Cerro de Pasco to the southeast) comes close to the lots just mentioned, although it has also some features in common with those from the bituminous limestones, and its matrix, a gray limestone, is also similar to that of the former lots. Lot 26, from near Huachon, faunistically the most puzzling, seems to occupy a position of its own lithologically also; it seems to be somewhat intermediate between the pure and the bituminous limestones.

With regard to faunal composition, even more variation than lithologically is found in the predominance of certain groups of fossils within the several lots. In the Pucará group on the whole gastropods may be said to be most abundant. Pelecypods and brachiopods are next in abundance, but crinoid stem links and echinoid spines also occur in many lots, whereas corals and sponges seem to be restricted to comparatively few. Stratigraphically most important, and deplorable, is the fact that not a single ammonite or other cephalopod or fragment thereof was found, among several tens of thousands of specimens, in any of the lots examined.

In many of the lots predominance of one or the other of the groups enumerated above is clearly noticeable. Thus gastropods predominate in lots 21, 26, 48, 70, 71, 78, 86, 87, 91, and in no. 49, and pelecypods in lots 2, 3, 6 to 8, 15, 28, 40, 44, 45, 51, 55, 56, 60, 67, 72, and 81 to 83; they are quite common in two of the most important "gastropod lots," viz., 48 and 86, also. Brachiopods predominate in lots 14A, 16A, 24, 29, 31, 35, 52, 57, 75, and 79 and are common in lot 54 also. Echinoid spines predominate in lots 11, 16, 58, 74, 76, and 77 and are furthermore quite abundant in lots 14A, 26, 31, and 35. Crinoid columnals are the most common fossils in lots 73 and 97 and quite abundant also in lots 26, 53, and 86. Corals predominate in lot 53, and sponges in lots 38 and 54; microscopic sponge spicules are abundant in lot 48.

[1] In lots 71 and 71A only.

Chemical Preparation

From the above survey of the lots it can readily be seen that most of the fossils in the Jenks Collection are silicified and thus lent themselves well to chemical preparation. After some early, not too successful attempts in 1943, etching was resumed with much improved facilities in the spring of 1946. The acid preparation of most of the lots present and the sorting of the residues took two years; it may be said to have yielded undreamed-of results. From a merely quantitative angle it resulted in a multiplication of the several hundred specimens that were originally visible on the surfaces to a total that could not be counted but that from the counted total of gastropods can conservatively be estimated as of the order of magnitude of one hundred thousand. This increase made itself felt in the number not only of individuals but of taxonomic units represented. Thus I could distinguish about 15 gastropod genera as long as my knowledge was restricted to what was visible on the surfaces of the pieces of rock sent in by Jenks. However, after acid preparation was achieved, the study of the gastropods revealed the presence of 62 genera, or altogether 70 supraspecific units (that is, genera and subgenera, excluding the only, or first, subgenus in every genus). It was this tremendous increase in material due to etching that compelled the writer to abandon his original intention, shared by Jenks, to take charge of all the invertebrates in the collection and enforced the division of the work as mentioned above.

PART 2. LATE TRIASSIC GASTROPODS FROM CENTRAL PERU

INTRODUCTION

THE STUDY OF THE GASTROPODS was begun as early as 1942 and was carried on through the following years with many and often long interruptions. Only since 1947 has the writer been able to concentrate more and more on this work. The descriptive part (Systematics) was concluded late in 1950.

MATERIAL

Of the 87 lots (including Jenks no. 49, see p. 4) of the Jenks Collection, only the 37 listed at the top of chart 1 yielded gastropods. By chemical preparation (see Part 1) the total number could be increased to about 16,500; of these only about 90, mostly fragments, or about one-half of one per cent of the total, had to be considered not determinable. As mentioned by Kummel (1950, p. 256), this writer has begun the study of Kummel's rich gastropod collections from Suta in northern Peru also, but since their chemical preparation has not yet been completed, it was deemed unwise to include them in the present report. A single exception was made for the species hereinafter provisionally named *Andangularia* aff. *subarmatae* Jaworski, represented by a few isolated specimens in three of Jenks' lots, but much more abundantly in the material from Suta. A few specimens from the latter locality are therefore referred to below, and one is figured (p. 182, pl. 11, figs. 33–35).

Acid preparation made not only for a tremendous increase of specimens available for study but also yielded many of excellent preservation. As an illustration of this, it might be mentioned that several visiting students, among them expert paleontologists, estimated the age of the fauna at first sight as "late Tertiary or so."

In particular, etching produced new evidence for the long and well-known fact that the gastropod shell consists of three layers (see Zittel, 1913, p. 517, and especially Johnson, 1949, p. 100[1]). The middle layer is frequently, if not commonly, silicified to a lesser degree than the outer and inner layers and proves therefore less resistant to hydrochloric acid. Thus in not a few cases the space between outer and inner layers is more or less empty. Sometimes it is filled by small quartz crystals which are, however, much too large to be considered a pseudomorphosis after the microscopic prisms of calcium carbonate mentioned by Johnson. Such quartz crystals are well visible, for example, in *?Lepidotrochus* sp. indet. (pl. 2, figs. 23, 24, 29), where the interval between outer and inner layers becomes unusually wide in the body whorl and is filled in druse fashion by the crystals. Thanks to the presence of such crystals or to partial preservation of that middle layer, the shell remains in most cases coherent despite the former's diminished or lack of acid-resistance. In the genus *Chartroniella*, however, separation of outer and inner layer is sometimes so complete that an inner cone can be freely rotated in an outer one (see p. 80).

From the tables of dimensions and explanations of plates the reader will readily gather the extremely small size of most of the gastropods here dealt with. Their average size is incomparably smaller than in the classic St. Cassian fauna, often considered as a dwarfed one. Only among Assmann's (1924) illustrations can similarly small specimens be encountered. The smallness of so many of the gastropods studied necessitated extensive use of the microscope and recourse to micropaleontologic techniques in this "macropaleontologic" investigation (see Triebel, 1947, p. 2). For a paleoecological evaluation of the small size of most of the gastropods here dealt with, reference is made to the Conclusions.

PREVIOUS LITERATURE

The geology of the regions of central Peru in which these gastropods were collected has been studied by Steinmann (1929) within the framework of his geological survey of Peru and in more detail by Boit (1940, 1940a, 1941, 1945, 1949), Harrison (1943), and Jenks (1949, 1951). Ruegg (1947) refers to the regions and formations of interest for this investigation in the comparative table on the formations of Peru.

[1] "The shell [of gastropods] consists of an organic base impregnated with calcite or aragonite. Usually there are three layers of calcareous matter, each of which is formed of very thin laminae. These are composed of microscopic prisms of calcium carbonate oriented obliquely to the surface of the shell but with a different orientation in each lamination."

The paleontological literature with an immediate bearing on the subject of the present report is, however, restricted to a few titles. Jaworski, after a preliminary paper (1920) in which he gave faunal lists including 13 gastropod species, dealt explicitly (1923) with those species, among others he had determined in Steinmann's fossil material. The latter used and republished Jaworski's results in the "Geologie von Peru" (1929). Körner (1937) described and illustrated the fossils collected by H. Kinzl on the Nevado de Acrotambo; and Cox (1949) some of those collected by Harrison in the Cerro de Pasco region. The last publication compelled me to rename two species on which work had been concluded considerably earlier and to relegate their designated types to the rank of "commoners," and to rewrite the discussions on several other species. In the course of my work on the present fauna I presented orally three papers on it (abstracts listed as Haas, 1946, 1948, and 1950). In the first of these a most tentative preview was given, in the last a concluding one, while the 1948 paper dealt with a phylogenetic problem, viz., the early stage of divergence between the two new genera *Hesperocirrus* and *Sororcula*.

TAXONOMIC AND BIOMETRIC PROCEDURES

The scarcity of previous paleontologic reports made this investigation appear to be largely directed into "terra incognita" and thus increased the writer's taxonomic responsibility, so that I proceeded with the utmost caution in the naming of new species.

To secure a reliable biometric basis for species distinctions, innumerable specimens (up to about 150 in the most abundant forms) were measured. By no means all of these measurements are included in this report. Wherever two or more specimens of approximately the same size essentially agree in dimensions, the measurements of only one, or of two at the most, are found in the tables preceding the species descriptions. Where, on the other hand, specimens of approximately the same size differ in dimensions, up to five or more of the same total height are included in the tables to show the range of variation in dimensions.

On the strength of the shell shape alone, species are distinguished only when a clear break in one or more dimensions is exhibited between them. Where, however, the differences between the extreme values of dimensions are more or less continuously bridged by intermediates, all the individuals are left in one species. Within some species (e.g., *Omphaloptycha jaworskii*, p. 137, and *Cylindrobullina vespertina*, p. 259) definite morphologic groups can be distinguished, but they are not granted any taxonomic standing as subspecific units. Thus the use of taxonomic varieties could be dispensed with. No geographic subspecies of species first described from other parts of the globe were encountered in the present material.

This procedure reduced the number of new species named, as did the extensive use of "open nomenclature," such as the designation "new species" but without name, "sp. indet.," or simply "sp.," wherever preservation and other conditions seemed not to justify a new name. These precautions could not, however, prevent the naming of most of the species as new, as might be expected in the first monographic treatment of a hitherto largely unknown fauna. Six trivial names given by Jaworski, Körner, and Cox to Peruvian species, one name given to a species from northwestern Argentina by Bonarelli, and six names of St. Cassian species (two of these only doubtfully) can be applied to species described in the present report. Furthermore, the names of three St. Cassian and/or Marmolata species and of one species from the Liassic of France are used with "cf." and those of a species of Jaworski's from Suta (northern Peru), of two from the Hallstatt limestones, and of two from St. Cassian, with "aff."

Of supraspecific taxonomic units, new subgenera (*Eosolariella*, *Eocalliostoma*) are proposed where a group of species appears to call for a taxonomic name of its own within a given genus, and new genera (*Pareuryalox*, *Hesperocirrus*, *Sororcula*, *Andangularia*, *Kitlistylus*, *Consobrinella*) only where it was felt that forms of the material under study, by themselves or with others previously described, could not possibly be accommodated within any existing genus. Finally, the two new cirrid genera *Hesperocirrus* and *Sororcula* deviate, chiefly by their peculiar embryonic characters, so distinctly from other Cirridae that creation of a separate subfamily (Hes-

perocirrinae) for them appears to be warranted. All these new subgeneric, generic, and subfamily names add up to a total of nine, or about 8½ per cent of all the supraspecific names used in the present report.

Except in such instances as are explained in the section on Systematics, the taxonomic sequence of Wenz' (1938–1944) handbook has been followed throughout.

REMARKS ON TERMINOLOGY

Nucleus

Whereas Cossmann (1895, pp. 9–18) and Wenz (1938, pp. 12, 13) use the terms "sommet embryonnaire" and "Embryonalgewinde," respectively, for the embryonic volutions of a gastropod shell and reserve the term "nucleus" for the rounded initial bubble on the apex, Shimer and Shrock (1944, p. 435)[1] prefer to call the latter the "protoconch" and use the term "nucleus" for all of the embryonic shell. Terminologically, it would seem more correct to restrict the term "nucleus" to what Shimer and Shrock call the "protoconch" and to use these two terms synonymously, but to speak of embryonic volutions when Cossmann's "sommet embryonnaire" and Wenz' "Embryonalgewinde" are meant. However, in the course of the many years through which the preparation of this report has extended, sometimes one terminology has been used, sometimes the other, and it is felt that it would hardly be worth while to change many passages in the manuscript merely to make the terminology of the embryonic whorls uniform. Wherever the term "nucleus" is used, its meaning is, I believe, clear from the context. Throughout the explanations of plates it is, for brevity's sake, used in the meaning "embryonic volutions."

Following Wenz (1938, p. 13, figs. 30, 31) embryonic volutions are termed "heterostrophic" only if coiled sinistrally in a dextral shell, or dextrally in a sinistral one. All other deviations of the way of coiling from that of the post-embryonic volutions are comprised in the term "alloiostrophic."

[1] Since Knight is credited by the above authors (1944, pp. v, 437) with the revision of the Paleozoic gastropods only, Shimer and Shrock are here considered the authors of the introductory section, "Class Gastropoda."

Spire

All authorities (e.g., Pelseneer, 1906, p. 81; Wenz, 1938, p. 12; Woods, 1947, p. 276) agree that the spire of a gastropod consists of all the volutions but the last, or body whorl. The practical application of this correct definition, however, has gone astray more often than not. Its only logical interpretation is bound to place the boundary between spire and body whorl 360 degrees behind the aperture or, in apertural view, one whorl above the anterior end of the suture. Strangely enough, this correct interpretation is only rarely encountered in the literature (e.g., in Delpey, 1940, p. 9, text fig. 1; Morris, 1947, chart, p. 4; Leonard, 1950, text fig. 3). On the other hand, Wenz' (1938, p. 12, fig. 28) and Woods' (1947, p. 277, fig. 130) diagrams, in placing the boundary of the spire right at the upper end of the aperture (=anterior end of the suture) and thus allowing just 0 degree for the last volution, diametrically contradict their own correct definitions, and the same fundamental error is found in Shrock's (*in* Shimer and Shrock, 1944, pl. 174, fig. 1) diagrammatic sketch of an idealized gastropod shell.[2] Intermediate between these gravely erroneous conceptions of the spire and the correct one, as indicated above, is that found in plate 6 of Abbott (1945) where the height is measured from 180 degrees behind the aperture upward.

Since many papers on fossil gastropods, not excluding Kittl's and Koken's important monographs, omit to give any indication as to how the height of the spire is measured, the respective statements in these papers, mostly giving the approximate ratio between height of the spire and total height or between heights of spire and body whorl, are worthless for purposes of comparison.

Ornamentation

This term is consistently used in the present report, despite Gill's (1949; 1949a, p. 63) proposal, not believed to be well founded, to replace it (or its British version "ornament") by "prosopon." After this decision was reached by the writer, Gill's pro-

[2] Similarly, Montanaro Gallitelli's (1942, text fig 2) "elevazione di spira" is in fact not the height of the spire but the vertical distance from the upper end of the aperture (=anterior end of the suture) to the apex.

posal has been aptly refuted, with approximately the same motivation, by Wright (1950).

MEASUREMENTS AND THEIR SYMBOLS

As a rule, the following measurements are given in the tables of dimensions: the total height of the shell (H) in millimeters, with up to two decimals; its maximum width (W), and the height of the spire (h), as defined above, both in per cent of H, decimals having been reduced or increased, respectively, to 1 or ½ per cent; the pleural angle (π), as defined by Knight (1941, p. 17, text fig. 1), in degrees and occasionally halves thereof. Knight's opinion is here followed that measuring the apical angle, termed "angle spiral" by d'Orbigny (1850–1855, pp. 10–13, pl. 235, figs. 1, 2) and "Gehäusewinkel" by some authors writing in German, is in many cases useless.[1]

Where the conch exhibits in basal view a high degree of ellipticity, a fifth dimension, the thickness (Th), measured at a right angle to the greatest diameter and expressed in per cent of W, is given.

In addition to the pleural angle, the sutural gradient ("angle sutural" d'Orbigny, *op. cit.*, p. 13, pl. 236, fig. 2; "Nahtanstieg" Häberle, 1908, pp. 275–280, text figs. 2–5) is repeatedly mentioned and its measurement given in degrees in the Systematics section of this report. The obliquity of the plane of the aperture is occasionally mentioned but it has never been measured in degrees, as was recently proposed by Llabador (1951), who even devised a special apparatus, similar to d'Orbigny's (1850–1855, p. 10, pl. 235, fig. 1; Häberle, 1908, p. 276, text fig. 1) helicometer and to those used by Häberle (*ibid.*, text figs. 5–8), for this purpose.

DEGREES OF ABUNDANCE AND THEIR SYMBOLS

Throughout this report the following terms and symbols are used to indicate the rarity or abundance of a given species:

Total of Specimens	Term	Symbol
1	Extremely rare	er
2–5	Very rare	vr
6–25	Rare	r
26–75	Not so rare	nr
76–150	Fairly common	fc
151–500	Common	c
500–1000	Very common	vc
More than 1000	Extremely common	ec

It will be noted that the richness of the material under study makes possible a very conservative use of the above terms. This may best be illustrated by the fact that, if all 26 gastropods referred by Cox (1949) to nine different species were to belong to the same species, that hypothetic species would, under the above scale, exceed a rare one by just one individual.

PHOTOGRAPHY

Of the 1274 photographs arranged on the 18 plates accompanying this report only one (pl. 1, fig. 38) was slightly retouched, to bring out better the cavity of the fragment.

Except where it was intended to show color markings, the specimens were whitened with ammonium chloride before being photographed to make details of ornamentation more distinct. Accordingly, in a few cases specimens had to be taken both unwhitened and whitened in the same pose (e.g., pl. 10, figs. 38, 39).

The smallness of most of the specimens figured made enlargement, mostly ×3, ×4, ×5, or ×8, occasionally even ×10, imperative. Only a few specimens could be shown in natural size (e.g., pl. 9, figs. 1, 4–6, 9, 10, 20, 24, 32; pl. 11, figs. 10, 17–20, 24, 26–29, 31), while reduction (to 3/4) had to be applied only quite exceptionally (pl. 9, figs. 20–24).

ACKNOWLEDGMENTS

First and foremost, our thanks to Dr. William F. Jenks for entrusting to me his collections for study and for later donating them to the American Museum of Natural History should here be repeated.

Furthermore, I wish to thank Prof. Carl O.

[1] It should be noted, however, that d'Orbigny, in distinguishing (*loc. cit.*) "regular," "convex," and "concave" spiral angles, was already well aware of the geometric facts that prompted Knight's substitution of the pleural angle for the apical one. However, d'Orbigny's distinction of an "angle inférieur" and an "angle supérieur" would, it is feared, prove cumbersome and unwieldy in practical application.

Dunbar for the loan of a rich collection of St. Cassian gastropods, identified by Kittl, from the Peabody Museum of Yale University, and Prof. Armando F. Leanza for the generous loan of abundant gastropod collections, belonging to the Department of Paleontology of Buenos Aires University, from the "Horizonte calcáreo-dolomítico" of various localities in the Argentine province of Jujuy. However, my request to Prof. Augustin E. Riggi, Director of the Museo Argentino de Historia Natural "Bernardino Rivadavia," for a loan of Bonarelli's (1921, 1927) gastropod types from the same formation, which are in the custody of that museum, went unanswered despite its support by the good offices of Professor Leanza, Dr. Norman D. Newell, and Prof. Horacio J. Harrington of Buenos Aires. The gap thus caused in the materials that would have been most desirable for comparison could not even be closed by the availability of the collection kindly put at my disposal by Professor Leanza, for the gastropods from the University of Buenos Aires could in such a study not be substituted for Bonarelli's types, since, although from the same formation, they are not from the same localities and cannot therefore be considered topotypes. Only careful examination will show which of them are conspecific with Bonarelli's types. Such examination presupposes extensive chemical and in part mechanical preparation of Professor Leanza's material, the work of at least a year or more. Thus, after a preliminary study, its thorough examination was postponed until after the completion of the present study, to avoid further delay.

I take this opportunity to pay tribute to the memory of the late Prof. Guido Bonarelli, who for three decades unswervingly persevered in his fight for his dating of the "Horizonte calcáreo-dolomítico," and after learning that I had found paleontological evidence supporting his position sent me three months before his death reprints of his last papers on this subject (Bonarelli, 1945, 1950, 1950a).

I also want here to repeat my thanks to Prof. Ardito Desio of the University of Milan, Prof. Sergio Venzo of the Museo Civico di Storia Naturale of Milan, and Prof. Geremia D'Erasmo of the University of Naples for their kind assistance in my unsuccessful endeavors to secure types, or at least topotypes, of *Guidonia songavatii* (Stoppani) and *Guidonia contabulata* (Costa).

Furthermore, I wish to add to the list of directors and curators of collections abroad to whom I am indebted the names of Director General Dr. Hermann Michel and Assistant Curator Dr. Friedrich Bachmayer of the Naturhistorisches Museum of Vienna and of Profs. Drs. Richard Dehm and Joachim Schroeder of the Palaeontologische Staatssammlung of Munich. In both these institutions I was permitted to carry out comparative research and given every assistance for it during the summer of 1951, some time after this report had been submitted for publication.

Finally, I express my gratitude to the Marsh Fund of the National Academy of Sciences for a grant-in-aid towards the preparation of the plates accompanying this report.

Repeated thought-provoking discussions with Drs. J. Brookes Knight, William F. Jenks, and Norman D. Newell, with the first on fossil gastropods in general and with the two others on the structure, stratigraphy, and paleoecology of the region concerned, should also here be remembered.

Of all those who, within the American Museum of Natural History, helped me to bring this report to a conclusion, I wish here to thank only a few, without, however, forgetting the kind cooperation of the others. Those few are: the Librarians, who through all these years never failed to satisfy my at times extravagant needs for literature; Mr. Robert Adlington, who did all the photographic work, and whose sharp eye and extraordinary skill enabled him to cope successfully with the thankless task of photographing hundreds of specimens, most of them microscopic in dimensions, in up to five poses each; Miss Edith G. Marks, to whom I am indebted for typing out the manuscript of this paper as she has all the previous manuscripts that I have written at this Museum, undeterred by sometimes most forbidding copy; Miss Ruth Tyler who, as Editor of Scientific Publications, has always been willing to discuss, and to advise on, the many problems arising in the course of the preparation of a paper of this size, even a long time before it actually went to press.

SYSTEMATICS

PLEUROTOMARIIDAE

THIS FAMILY is represented in our material by the five genera *?Worthenia*, *Sisenna*, *Pareuryalox* (new), *Ptychomphalina*, and *Pleurotomaria*, but the altogether 15 species, more than half left unnamed, which are, in some cases only tentatively, referred to these genera, total only 37 specimens, many of them fragments.

De Stefani's genus *Guidonia*, to which six species with more than one thousand specimens are referred below, lacks a slit band and therefore certainly does not belong to the Pleurotomariidae, although it was considered a pleurotomariid and suppressed incorrectly in favor of *Worthenia* by Kittl and others.

WORTHENIA DE KONINCK

Some students of Paleozoic gastropods have felt disinclined to admit that the many Triassic species referred by Kittl (e.g., 1891, p. 181), Koken (e.g., 1897, p. 40), and others to *Worthenia* are congeneric with the type species *W. tabulata* (Conrad), which is Mississippian in age, and with other Paleozoic representatives of de Koninck's genus. Thus Knight (*in* Shimer and Shrock, 1944, p. 457) questions the survival of *Worthenia* in Triassic times, whereas Wenz (1938, p. 127) makes no reservation as to the inclusion of Triassic forms in this genus.

It may indeed by doubted if all the various forms hitherto described under the latter name from the Triassic—which, in the St. Cassian fauna alone, Kittl (1891) felt himself compelled to subdivide into six groups—are really referable to de Koninck's genus or should be assigned to as many, or almost as many, independent genera. However, their reclassification cannot possibly be attempted within the scope of the present study, since only two of those groups of "*Worthenia*" are represented in the Peruvian fauna under examination, one by three forms, the other by one species only. One is Kittl's (1891, p. 183) group of *W. coronata* (Münster), to which belong the first three species here dealt with, namely, *?W. rhombifera*, previously described by Körner from northern Peru, and two apparently new species which have been left unnamed. The second group is that of *W. texturata* (Münster), distinguished by the comparatively wide open umbilicus; the other *Worthenia* species previously described by Körner from northern Peru and also represented in the present material, *?W. basifalcata*, comes closest to this group of Kittl's.

For the reasons indicated above the following species are referred to the genus *Worthenia* only with a question mark.

GROUP OF *Worthenia coronata* MÜNSTER

?Worthenia rhombifera Körner

Plate 1, figures 1–7

Worthenia rhombifera n. sp., KÖRNER, 1937, p. 205, pl. 13, figs. 4a–c.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26508:1	4.2 mm.	95	33	88°
26508:2	?	?	?	?91°

The second specimen as far as preserved (most of the spire is missing) is 8 mm. high and 9.8 mm. wide; the height of the body whorl alone is 6 mm.

DESCRIPTION: This species was established and described quite explicitly by Körner (*loc. cit.* in synon.) so recently that it is not here described anew in full. Only some details which may be not observable so well in Körner's holotype or in which our specimens differ from it are here described. The original description does not mention the fact that the slit band can be clearly seen to be bordered by two sharp revolving keels which are quite marked on the teeth of the slit band keel as well as between them. In these intervals the slit band appears to be considerably deepened between these two keels. I would call the little prominences of the slit band keel teeth rather than "blunt, saw-tooth-like thorns," as does Körner, since they are not very prominent, as the term "thorns" would lead one to expect, in either our specimens or the holotype (see Körner's figs. 4a, 4b). There is, however, a remarkable difference between the former and the latter inas-

much as these teeth are much wider and less numerous in the body whorl of the holotype than in that of the larger shell from Cerro de Pasco which is of the same size. Whereas only seven per quarter whorl can be counted in Körner's figure 4b (and in our smaller specimen as well), there are about 13 per quarter whorl in the larger one. Correspondingly, they are considerably narrrower; whereas, roughly, one such tooth corresponds to each subsutural transverse fold in Körner's illustration, there are as many as four to each fold in the larger shell from Cerro de Pasco, but only from one to two in the smaller one. The increase in number of teeth of the slit band keel seems to represent a later ornamentational stage that sets in earlier in the specimen from Cerro de Pasco than in that from the Nevado de Acrotambo. In the number of subsutural folds or nodes, however, our specimens agree well with the latter; from five to six per quarter whorl are present in the body whorl of our smaller shell (20–24 per whorl according to Körner's description), and from four to five in that of the larger one. Körner himself noted that they are set somewhat narrower on the earlier whorls. In our larger specimen they are, moreover, more strongly developed. They are not only wider than in the holotype but are considerably higher and rise above the suture so as to conceal the lower lateral keel at the end of the penultimate whorl, whereas in our small individual that keel is visible just above the suture, as indicated for the holotype in Körner's original description. This strong development of the subsutural nodes makes the teeth of the slit band keel appear like delicate beads in comparison; it seems to be another feature of the afore-mentioned later ornamentational stage reached earlier by the Cerro de Pasco specimen than by the holotype.

Some minor ornamentational differences between them may also be noted: in our larger shell at least seven revolving lines can be counted between the two lateral keels, as compared to five in the holotype, and 13 spiral keels on the base, as compared to 10 in the holotype; about the same number can be observed in the smaller shell from lot 33 and in the base fragment from lot 26.

All these differences are, however, believed to fall within the scope of individual variation, especially since Körner's description of his species is based on a single individual. In the over-all picture, shell shape and general character of ornamentation leave no doubt as to the conspecificity of our three specimens with Körner's holotype.

Since most of the spire is missing in our larger specimen and the nucleus is worn in the smaller one, no reliable observations on the earliest ontogenetic stages of this species could be made in the present material; reference is, therefore, made to their careful description by Körner (*loc cit.*).

REMARKS: Körner correctly assigned his species to Kittl's group of *Worthenia coronata* Münster. But in stating that that group differs from *W. rhombifera*, among other characters, in lacking a transverse sculpture on the apical side of the whorls, he entirely overlooked the fact that this apical transverse ornamentation is (at least as indicated in the specific name[1]) the distinctive character of *W. subgranulata* (Münster).[2] It is also present in the closely related *W. liebeneri* (Laube).[3] It is these two St. Cassian species which Körner's resembles most closely, without, however, being identifiable with either of them, at least as long as species are as narrowly circumscribed within this group as they have been in previous literature.[4] *W. subgranulata* lacks the teeth of the slit keel, and *W. liebeneri* differs by carrying beads rather than teeth on it, these beads being connected by a revolving keel marking the middle of the slit band, whereas two such keels border the slit band in the present species. As a third

[1] Strangely enough, none of Münster's types reexamined by Kittl shows the subsutural nodes indcated in the specific name. Therefore, Kittl (1891, p. 185) prefers to rely on Laube's (1868, p. 82, pl. 27, fig. 2) description. As a matter of fact, of six specimens from St. Cassian in the collections of the Peabody Museum of Yale University, identified by Kittl himself as *W. subgranulata*, only one shows a faint indication of this character.

[2] Laube, 1868, p. 82, pl. 27, fig. 2; Kittl, 1891, p. 185, *cum synon.*, pl. 2, figs. 12–15.

[3] Laube, 1868, p. 86, pl. 28, fig. 3; Kittl, 1891, p. 186, pl. 2, fig. 16.

[4] Kittl (1891, p. 86) was well aware of the fact that *W. liebeneri* should be considered merely a variety of *W. subgranulata* or a transitional form. Still he treated it formally as an independent species, as did Laube before him.

St. Cassian species, which Körner overlooked in his discussion of *W. rhombifera*, *W. münsteri* (Klipstein)[1] might here be mentioned. It resembles the present species in general sculptural character and even in the details of the slit band keel, but the transverse ornamentation of the apical side of its whorls consists of ribs extending all the way down to the shoulder rather than of folds or nodes restricted to the upper part of the apical region, as in *W. rhombifera*, and it is much higher and more slender in shell shape.

For distinction of this species from the other "*Worthenia*" from the Nevado de Acrotambo, ?*W. basifalcata* Körner, which is also represented in the material from Cerro de Pasco, see the discussion of that species. The two other forms referred to the group of *W. coronata*, ?*Worthenia*, new species 1 and new species 2, are compared below with the present species. Forms from Cerro de Pasco referred to the genus *Guidonia* are also compared with the present species in their discussions.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
33	26508	2
26	26508/1	1[2]
	Total	3

?Worthenia, new species 1

Plate 1, figures 10–12

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26511	8.2 mm.	*ca.* 115	38	98°

DESCRIPTION: Shell turbinate, consisting of about four volutions. Spire flatly conical, attaining only two-thirds of the body whorl in height. Sutures deeply channeled. Apical part of the whorls consisting of a conical upper part, carrying the transverse folds (described later), and a concave lower part. The boundary between is marked by an edge which does not, however, carry a keel. The lateral part of the whorls is also conical, the lower lateral keel, which is immediately above the deep sutural groove, projecting much farther outward than do the two keels bordering the slit band. Of the latter, the lower in turn projects markedly farther outward than the upper. The deepened slit band, with its two accompanying keels, occupies a third or more of the height of the lateral part of the whorl; the band between the slit band and the lower lateral keel is also concave. Lateral and apical zones about equally high. Body whorl increasing rather rapidly in both height and width. Base strikingly flat immediately below the lower lateral keel, then rising to form a conical central part. Columella straight, strong. Inner lip reflexed over it, leaving open a small but distinct umbilical niche. There seems to be an indication of a wide shallow channel, as in *W. subgranulata*, at the lower part of the aperture the outer margin of which is unfortunately not preserved. In both apical and basal views the shell is decidedly elliptical in shape.

The main revolving elements of the ornamentation are the two sharp keels bordering the broad slit band, which are in one part of the body whorl, apparently owing to some lesion of the shell, squeezed together so as to narrow the slit band considerably, and the lower lateral keel which is much stronger than either of the keels bordering the slit band, but less broad than the slit band together with its two accompanying keels. In addition, there are from seven to nine revolving lirae on the base; they are only indistinctly recognizable in the nearly complete shell from lot 42, but clearly so in the fragment A.M.N.H. No. 26511/1:1 (fig. 10). No such striation can be seen elsewhere on the former.

The transverse ornamentation consists of the folds, mentioned above, of the apical part of the whorls and of growth striae. The former are blunt, rursiradiate, and sickle-shaped, with the concavity facing backward. On the body whorl they are distinct in the upper conical zone of the apical band only, thus accentuating the contrast between this zone and the lower, groove-like one immediately above the slit band keel.

[1] Laube, 1868, p. 83, *cum synon.*, pl. 27, fig. 8; Kittl, 1891, p. 186, pl. 2, figs. 20, 21.

[2] A small but well-preserved fragment of a base.

The growth striation, observable only where preservation permits, is rather dense. The striae run obliquely backward over the apical part of the whorl, then cross the slit band in a perpendicular direction, exhibiting only a very shallow lunula. Below the slit band keel they seem to form a shallow forward bulge and then gradually to resume their backward direction. On the base they run in a shallow, forward convex arc backward towards the umbilical niche, becoming fold-like in the posterior part of the base fragment A.M.N.H. No. 26511/1:1. They produce more or less distinct beads both on the lower lateral keel of specimen A.M.N.H. No. 26511 and on some of the lirae of the base fragment A.M.N.H. No. 26511/1:1.

The earliest ontogenetic stages, as far as they could be studied, show no planospiral stage. The first two whorls seem to be smooth.

REMARKS: Within the Peruvian material here under study *W. rhombifera* Körner comes closest to the present form. It can, however, readily be distinguished by its more staircase-like shell profile, especially by the lateral band of the whorls, which is cylindrical, not conical, by its higher spire, and by its slit band which is not so wide as in the present form and tuberculated. *?Worthenia*, new species 2, and *?W. basifalcata* are compared below with this form. *?Worthenia*, new species 1 resembles in its apical ornamentation several forms of the group of *W. coronata* from St. Cassian, namely, *W. subgranulata* (Münster) (Kittl, 1891, p. 185, *cum synon.*, pl. 2, figs. 12–15), *W. liebeneri* (Laube) (Kittl, 1891, p. 186, *cum synon.*, pl. 2, fig. 16), and *W. spuria* (Münster) (Kittl, 1891, p. 191, pl. 3, figs. 3, 4), but differs from all of them by its depressed spire and by its conical lateral band, from *W. spuria*, in addition, by the presence of a strong lower lateral keel. The last character serves to distinguish it from *W. dregeri* Kittl (1891, p. 195, pl. 2, fig. 33), referred by its author to the group of *W. crenata*, also, which somewhat resembles it in shell shape except for the higher spire.

Thus the present form cannot be identified with any previously described species, but its poor preservation does not justify giving it a specific name.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
42	26511	1
26	26511/1	3[1]
53	26511/2	1[1]
	Total	5

?Worthenia, new species 2

Plate 1, figures 8, 9

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26529:1	*ca.* 12.5 mm.[2]	*ca.* 103	*ca.* 32	116°[3]

DESCRIPTION: Shell turbinate, somewhat turreted, slightly concavo-convex. About seven volutions can be counted in the largest and least incomplete specimen present (no. 1). The spiral ones exhibit an apical band, rising in profile at an angle of about 30 degrees, and a vertical lateral one. Towards the end of the penultimate whorl and in the body whorl, however, the apical band, though still sloping gently outward, becomes more and more concave, forming eventually a deep groove which is considerably overtopped by the strong upper main keel. It cannot safely be decided if and to what extent this change is due to crushing. However, the decidedly elliptical aspect of the shell in both apical and basal views seems not to be due to crushing, for this character is observable in a smaller specimen (no. 2), which also consists of a base only. Base conical, gently rounded, not clearly separated from the lateral face of the body whorl. In neither of the shells present is the aperture well preserved. The columellar lip seems to be reflexed and accompanied by a shallow umbilical furrow. The columella seems to be perforated.

The revolving ornamentation is most conspicuous. Above the suture only two keels, separated by a deep, rather narrow groove, can be recognized. The upper one, accentuating the apico-lateral shoulder, is the slit band keel and consists, properly speaking, of

[1] Fragments.
[2] Estimated; the shell is incomplete.
[3] If measured from the penultimate whorl up, π amounts to 103½° only.

two sharp keels between which the slit band is deeply engraved. The lower main keel, hardly less prominent than the upper, but single, is just visible above the suture. On the base other revolving keels follow which are more or less equally spaced and rather blunt. Six can be counted on the incomplete base of specimen number 1, but their total number can be assumed to have been at least seven or eight. On the fragment of the base of another shell (no. 3) of about the same size as number 1, which is believed to belong to the same species, the first of these keels is only a little weaker than the lower main keel, but the following four or five (more are not preserved) decrease rather rapidly in strength. Fragment number 4, also believed to be conspecific but obviously from a shell much larger than number 1, is distinguished by the wide distances between the first four keels, of which the third is as heavy as the second. The fourth, fifth, and sixth are markedly less prominent, but still quite coarse, and much more closely set than those higher up on the body whorl.

Rather coarse growth striae can be recognized only here and there in specimen number 1. They run obliquely backward on the apical face and on the base but, so it seems, more or less perpendicularly across the lateral face; on the slit band keel they form a shallow lunula. On fragment number 4 growth striae are well recognizable only where crossing the keels.

The apex of specimen number 1 is, though entire, too corroded to permit reliable observations on the earliest ontogenetic stages.

REMARKS: Like the preceding, the present species lacks tubercles on its slit band keel, considered by Knight (1941, p. 386) a distinctive character of the genus *Worthenia*. In this respect, as in shell shape, the present species resembles the Pennsylvanian *Phanerotrema? welleri* Newell (1935, p. 348, pl. 36, figs. 3a–g), made by Knight (1945, p. 573) the type species of his genus *Ananias*. Lacking, however, the high concave outer whorl face and the angulation separating the base from it, the form under discussion cannot be referred to Knight's genus either. For the reasons stated above it is, with the other "*Wortheniae*" in the present material, provisionally and doubtfully left with de Koninck's genus.

From all three other "*Wortheniae*" from Peru it is readily distinguished by its somewhat turreted shell shape and comparatively high, markedly gradate spire. From the two preceding species it differs, furthermore, by the lack of a transverse ornamentation other than growth striae and by its low lateral whorl face, from *?W. rhombifera*, in particular, also by its untuberculated slit band keel. *?W. basifalcata* is compared in more detail below.

Of the "*Wortheniae*" of the St. Cassian and related faunas of Europe *W. joannis austriae* Klipstein (Kittl, 1891, p. 187, *cum synon.*, pl. 2, figs. 17–19) seems most to resemble in shell shape the present species, with which it has also the untuberculated slit band keel in common. The latter is, therefore, tentatively referred to Kittl's group of *W. coronata* Münster in which Kittl includes Klipstein's species. However, in other characters, especially in its ornamentation, *?Worthenia*, new species 2 differs too much from *W. joannis austriae* to be considered conspecific.

OCCURRENCE: Represented in lot 34 only by an incomplete shell and three poor fragments (A.M.N.H. No. 26529).

GROUP OF *Worthenia texturata* MÜNSTER

?Worthenia basifalcata Körner

Plate 1, figures 13–21

Worthenia basifalcata KÖRNER, 1937, p. 206, pl. 13, figs. 5a–c.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26513/1	*ca.* 3.07 mm.	*ca.* 115	*ca.* 16	106°
26513:1	5.4	122	24	*ca.* 115°

DESCRIPTION: This interesting species was described very carefully by Körner not long ago. His description therefore is supplemented only insofar as our material, though as scanty as his, permits of better observation of details or does not fully agree with it.

In the only shell found in lot 48 (A.M.N.H. No. 26513/1) the nucleus can be recognized to be planospiral and the earliest volutions to be gently rounded. First the shoulder keel, then the subsutural keel develop, thus gradually lending groove character to the apical band; a little later in the ontogeny increasing

tuberculation makes these keels stand out even more boldly. This tuberculation, particularly of the subsutural keel, can well be seen in the smallest fragment from lot 26 (A.M.N.H. No. 26513:3; fig. 21). In another fragment from the same lot (A.M.N.H. No. 26513:4), which represents a somewhat later stage and which possibly belongs to the same shell as the fragmentary base, described below, the tuberculation of both these keels exactly resembles Körner's illustration (1937, pl. 13, fig. 5a). In the largest shell present (A.M.N.H. No. 26513:1) this tuberculation is markedly denser than reported by Körner, there being 18 tubercles on the subsutural keel and 25 on the shoulder keel in the body whorl. This difference is, however, believed to come within the range of individual variation. In both individuals mentioned the tubercles of the subsutural keel can be recognized to be directed obliquely backward. They are nothing other than the raised upper ends of folds, or bundles of growth striae, which continue in that direction across the apical band. Only in the juvenile A.M.N.H. No. 26513/1, mentioned above, can the tubercles of the shoulder keel also be observed to continue into folds which run, though somewhat less obliquely, backward across the lateral band to the lower lateral keel; on it they produce a denticulation, less prominent than the tuberculation of the two other keels (fig. 13). That keel shows a similar denticulation at the beginning of the body whorl of the largest shell (A.M.N.H. No. 26513:1), contrary to Körner's opinion that it is untuberculated. On the rest of the body whorl, however, growth striae produce only an extremely fine granulation in crossing the keel. In specimen A.M.N.H. No. 26513/1 growth folds can be seen to continue on the base in a backward direction, which gradually changes to a radial one towards the umbilicus, but there is in this specimen hardly any indication of the circumumbilical folds, aptly described and figured by Körner as an outstanding characteristic of the present species. They are, however, excellently developed in the two larger shells present; six can be counted on the last half whorl of the fragmentary base A.M.N.H. No. 26513:2 (fig. 16) and seven on that of the largest shell (A.M.N.H. No. 26513:1, fig. 17). In the latter these folds vanish about halfway between the umbilical margin and the periphery,[1] whereas they seem to continue almost as far as the periphery in specimen A.M.N.H. No. 26513:2, where they are heavier, sharper, and more pronouncedly falciform. At the other end these transverse folds continue quite some way down the umbilical funnel, where they are well marked in specimen number 2, but less so in number 1.

The base is conical, rather high, and moderately convex in all three specimens in which it is present. In the two larger ones (A.M.N.H. No. 26513:1, 2) about a seventh of its diameter is occupied by the umbilical opening, but considerably less in the juvenile A.M.N.H. No. 26513/1, where it is partly covered by a callosity formed by the thickened inner lip. The two larger shells do not show the "light circumumbilical keel" tentatively assumed by Körner, but there is a heavy circumumbilical ridge in the juvenile A.M.N.H. No. 26513/1. Near its anterior end this ridge is joined by another, sharper one which connects the bottom of the aperture with the thickened upper part of the inner lip and surrounds a deep, crescent-shaped depression accompanying the unthickened lower part of the lip on its outer side (figs. 14, 15).

Revolving ornamentation other than the three main keels can well be seen in specimens A.M.N.H. Nos. 26513:1, 26513:2, and 26513:3. In the small fragment, number 3, three revolving striae, with an even finer thread between the two outermost, can be recognized in the peripheral zone of the base. In the largest shell present (no. 1) such ornamentation shows all over the conch, best in the outermost zone of the base where no robust circumumbilical folds obscure it. There are three minor revolving keels which gradually decrease in strength inward in this outer zone of the base. In the inner one, seven revolving striae are recognizable on the transverse folds only. In specimen A.M.N.H. No. 26513:2 this revolving striation can be followed all the way down the umbilical funnel where at least 10 more such thread-like striae can be counted. Five more are present

[1] The same is obviously meant by Körner's sentence: "Gegen die Mitte der Basis hin verwischen sich die Querfalten allmählich."

on the lateral band of this shell, three on the tubercles of the shoulder keel and four on those of the subsutural one, but this striation is only faintly indicated on the concave band between them. No traces of a revolving striation are, however, found on the juvenile shell A.M.N.H. No. 26513/1. This could be attributed to surface wear, but on the other hand this shell shows the growth folds described above quite well.

Some growth striae are also observable in the upper part of the conch A.M.N.H. No. 26513:1. They run strongly obliquely backward across the apical band, following the direction indicated by the tubercles of the subsutural keel. Growth striae are again visible on the lateral band where they form a shallow forward convexity immediately below the shoulder keel. Then they assume a steep, only slightly backward direction which they still maintain in crossing the lowermost main keel. On its lower surface they turn more sharply backward and run in a more or less radial direction, gradually assuming that of the circumumbilical folds, all over the base. Only in the small shell can some lunulae be recognized, but the presence of a selenizone is indicated in the otherwise best-preserved specimens A.M.N.H. Nos. 26513:1 and 26513:3 by the break in the course of the growth striae on the shoulder keel, thus proving that keel to be indeed a slit keel, as assumed by Körner, although he could not observe any growth striae in that part of the conch.

The aperture, which remained unknown to him, can well be studied in two of our specimens (figs. 14, 17). It resembles that of *W. texturata*, as illustrated in Kittl (1891, pl. 3, fig. 10), but it is wider and somewhat depressed. In its upper part the inner lip is considerably thickened and reflexed in the smallest shell present, but less so in the largest, in which it runs much more steeply, almost perpendicularly, downward.

REMARKS: As repeatedly pointed out, the juvenile from lot 48 (A.M.N.H. No. 26513/1) differs in several respects from the shells and fragments from lot 26 (A.M.N.H. No. 26513:1–26513:4). However, since it agrees with them in shell shape and in ornamentation of the spire, it is without hesitation also referred to Körner's species.

From all three forms of *?Worthenia* referred to the group of *W. coronata* in the present paper, *?W. rhombifera* Körner and *?Worthenia*, new species 1 and 2, *W. basifalcata* is readily distinguished by its comparatively wide open umbilicus, surrounded by the characteristic transverse folds, and by the perpendicular columella on the one hand and by its distinctly planospiral nucleus and its altogether depressed conch on the other.

A certain resemblance in shell shape and, in the case of *Guidonia parvula*, the presence of somewhat similar circumumbilical folds invites a few comparative remarks with respect to some species referred to the genus *Guidonia* (see pp. 69, 74, 77), and the presence of similar circumumbilical folds causes, in basal view only, a certain resemblance of the present species to *Jurassiphorus triadicus* (p. 255).

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26513	4[1]
48	26513/1	1 (juvenile)
53	26513/2	2 (doubtful)
	Total	7

SISENNA KOKEN

This genus, distinguished among the Pleurotomariidae by the site of the slit band on the upper shoulder, by the forward convex tongue formed by the growth striae immediately beneath the slit band, and by the more or less pronounced revolving ornamentation, is represented in the material under study by a medium-sized shell in lot 69, a small, poorly preserved one in lot 45, by several fragments in lot 86 which must be referred to three different species, and by a single fragment in lot 48, which possibly belongs to one of these species.

Sisenna, new species 1

Plate 1, figures 23–25

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26504	12.8 mm.	117	63	80°

DESCRIPTION: Shell turbinate, somewhat elliptical in outline, consisting of four and a

[1] One incomplete, two fragments.

half whorls. Sutures shallowly channeled. The whorl profile shows a gently sloping apical band and a much steeper, though not perpendicular lateral one, both of which are slightly concave. An edge hardly less pronounced than that between apical and lateral bands separates the lateral band from the base of which the outer zone is flatly conical and only gently convex. More than half of its diameter is occupied by the deep, funnel-shaped umbilicus which is bounded by a rounded shoulder, becoming more pronounced towards the aperture. Aperture irregularly pentagonal, with the inner lip rising steeply towards the ceiling and, so it seems, thickened and slightly reflexed. The ornamentation is dominated by the two main keels bordering the lateral band, the upper of which is the slit band keel and seems to be thicker than the lower one. However, the details reported in Koken's descriptions of his various species of *Sisenna* are not observable in the slit band of the present specimen. An indistinct, blunt, subsutural keel seems to develop on the body whorl only. About 12 closely set, concentric, revolving keels cover the outer zone of the base and the outermost one of the umbilical funnel, the inner parts of which seem to be smooth. These keels are much finer than those on the outside of the conch; they show under the microscope a faint granulation and decrease in strength towards the center. Growth striae are not well preserved. They can, however, be recognized to run obliquely from the upper left to the lower right across the apical band, then to form a pronounced lunule on the upper lateral keel and a forward-projecting tongue on the lateral band.

EARLIEST ONTOGENETIC STAGES: The embryonic volutions can be recognized to be somewhat inclined towards the main axis of the shell.[1]

REMARKS: The shape of the shell, especially the wide umbilical funnel, and the course of the growth striae leave no doubt as to the reference of this form to *Sisenna*. It differs even from those species which may be said to be closest to it, i.e., *S. descendens* Koken (1897, p. 35, pl. 8, figs. 2–4) and *S. euspira* Koken (*ibid.*, p. 36, pl. 9, figs. 5, 6), by the marked edge separating the lateral band from the base, by the slight concavity of the former, and by the more pronounced spiral ornamentation of the latter; from *S. descendens*, in addition, by its lower spire and much wider pleural angle.

The other Peruvian representatives of this genus are compared below with the one here discussed. No other form in the present material resembles it enough to require comparison.

OCCURRENCE: A single specimen in lot 69 (A.M.N.H. No. 26504).

Sisenna, new species 2

Plate 1, figures 22, 28

DESCRIPTION (INCLUDING DIMENSIONS): The above designation has been given to a single whorl fragment of a shell which, when complete, may have measured between 12 and 15 mm. in width and somewhat more in height. Whorl profile (fig. 28) and ornamentation (fig. 22) show so well that description and illustration of this specimen may be justified despite its fragmentary condition.

There is a gently concave apical band, sloping at an angle of about 45 degrees. It is separated by the upper shoulder from a much steeper (gradient about 75 degrees) lateral face which is more than twice as high as the apical one. It is in turn separated from the decidedly truncate base by a pronounced peripheral edge which is accentuated by an extremely strong and prominent, hollow keel.

On closer examination this main keel can be recognized to be a bundle of three secondary keels: one on its crest, another, about equally strong, above, and a third, less thick, beneath the middle keel. There is a deeply engraved furrow between the last two but only a shallow one between the middle and the upper of these three secondary keels. The lowermost is separated by another narrow, deeply engraved furrow from the outermost basal keel. Two more follow at much wider intervals in the outer, and only preserved, portion of the base. The lateral whorl face carries a little above its middle a well-developed keel which projects much less than

[1] This slight degree of alloiostrophy does not seem hitherto to have been recorded for this genus. It is not mentioned by Koken in his description of the embryonic characters of *S. turbinata* (1897, p. 33), but in his apical views of this species (*ibid.*, pl. 5, fig. 56, pl. 6, fig. 16) this inclination of the initial whorls can clearly be recognized.

the peripheral keel. There is one more on the shoulder which carries the slit band; this upper keel is very blunt and markedly lower than the one on the lateral whorl face, not to speak of the peripheral one. Its upper boundary is marked by an indistinct ledge, and it is followed beneath by a comparatively wide but shallow furrow.

The fine growth striae start from the upper suture in a steeply oblique backward direction. Then they assume a much more flatly oblique direction on the apical band. They form well-developed lunulae on the shoulder and a rather flat, forward convex tongue on the upper third of the lateral whorl face. Then they resume their backward oblique direction which they also maintain in crossing the peripheral keel and on the base.

REMARKS: From the preceding, the present form is readily distinguished by its higher lateral whorl face, much more truncate base, and markedly more elaborate revolving ornamentation. For other comparisons, see below and page 23.

OCCURRENCE: A single fragment in lot 86 (A.M.N.H. No. 27536).

Sisenna, new species 3

Plate 1, figures 26, 27

DESCRIPTION (INCLUDING DIMENSIONS): This single fragment agrees with the preceding in assumed shell size and in whorl profile (fig. 26), except that the apical band rises more steeply and that the lateral face also is gently concave, but it differs too clearly in the following details of ornamentation (fig. 27) to be considered conspecific.

There is a fine revolving keel, or lira, about halfway between the upper shoulder and the channeled suture. Two more lirae follow, on the lateral whorl face, immediately below the slit band keel, thus causing it to appear much wider than it actually is. Furthermore, the lateral whorl face carries not only one but two quite strong keels, one at about its lower third, the other slightly below its upper third; the sunk band between them is about twice as high as the bands above and below. The peripheral keel projects similarly strongly as in the preceding form, but it is not so wide, and secondary keels cannot clearly be recognized on it.

The course of the growth striae appears to be the same as in *Sisenna*, new species 2.

REMARKS: The differences of this form from the preceding are pointed out in the description. It differs from *Sisenna*, new species 1, as does *Sisenna*, new species 2, in its higher lateral whorl face, decidedly truncate base, and in its revolving ornamentation which is here even more elaborate than in *Sisenna*, new species 2. The present form is also compared with the two remaining forms of *Sisenna* in their respective discussions below.

OCCURRENCE: A single fragment in lot 86 (A.M.N.H. No. 27537).

?Sisenna sp. indet.

Plate 1, figures 32, 33

DESCRIPTION (INCLUDING DIMENSIONS): A fragment from a shell which may have reached a width of about 12 mm. consists of parts of the base and of the lateral whorl face. It shows a rather steep lateral band and a convex outer zone of the base; this outer zone is separated by a revolving ridge from the umbilical funnel which is wide and must have been quite deep. The periphery is marked by a blunt edge carrying a broad, slightly projecting keel. Two revolving keels can be seen above it on what is preserved of the lateral whorl face and three below it in the outer zone of the base. All these keels are weaker than the peripheral keel but still quite broad. They appear rather flat, but this is evidently, at least in part, caused by wear. The umbilical funnel seems to be smooth.

Growth striae can be seen to run at an angle of about 45 degrees backward over the lateral whorl face, then to turn decidedly forward in crossing the peripheral keel. After continuing in that direction on the outer zone of the base, they seem to change in a gentle arc to a more radial direction. They tend to unite in irregular bundles which lend a faintly tuberculate appearance to the peripheral keel and to the keels immediately above and beneath.

A considerably smaller shell fragment from lot 48 may be conspecific with the one from lot 86 just described. This assumption, based on a certain similarity in the character of ornamentation, is, however, purely tentative since different portions of the shell are pre-

served in these two fragments. The smaller fragment consists of a rather high, gently concave apical whorl face carrying three revolving lirae, and of the upper part of a nearly perpendicular lateral face which is separated from the apical one by a rather sharp shoulder keel and carries at some distance below it another keel of about the same strength or even slightly stronger. No growth striae are recognizable on this fragment. It can be assumed that the lower of the two keels corresponds to the uppermost keel preserved in the fragment from lot 86, but this is highly conjectural. At any rate, this second fragment is doubtfully attached to the first.

REMARKS: Since a slit band cannot be observed in either, both fragments are only doubtfully assigned to this genus, to which shell shape and ornamentation might refer them. This form differs from *Sisenna*, new species 1, by its lateral band which is not concave, the more convex outer zone of the base, and by its less dense revolving ornamentation. *Sisenna*, new species 1, furthermore lacks the ornamentation of the lateral and apical whorl faces, as found in the present form. *Sisenna*, new species 2 and 3 are readily distinguished from this form by the stronger and more elaborate revolving ornamentation, the much more pronounced peripheral edges, and the decidedly truncate bases. *S.* aff. *excelsiori* is compared below with the present form.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26542	1
48	26542/1	1 (doubtful)
	Total (fragments)	2

Sisenna aff. **excelsiori** Koken

Plate 1, figures 34, 35

DESCRIPTION (INCLUDING DIMENSIONS): The single small shell here dealt with consists of the body whorl and one and one-quarter of the preceding volutions but lacks the upper part of the spire. As preserved, it measures about 2 mm. in height and about 1.7 mm. in width. The pleural angle amounts to about 50 degrees.

Shell shape broadly conical, with truncate base. The profile of the volutions present, which are separated by deeply channeled sutures, exhibits an apical band sloping at an angle of about 40 degrees and a perpendicular, or even slightly overhanging lateral one. In the body whorl that lateral face is separated by a distinct, though rounded peripheral edge from the base which is only gently convex and perforated by a funnel-shaped, narrow umbilicus. The aperture is pentagonal in outline, somewhat reminiscent of that of *S. descendens* Koken (Koken, 1897, pl. 8, fig. 4a). The inner lip is not well enough preserved to permit any statement as to its characters.

The edge delimiting the lateral whorl face from the apical one is accentuated by a keel on which occasional growth striae can be seen to form lunulae (fig. 34) and which is therefore considered a slit band keel. Above it the growth striae run decidedly backward, below it decidedly forward. No other ornamentation than growth striae and folds is observable. They lend a crenulated aspect to the upper margin of the posteriormost part of the body whorl immediately beneath the suture.

REMARKS: This incomplete shell is undoubtedly a pleurotomariid and on the strength of the features recorded in the above description is believed to come closest to *S. excelsior* Koken (1897, p. 35, pl. 8, fig. 14) from the ?Carnian Hallstatt limestones of the northern Alps. It is, however, stouter in shell shape and cannot be considered conspecific.

From the congeneric specimen described above as *Sisenna*, new species 1, it differs in its markedly less depressed shell shape, more deeply channeled sutures, and much narrower umbilicus. The last difference is valid for distinction of the present form from that listed above as *?Sisenna* sp. indet.

It lacks, furthermore, the revolving ornamentation of the latter. *Sisenna*, new species 2 and 3 deviate even further from the present specimen by their strong and elaborate revolving ornamentation and by their much more pronounced peripheral edges and truncate bases.

OCCURRENCE: A single incomplete small shell in lot 45 (A.M.N.H. No. 27699).

PAREURYALOX,[1] NEW GENUS

Only most reluctantly is a new genus established on a few specimens, only one of which, though damaged, permits a study of the generic characters. The low site and the considerable width of the selenizone, as well as the general character of the ornamentation, bring this genus close to *Euryalox* Cossmann, 1897 (new name for *Sagana* Koken, 1896, *non* Thorell, 1875). But the greater width of the selenizone, which is subdivided by a strong keel, and the absence of an umbilicus[2] seem to constitute differences of sufficient importance to warrant generic separation. However, the close resemblance of both genera is implicit in the name chosen for the new genus.

The generic diagnosis is as follows: Shell moderately large, turbiniform, with moderately high spire and comparatively large body whorl, consisting of from four to five whorls. Whorl profile gently rounded, sutures rather deep, channeled. Base conical, moderately convex. Columella hollow. Aperture subelliptical; outer lip unknown; columellar lip reflexed, all but covering a rather deep and narrow umbilical niche. No umbilical opening.

Ornamentation elaborate, lattice-like; revolving ornamentation extends all over the shell and consists of rather closely set, beaded main keels between which thread-like secondary keels are intercalated on the penultimate and body whorls. Transverse ornamentation consists of a dense growth striation which, in crossing the primary keels, produces closely set beads. On the body whorl it assumes a rib- or fold-like appearance. In general the striae run obliquely backward, only in the lower half of the selenizone obliquely forward. Selenizone unusually wide, occupying almost all of the lower half of the spiral whorls, bordered by the suture on the one hand and a beaded keel on the other and subdivided by another beaded keel on which the lunulae culminate. In profile the selenizone appears as two rather deep furrows, the one supersutural, the other immediately above the former and separated from it by the aforementioned keel. On the body whorl the selenizone is far less distinct than in the spire and indicated merely by a slight twist of the transverse ribs.

Nucleus but incompletely known, apparently not planospiral. Both revolving and transverse ornamentation already present on second volution.

GENOTYPE (BY MONOTYPY): *Pareuryalox perornata*, new species.

Pareuryalox perornata, new species

Plate 1, figures 30, 31, 42, 43

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26506:1[3]	?	?	?	*ca.* 65°
26506:2	5.4 mm.	77	39	?
26506/1 (holotype)	14.8	73	45	53°

As far as can be judged by the few specimens measured, W and π tend to decrease, and h tends to increase, with growth.

DESCRIPTION: Since this is the type species of a hitherto monotypic genus, the generic diagnosis will serve as a general outline of the description of the species; here only some details need be filled in. This description is based on the (broken) holotype, and on two other much smaller, poorly preserved, though undoubtedly conspecific specimens.

SHELL SHAPE: The spire is conical on the whole, and the lateral faces of the penultimate and antepenultimate whorls rise at an angle of about 56 degrees. The greatest width of all whorls is marked by the sixth beaded keel which halves the selenizone.

ORNAMENTATION: Six strong, beaded keels can be counted on the antepenultimate and penultimate whorls; the fifth forms the upper boundary of the selenizone, and the sixth subdivides it. There is a seventh such revolving keel; it is, however, covered by the follow-

[1] Derived from παρά, beside, and Ευρυάλοξ (generic name created by Cossmann), wide furrow. Αλοξ being merely another rendition of αὖλαξ, the gender is feminine, not masculine, as assumed by Wenz (1938, p. 136, caption to fig. 182).

[2] Koken's (1897, p. 38) statement, taken over in Wenz' (1938, p. 136) generic diagnosis, that *Euryalox* has a "wide" umbilicus is contradicted by the descriptions of all his species of "*Sagana*" but one ("*S.*" *bellisculpta*). For the three others, including "*S.*" *juvavica*, designated genotype of *Euryalox* by Wenz (*loc. cit.*), the umbilicus is stated to be narrow.

[3] This specimen measures 4.0 mm. in width; its spire is 2.1 mm. high.

ing whorls in the earlier volutions and visible only in the body whorl, marking the boundary between its lateral face and the base. The fifth, sixth, and seventh keels stand out by greater strength and prominence. Beyond the seventh, there follow on the base six or seven more primary keels. Secondary keels begin to be intercalated between the primary ones in the lower half of the penultimate whorl where preservation permits the recognition of two which accompany the sixth beaded keel, three in the furrow above, and two in the furrow below. Here they are still very fine and thread-like, but they are markedly stronger in the corresponding zone of the body whorl; however, here also they can readily be distinguished from the primary keels not only by being considerably weaker but also by only rarely carrying beads or nodes. The secondary keels between the fifth and sixth and sixth and seventh primary ones are by far the strongest. The first of the base, immediately below the seventh primary keel, is somewhat weaker, but still much stronger than the following ones. The secondary keels of the base are quite regularly intercalated between two primary ones each and gradually assume a thread-like appearance.

About 15 beads per quarter whorl can be counted on the penultimate volution and about as many rather coarse, transverse ribs on the body whorl. Near its anterior end they assume the shape of irregular folds which are separated from one another by similarly irregular furrows. The slight twist of the transverse ribs in the zone of the body whorl between the fifth and seventh beaded keels, here constituting the only indication of the selenizone, is mentioned in the generic diagnosis. In the holotype this twist can be observed best in the posterior part of the body whorl. Beyond the seventh primary keel these folds seem to resume their original obliquely backward direction.

REMARKS: The generic differences between *Pareuryalox* and *Euryalox* Cossman (=*Sagana* Koken) serve also to distinguish the present species from all the species of "*Sagana*" described and figured by Koken (1897, pp. 38–40, text figs. 6–8; pl. 6, figs. 4, 9, 10, 12; pl. 7, fig. 3 [not 4, as erroneously printed in both text and explanation of plate]; pl. 8, figs. 5–7) from the Triassic of the Hallstatt region and by Krumbeck (1924, pp. 48 [190]–51 [193], pl. 182 [4], figs. 5–7) from that of Timor. In the density and fineness of ornamentation the form separated by Koken (*ibid.*, p. 38, pl. 8, fig. 7) as variety *interstrialis* from his "*Sagana*" *juvavica* comes closest to ours.

Within the Peruvian material one form only, viz., *Homalopoma subcinctum* (d'Orbigny), calls for comparison with the present one because of the close resemblance in spiral whorls.[1] However, complete shells of our two forms could not possibly be considered conspecific, since their shapes are quite different, *P. perornata* being much more slender, its body whorl much larger, and its spire somewhat higher; correspondingly, its pleural angle is markedly smaller than in *Homalopoma subcinctum*. However, the spiral whorls also can be well distinguished on closer examination. Those of the latter form lack the double furrow in their lower half so noticeable in the present species. There are fewer primary keels, which are not so closely set as in the species under examination, and no secondary ones, so that the ornamentation does not look so dense and elaborate as in *P. perornata*. Finally, there is no slit band in d'Orbigny's species which is a turbinid, not a pleurotomariid.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
29	26506	3
97	26506/1	1
	Total	4

PTYCHOMPHALINA BAYLE

There has been plenty of discussion in the literature (see, e.g., Kittl, 1891, pp. 202–203; Koken, 1897, pp. 20–21; Kittl, 1899, p. 7) on the delimitation between *Ptychomphalus* Agassiz, *Ptychomphalina*, *Cryptaenia* Eudes-Deslongchamps, *Mourlonia* de Koninck, and other genera. As far as the literature on Alpine Triassic gastropods is concerned, the polemics between Kittl and Koken ended

[1] A similar superficial resemblance misled Hörnes (1855, p. 38, pl. 2, fig. 1) to identify the form later renamed *Sagana hörnesi* by Koken (1897, p. 39, pl. 6, figs. 8, 12; pl. 8, fig. 5), under the name of "*Turbo decoratus*," with *Pleurotomaria decorata* Münster (later renamed *P. triton* by d'Orbigny).

with a somewhat reluctant acceptance of the name *Ptychomphalina* by Kittl for the forms to which he had previously applied the name *Ptychomphalus*.

In the present report *Ptychomphalina* is used for more or less similar forms, chiefly on the strength of the distinctive characters ascribed by Wenz (1938, pp. 144, 154) to these two genera. According to these, the site of the slit band is supersutural in *Ptychomphalina* but subsutural in *Ptychomphalus*. Now the slit band (or what must be taken for an indication of its presence) can, in most of the forms dealt with under this generic heading, be observed above the suture, where more than one volution is preserved, or in such a site above the periphery as to justify the assumption of its supersutural position. This holds true for all the following forms except the first in which the slit band is directly on the peripheral keel but which resembles a St. Cassian *Ptychomphalina* closely enough to be referred to this genus.

This form, *P.* cf. *protei* ([Münster] Laube), is actually the only one present for which this generic reference is felt to be rather safely established. All the others can only tentatively be referred to *Ptychomphalina*. They might belong to some new genus, for the creation of which the available material is, however, much too scanty. The four forms here included total not more than 11 specimens altogether, of which only four are more or less complete but very small shells, whereas all the others are either whorl fragments or poorly preserved.

Ptychomphalina cf. **protei**
([Münster] Laube)

Plate 1, figures 29, 36–38, 44, 45

Cf.:

?*Pleurotomaria Protei* MÜNSTER, 1841, p. 112, pl. 12, fig. 12.

Scalites Protei Münster sp.; LAUBE, 1868, p. 77, pl. 26, fig. 7.

Ptychomphalus Protei Laube sp.; KITTL, 1891, p. 203, *cum synon.*, pl. 1, figs. 11–13.

DESCRIPTION (INCLUDING DIMENSIONS): Four whorl fragments from lot 48, two of which may belong to the same shell, and a single fragment from lot 26 are dealt with under the above designation. Two of the former represent a considerably larger shell size than all the others; the shells from which they stem may, when complete, have measured about 20 mm. in width, and those to which the smaller fragments belong between 8 and 10 mm. or, in the case of specimen A.M.N.H. No. 27697/1, somewhat less. To judge by the whorl profile, the height of all these shells may have somewhat exceeded their width.

The whorl profile (figs. 36, 37, 45) is decidedly triangular; upper and lower faces meet at an angle of about 100 degrees in the small fragments and at a somewhat less obtuse angle in the two large ones (A.M.N.H. Nos. 27697:3, 27697:4). In the smaller fragments the upper face is distinctly concave and the lower gently so between the peripheral edge and another blunt edge which marks the boundary between lower face and base. In the afore-mentioned large whorl fragments the upper face is plane or gently convex, the lower one plane. In all fragments present both faces meet in a sharp peripheral edge which might be called a gable rather than a keel. Only in the two large fragments the fact that the upper face projects beyond the upper margin of the lower, thus leaving a kind of half groove between them, produces the appearance of a sharp keel (fig. 45).

This observation is in good agreement with that made by Kittl (1899, p. 88) in his description of *P. moscardii* (Stoppani), that this edge is sharper the closer it is to the aperture.

Only in the small fragments can the growth striae be seen to form small lunulae and to cause a fine granulation on the peripheral edge, which is thus believed to carry the slit band. The growth striae run obliquely backward across the upper whorl face (fig. 29); on the lower one they describe a forward convex arc, then assume a more or less radial direction. No growth striation but an indistinct revolving ornamentation is observable on the two large fragments, best on the upper face of specimen A.M.N.H. No. 27697:3, which carries about eight extremely flat lirae separated by intervals of about the same width. In one of the smaller fragments (A.M.N.H. No. 27697:2) four rather large but flat tubercles, somewhat elongated in a forward oblique direction, are recognizable just beneath the upper suture. A single such tubercle in a slightly lower site is found in another

small fragment (A.M.N.H. No. 27697/1).

REMARKS: Although certain differences, especially in whorl profile, exist between the smaller fragments and the two larger ones, all these fragments are here dealt with together, considering that these differences are perhaps due merely to ontogenetic changes.

In its characteristic whorl profile, especially in the sharp peripheral edge, this form considerably resembles *P. protei* from St. Cassian and its near relatives from the Esino limestones, *P. canovana* Kittl (1899, p. 7, pl. 1, fig. 3) and *P. moscardii* (Stoppani; Kittl, 1899, p. 8, text fig. 1, pl. 1, figs. 4–5), which differ from *P. protei* in minor characters only. It is believed to come closest to the first of these species and has been designated accordingly. It cannot be considered conspecific, since it lacks the true keel present in *P. protei*, and has a faint revolving ornamentation which, according to Kittl (1891, p. 204, 1899, p. 8), is absent in Münster's species.[1] The latter shows no traces of the subsutural nodes present in two of our smaller fragments.

From all the following species that are tentatively referred to this genus the present form is readily distinguished by its sharp peripheral edge and by the site of the slit band on, not above, the periphery.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27697	4
26	27697/1	1
	Total (fragments)	5

?Ptychomphalina discoidea, new species

Plate 1, figures 46, 47, 54–58

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27693 (holotype)	1.79 mm.	125	$9\frac{1}{2}$	116°
27693/1	*ca.* 2.35	*ca.* $114\frac{1}{2}$	*ca.* 7	111°

That the values for both W and π are lower in the larger than in the smaller specimen may be in line with usual growth trends. However, the spire also is lower (instead of higher, as might be expected) in the larger shell.

SELECTION OF TYPE: The better preserved, though smaller shell is designated holotype.

DESCRIPTION: Shell consisting of from three to three and a half volutions, flatly biconical, almost discoidal in shape. Profile of the spire nearly unbroken, except for the engraved sutures. Body whorl characterized by a blunt, well-rounded middle edge; its profile is triangular, but with a truncate vertex. Its apical face can be seen in the holotype to become slightly concave in its lowermost third, and it is in the same zone that a conspicuous furrow running across this whorl and obviously indicating the site of an old apertural margin shows a distinct forward concave sinus (fig. 54). Both these facts suggest a slit band which, however, cannot be recognized as such in the holotype. In the somewhat larger paratype the middle zone of the apical face of the body whorl is broken out in its anteriormost quarter. From there the lower margin of this gap can be followed through all the rest of the body whorl and still through about a quarter of the penultimate one as a narrow but quite deeply engraved furrow, which is situated at the lower third of the apical face and which, although the surface is too worn to permit observation of a selenizone, cannot be otherwise interpreted than as a slit band. The aperture is about as wide as high and is subrhombic in outline but has a subcircular lumen. The outer lip is rather thin, but the inner one is thickened and in its upper part slightly reflexed. The base is gently convex and perforated by a deep umbilicus the width of which equals about one-sixth of the diameter of the base in the holotype, but only about one-eighth in the paratype. In the former it is surrounded by a distinct edge which, however, loses sharpness towards the aperture. No circumumbilical edge is recognizable in the paratype.

The body whorls of both specimens show a delicate revolving ornamentation which can distinctly be seen only on the apical face of the holotype and between the slit band and the umbilical margin in the paratype. In these places about 10 flat lirae separated by

[1] An indication of revolving lirae similar to those observable in the fragment A.M.N.H. No. 27697:4 can, however, be seen on the lower face of the body whorl in Kittl's figure 11 (1891, pl. 1).

markedly narrower, shallow furrows can be counted in the holotype and about 15 somewhat narrower ones in the paratype.

No individual growth striae are observable, but the shape of the aperture can be inferred from the course of the transverse furrow of the holotype. It runs obliquely backward across the apical face of the body whorl, forming first a shallow forward convexity, then the forward concavity already mentioned, which obviously indicates the site of the slit band. After crossing the periphery it forms a hook, turns backward again, and runs in a shallow, forward concave arc towards the umbilicus.

EARLIEST ONTOGENETIC STAGES: In the holotype the embryonic volutions can be seen to be somewhat depressed, though not strictly planospiral. This gives a blunt appearance to the apex.

REMARKS: As indicated, this form and the two following can only tentatively be referred to *Ptychomphalina* from the type species of which, *P. striata* (Sowerby), they deviate in some essential characters, chiefly in the site of the slit band which is above, not on, the periphery.

Despite this uncertainty of the generic reference and the availability of only two specimens, the excellent preservation of the holotype and the fact that in both the slit band is well observable seem to justify the establishment of this species. It has the triangular whorl profile in common with *P.* cf. *protei*, but its peripheral edge is blunt, not sharp as in that form. For comparisons with *?Ptychomphalina*, sp. indet. 1 and sp. indet. 2, see the discussions of those forms below.

With its moderately wide umbilicus, *?P. discoidea* somewhat resembles in basal view the forms referred below to *Solariella* (*Eosolariella*), but they lack the circumumbilical ridge and revolving ornamentation of the present species, not to speak of their quite different whorl and shell profiles and the absence of a slit band.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27693	1
26	27693/1	1
	Total	2

?Ptychomphalina, sp. indet. 1

Plate 1, figures 48–53, 59, 60

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27694	*ca.* 1.74 mm. (est.)	*ca.* 109½	*ca.* 9½	106°

DESCRIPTION: The single shell measured above seems to be congeneric with the preceding species, but it cannot be considered conspecific. Although the shell is on the whole also biconical, the profile of the body whorl is not so triangular as in *?P. discoidea* but well rounded, and that of the penultimate volution exhibits even an almost perpendicular lateral face beneath a rounded shoulder which connects the former with a gently sloping apical band. If this specimen is compared with the holotype of the preceding species, these differences make for a lesser width and for a less wide pleural angle at the same size and at the same relative height of the spire. The aperture, the lower part of which is unfortunately missing in the present specimen, may be assumed to have resembled that of *?P. discoidea*, but the inner lip is considerably thickened to the extent that it conceals part of the umbilicus. Even regardless of this concealment the umbilicus, which attains only about one-tenth of the diameter of the base in width, is much narrower than in the preceding species. In the present shell, too, a transverse furrow indicating an old apertural margin is preserved (figs. 48, 49, 51, 52). Both apical and basal faces of the body whorl being less flattened than in *?P. discoidea*, it runs less obliquely backward than in that species but otherwise its course is the same; it shows also the same forward concave sinus, indicating the slit band, in the lower third of the upper face of the body whorl. This slit band can also be recognized in the posterior part of this whorl and in the anterior part of the penultimate one (fig. 48), but merely as a hardly perceptible depression between two of the revolving lirae which seem to be a little more distant from each other than the others. A revolving ornamentation similar to, but a little stronger than, that of the preceding species is present on the body whorl and the two preceding whorls. In the former about 10 such

lirae can be counted from the umbilicus to the periphery, and about eight more from there to the suture. On the upper face of this whorl they are about as wide as, but on the lower one they are markedly wider than, the shallow grooves between them. A fine denticulation of these revolving lirae suggests the presence of delicate growth striae which can otherwise not be observed. Their course may be assumed to be the same as that of the transverse furrow.

In this specimen the apex, which is not very well preserved, is obtuse, thus indicating that the embryonic volutions are flat but hardly planospiral.

Two considerably larger specimens from lot 57, which are casts with only partly preserved shells, may be conspecific with the one described above. The larger (A.M.N.H. No. 27694/1:2), which has in addition to a badly damaged body whorl most of the spire preserved, attains a little more than 5 mm. in height and nearly 6 mm. in width, and the smaller (A.M.N.H. No. 27694/1:1) consists of a body whorl only, which is nearly 4 mm. high and a little wider. The latter specimen is the better preserved. Both resemble the one described above in shell shape. The umbilicus of specimen A.M.N.H. No. 27694/1:1 is markedly wider than that of A.M.N.H. No. 27694, attaining about one-sixth of the diameter of the base in width (fig. 53). The inner lip is less thickened but clearly reflexed over a groove which accompanies it on its outer side and gradually widens into the umbilicus. At least in its inner part, the aperture is much more complete in this specimen than in the measured one. The inner lip can be seen to form a well-rounded arc near the ceiling of the aperture, then to run almost straight and steeply obliquely down to the bottom which is narrowly rounded (fig. 60). The slit band can be recognized as a distinct groove immediately above the periphery in the body whorls of both casts and in the penultimate volution of the larger one, where also the revolving ornamentation is indistinctly visible. The latter can be studied much better in specimen A.M.N.H. No. 27694/1:1 where four revolving keels, or lirae, stand out, one somewhat above, one on, and two below, the periphery, with the slit band between the two uppermost (fig. 59). Faint indications of weaker lirae can be recognized here and there on the base.

REMARKS: Comparison with *?P. discoidea* is integrated in the above description of specimen A.M.N.H. No. 27694. *?P.* sp. indet. 2 is compared below.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26694	1
57	27694/1	2
	Total	3

?Ptychomphalina sp. indet. 2

Plate 1, figures 39–41

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27540	*?ca.* 1.23 mm.	*?ca.* 163½	*?ca.* 36½	87°

Since a crinoid columnal sticks to the apical side of this specimen, both its total height and the height of its spire can be only vaguely estimated; however, its width could reliably be found to amount to 2.02 mm., and the measurement of the pleural angle may be considered reasonably correct.

DESCRIPTION: Shell shape flatly conical, solariid. The three last volutions are visible; they may be preceded by from two to three more. Those visible are very low and gently convex and separated by shallowly channeled sutures; nevertheless, the shell profile appears at first sight almost unbroken. In the body whorl a blunt edge, separating the upper face from the lower, marks the periphery. This lower face changes without sharp boundary to the base, a full half of the width of which is occupied by the umbilicus, entirely filled by another crinoid columnal; its ring-shaped outer zone is only gently convex. On the whole, the base is perfectly flattened, if not slightly concave. The aperture is subcircular, with an obtuse angulation at its upper end.

Growth striae can be seen to run obliquely backward over the apical face of the body whorl, to form distinct lunulae immediately above its blunt peripheral edge, and to assume a forward oblique direction on its lower face, but they cannot be followed into the outer zone of the base the surface of which is

corroded. A weak keel, or lira, marks the boundary between lower whorl face and base, with another similar one somewhat above it. Both are beaded by the crossing of growth striae.

The crinoid stem link on the apical region of this shell bars observation of its early ontogeny.

REMARKS: The selenizone, recorded above, refers this peculiar shell to the Pleurotomariidae. Within this family it is, even more questionably than the two preceding species, referred (*faute de mieux*) to the genus *Ptychomphalina*. From all its preceding forms, including *?P. discoidea* which it otherwise somewhat resembles, it differs essentially by its absolutely flat base and extremely wide umbilicus which are responsible for the solariid shell shape.

The latter character causes a certain similarity to *Anomphalus helicoides* and *Solariella (Eosolariella) distincta* which is discussed below under those two forms.

OCCURRENCE: A single specimen in lot 26 (A.M.N.H. No. 27540).

PLEUROTOMARIA J. SOWERBY

?Pleurotomaria ex aff. **P. haueri** Hörnes

Plate 2, figures 1, 8

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27698	9.5 mm. (est.)	*ca.* 83	31 (est.)	62°

DESCRIPTION: A single incomplete cast from lot 16A, with only the body whorl and two and a quarter of the preceding volutions preserved, shows a trochiform shell shape and flatly sloping, gently convex whorls which are separated by deeply channeled sutures and attain maximum width somewhat above these sutures. The base, separated by a sharp, keel-like edge from the lateral face of the body whorl, is absolutely flat around the umbilical funnel the width of which amounts to a little more than three-eighths of the diameter of the base and which is surrounded by a distinct edge. The aperture seems to have been subrhombic in shape.

The only traces of ornamentation preserved on the present cast are those of growth striae which run at an angle of about 60 degrees obliquely backward across the lateral face of the body whorl and form lunulae, indicating the presence of a slit band on the peripheral keel, thus making it appear delicately beaded. The course on the corroded base is not recognizable.

REMARKS: The presence of a slit band refers this specimen to the Pleurotomariidae. Within this family it greatly resembles *P. haueri* Hörnes (1855, p. 47, pl. 2, fig. 11; Koken, 1897, p. 24, pl. 3, figs. 1–3, 9) in shell shape, although its preservation does not permit recognition of the revolving keels in that species both above and beneath the slit band. It is therefore tentatively referred to Koken's (*loc. cit.*) group of *P. haueri* Hörnes.

This specimen requires no comparison with any other form in the material under study.

OCCURRENCE: A single specimen in lot 16A (A.M.N.H. No. 27698).

MURCHISONIIDAE

TRYPANOCOCHLEA TOMLIN

(=**VERANIA** KOKEN, NON VÉRANY)

A single shell exhibits so perfectly the distinctive characters of this genus that it can be safely referred to it; it represents a new species, but its preservation is too poor to assign it a specific name.

Koken's (1897, p. 105) genus was established on a single specimen which when complete may have been about 9 mm. high. Since the present shell when complete must have reached 25 to 30 mm. in height, Wenz' (1938, p. 162) generic diagnosis must be amended to include "small to moderately large" shells.

Trypanocochlea, new species

Plate 2, figure 7

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26505	20.5 mm.[1]	?	?	22°

DESCRIPTION: Shell shape high spired, with deep, channeled sutures. Whorl profile triangular, with the slit band keel marking the greatest width; apical band rising at an angle of about 60 degrees, lateral band sloping at an angle of about 75 degrees. Base conical. Columella thick, massive; only faint, indistinct traces of folds, as in *T. cerithioides*, are

[1] As preserved. The specimen measures 11 mm. in width. As preserved, its spire is 12 mm. high.

observable on it. No umbilicus. Aperture too poorly preserved to be described.

ORNAMENTATION: Apart from the growth striation, described below, there is only revolving ornamentation. The periphery is occupied by the slit band keel which attains about one-seventh of the whorl in height and projects considerably. It is bordered by two neat edges, so as to appear rectangular, though with rounded edges in cross section. Only in the most anterior portion of the last preserved whorl can a thread-like secondary keel be seen to run along the middle line of the slit band keel. Moreover, there are two revolving keels in the uppermost part of the whorl, namely, a finer one immediately below the suture and a somewhat stronger one at the upper fourth of the apical band, and two more on the lateral band. The upper of these, which is second in strength only to the slit band keel but still considerably weaker, is situated about halfway between the slit band and the suture, the lower one, which is very weak, is immediately above the suture. A faint undulation can be observed in the lower of the two upper keels, there being about four very blunt projections per quarter whorl; in the slit band keel this undulation is even fainter and hardly perceptible, so that it is by no means comparable to the thorns present in the type species, *T. cerithioides*.

The course of the growth striae can easily be followed (fig. 7). They run perpendicularly from the subsutural keel to the next, then obliquely backward to the slit band, on which they form a distinct lunula, then obliquely forward to the suture. In side view, the angle between the growth striae above and those below the slit band measures about 110 degrees.

Earliest ontogenetic stages cannot be studied, since the nucleus is not preserved.

REMARKS: Shell shape and especially the details of sculpture and growth striation refer this form beyond any doubt to *Trypanocochlea*. From the only previously known species of this genus, *T. cerithioides* (Koken), it can readily be distinguished by its much larger size and the absence of pronounced thorns from its slit band keel and of clear folds from its columella.

OCCURRENCE: A single specimen in lot 48 (A.M.N.H. No. 26505).

EUOMPHALIDAE

This family is represented in our material by less than a score of specimens, only eight of which are generically determinable. They are referred below to the genera *Euomphalus*, *Phymatifer*, *Discohelix*, and *Brochidium*.

In addition, there are a few extremely poor fragments in lot 16A and one in lot 29 which may belong to shells of this family or be worm tubes. They have been designated merely as ?euomphalid fragments (A.M.N.H. Nos. 27541, 27541/1).

EUOMPHALUS J. SOWERBY

The form listed under this generic heading, only one of the two specimens of which is sufficiently well preserved for closer examination, is believed to be related to *Euomphalus cassianus* Koken (1889, p. 416, pl. 14, fig. 2; Kittl, 1891, p. 227, *cum synon.*, pl. 4, fig. 23), a species referred by Cossmann (1915, p. 133) and, following him, Diener (1926, p. 50) to the genus *Schizostoma* Bronn. Since, however, Knight (1934, pp. 143, 144) has convincingly demonstrated that the type species of *Euomphalus* and *Schizostoma* are closely related, if not conspecific, the latter genus is, notwithstanding Cossmann's (1915, p. 131) and Wenz' (1938, p. 192) opinions to the contrary, here considered a synonym of *Euomphalus*.

Euomphalus, new species

Plate 2, figures 2, 3, 9, 10

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27542:1	0.78 mm.	207	Top concave	195°

DESCRIPTION: The following description is based on the smaller of two shells (no. 1); the other (no. 2), the diameter of which is almost twice that of the former, is badly corroded and permits no observation of any details but is believed to be conspecific.

Shell consisting of about two and one-half volutions, dextral, disk shaped. Apical side concave, umbilicus deep, perspective, attaining nearly half the diameter of the base. The apical face of the body whorl, which is flat and slopes gently inward, is separated by a sharp edge from its rounded convex lateral face, which is in turn separated from the base

by a well-pronounced, though less sharp, peripheral edge. This whorl profile can be recognized in the shape of the aperture (fig. 3). Its upper outer corner reaches somewhat above the highest point of the body whorl 180 degrees back from the aperture.

The lower half of the lateral whorl face shows faint indications of two revolving keels, but the course of the growth striae cannot reliably be recognized, nor can the earliest ontogenetic stages.

REMARKS: This form may be compared with *E. cassianus* Koken (see paragraph under the generic heading above). It is readily distinguished from that species by the profile of the body whorl which is higher than wide, whereas the opposite ratio prevails in Koken's species, by its clearly convex, not slightly concave, lateral face, and by its less truncate base which lacks the wide circumumbilical groove seen in Kittl's figure 23.

OCCURRENCE: Two specimens in lot 76 (A.M.N.H. No. 27542).

PHYMATIFER DE KONINCK

Although Knight (1934, p. 144) considers de Koninck's name a synonym of *Euomphalus*, this genus, because of its raised spire and the tubercles on its upper shoulder and occasionally also on the lower one, is believed to be sufficiently distinct from *Euomphalus* to be separated from it, as it is by both Cossmann (1915, p. 130) and Wenz (1938, p. 192).

Cossmann's (*loc. cit.*) designation of *P. tuberosus* as the type species, accepted by Wenz (*loc. cit.*), cannot be considered valid, since de Koninck himself had designated *P. pugilis* as the genotype (Knight, 1941, p. 243).

Phymatifer peruvianus, new species

Plate 2, figures 5, 6, 12, 13

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27543 (holotype)	1.40 mm.	190	16	140°

DESCRIPTION: Shell consisting of two and one-half volutions, nearly discoidal, almost twice as wide as high, with flatly conical spire, flattened and markedly concave base, and deep umbilicus the diameter of which equals about one-fourth of that of the base. The body whorl exhibits a wide, nearly horizontal, slightly concave apical band, separated from the lateral face by a sharp edge which is accentuated by the heavy upper tubercles. The lateral face of this whorl is gently convex and, except for its lowermost third, almost perpendicular; only in its lower part it bends inward towards the pronounced edge which separates this lateral face from the base and is also marked by tubercles. The outer zone of the base is decidedly concave between the peripheral edge and the quite sharp circumumbilical one and slopes inward, at first quite steeply, then the more gently the nearer the aperture.

The aperture slants markedly backward from the upper to the lower margin and is subquadratic in outline, with a subcircular lumen. The umbilicus is funnel-shaped and has a steep, almost perpendicular wall.

Of the heavy tubercles that crown the shoulder, seven can be counted on the anterior half of the body whorl. In apical view they tend to be elongated radially; in side view, they make for a scalloped aspect of the shoulder. The edge surrounding the base carries 14 bullate tubercles which are more closely set in the posteriormost and anteriormost portions of the body whorl than between them. An extremely fine revolving striation can be seen on the lateral face of this whorl, best on its lower half (figs. 5, 6, 12). On the same face only growth striae can be recognized; they run in a gently forward convex arc steeply obliquely backward across it.

EARLIEST ONTOGENETIC STAGES: Apex and spire are corroded, but the nucleus can be seen to be flattened; the spiral whorls seem to be smooth.

REMARKS: Both shell shape and sculpture clearly assign this form to the genus *Phymatifer* and characterize it well enough to dispense with any comparison with other euomphalids in the present material. These facts may justify the establishment of a named species on the single specimen present. Of the St. Cassian species referred by Cossmann (1915, p. 131) to this genus[1] and comprised by Kittl (1891, p. 224) in his group of

[1] As seen from Cossmann's reference to Kittl's figures 14–22 on plate 4, *P. lineatus* (Klipstein) is erroneously omitted in the former author's enumeration.

Euomphalus lineatus, *P. biarmatus* (Klipstein, 1843, p. 203, pl. 14, fig. 16; Kittl, 1891, p. 225, *cum synon.*, pl. 4, fig. 20) seems to come closest to the present one, but Klipstein's species has two tuberculate keels above the middle of the body whorl, and the edge separating its lateral face from the base is less pronounced and untuberculate.

OCCURRENCE: A single shell in lot 31 (A.M.N.H. No. 27543).

DISCOHELIX DUNKER

Discohelix sp.

Plate 2, figures 4, 11

DESCRIPTION (INCLUDING DIMENSIONS): This fragment of a whorl, belonging to a sinistral disk from 2 to 2½ mm. wide, has no part whatever of the preceding whorls attached; this seems to indicate that the conch was fully evolute. An entirely flat apical whorl face is separated by a distinct though rounded edge from the lateral one which is gently convex and slopes inward from its uppermost part, where the whorl is widest, to the sharp edge separating it from the deeply concave base. Its outer zone is in itself slightly concave between the peripheral edge and the less pronounced circumumbilical one. The umbilicus must have been quite wide. The subquadratic aperture reproduces the whorl profile.

Growth striae can be seen to describe on the lateral whorl face a forward convex arc the chord of which runs obliquely from the upper left to the lower right and which culminates at about the lower third of this face.

REMARKS: Certain Liassic forms such as *D. calculiformis* Dunker, the type species, and *D. pygmaea* Dunker (see Wenz, 1938, p. 197, text figs. 344, 345) and two from the Muschelkalk of the Germanic Trias, namely, *D. exiguus* (Phillips) and its var. *arietina* (Schlotheim), as figured by Picard (1904, pp. 474, 476, pl. 10, figs. 5, 6), although dextral, seem to resemble the present fragment more closely than *Straparollus ultimus* Kittl (1891, p. 228, pl. 4, fig. 24), from St. Cassian, which is referred to *Discohelix* by Cossmann (1915, p. 134) and the whorl profile of which is quite rounded.

The sinistral coiling and the peculiarities of the whorl profile distinguish this fragment from the two preceding species; it also lacks the upper and lower tubercles present in *Phymatifer peruvianus*. Among the various euomphalid genera that come into consideration *Discohelix* seems best qualified to accommodate it.

OCCURRENCE: A single fragment in lot 26 (A.M.N.H. No. 27544).

BROCHIDIUM KOKEN

This genus, here conceived as diagnosed by Kittl (1891, p. 232) and Wenz (1938, p. 198), is represented in our Peruvian material by four specimens only, two of which seem to be dextral, whereas the other two are sinistral. The first two may belong to one species; the last two represent two different species. Only the first of these three (? or four) forms is well enough preserved to be given a specific name.

Brochidium vareasense, new species

Plate 2, figures 14, 15, 19–21

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27545 (holotype)	1.18 mm.	234	Top concave	*ca.* 200°

DESCRIPTION: Shell discoidal, nearly planospiral and fully evolute, with both apical and basal faces concave; it consists of about two volutions. Although the protoconch is not preserved, the inner whorl can be seen to cling with its initial part to the outer, thus leaving a hole, which measures about one-eighth of the whole shell in width, open in the center. A little more than a third of the outer whorl (which is, however, not complete) is detached from the inner one. On what is believed to be the basal side the outer whorl projects a little farther beyond the inner whorl than on the opposite side. If so oriented (figs. 14, 15), the shell must be considered dextral.

The whorls are tube-like, with a nearly circular profile; in the outer volution, however, an extremely obtuse, hardly perceptible edge appears at the periphery. The slope of the whorl profile from the apical side towards this edge is somewhat steeper than that from the edge towards the base. This whorl profile is reproduced in the outline of the aperture (fig. 15).

Fourteen rather heavy, straight, slightly prorsiradiate ribs which run around all the whorl profile except its inner face are present on the first three-quarters of the inner volution. The intervals between them are somewhat narrower than these ribs. The outer whorl is smooth, except for fine growth striae which run nearly straight across its outer face (fig. 14).

A smaller, incomplete disk from lot 26, attaining not quite 2 mm. in diameter and consisting essentially of the first volution only, with parts of the posterior third of the second attached, shows the same central hole, the same whorl profile, and a similar though much less distinct costation. Since in this specimen the apical side is almost flat, whereas the basal one is deeply concave, its conspecificity with the holotype remains doubtful.

This smaller shell is remarkable for apparently having the protoconch preserved. It projects from the initial part of the inner whorl which, in this specimen also, clings to the preserved portion of the outer whorl, hook-like into the central hole (fig. 19).

REMARKS: The loose coiling, the open apex, and the tube-like, costate whorls clearly refer this species to *Brochidium*.

Of the previously known species of *Brochidium*, *B. aries* (Laube, 1868, p. 76, pl. 25, fig. 15; Kittl, 1891, p. 233, *cum synon.*, pl. 4, fig. 32) comes closest to the present form but differs from it by sinistral coiling and the costation which extends to the outer whorl and is crossed in the interior zone by two or three revolving keels. The same differences hold true for *B. ornatum* Koken (1889, p. 434, pl. 14, fig. 3), doubtfully considered by Kittl a synonym of *B. aries*. *B. pustulosum* Koken (*ibid.*, fig. 7) which, according to Kittl (1891, p. 234), may be merely a variety of *B. aries*, shows just the beginning of the detachment of the outer volution which is to a larger extent observable in our holotype. Otherwise Koken's species differs from ours by its much more delicate, lattice-like ornamentation.

The only species of this genus hitherto described and illustrated from Peru, *B. spinosum* Körner (1937, p. 207, pl. 13, fig. 6) from the Nevado de Acrotambo, recorded also by Cox (1949, p. 36) from Hacienda Huanca, is dextral, as is *B. vareasense*, but differs from it widely by its much heavier sculpture, which persists throughout development, and chiefly by its strong, long, median spines.

For comparisons with *Brochidium* sp. indet. 1 and sp. indet. 2, see the discussions of those forms below.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
57	27545	1
26	27545/1	1 (doubtful)
	Total	2

Brochidium sp. indet. 1

Plate 2, figures 17, 18

DESCRIPTION (INCLUDING DIMENSIONS): A poorly preserved and incomplete shell, measuring about $1\frac{3}{4}$ mm. in width and about $1\frac{1}{4}$ mm. in height, differs from *B. vareasense* by sinistral coiling, greater height, and a much wider difference between the apical and basal faces. The apical face, most of which is missing, must have been quite flat; it is separated by a pronounced shoulder from a strongly convex lateral face which slopes inward and changes imperceptibly into the base. The basal face is quite high and shows a distinct though not sharp circumumbilical edge. The umbilicus, measuring in diameter about one-third of that of the shell, is comparatively narrow and funnel-shaped and continues upward into the central hole of the apical face. The aperture (fig. 17) is subcircular, with a truncate top.

Broad radial folds, four of which can be counted per quarter whorl, are recognizable on the posterior half of the outer whorl only (fig. 18); they seem to continue, as much thinner ribs, in a radial direction down the umbilical wall. In the anterior half of this volution the circumumbilical edge seems to carry some indistinct tubercles, but both lateral whorl face and base are here smooth, except for extremely fine growth striae which seem to run nearly perpendicularly across the former.

REMARKS: As seen from the above description, this specimen is specifically different from *B. vareasense* as well as from any *Brochidium* species recorded in previous litera-

ture, but it is much too poorly preserved to be given a specific name.

See the discussion of the following form for comparison.

OCCURRENCE: A single incomplete specimen in lot 26 (A.M.N.H. No. 27546).

Brochidium sp. indet. 2

Plate 2, figures 16, 22

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27547	*ca.* 1.75 mm.	*ca.* 203	Top concave	125°

DESCRIPTION: With a diameter of about 3½ mm., this incomplete shell is the largest *Brochidium* in the present assemblage. Except for being sinistral, it resembles the holotype of *B. vareasense* in shape and in the profile of the outer whorl, the periphery of which is even more distinctly fastigate (fig. 22). It also shows a similarly wide, if not wider, hole in the apical face, but the initial part of the inner whorl is not preserved (fig. 16). On the other hand, this shell deviates more widely than the holotype from the planospiral shape, there being no doubt as to which is the apical and which the basal face (fig. 16).

The surface is so badly corroded that the presence of radial ribs cannot be excluded. Growth folds seem to form a forward-pointing tongue on the peripheral edge.

REMARKS: From *B. vareasense* the present specimen differs in whorl profile and by its more disk-like shell shape. Owing to poor preservation, it is not given a specific name.

OCCURRENCE: A single specimen in lot 76 (A.M.N.H. No. 27547).

PLATYACRIDAE

This family is represented in the material examined by a few fragments and a few juveniles only. Three of the former are tentatively referred to the genus *Platyacra* and the fourth with even more reservations to *Lepidotrochus*. Equally uncertain is the reference of two juvenile forms, represented by three individuals each, to the genus *Hyperacanthus*.

Wenz (1938, pp. 202, 203) includes all three genera in the above family.

PLATYACRA (VON AMMON[1]) ZITTEL
SUBGENUS **ASPERILLA** KOKEN

?Platyacra (Asperilla) sp. indet.

Plate 2, figures 27, 28, 33, 34

DIMENSIONS: None of the three fragments present permits proper measurements, but the largest (no. 1) measures about 2.2 mm. in height; when complete, the shell to which it belongs must have been nearly 5 mm. wide and must have had a pleural angle of approximately 120 degrees.

DESCRIPTION: Shell small, sinistral, depressed, with a flat top consisting, as far as preserved, of four volutions. The two embryonic ones seem to be slightly sunk within the first postembryonic volution which is still entirely flat on its upper surface and the cross section of which is rhombic externally but circular internally. The periphery is marked by a strong, reënforced edge. Immediately below it the suture separating this whorl from the next is shallowly engraved. The profile of the fourth volution slopes at an angle of about 30 degrees from the suture to the periphery; the slope is an even one in its upper part but becomes slightly concave before reaching the periphery. The peripheral keel is even more pronounced than in the preceding whorl and strongly reënforced internally; the inner whorl profile is quite round. Only the outer zone of the base is partly preserved; it seems to slope somewhat more steeply than the upper whorl face. On the basal side, too, the peripheral keel is accompanied by a concavity which is a little more pronounced than that of the upper side (fig. 27). The aperture is not preserved. In the smallest fragment present (no. 3), the base of which is broken off, the umbilicus can be recognized to have been circular in outline, wide open and deep.

The embryonic volutions and the first postembryonic volution are smooth; only on the second does ornamentation set in. It consists mainly of a subsutural row of tubercles, observable in the largest fragment (no. 1) only, and of thorn-like, hollow teeth along the periphery, which can be studied in both fragments numbers 1 and 2. Of both these sculptural elements there are four per quarter whorl. The subsutural tubercles are elongated

[1] See Ammon (1893, p. 168).

in a steeply oblique backward direction so as to extend over a little more than the uppermost third of the upper whorl face; thus they might be called blunt folds. The peripheral teeth are elongated in the revolving sense so as almost to touch each other and to present in basal view a gently undulating keel. On the last whorl present the growth striae run in a backward concave arc from the suture obliquely backward about as far as the middle of the upper whorl face. There they swing in a well-rounded loop forward and run in this direction to the periphery, forming a forward concave arc. On the base they seem to continue in a more or less radial direction. In addition to the growth striation there is a fine revolving one which, in both fragments numbers 1 and 2, can be better observed on the base than on the upper whorl face.

REMARKS: Tentative reference of the present form to the genus *Platyacra, sensu lato*, and within that genus to the subgenus *Asperilla* is believed to be justified by the distinctive characters reported in the description and illustrated in plate 2.

The present form resembles the sinistral *P.* (*A.*) *calcar* (d'Orbigny) (see Cossmann, 1915, pl. 9, figs. 10–12) from the Charmouthian,[1] the contemporary *P.* (*A.*) *mayensis* Cossmann (1915, p. 209, pl. 9, figs. 18–21), which is, however, dextral, and the subgenotype *P.* (*A.*) *longispina* (Rolle) from the Kimmeridgian (see Wenz, 1938, p. 203, fig. 360), which is also dextral, much more than the dextral Triassic form from the Feuerkogel illustrated by Koken (1897, pl. 23, fig. 17) without determination, which Cossmann (1915, p. 209) refers to *Asperilla* and believes to be perhaps conspecific with *Delphinula kokeni* Picard (1903, p. 477, pl. 10, fig. 7).[2]

OCCURRENCE: Three small fragments in lot 26 (A.M.N.H. No. 26541).

LEPIDOTROCHUS KOKEN

This genus was established by Koken in 1895 (p. 451) simultaneously with *Hyperacanthus* (see p. 37). Stating both to be closely related, he referred them to the "Trochidae or Astraliidae, respectively," but only a year later (1896, pp. 93, 94) he placed both genera in the Trochonematidae, and maintained this reference also in his Hallstatt monograph (1897, p. 61). Both Cossmann (1915, pp. 205, 206, 209, 210) and, following him, Wenz (1938, p. 203) accept *Lepidotrochus* in the circumscription given this genus by Koken but consider it more closely related to *Platyacra* than to the Trochonematidae. Consequently, the former author refers it to the Delphinulidae and the latter to the Platyacridae. Although *Lepidotrochus* is relegated to subgeneric rank under *Platyacra* by Cossmann and Wenz (*loc. cit.*), it is here granted the same generic standing as both *Platyacra* and *Hyperacanthus*, as it was by Koken.

?Lepidotrochus sp. indet.

Plate 2, figures 23, 24, 29, 30

DESCRIPTION (INCLUDING DIMENSIONS): The only fragment present consists of about a quarter of the penultimate volution and a much smaller part of the apical face of the last volution of an extremely flatly conical, dextral shell. The maximum width reached by the last volution may have been about 35 mm. Its height cannot be estimated even approximately.

The apical face of the penultimate whorl slopes in the upper part at an angle of about 50 degrees but in the lower part at only about 30 degrees, and therefore appears concave in profile. Immediately above the suture it ends in a blunt keel which carries at irregular intervals indistinct teeth or tubercles varying in width. Where the body whorl is preserved, only an extremely narrow zone of the base of the penultimate volution is visible above the body whorl, and the suture between them appears deeply channeled. The apical face of the body whorl slopes at about the same small angle as the lower part of the penultimate whorl towards a peripheral edge which seems in the body whorl blunter and more rounded than in the penultimate. As seen at both ends of the fragment, the test is here unusually thick. Whereas its outer layer connects with the suture, the inner forms the ceiling of the body whorl, overlying in part the base of the

[1] Incorrectly designated subgenotype by Cossmann (1915, p. 208) after Koken's earlier selection of *P.* (*A.*) *conoserra* (Quenstedt) = *longispina* (Rolle).

[2] Referred by Diener (1926, p. 47) to the genus *Coelocentrus*.

penultimate whorl. The space between these two layers of the shell is filled with quartz crystals (figs. 23, 24). The same phenomenon can be observed on a correspondingly smaller scale on the outermost zone of the base of the penultimate whorl. This base forms an angle of about 40 degrees with its apical face; it is only slightly convex and appears flat on the whole. It is ornamented with nine revolving lirae, which decrease both in strength and in the width of the intervals between them towards the center. The last seems to be just at the periphery of a shallow umbilicus. Neither this umbilicus nor the aperture can be seen.

Growth striae which run obliquely backward can only dimly be seen in one place in the upper zone of the apical face of the penultimate whorl. They seem to be much more oblique in the lower zone and to cross the peripheral keel without any marked deflection. They can be more easily recognized over the base (fig. 30). In the outermost zone their obliquity reaches its maximum but, proceeding towards the center, it tends somewhat to decrease from one revolving lira to the next, thus causing the growth striae gradually to approach a radial direction (cf. Koken, 1897, pl. 11, fig. 8c). What little of the apical face of the body whorl is preserved is too corroded to permit any reliable observation of growth lines.

REMARKS: Reference of this very incomplete fragment to this genus is based on the shell profile and on certain details of the ornamentation, such as the tooth-like peripheral tubercles, the revolving ornamentation of the base, and, most of all, the peculiar deflection of the direction of the growth striae by the revolving lirae. Since neither the spire nor the aperture nor the umbilicus of this form is known, its reference to *Lepidotrochus* is very tentative, despite the characteristic features of the genus that could be observed.

Of the *Lepidotrochus* forms described and illustrated by Koken, only the mut. *retiaria* of his *L. cancellatus* (1897, p. 62, pl. 11, fig. 6) resembles the present form in shell shape, especially in the flat slope of the apical whorl faces and in the site of the peripheral keel immediately above the last suture. However, the present fragment indicates an even more flatly conical shell shape. It is indeed the flattest conical conch within the material under study; this fact dispenses with all further comparisons.

OCCURRENCE: A single fragment in lot 48 (A.M.N.H. No. 27535).

HYPERACANTHUS KOKEN

Mixed with the many small trochids referred below to the genus *Solariella* were a few equally small specimens, two in lot 71 and three in lot 86, which on closer examination turned out to be generically different. Only after most careful consideration are they tentatively assigned to the above genus, established by Koken (1895, p. 451) on *Cirrus superbus* Hörnes (1855, p. 48, pl. 1, fig. 5; Koken, 1897, p. 63, pl. 11, figs. 10, 11). This generic reference can be based only on the characters of the embryonic and earliest postembryonic volutions and is therefore subject to reservations.

The juveniles from lot 86 differ in some characters and may be specifically different from those in lot 71. The two forms are therefore separately dealt with below.

?**Hyperacanthus** juvenile form 1

Plate 2, figures 25, 26, 31, 32

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27688:1	1.86 mm.	*ca.* 94	6	103°

DESCRIPTION: The best preserved of the three shells present (no. 1) consists of four volutions, including two embryonic ones. The latter are planospiral, with the first even slightly sunk within the second. The first postembryonic whorl is roughly rectangular in profile, with a blunt and rounded shoulder separating a flat, nearly horizontal apical band from a nearly vertical lateral one. Another rounded edge bounds this lateral band below, just above the deeply engraved suture. The body whorl is very large as compared with the preceding volution. Its apical band slopes gently; the shoulder separating it from the lateral whorl face is slanted and accentuated by an unusually broad but rather low keel (which might suggest a slit band but for the presence of which other indications are lacking). Another, less pronounced keel marks the boundary between the lateral whorl face, which is comparatively low and

slightly sunk between those two keels, and the base. The latter is high and convex but deeply excavated by the rather narrow umbilicus. In both complete shells present the aperture is obstructed: in specimen number 1 by an even smaller juvenile of the same form, in number 2 by some shell fragment. At any rate, the aperture can be recognized to have been rounded, without angularity at the bottom. The inner lip is reflexed over the umbilicus, part of which it conceals, and is accompanied by a rather deep circumumbilical depression.

In the anterior half of the body whorl of specimen number 1 the boundary zone between lateral face and base is marked by eight or nine dark dots which are aligned more or less along the lower keel. They are believed to indicate the points of attachment of broken-off spines. The presence of a few such dark dots, in about the same location, on the small shell sticking in the aperture of this specimen supports the assumption of conspecificity (fig. 31).

Growth striae can dimly be seen running slightly obliquely backward across the apical face of the body whorl, then perpendicularly down its lateral face. They form no lunulae on the shoulder keel.

REMARKS: With all reservations imposed on any such comparison by the enormous differences in size, there are good reasons for considering this juvenile form congeneric with *H. superbus*, the type species (by monotypy) of *Hyperacanthus*, as illustrated by Koken (1897, pl. 11, figs. 10, 11). The flatness of the apex is well seen in his figures 10b and 11a, and is also mentioned in Wenz' (1938, p. 203) generic diagnosis. The apertural view of our specimen number 1 surprisingly resembles Koken's figure 10a, although the specimen there depicted is from 15 to 20 times larger than ours. Finally, should the interpretation of the dark dots in its peripheral zone prove to be correct, then traces of the spines so characteristic of this genus would be present at the location where one of the main rows is situated in much larger shells.[1]

This form is compared with the next juvenile form below. See also the discussion of *?H.* juvenile form 2 for comparison with small shells of the genus *Guidonia*. The differences between *?H.* juvenile forms 1 and 2 and small trochids referred below to the genus *Solariella* are pointed out in the discussion of *S. (Eosolariella) pusilla*.

OCCURRENCE: Represented only in lot 71 by three juveniles, if the smallest shell sticking in the aperture of specimen number 1 is included (A.M.N.H. No. 27688).

?Hyperacanthus juvenile form 2

Plate 2, figures 38–40, 45

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27689:1	*ca.* 1.71 mm.	*ca.* 108	*ca.* 6½	100°
27689:2	*ca.* 2.02	*ca.* 105½	*ca.* 8½	100°

The fact that W is smaller and h greater in the larger of the two measured specimens seems to indicate the usual trends of W to decrease, and of h to increase, with growth.

DESCRIPTION: This form can best be described by pointing out its differences from the preceding one, with which it is considered congeneric, though not conspecific.

Its embryonic and spiral volutions agree well with those of *?Hyperacanthus* juvenile form 1 except that here the two lateral keels appear earlier, viz., on the anterior half of the penultimate whorl of the largest and best shell present (no. 2). The body whorl, however, is not so large as, and is somewhat wider than, in the preceding form. Its two lateral keels are found at the same sites as there, but here they are about equally strong and seem to be a little less distant from each other. In this form, too, the band between them is slightly concave.

In the same individual (no. 2) the base appears to be less high than in the preceding form, and the inner lip to be more distinctly reflexed and somewhat thickened. The outer lip can here be recognized as thin and semicircular. The umbilicus seems to be closed in this individual, but since it is clearly open in the two others, it may be merely filled with subsequently deposited shell substance.

No traces of points of attachment of spines can be recognized in this form, but the growth striae can be seen more clearly than in the

[1] Even there they are, according to Koken (1897, p. 63), "preserved only under exceptionally favorable conditions."

preceding one on the apical and lateral faces of the body whorl, where their course is as described there, as well as on the base, where they first turn gently forward and then run in a radial direction towards the umbilicus (figs. 38, 45).

REMARKS: This form, because of its close similarity to the preceding one, is also tentatively referred to the genus *Hyperacanthus*.

This form, even more than the preceding, somewhat resembles juveniles of *Guidonia*, particularly those of *G. planetecta*. The lateral keels do not, however, project so strongly and therefore affect the profiles of the whorls and of the shell on the whole by no means so decidedly as in that genus; rather, they cling to the shell profile.

For comparisons with the small trochids referred to the subgenus *Eosolariella* of the genus *Solariella*, see page 90.

OCCURRENCE: The two measured specimens and a third even smaller one were found in lot 86 (A.M.N.H. No. 27689).

CIRRIDAE

The sinistral gastropods from the Peruvian Triassic dealt with under this heading markedly differ in their nuclear characters from the other members of the family to which they otherwise seem to show the greatest affinity. They are therefore only doubtfully attached to it with regard to the possibility that their similarity, due chiefly to sinistral coiling and other characters of the adult shell, may be merely homeomorphic. Since their immediate ancestry is unknown, as are their post-Triassic descendants,[1] I refrain at present from establishing an independent family for them, but I separate them from the rest of the Cirridae as the following subfamily.[2]

HESPEROCIRRINAE, NEW SUBFAMILY

DIAGNOSIS: ?Cirridae with sinistral, trochiform shells of small to moderate size, distinguished by nuclei which are planospiral or even slightly concave and somewhat inclined towards the axis of the conch.[3] Sutures shallowly engraved to deeply channeled, accompanied as a rule by a strongly projecting keel or row of tubercles above and a less prominent keel or row below. Base flat or gently rounded, leaving a narrow to moderately wide umbilicus, or at least an umbilical niche, open, which continues into a hollow columella. Aperture rhombic or subrectangular to rounded-subquadratic, with truncate base and continuous peristome; outer lip sharp and thin, inner one reflexed more or less widely over the umbilicus or umbilical niche. Elements of postembryonic ornamentation: Transverse ribs carrying from two to four tubercles which are arranged in revolving rows, becoming, in some species only, continuous keels. Only exceptionally are revolving keels present on the base also. There is, furthermore, as a rule a fine revolving striation on the whorl faces, on the base, or on both. Growth striae run obliquely backward over most of the whorl faces and the outer zone of the base and then change to a radial direction.

GENERA: Two genera can readily be distinguished within the new subfamily: a larger one, with strongly convex postembryonic whorls, separated by more or less deeply channeled sutures, and with pleural angles of more than 50 degrees, and a smaller one, with flat or even slightly concave postembryonic whorls, shallowly channeled or engraved sutures, and pleural angles in maturity of less than 45 degrees. For other differences the reader is referred to the following generic diagnoses.

DESIGNATION OF TYPE GENUS: The larger genus, *Hesperocirrus*, much more common and represented by more forms than the smaller, is designated type genus of this subfamily.

DISCUSSION: According to Grabau (1912, p. 766), ". . . species agreeing in the proto-

[1] With one possible exception; see page 41.

[2] Creation by Knight (1930) of a separate subfamily Pseudozygopleurinae (=Palaeostylinae according to Wenz, 1938, p. 381) within the family Loxonematidae for certain genera differing in nuclear characters from other loxonematids, particularly from the true Zygopleurinae, might be considered a precedent.

[3] Dr. J. Brookes Knight raised the question, on examining plates 2 and 3, whether the group here dealt with might not consist of hyperstrophic (Pelseneer, 1906, p. 82, text figs. 49, 64) dextral rather than sinistral forms. After examining some representative specimens with well-preserved nuclei he agrees with me that there is no sufficient evidence for such an assumption. The concavity of the nuclei, which suggested it to Knight, is as a rule shallow and more pronounced only in *Sororcula costata* (p. 54, pl. 3, figs. 32, 40).

conch and early conch characters may yet differ so widely in adult characters that it may be necessary to make two or more distinct genera. In that case the early conch stages and the protoconch assume family or ordinal values." This statement is valid for the present case, except that only subfamily rank is here granted to the distinctive nuclear characters.

Unfortunately, no explicit descriptions of nuclei can be found in the diagnoses of any of the genera which those of the present subfamily resemble in general appearance and certain other characters. Only by inference can their nuclei be assumed to be essentially different from those characteristic of the Hesperocirrinae.

Of the various subgenera of the type genus *Cirrus, sensu lato,* of the family Cirridae, to which the Hesperocirrinae are here tentatively referred, *Spirocirrus* Cossmann [1915, p. 201; type *S. calisto* (d'Orbigny), *ibid.*, pl. 8, figs. 16–19] considerably resembles in both shell shape and ornamentation some species of the genus *Hesperocirrus*, but, as seen in d'Orbigny's illustration of the type species (reproduced, as fig. 366, by Wenz, 1938, p. 205) its spire is pointed, not truncate as in the present subfamily. The same seems to hold true for *Cirrus, sensu stricto,* also, to judge by Cossmann's (1915, pl. 8, fig. 12) illustration of his "plesiogenotype" *C. leachi*, var. *moorei*, and for the Cirridae altogether, as hitherto known, as can be inferred from the distinction made by Cossmann (1915, p. 198) between them and the genus *Delphinula* in which "le sommet de la spire est toujours aplati."

Within that family, particular attention need be given here only to the Triassic forms hitherto referred to *Cirrus, sensu lato,* namely, three species from the "Hauptdolomit" of the Brenta Valley (northern Italy) described and figured by Del Campana (1908, pp. 481–485, pl. 15, figs. 9–13).[1] Unfortunately, all are too poorly preserved to be of any value for comparison, nor can much be gained in this respect from the descriptions. To judge by the illustrations, *C. triadicus* (*ibid.*, p. 482, pl. 15, fig. 10), compared by that author with *Scaevola busambrensis* Gemmellaro[2] might be a *Hesperocirrus*.[3]

Outside the family Cirridae, the following genera come into consideration for comparison with those included in the present subfamily.

Hamusina (family Amberleyidae), established as an independent genus by Gemmellaro (1879, p. 165) but relegated to a subgenus of *Amberleya* by both Cossmann (1915, p. 50) and Wenz (1938, p. 263), is essentially different, since it has, according to all those authors, an acute (Gemmellaro) or pointed (Cossmann) spire or a pointed apex (Wenz), a character which can clearly be seen in d'Orbigny's figure of the genotype *H. bertheloti* (reproduced by Wenz, 1938, p. 264, fig. 543) and which *Hamusina* has in common with *Amberleya, sensu stricto*.[4]

An acute spire is attributed to the genus *Scaevola* (family Turbinidae) also by its author, Gemmellaro (1879, p. 168).[2]

The early whorls of the Devonian genus *Antitrochus*[5] (family Trochonematidae) are unknown, according to Knight (1941, p. 42), so that it cannot be compared as to its nuclear characters with the Hesperocirrinae. This seems to be of minor importance, since the remarkable resemblance in both shell shape and ornamentation between the type species *A. arietinus* Whidborne (see Knight, 1941, p. 41, pl. 53, fig. 1) and *Hesperocirrus triasicus* is attributed merely to homeomorphic recurrence.

[1] The three other Triassic forms listed by Diener (1926, p. 60) that had been named *Cirrus* by older authors are all dextral and have long since been referred to other genera.

[2] *Scaevola busambrensis* Gemmellaro (1879, p. 169, pl. 5, figs. 1, 2), however, seems to have a truncate nucleus. In that author's figure 1 its outline can even be seen to be slightly crenulated, which might indicate the fine ribs of the nuclear whorls, as present in the Hesperocirrinae. Should this assumption be correct, then *S. busambrensis*, which Cossmann (1915, p. 200) refers to *Cirrus, sensu stricto,* rather than to *Scaevola*, may well belong to *Hesperocirrus*.

[3] Should this assumption prove correct, Cox' name "*triasicus*" (see below, p. 44) would be too similar to Del Campana's to be kept for the Peruvian species.

[4] The only South American form previously referred to *Hamusina*, Möricke's (1894, p. 29, pl. 5, fig. 3) *H.* cf. *damesi* Gemmellaro from the Jurassic of Chile, is too poorly preserved for comparison.

[5] Considered by Cossmann (1915, p. 15) a synonym of *Portlockia* de Koninck; the latter name, however, is preoccupied by McCoy and must be replaced by *Yunnania* Mansuy (Wenz, 1938, p. 229).

APPENDIX: Only a considerable time after this section had been finished, G. Dubar's (1948) monograph on the Domerian fauna of the Jebel Bou-Dahar, Morocco, came to hand. There (pp. 128–130, pl. 10, figs. 12–15), he describes and illustrates two new Liassic gastropod species, *Amphitrochilia* (*Aristerella*) *undata* and *A.* (*A.?*) *rorata*, the former selected as the type species of, but the latter only doubtfully referred to, his new sinistral subgenus *Aristerella* of *Amphitrochus* Cossmann, 1907.[1] Unfortunately, no indications as to the nuclear characters are found in Dubar's descriptions or in his figures, but the resemblance between the basal view of the holotype of *A.* (*A.*) *undata* shown in his figure 12c and that of *Hesperocirrus striatus* (pl. 2, fig. 60) is so striking as to suggest the possibility of congenerity. Should reëxamination of *A.* (*A.*) *undata* prove it, then Dubar's name *Aristerella* would, as a generic one, take precedence over *Hesperocirrus*, proposed below, and *Aristerella undata* would have to replace *H. robusteornatus*, designated in the present paper, as the type species of the genus. *A. undata* is, however, clearly specifically different from all the *Hesperocirrus* species here described. *A.? rorata*, on the other hand, may well belong to my genus *Sororcula*.

Should these assumptions prove correct in the future, the subfamily Hesperocirrinae (then to be renamed Aristerellinae) would be recognized to continue from the late Triassic into the late Middle Liassic. Even then I would still maintain its tentative reference to the Cirridae rather than to the Trochidae, for careful examination discloses essential differences, which may well be granted generic or even family rank, between the middle and late Jurassic genus *Amphitrochus* Cossmann (see Cossmann, 1918, pp. 298–300, pl. 10, figs. 1–3, 10, 11, 40; Wenz, 1938, p. 285, figs. 613, 614), the type species of which is *Trochus duplicatus* (Sowerby), on the one hand and *A. undata* Dubar and the forms here dealt with under the generic name *Hesperocirrus* on the other.

[1] Incorrectly (cf. pp. 159, 179) renamed *Amphitrochilia* by Cossmann in 1909 (see Cossmann, 1918, p. 298).

HESPEROCIRRUS,[2] NEW GENUS

DIAGNOSIS: Conch sinistral, trochiform, of moderate size, consisting of up to eight whorls. Embryonic characters as stated for the subfamily.

Shedding of the nucleus seems to occur frequently; this seems to account for the many detached nuclei present which are strongly reminiscent of the worm *Spirorbis*. In several shells of *H. triasicus* and in one each of *H. robusteornatus* and *H. modestus* scars thus produced can be seen to be closed by bubble-shaped septa. Profile of earliest whorls low and well rounded, of the later ones strongly convex. Pleural angle always exceeds 50 degrees. Sutures more or less deeply channeled. Base gently rounded, perforated by more or less wide umbilicus. Aperture subquadratic to subcircular. Inner lip, widely reflexed over the umbilicus, extends in some species as a callosity over the ceiling of the aperture and over the adjacent part of the base. Embryonic whorls, except for the first one and a half, finely and densely costate. Ornamentation of later volutions as described for the subfamily, with tubercles becoming sometimes quite heavy. In only two species (*H. triasicus* and *H.*, new species) there are, in addition to the revolving keels on the whorl faces, several such keels on the base also. In the former species both the conical surface of the conch and its base are covered with a lattice produced by the crossing of revolving and transverse sculptural elements. In the two largest species (*H. robusteornatus* and *H. triasicus*) the growth striae can be followed across the umbilical margin into the umbilical funnel.

DESIGNATION OF TYPE SPECIES: Of the species of this new genus, *H. triasicus* is undoubtedly the most spectacular and is furthermore represented by the greatest number of individuals. Since its elaborate ornamentation is, however, not found in any other named species of *Hesperocirrus*, it seems not well qualified for the type species. Therefore, another species attaining about the same size and not so rare, *H. robusteornatus*, is herewith designated genotype.

DISCUSSION: The differences between this

[2] Composed of *hesperus* (the evening, the west) and the existing generic name *Cirrus*.

genus and *Sororcula* are summarized under the heading Hesperocirrinae and more explicitly detailed in the discussion of *Sororcula* below.

For comparison of *Hesperocirrus* with other sinistral genera, both within and outside the family Cirridae, see discussion of the Hesperocirrinae. There chiefly differences in embryonic characters between the Hesperocirrinae and comparable genera are dealt with. In other than embryonic characters the present genus differs from *Hamusina* by its open umbilicus, lacking in Gemmellaro's genus, and from *Scaevola*, which has an even wider umbilicus (Gemmellaro, 1879, pp. 170, 171, descriptions of *S. intermedia* and *S. liotiopsis;* Wenz, 1938, p. 337, generic diagnosis), by lacking the varices characteristic of that genus.

OCCURRENCE: This genus is represented by five species, totaling approximately 160 specimens (including incomplete ones, especially detached nuclei, and fragments deserving closer study), in lots 69, 70, and, most abundantly, 86. Thus it must be considered one of the less common genera, though not a rare one, within the fauna under examination.

Except for a poor shell fragment in lot 48 doubtfully referred to *H. triasicus*, it is not represented in any of the lots in which *Sororcula* was found, viz., 26, 29, 33, 48, 53, 67, and possibly 57.

In addition to the specimens referred to the following five species, about a dozen detached nuclei from lot 86, too small or too poorly preserved for specific identification, can still be assigned to *Hesperocirrus* owing to the fact that the second nuclear whorl markedly projects beyond the first, which is not so in *Sororcula*.

Under the same number (A.M.N.H. No. 26532) some small fragments from lot 86 too poor for specific identification but recognizable as belonging to this genus have also been listed.

Finally an utterly worn and incomplete fragment of a sinistral form from lot 69 with a pleural angle of about 55 degrees (A.M.N.H. No. 26532/1) apparently belongs to the present genus but cannot be determined more closely.

Hesperocirrus robusteornatus, new species

Plate 2, figures 35–37, 41, 43, 44, 47–49, 51–53, 58

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26533:1	2.18 mm.	105	13	79°
26533:2	2.52	104½	15½	75°
26533:4 (syntype A)	6.84	80½	30½	62°
26533:5	7.2	76½	28½	62°
26533:6	7.56	77½	35½	58°
26533/2:1	11.76	*ca.* 75½	35½	56°
26533/1 (syntype C)	22.2[1]	83	42	53°

As seen from the table, width and pleural angle decrease, and the height of the spire markedly increases, with growth. This is, to a certain extent at least, due to the flatness of the nucleus which affects the over-all dimensions of smaller conchs to a higher degree than those of larger ones.

SELECTION OF TYPES: Although this species is represented by a considerable number of well-preserved individuals, none shows all its characters equally well. Therefore, specimens A.M.N.H. Nos. 26533:4, 26533:7, and 26533/1 are herewith designated syntypes A, B, and C, respectively; the first shows the nucleus and the early post-nuclear stages best, the second is the best-preserved adult body whorl, and the third the largest complete adult.

DESCRIPTION: Most characteristic of the shell profile of this species are its deeply channeled sutures which give it a very rugged appearance (figs. 43, 44, 48, 58). This deep indentation is due to the far-projecting, heavy lower keel, which accentuates the periphery, on the one hand, and to the far-receding oblique apical band of the whorls on the other. Thus in mature individuals like syntype C the outermost zone of the bases of the spiral whorls becomes visible (fig. 58). The whorl profile is characterized by a low lateral band, which seems to be even more narrowed by the bordering rows of heavy tubercles, and an apical band

[1] This shell had one more whorl, as proved by the fact that the rim of its ceiling still sticks to the base of the last preserved one; including the missing whorl, the total height can be estimated at about 33 mm.

which is about one and one-half times as high and rises at an angle of about 60 degrees.[1] The base is gently convex, and the deep, funnel-shaped umbilicus is moderately wide and surrounded by a sharp ridge which marks the inner boundary of the base and is outwardly accompanied by a shallow furrow (fig. 49). The interior outline of the aperture is subquadratic, with a rounded upper inner corner and a clearly truncate base; the inner lip is widely reflexed over the umbilical funnel (figs. 41, 43).

The transverse ornamentation sets in on the second nuclear volution, as observable in specimen A.M.N.H. No. 26533:1 better than in syntype A (no. 4) the nucleus of which is somewhat worn. In the former, there are about 20 fine ribs on that whorl; the costation can clearly be seen to decrease in density. In the first half of the following volution, the first post-nuclear one, only eight ribs can be counted which gradually increase in strength and develop blunt, but already quite pronounced tubercles both on the shoulder and above the suture. In the second half of the same whorl there are only six ribs, still recognizable as such on the apical face, but rather indistinct on the lateral one. The tubercles have become considerably heavier and the lower ones are expanded in the revolving sense so as to amalgamate into a strong supersutural cockscomb keel (figs. 35–37). The revolving row of shoulder tubercles and the cockscomb keel, the latter always projecting somewhat farther than the former, remain the dominant sculptural elements throughout further development; its next stages, comprising the second and third post-nuclear volutions, can best be studied in syntype A (figs. 43, 44). The ribs are still present, though indistinct on the conical apical band where they gradually assume a steeply oblique backward direction, as distinct from the radial one of earlier stages, but they have entirely disappeared on the lateral band which is now deeply sunk between the heavy keels; for the upper row of tubercles also has now assumed the aspect of a cockscomb keel. On the other hand, the peripheral keel has become almost even, showing towards the end of the third post-nuclear volution, in basal view only, quite gentle undulations. Just at the beginning of this volution a third row of tubercles begins to develop on the ribs of the apical face, about halfway between the suture and the shoulder. Towards the end of this whorl they become quite strong, although not nearly so strong as those on the shoulder, and begin to be interconnected by a faint but discernible revolving ridge or incipient keel.

However, in all these sculptural characters development seems markedly accelerated in syntype A, just described. In the even slightly larger specimen number 5 (figs. 48, 53) the lower cockscomb keel shows quite prominent undulations to the end, and there is no trace of the tubercles of the third, uppermost row. Otherwise the two shells are very similar in ornamentational character, except that there are only five transverse elements in the last half whorl of number 5, as compared to six in syntype A.

Only five tubercles per half whorl, or nine per whorl, are present in the last volution of a slightly larger individual, number 6 (figs. 47, 51, 52). Also those on the shoulder are unusually heavy, but less expanded in the revolving sense than in the two shells just discussed; the lower ones, on the other hand, are amalgamated into a solid keel to about the same extent as in syntype A. This specimen is further remarkable for showing in its two last volutions a faint subsutural ridge, comparable to that described below (p. 49) in *H. striatus*, but not observed in any other shell of the present species, and for the fine revolving striation of the base. The appearance, as if its earlier whorls were less heavily ornamented than usual in this species, is believed to be caused by wear only. If nothing else, the strong, somewhat lamellar growth striation of this shell proves its conspecificity beyond any doubt.

As the individual that shows the mature ornamentation of this species best, syntype C (A.M.N.H. No. 26533/1) is illustrated in plate 2, figure 58. Here the tubercles of the third row begin to develop only about one and a half whorls before the end, that is, about at the beginning of the fourth post-

[1] Measured in the internodals; measurement of the slope over the tubercles proves impractical in this species since they project too far.

nuclear whorl or a full volution later than in syntype A, the sculptural development of which is accelerated. They reach full strength in the last whorl present, where they are seen to ride, as it were, on the much heavier shoulder tubercles and to be interconnected by a weak revolving keel which is here also situated at about the middle of the apical band.

In syntype C nine main elements of transverse ornamentation are counted on the penultimate whorl and 10 on the last. Especially on the latter, the upper pairs of tubercles assume the aspect of heavy tassels and a slightly backward oblique direction, whereas they run more or less radially on the earlier whorls.

The lower tubercles do not show the trend observed in syntype A to project less and less with growth but remain prominent to the end, and the lower keel preserves its cockscomb character accordingly.

Almost the same growth stage as in syntype C is represented by syntype B (A.M.N.H. No. 26533:7, figs. 41, 49), which is an incomplete but otherwise well-preserved body whorl. Here there are five main elements of transverse ornamentation per half volution; the twofold upper tubercles and their connecting revolving keels resemble those of syntype C, but the lower tubercles and the cockscomb keel which they form in their entirety are markedly less heavy and, viewed from the base, are accompanied on the inner side by a distinct furrow.

In both these syntypes as well as in specimens numbers 5 and 6 and in the shell fragment A.M.N.H. No. 26533:3 growth striae can be observed on the surface of the whorls (figs. 41, 48, 49, 52, 53, 58). They are closely set but rather strong and sometimes somewhat lamellar. They run obliquely backward from the suture to the shoulder, then in a less oblique or almost perpendicular direction across the lateral band, where they form a forward concave arc and tend to unite into irregular bundles. Below the periphery they resume their backward oblique direction. On the base they can best be studied in syntype B (fig. 49), where they are seen a little inward of the periphery to turn forward again and to run in a gentle, forward concave arc with slightly rursiradiate chord towards the circumumbilical ridge. They cross it, lending it a finely beaded appearance, and can still be followed down the wall of the umbilical funnel.

Only under exceptionally favorable conditions can an extremely fine revolving striation be recognized, in oblique illumination, on the base, namely, in paratypes A.M.N.H. Nos. 26533:5, 26533:6, and 26533/2:3. The striae are in this species, as distinct from those in *H. striatus* (see below, p. 49), thread-like and narrower than the interspaces between them. From 12 to 15 seem to be present on the base of specimen number 6 (fig. 47) and about 10 in the outer zone of that of specimen number 3. Only faint indications of such a striation can be seen in paratype number 5 (fig. 53). This concentric striation of the base seems to disappear with growth. No trace of it can be found on the excellently preserved base of syntype B (fig. 49).

EARLIEST ONTOGENETIC STAGES: The nucleus has the shape peculiar to the genus and is sometimes shed. The scar so produced is closed by a septum in specimen A.M.N.H. No. 26533/2:2.

REMARKS: For comparisons with other species of this genus occurring in the present material, see pages 47, 48, 49, and 50.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26533	37
69	26533/1	1
70	26533/2	3 (incomplete)
Total (including detached nuclei and fragments)		41

Hesperocirrus triasicus (Cox)

Plate 3, figures 1–15, 19–22, 25–27

Hamusina triasica sp. nov., Cox, 1949, p. 39, pl. 2, fig. 12.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26534:1	2.3 mm.	100	11	80°
26534:2	2.5	106½	14½	78°
26534:3	2.7	102	12½	75°
26534:4	4.0	100	20	86°
26534:5	4.56	94½	15½	69°
26534:7	7.8	89	28½	66°

A.M.N.H. Nos.	H	W	h	π
26534:8	16.2	74	34	60°[1]
26434:9	*ca.* 19.2	*ca.* 91	*ca.* 25	70°
26534:10	*ca.* 21.0	*ca.* 95	*ca.* 28½	80°
26534:11	*ca.* 22.0	*ca.* 73½	*ca.* 33½	62°
26534:12	*ca.* 28.0	*ca.* 83½	*ca.* 29	61°
26534:13	*ca.* 30.0	?	*ca.* 23½	57°

In this species the same general trends towards decrease of width and pleural angle and increase of height of the spire can be followed in the course of growth as in *H. robusteornatus*, and for the same reasons. However, they do not find so clear an expression in the table of dimensions as in that of the preceding species. The presence in the measured sample of some specimens with depressed-conical shell shape accounts for this difference; among the adults they are represented by numbers 9 and 10 which show considerably higher values for both width and pleural angle than would be expected at their places in the series. In pleural angle they are even surpassed by specimen number 14 (otherwise not measured), in which π seems to reach about 90 degrees. The opposite extreme is represented by specimen number 8, the pleural angle of which, estimated at about 50 degrees,[1] is far below the mean, and specimen number 11; the table shows that in both the spire is unusually high. It will be seen in the following description that depressed-conical shells are also characterized by particularly coarse ornamentation, and acute-conicals, namely, numbers 8 and 11, by a much more delicate one. However, since the least incomplete of the largest shells present, number 12, proves to be somewhat intermediate between these extremes, it seems unjustifiable to separate either, as a variety from the typical form.

DESCRIPTION: Shell trochiform, with deeply channeled sutures, gently convex base, and comparatively wide, funnel-shaped umbilicus. The whorl profile is angular during the earlier stages, with a pronounced shoulder separating the apical whorl face from the lateral face. The latter is as high as, or slightly higher than, the former, which rises at an angle of about 60 degrees between the ribs, and of about 45 degrees along them. At a later stage, as exemplified by specimen number 11 (fig. 22), a revolving keel intercalated on the apical band subdivides it into an almost horizontal upper face, which serves even more to accentuate the deeply channeled suture, and a lower one which slopes towards the shoulder at about the angles mentioned above. Still later, for example, in specimen number 12 (fig. 26), the multiplying revolving ornamentation overgrows, as it were, the original profile so as to lend a rounded-convex appearance to the whorl. The shoulder can then be located only by following it up from earlier stages at which it is still clearly recognizable. In the body whorl of the shells of the depressed type, for example, in specimen number 10, this development goes even further, so that an almost evenly sloping conical face extends all the way from the suture to the periphery (fig. 12). However, crushing may have contributed to this somewhat aberrant whorl profile. On the other hand, the peripheral edge, which separates the lateral band from the base, remains pronounced throughout development, even more so since the revolving keel accentuating it is marked by the strongest tubercles. Below the peripheral edge, the outermost zone of the base becomes visible even in spiral whorls.

The aperture is at earlier stages (e.g., specimens nos. 2, 4, 7; figs. 3, 8) truncate below and rounded-subquadratic, but it becomes subcircular in later stages, as exemplified by specimens numbers 8 (fig. 13) and 12. The inner lip is widely reflexed over the umbilicus and extends upward into a callosity which covers the ceiling of the aperture and the adjacent part of the base.

The nucleus is that characteristic of the genus; in specimens numbers 2 and 4 (figs. 7, 8, 10; 2–4) it can clearly be seen to be not only flat but even slightly concave, the first embryonic whorl being somewhat sunk within the coil formed by the second. Ornamentation sets in in the second half of the latter and consists of fine transverse ribs, 11 of which can be counted per half whorl. Thus costation seems to be somewhat denser than in *H. robusteornatus* even at this early stage.

[1] Measured from penultimate whorl up; the body whorl is too incomplete to permit measurement of π, but there it must have been much smaller; it may be estimated to have decreased to about 50 degrees.

The same holds true for the earliest post-nuclear half whorl which carries nine costae, as compared to eight in the type species. As in the latter, the density of costation rapidly decreases. On the second post-nuclear whorl of specimen number 4 there are only 13 ribs which now closely resemble those described in *H. robusteornatus* for the same stage, especially in developing heavy tubercles on both shoulder and periphery; the lower ones project farther than the upper ones. Otherwise they do not differ from each other, as they do in the preceding species; both are rounded and connected by only indistinct revolving ridges which are markedly less conspicuous than the transverse ribs. The latter, which follow a radial direction in the earliest stages, begin now to assume a steeply oblique backward one.

At a stage only a little more advanced additional tubercles develop in specimen numbers 6 and 7 (figs. 1, 6) both halfway between the suture and the shoulder and halfway between the shoulder and the periphery. They are, in their turns, connected by faint revolving ridges. Those of the shoulder and the periphery have meanwhile increased in strength. Thus there are now four revolving ridges or keels, two prominent ones with a weaker one between and another above them. Meanwhile revolving ornamentation has developed on the base also. At a stage as early as that represented by specimen number 2 (see table of dimensions) three extremely fine, thread-like, revolving keels can be recognized, and a fourth even finer one accompanies the pronounced circumumbilical ridge. Four such keels, followed by even finer threads towards the umbilicus and apparently with other threads intercalated between them, can be counted in specimen number 4 and at least five in the somewhat larger specimen number 5 (figs. 5, 9).

Sculptural development has progressed far in the next stage observable, represented by the slender specimen number 8 (figs. 13–15). The ribs, seven or eight of which are present on the last half whorl, are strong and still continuous, but the revolving ornamentation has also evolved to such a degree as to give a lattice-like appearance to the ornamentation, with spirally elongated tubercles wherever ribs are crossed by revolving keels. Above the peripheral keel, which is the strongest and projects farthest, there are three keels, the middle one of which is the shoulder keel, with a faint secondary keel between it and the following one. On the base there are four more revolving keels inside the periphery, the innermost of which accentuates the circumumbilical border. They are more or less equally spaced and carry as a rule no tubercles, since the transverse ribs are still limited to the apical and lateral whorl faces. Towards the end of the last volution, however, they begin to continue across the periphery and to produce tubercles on the outermost of the basal keels. On the base of specimen number 9, one of those with a wide pleural angle and a low spire, there are four revolving keels (not including the peripheral keel), but a secondary one is now intercalated between the second and the third from the periphery. Furthermore the third is more prominent than the others, and the base slopes from it in a slightly concave band towards the innermost keel, thus causing the appearance of a duplicated umbilical border (fig. 19). Shell number 10, which shows the depressed conical shell shape most conspicuously, stands out also by having unusually heavy and oblique transverse ribs, of which as many as nine are present on the last half whorl, and equally heavy tubercles. There are three revolving keels above the peripheral keel and four on the base, with a fifth visible on the wall of the umbilical funnel. Except the last, all these revolving keels are also markedly heavy, and those of the base assume a beaded appearance (figs. 12, 20). Ornamentation is much finer in the graceful shell number 11, best and most complete representative of the slender and more delicately ornamented individuals of this species (figs. 22, 27). Eighteen ribs are present on the penultimate volution and as many as 19 on the last, where they become indistinct and are surpassed in strength by the revolving keels, of which there are four, including the peripheral, with a faint secondary keel each above and below the second main keel. On the base there are five main revolving keels, which seem gradually to increase in strength towards the umbilicus, and a faint secondary keel between the second and the third main keels.

The most elaborate ornamentation found in this species is exhibited by the two largest specimens present, numbers 12 and 13; the former is illustrated in figures 21, 25, and 26. There are 19 and 17 transverse elements, respectively, and in both shells four revolving main keels above the periphery, with a faint secondary keel just above the peripheral keel. In specimen number 12 there is one more secondary keel just below the suture. The base is in both specimens ornamented by five more or less equally spaced revolving keels, with a sixth running inside the umbilical funnel, as it does in specimen number 10 also. Except the last, all these keels are beautifully beaded in specimen number 12. This may be ascribed to their being crossed at first by bundles of growth striae, but towards the end of the last volution the ribs of the upper surface continue into the outer zone of the base, producing quite similar, though somewhat weaker, spirally elongated tubercles there as they do above the periphery.

It is on this base of specimen number 12 that the growth striae can best be observed (fig. 21). They follow the same course as in *H. robusteornatus*. Near the anterior end they become distinctly lamellar, thus producing on the revolving keels beads more closely set than in the earlier parts of this volution.

REMARKS: From Cox' description and figure his "*Hamusina*" *triasica* can readily be recognized as belonging to this species, whose name must thus be the one proposed by Cox and whose previously selected types must be relegated to the rank of simple specimens. Description and plates have, however, been left unchanged, since the 60 specimens available yield much more complete information on this species than Cox' not too well-preserved holotype. For the reasons why this species cannot be referred to *Hamusina* reference is made to the sections on the subfamily and the genus.

In the early stages the differences of the present species from the genotype, *H. robusteornatus*, are not so conspicuous. The lateral band is as high as, or even higher than, the apical one, whereas it is lower in the type species. The costation is slightly denser, and the tubercles, especially those of the lower row, do not to the same extent tend to amalgamate into heavy revolving keels. In its later stages, however, *H. triasicus* is readily distinguished from *H. robusteornatus* by its less heavy and more elaborate ornamentation, mostly by the presence of a considerable number of revolving keels on both the surface and the base which equal the transverse sculptural elements in strength and combine with them to form an attractive lattice pattern. For comparisons with other species of the genus, see the discussions of the respective forms below.

The close similarity in both shell shape and character of ornamentation with *Spirocirrus "reticulatus"* Hudleston (1892, p. 307, pl. 24, fig. 16; see also Cossmann, 1915, p. 202) from the Inferior Oolite of England deserves mention. The English form, apart from apparently not sharing the peculiar nuclear characters of *H. triasicus*, has a clearly concave outline and a more pointed spire, and the transverse ribs dominate the ornamentation even on the base and do not dissolve into beads as in the present species.

The superficial resemblance of the present species to *Antitrochus arietinus* Whidborne is alluded to above (p. 40) as a case of homeomorphic recurrence.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26534	59
48	26534/1	1[1]
	Total	60

Hesperocirrus, new species

Plate 2, figures 50, 55, 59

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26535:1	15.4 mm.	67	39½	53°

DESCRIPTION: The above are the dimensions of the smallest and only complete specimen of the three present. In addition there are a cast (specimen no. 2), so badly broken in the course of chemical preparation that it could be rebuilt only haphazardly, and it is doubtful whether it now shows the proportions of the conch correctly, and a

[1] A doubtful fragment.

short body whorl fragment (no. 3) which shows the ornamentation best.

In shell shape the shell measured above seems to approach most closely the more acutely conical individuals of *H. triasicus* (e.g., no. 8, table of dimensions of that species), but it is more slender and has an even higher spire. Also its whorls are less convex and its sutures not so deeply channeled. The two incomplete specimens are believed, on account of ornamentational characters, to be conspecific with the first.

On the penultimate volution of specimen number 1 there are only eight rather sharp and strong transverse ribs, but there must have been about 12 or more per whorl on the two fragments which represent a considerably later ontogenetic stage. In some of the intervals between them growth striae tend to develop into secondary ribs; they, too, produce beads where crossing the revolving keels. Of those, there are at least four, but probably five above the periphery. One keel, which is the strongest, marks the periphery; below it follow six more revolving keels. The innermost marks the boundary of the umbilicus which seems to have been, in this form also, funnel-shaped and not very narrow. In addition, there is a fine secondary keel between the peripheral one and the next.

The earliest ontogenetic stages are not observable, but other characters leave no doubt as to the congenerity of this form with the preceding species.

REMARKS: This form clearly differs from *H. triasicus* in shell shape and by its more pronounced transverse ribs and its considerably denser revolving ornamentation; from *H. robusteornatus* by its much less deeply channeled sutures, less heavy ornamentation, and the presence of numerous spiral keels. By the last character and others it differs also from *H. striatus* and from *H. modestus* (see also the discussions of these forms below). Thus it must be considered a separate species which is, however, too poorly represented to be granted a specific name.

OCCURRENCE: Very rare (three specimens) in lot 69 (A.M.N.H. No. 26535).

Hesperocirrus striatus, new species

Plate 2, figures 42, 46, 54, 56, 57, 60

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26536:1 (syntype A)	2.18 mm.	97½	13	58°
26536:2	3.4	90	24½	70°
26536:2	5.28	?80	19	73°
26536:4 (syntype B)	*ca.* 10.5	*ca.* 92	*ca.* 23½	85°

As seen from the table, this species deviates from all others of this genus in that the pleural angle steadily increases with growth, whereas it decreases in other species. Accordingly, the relative width of the conch decreases only in the earlier ontogenetic stages, as long as the flatness of the nucleus still considerably affects the results of the measurements, but then increases again. The height of the spire seems to increase with growth in this species also.

SELECTION OF TYPES: In this species, too, the largest and otherwise most characteristic individual (no. 4), herewith designated syntype B, has its nucleus not well preserved. Therefore, a small shell with excellently preserved nucleus (no. 1) is selected as syntype A.

DESCRIPTION: Owing to the peculiarities of the way of growth of this species the shell shape is comparatively slender in youth but broadly conical in adults; therefore, the surface of the cone appears slightly concave in profile (figs. 56, 57). Among the Hesperocirrinae the present species alone shows this character, which is much more conspicuous in some other Cirridae, particularly in *Cirrus, sensu stricto* (see Wenz, 1938, p. 204, figs. 364, 365). The sutures are only shallowly channeled. The whorl profile is decidedly angular. The lateral band, which is markedly higher than the apical one, is bordered both above and below by pronounced edges, both of which are further accentuated by the rows of tubercles produced by the transverse ribs. Along these ribs, the apical band rises at an angle of 20 degrees or less, between them at an angle of about 30 degrees.

The base is almost flat; the aperture exhibits the same characters as in the genotype;

the open umbilicus is deep and rather narrow.

The ornamentation is dominated by the tubercles and by the ribs which carry them. The latter begin at or, in the body whorl, somewhat below the suture and run down the apical band, gradually increasing in strength. They reach maximum prominence on the shoulder, where they form the tubercles of the upper row; then they run over the lateral band and end abruptly at the periphery, there forming the tubercles of the lower row. In syntype B their course is more or less perpendicular in the spiral whorls but becomes gradually oblique backward on the body whorl. In the early post-nuclear whorls the upper tubercles are laterally compressed and markedly sharp, with their points turned slightly upward; later these tubercles are somewhat less sharp but still quite prominent. The lower tubercles project less and are expanded in the spiral sense throughout development. They form, along the periphery, a gently undulating cockscomb keel, best seen in basal view (fig. 60), whereas the upper row of tubercles remains discontinuous and cannot well be called a keel. There is present, however, a faint, gently undulating subsutural ridge, or keel. It is best developed in the penultimate volution and in the posterior half of the last, but fades in its anterior half. There are 12 transverse ribs, and upper and lower tubercles accordingly, on the body whorl and 11 on the penultimate one.

Only in syntype B a fine and dense revolving striation is recognizable on the lateral faces of the two last whorls and on the base. Faint traces of it seem to be observable on the apical face also of the penultimate volution. From six to seven such striae can be counted on the lateral band of the body whorl and up to 15 on the base. The outermost ones of the latter partake, in a degree diminishing from the periphery inward, in the undulations of the peripheral outline. All these striae are quite flat and considerably broader than the extremely shallow furrows between them. The specific name has been derived from this striation.

Growth striae, where observable, seem to follow the pattern common in this genus; in some specimens (e.g., no. 2) they give a slightly beaded appearance to the circumumbilical edge.

EARLIEST ONTOGENETIC STAGES: Where preserved, the nucleus shows the features distinctive of the Hesperocirrinae; they can best be studied in syntype A (figs. 42, 46). It is worth noting that, for example, in specimen number 2, the first post-nuclear whorl exhibits the costation characteristic of this species, viz., sharp ribs culminating in laterally compressed, pointed upper tubercles and ending in lower ones which are here only a little less prominent. In this individual, however, these ribs run obliquely backward even at that early stage, whereas they begin to do so only on the body whorl in syntype B (figs. 54, 57).

REMARKS: This species deviates from all the congeneric ones present by its peculiar mode of growth. Furthermore, it differs from *H. robusteornatus* by its higher lateral band, from *H. triasicus* and *H.*, new species, by the lack of revolving keels (from which the spiral striation described above is essentially different), and from all three species named by its more angular whorl profile, its less deeply channeled sutures, and its characteristic transverse ornamentation. See *H. modestus*, below, for comparison with that species.

OCCURRENCE: Rare in lot 86, where it is represented by nine specimens, including fragments (A.M.N.H. No. 26536).

Hesperocirrus modestus, new species

Plate 3, figures 16–18, 23, 24, 29, 37–39

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26537:1 (syntype A)	1.57 mm.	128	7	86°
26537:4 (syntype B)	10.86	82	30	63°
26537:5 (syntype C)	14.1	83	30½	61°

The trends predominating in this genus of the relative width of the shell and the pleural angle to decrease, and of the height of the spire to increase, with growth can well be recognized in this table. In specimen number 1, which is smaller than any other measured shell of this genus and consists of embryonic

volutions only, the width of the shell and the lowness of the spire find a more conspicuous expression than in any of the preceding tables of dimensions.

SELECTION OF TYPES: In addition to the largest and otherwise best-preserved shell, number 5, herewith designated syntype C, specimens numbers 1 and 4 are selected as syntypes A and B, respectively; the former because of the perfect nucleus, which is not well preserved in syntype C, and the latter because it exhibits an umbilicus of a width believed to be standard in this species, whereas the umbilicus is unusually narrow in syntype C.

DESCRIPTION: Shell trochiform, with shallowly channeled sutures and moderately angular whorls. Their vertical lateral band is hardly higher than the apical one which rises at an angle of about 45 degrees along the ribs and at one of about 60 degrees between them. Base rather flat, aperture like that of the preceding species, umbilicus narrow, mostly so in the largest shell present (syntype C).

The transverse ornamentation is more conspicuous than the revolving one. The former consists in adults of indistinct, blunt folds rather than ribs which run from the suture down to the lower edge of the whorl. Their direction is perpendicular in the early post-nuclear whorls and becomes first a little, then increasingly, oblique backward on the body whorl of syntype B and on the last two volutions of the largest shell present (syntype C), but even on the body whorl of the latter the obliqueness is still rather steep. Fourteen such folds can be counted on the body whorl of specimen number 4 (syntype B), but only 12 on the body whorl and 11 on the penultimate volution of specimen number 5 (syntype C). These folds become more conspicuous only where carrying tubercles, of which there is, except in syntype C, one row each along the shoulder and along the periphery. These tubercles are blunt and rounded; those of the lower row show a slight trend towards elongation in the revolving sense. Thus they may be said to form an indistinct cockscomb keel, whereas the upper row of tubercles remains discontinuous. The same is true of a third row which is intercalated, on the body whorl of the largest shell (syntype C) only, about halfway between the shoulder and the gently undulating ridge or indistinct keel immediately below the suture. This subsutural keel carries no tubercles. Those of the intercalated third row are somewhat smaller than those on the shoulder but otherwise similar. They unite with them to give the impression of twin tubercles. A similar duplication is found in the fourth and fifth lower tubercles from the anterior end of syntype C. Accordingly, the peripheral cockscomb keel appears there indistinctly doubled (figs. 23, 24).

In syntype B, the surface of which is badly corroded, what might be faint traces of revolving striae are encountered sporadically, but no continuous revolving striation, as described in the preceding species, is found anywhere in this specimen or in syntype C, the surface of which is in much better condition, especially not on their bases.

In the latter specimen growth striae can be seen to run parallel with the afore-mentioned transverse folds over the surface of the cone and in flat, forward concave arcs all over the base towards the umbilicus.

The earliest ontogenetic stages are best observable in specimen number 1 (syntype A; figs. 16, 18). As in the preceding species, the nucleus shows the features distinctive of the subfamily. Accordingly there is a fine and dense costation, consisting of 15 ribs, on the second nuclear whorl. Here the costae are much more pronounced than they are later, and they continue beyond the periphery in a radial direction over most of the base. On the next (first post-nuclear) volution, however, they move farther apart (corresponding to a number of only about 12 per whorl) and simultaneously both upper and lower tubercles develop. Soon the ribs become much less distinct.

In an otherwise poor fragment the scar caused by shedding of the nucleus can be seen to be closed by a septum.

REMARKS: From all the congeneric species hitherto described the present one differs by its altogether weaker, blunter, and less elaborate ornamentation, a fact alluded to in its specific name; from *H. triasicus* and *H.*, new species, furthermore, by the absence of spiral keels on its base, and from *H. striatus* by the lack of a revolving striation and by the less angular whorl profile; from *H. robusteornatus* and *H. triasicus* by its more

shallowly channeled sutures; finally, from the former by its somewhat higher lateral band and from the latter by its narrower umbilicus.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26537	43[1]
70	26537/1	1[2]
	Total	44

SORORCULA,[3] NEW GENUS

DIAGNOSIS: Conch sinistral, slender-trochiform, rather small, consisting of up to seven volutions. Nuclear characters as stated for the subfamily, but nucleus increases more slowly in width. Profile of earliest whorls low, rounded, of the later ones flat or even slightly concave. First post-nuclear whorl projects only slightly beyond second nuclear one. Pleural angle, in maturity,[4] never reaches 45 degrees. Sutures engraved to shallowly channeled. Base truncate, nearly flat, with narrow umbilicus or at least an umbilical niche. Columella hollow. Aperture subrhombic. Inner lip rather widely reflexed over umbilicus or umbilical niche. Nuclear volutions smooth in the type species but ornamented as in *Hesperocirrus* in the other. Post-nuclear ornamentation consists of tubercles arranged in two revolving rows or keels and connected, in *S. costata* only, by distinct transverse ribs; of a fine and dense revolving striation; and of growth striae which follow the course observed throughout this subfamily.

DESIGNATION OF TYPE SPECIES: Although the specimen in the best preservation (A.M.N.H. No. 26540:3) is found in *S. costata*, not this species but *S. gracilis* is herewith designated genotype, since the type of ornamentation without distinct transverse costae observed in the latter species is believed to predominate in this genus, as far as hitherto known.

DISCUSSION: From *Hesperocirrus* the present genus differs chiefly by its smaller size, more slender shell shape, flat or even slightly concave whorl faces, shallower sutures, lower pleural angle, almost flat base, narrower umbilicus, which is, in the type species, even reduced to a mere umbilical niche, and by its altogether more delicate ornamentation.

For comparison of the present genus with other sinistral genera, see the discussion of the subfamily Hesperocirrinae above. The other than nuclear characters used above for the distinction of *Hesperocirrus* from Gemmellaro's genera *Hamusina* and *Scaevola* serve also to distinguish *Sororcula* from those two genera, with the qualification that in the type species of *Sororcula* there is an umbilical niche rather than an umbilicus.[5]

OCCURRENCE: Much less common than *Hesperocirrus*, this genus, is represented by two species only, together with 27 individuals. It occurs in six different lots (26, 29, 33, 48, 53, and 67) and possibly in a seventh, as compared to three lots only in which *Hesperocirrus* is found. As stated above, these occurrences are mutually exclusive, if a poor shell fragment in lot 48 doubtfully referred to *H. triasicus* is omitted. Thus the two groups of lots seem to represent different horizons or different ecologic environments.

A single internal mold of a sinistral gastropod from lot 57, the whorls of which appear somewhat rounded but which exhibits at a pleural angle of about 40 degrees a shell shape and an open umbilicus similar to those found in the two following species, is, under the designation *?Sororcula* sp. indet. (A.M.N.H. No. 26538), tentatively referred to this genus. The same designation has been

[1] Mostly fragments.

[2] A doubtful, poor nucleus.

[3] Meaning the little sister (of *Hesperocirrus*). Brisson created the linguistically monstrous name *Fratercula* for an avian genus in 1760 (Neave, 1939), so it seemed wise to avoid the name "*Fraterculus*," originally intended for the present genus.

[4] This restriction is necessary because in two small juveniles of *Sorocula gracilis* and a much smaller nucleus of *Sororcula costata* pleural angles of about 60 degrees were measured. The depressed shape of the nucleus, of course, greatly affects the results of measurements at such an early stage. However, all pleural angles measured at a total height of more than 2.2 mm. in the first species, and of more than 1 mm. in the second, are below 45 degrees, whereas they vary between 53 degrees and almost 90 degrees in *Hesperocirrus*.

[5] It remains doubtful whether the words "lato columellare escavato" used in Gemmellaro's (1879, pp. 166, 167) descriptions of both his species of *Hamusina* indicate the presence of an umbilical niche.

applied to a badly crushed specimen in lot 53 (A.M.N.H. No. 26538/1). Before being crushed, it must have been at least 8 mm. high; should it really belong to this genus, it would be exceeded in size only by the fragment A.M.N.H. No. 26539:8 of *S. gracilis*, mentioned below.

Sororcula gracilis, new species

Plate 3, figures 28, 30, 31, 35, 36, 42–46

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26539:1	1.74 mm.	90½	26	59°
26539:3 (syntype A)	*ca.* 2.18	*ca.* 90	*ca.* 23	59°
26539:5	3.40	78	36½	43°
26539/2 (syntype B)	6.00	74	40	41½°
26539/1	*ca.* 6.7	*ca.* 62½	*ca.* 43	37°

As clearly seen from the above, the relative width of the conch and the pleural angle decrease, and the height of the spire increases, with growth.

SELECTION OF TYPES: A.M.N.H. No. 26539:3, although small, is designated syntype A because of its well-preserved nucleus, an essential generic character. The best of the larger individuals (A.M.N.H. No. 26539/2), in which the nucleus is not preserved, is designated syntype B.

DESCRIPTION: Shell slender-trochiform, consisting of up to seven volutions, which are separated from one another by clearly though shallowly channeled sutures. Nucleus planospiral, with the first embryonic whorl slightly sunk within the second. First postnuclear volution projecting only a little beyond the second nuclear one. The following whorls, each the shape of a frustum of a cone, exhibit narrow, flat apical bands which are separated by a pronounced edge from the conical surfaces. All the latter combine to form a continuous conical outline, unbroken except for the notches produced by the channeled sutures and narrow apical bands. In the later stages the conical surfaces become gently concave in profile, owing to the prominence the subsutural and supersutural rows of tubercles assume with growth (figs. 30, 31, 42, 43, 45, 46). In a fragment from lot 48 (A.M.N.H. No. 26539/4:1), however, this concavity of the body whorl is quite pronounced at an earlier stage, this specimen corresponding in size to syntype A. The base is separated from the surface by a rather sharp edge; it is truncate and almost flat. The aperture is subrhombic, with gently convex upper and inner margins. The inner lip is rather widely reflexed over the narrow umbilical niche (fig. 42). No such niche can be seen in the shell A.M.N.H. No. 26539:5, but its conspecificity is beyond any doubt. It may have been filled by subsequent deposition of shell substance. In this shell also the columella can be recognized to be perforated.

No ornamentation can be seen on any of the three nuclei preserved, but revolving striation seems to set in soon after, at the beginning of the first postnuclear volution; it becomes distinct on the next. With growth these thread-like revolving striae do not increase in strength but in number only; their density seems to remain the same. In specimens A.M.N.H. Nos. 26539:3 and 26539:5 they seem to decrease in strength from the upper suture to the lower. About 15 can be counted on the last whorls of both these shells. In A.M.N.H. No. 26539:5, however, one stria, somewhat above the middle of the whorl surface, stands out by greater strength and forms a faint revolving keel (figs. 43, 45). A similar condition can be observed in specimen A.M.N.H. No. 26539:2. On the largest shell but one (syntype B, A.M.N.H. No. 26539/2) the striation is just as fine and dense as on the smaller shells. There may be between 15 and 20 striae all over the surface of the whorl, but here no differentiation as to strength is visible. They are extremely finely beaded, apparently owing to the crossing of growth striae. This revolving ornamentation is present on the base also and is as fine as, or finer than, on the conical surface. From the periphery to the umbilical niche—or, in A.M.N.H. No. 26539:5, to the columella—about 12 spiral threads can be counted in syntype A, about 15 in A.M.N.H. No. 26539:5, and more than 20 in syntype B and in the fragment of a shell of about the same size (A.M.N.H. No. 26539:6). As seen best in syntype A, they slightly increase in

strength from the periphery inward (figs. 28, 36). In the aforementioned fragment A.M.N.H. No. 26539/4:1 the peripheral zone of the base seems smooth, perhaps only owing to corrosion. Here only about eight revolving threads are recognizable from the smooth outer zone inward.

Less delicate than the revolving ornamentation is the transverse one. On the second post-nuclear volution rows of tubercles develop both below and above the sutures. They are rather blunt and somewhat elongated in a steeply backward oblique sense. In some shells (e.g., A.M.N.H. Nos. 26539:2 and 26539:5; figs. 43, 45) the subsutural nodes can be seen to be connected by indistinct ridges, running, in that sense, with the supersutural ones. In the early stages the latter tend to amalgamate into a supersutural keel. This keel becomes most conspicuous and quite thick in a fragment from lot 48 (A.M.N.H. No. 26539/4:1). However, this trend does not last. In the later stages the lower tubercles are just as clearly separated from one another as the upper ones, and the former become stronger than the latter and more clearly elongated diagonally. On the last volution of syntype B they assume a distinctly triangular shape, with the points of the triangles pointing apicad, and are much larger and heavier than the upper tubercles which remain bullate. The tubercles seem at first to decrease in number with growth. Ten upper tubercles per half whorl can be counted in specimens A.M.N.H. Nos. 26539:2 and 26539:3, but only seven in specimen A.M.N.H. No. 26539:5; in the largest shell but one (syntype B) there are nine. However, in the two last shells only six and seven lower tubercles correspond to seven and nine upper ones, respectively.

Only where preservation permits can fine and dense growth striae be recognized to run obliquely backward over the whorl surfaces and more or less radially over the base. There they could well be observed in two fragments (A.M.N.H. Nos. 26539:6 and 26539/5:1) only, but the beads they produce in crossing the revolving threads are recognizable in other shells (A.M.N.H. No. 26539:5; fig. 28).

REMARKS: From all the species of *Hesperocirrus* the present form is readily distinguished by its smaller size, markedly lower pleural angle in maturity, slender shell shape with an essentially unbroken profile, smooth nuclear volutions, and by the fact that the first post-nuclear whorl projects only a little beyond the nucleus.

For comparison with the only other Peruvian species of *Sororcula*, *S. costata*, see the discussion of that species below.

A closely related if not conspecific form occurs in the hitherto unpublished, supposedly Upper Triassic fauna from near Lewiston, Idaho.

There is a certain similarity in both shell profile and character of ornamentation between *S. gracilis* and *Hamusina zignoi* Gemmellaro (1879, p. 167, pl. 4, figs. 42–46) from the Liassic of Sicily, but the spire of *zignoi* was described as "acutissima." Should this characterization omit the nucleus and should it, as some of Gemmellaro's figures seem to indicate, be truncate and planospiral, then his form, although about four times as large, might be a *Sororcula* rather than a *Hamusina*, and the aforementioned resemblance might well be due to congenerity.

OCCURRENCE: Rare.

LOT	A.M.N.H. NOS.	NO. OF SPECIMENS
26	26539	8
29	26539/1	1
67	26539/2	1
33	26539/3	1
48	26539/4	2
53	26539/5	3
	Total	16

Most of the specimens from lot 26 are nuclei or juveniles; a body whorl fragment (A.M.N.H. No. 26539:8) indicates a width of the shell of at least 15 mm., or more than five times that of the largest measured paratype from this lot (A.M.N.H. No. 26539:5). The entire shells in lots 29 and 67 are considerably larger than the latter, but they do not reach the size of the former. Fragments from lots 33 and 53 indicate the same size as, or a greater size than, that reached by the shells from lots 29 and 67.

Sororcula costata, new species

Plate 3, figures 32–34, 40, 41

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26540:1[1]	0.9 mm.	112½	6	*ca.* 60°
26540:2	1.34	96	16	39°
26540/1:1	1.41	96½	18½	44°
26540:3 (holotype)	3.24	79½	33½	36°

In this species the same trends as in the preceding and in the Hesperocirrinae generally can be seen in the table of dimensions. W and π decrease with growth, the latter value even faster than in *S. gracilis*, if the size of the shell is taken into account, and h increases accordingly.

SELECTION OF TYPE: Specimen A.M.N.H. No. 26540:3, which not only exhibits the adult characters well but also has a perfectly preserved nucleus, is herewith designated holotype.

DESCRIPTION: Shell consisting of up to seven volutions, slender-trochiform, with only shallowly engraved sutures. Nucleus truncate, with first embryonic volution markedly sunk within the second. The nuclear whorls are well rounded. The postnuclear ones, the first of which projects even less than in *S. gracilis* beyond the nucleus (figs. 33, 34), have a conical surface which in profile appears almost even in earlier stages, but later becomes clearly concave, owing to the prominence of both subsutural and supersutural rows of tubercles. On the whole, the shell profile appears unbroken, as in the preceding species. The base, which is separated from the conical surface by a pronounced edge, is almost flat and perforated by a narrow umbilicus which seems to continue into the hollow columella. The shape of the aperture is obliquely rhombic as in *S. gracilis;* in the present species, too, the inner lip is quite widely reflexed over the umbilicus.

In contradistinction from the preceding species, in the present one ornamentation starts on the second nuclear volution which shows the same fine and dense costation (about 10 ribs per half whorl) as is common in the genus *Hesperocirrus*. These ribs can be seen to extend even beyond the periphery into the base. The same kind of costation persists on the early post-nuclear whorls, but it gradually decreases in density, there being only eight per half whorl on the first and seven on the second. On the latter these transverse ribs assume a steeply oblique backward direction and begin to develop tubercles at both ends. On the third postnuclear volution these tubercles tend to amalgamate into revolving ridges or keels, the subsutural ones less so than the supersutural ones. In the body whorl the supersutural nodes unite to form a continuous keel which in basal view shows only very gentle undulations indicating the tubercles. Although the tubercles remain discontinuous in the subsutural keel, it is, though less prominent, about as thick as the lower one. Much as these two revolving elements affect the general picture, chiefly if the light falls from the apical side, the transverse elements may well be said to dominate the ornamentation of this species, and the costae, 11 of which can be counted on the body whorl of the holotype, remain continuous to the end (figs. 33, 34). This character is alluded to in the specific name.

In addition to the subsutural and peripheral keels there is a fine revolving striation which can only be observed in the holotype. Ten to 12 such striae can here be counted on the conical surface of the body whorl, where they are best visible on the subsutural keel, and about 15 on the base. All these striae are thread-like and about as broad as, or somewhat narrower than, the intervals between them.

Growth striae also are recognizable in the holotype only. They run, a little more obliquely than the ribs, backward across the conical whorl surface and more or less radially over the base, producing here and there tiny beads on the revolving striae they cross.

REMARKS: From its sister species, *S. gracilis*, *S. costata* is readily distinguished by the smaller size, by having, except in the nuclear stage, a more acute apical angle at the same size, and chiefly by the costation of the nucleus, by the fact that its ribs are continuous throughout development, and by the dominance of the transverse ornamentation thus brought about.

[1] A nucleus.

This species has the early beginning of transverse ornamentation and the costation of the nucleus in common with the genus *Hesperocirrus*, from which it otherwise differs in the same way as *S. gracilis*.

A certain similarity in shell shape, whorl profile, and character of ornamentation with the dextral *Calliostoma* (*Eocalliostoma*) *concavum* is discussed under this latter species.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26540	9[1]
26	26540/1	2
	Total	11

ACMAEIDAE

ACMAEA ESCHSCHOLTZ

?Acmaea sp. indet.

Plate 4, figures 4, 10

The dimensions of A.M.N.H. No. 2755:1 are: larger diameter, 23 mm.; smaller diameter, 19 mm.; height, estimated at 5 to 6 mm.

DESCRIPTION: The only shell with a full outline, measured above, is extremely thin and unfortunately broke in the course of preparation into many fragments. It had to be rebuilt as far as feasible. It is oval in shape, with the anterior margin markedly narrower than the posterior one, and much depressed. The apex is missing, but from the course of the concentric ornamentation it can be inferred to have been in a nearly central position, only slightly nearer to the posterior than to the anterior margin. At about the outer third of the distance from the margin to the center runs a shallow furrow (better recognizable on the right side of the shell and in its posterior portion than elsewhere), from which the gradient towards the apex is somewhat steeper than in the outermost zone.

The ornamentation consists of radial ribs or folds and of concentric lamellae. Both these sculptural elements are irregularly distributed and more clearly recognizable in some parts of the shell than in others. There may be about 40 radial ribs or folds which vary widely in both width and prominence; those in the anterior portion of the shell are remarkable for deviating from the radial direction. Where well developed, these radial ribs are of about the same width as the intervals between them or somewhat narrower. Here and there the outer ends of the ribs project somewhat beyond the margin, but this seems to be merely a matter of preservation, the parts of the shell reënforced by ribs resisting corrosion better than those between them. The concentric lamellae, visible only here and there, are quite regular and uniform and slightly wider than the furrows between them in one place of the inner portion of the shell, but more irregularly spaced towards the periphery. In the former place three can be counted to 1 mm., and 12 to 5 mm. in the shell fragment A.M.N.H. No. 27551:2. This fragment shows, even better than the almost complete shell (no. 1), reddish brown color markings in the shape of radial wedges varying in width (fig. 10). The interior shell surface is smooth; no muscular impressions are recognizable.

REMARKS: Although this form deviates very far indeed from *Acmaea mitra* Eschscholtz (see Wenz, 1938, p. 222, fig. 412), the type species of *Acmaea, sensu stricto*, it is tentatively referred to *Acmaea, sensu lato*, mostly owing to its resemblance to *Patella lineata* Klipstein (1843, p. 204, pl. 14, fig. 22) from St. Cassian, referred by most later authors (e.g., Kittl, 1891, p. 174; Broili, 1907, p. 76, pl. 6, fig. 19; Diener, 1926, p. 111) to this genus. The fact that Wenz (1938, p. 220) gives the stratigraphic range of *Acmaea* as Middle Triassic to Recent, although only one of its 17 subgenera listed by him is said to appear in the Middle Jurassic, two in the Oligocene, one each in the Miocene, Pliocene, and Pleistocene, and all the others are recent, seems to indicate that he accepts the reference to this genus of Klipstein's species. It has the apex in the same site as the Peruvian form but differs from it by being higher and more conical, by its outline which tapers less anteriorly, and by its markedly denser radial costation. *A. posticedilatata* Scalia (1914, p. 4, pl. 1, fig. 11), however, is very different from the present form in both outline and profile of shell and in the great eccentricity of its apex, but its generic reference is open to question. The Liassic *A. schmidti* (Dunker;

[1] Mostly nuclei and juveniles.

Terquem, 1854, p. 281, pl. 18, fig. 4; Cossmann, 1902, p. 201, pl. 3, figs. 34, 35; Haber, 1932, p. 164, *cum synon.*) is not so dissimilar in ornamentation but much higher and markedly broader in shape.

Of species referred to other genera, *Scurria (Hennocquia) hennocquii* (Terquem, 1854, p. 282, pl. 18, fig. 1), type species of Haber's (1932, p. 220) subgenus *Hennocquia*, resembles the Peruvian form in shell shape and character of ornamentation, but since an anterior site of the apex is considered by Wenz (1938, p. 219) a distinctive character of that subgenus, our form, in which the apex is in a nearly central position but slightly nearer to the posterior margin than to the anterior one, cannot be considered congeneric. It deviates much farther from *Scurria scurra* (Lesson; Wenz, 1938, p. 219, fig. 404), the type species of *Scurria, sensu stricto*, and also from some Triassic species referred to *Scurria* in literature, namely, *Patella campanaeformis* (Klipstein, 1843, p. 204, pl. 14, fig. 21; for synonymy, see Diener, 1926, p. 114), *S. conulus* (Hörnes; Koken, 1897, p. 16, pl. 1, figs. 1, 2), *S. depressa* Koken (*ibid.*, fig. 3), *S. pelta* Böhm (1895, p. 214, pl. 9, fig. 3), *S. striata* (Read) Broili (1907, p. 73, pl. 6, figs. 6, 7).[1] Reference to the respective illustrations may here dispense with further comparisons.

On the other hand, two Triassic species of the genus *Patella* are not so dissimilar to our Peruvian limpet. *P. crateriformis* Kittl (1895, p. 111, pl. 1, figs. 1, 2; Böhm, 1895, p. 213, text fig. 2, pl. 9, figs. 6, 6'; Kittl, 1899, p. 5, *cum synon.;* Broili, 1907, p. 74, pl. 6, fig. 8) from the Marmolata and other localities of the southern Alps is just as low but is broad-elliptical rather than oval in outline and its radial costation is markedly denser and shows, at least in Böhm's figure 6, differentiation between primary and secondary ribs. *P. scutelliformis* Blaschke [1905, p. 172, pl. 19, fig. 4; synonym: *P. magna* (Read) Broili, 1907, p. 74, pl. 6, figs. 11–16, 39], resembles the present form in shape but is readily distinguished by its more eccentric apex and by its broad radial folds which produce a distinct, quite regular undulation of the margin.

[1] *Scurria petricola* Kittl (1895, p. 111, pl. 1, figs. 4, 5) from the Marmolata was transferred by Böhm (1895, p. 260, pl. 9, fig. 5) to Whitfield's genus *Lepetopsis*, and this transfer was accepted by Kittl (1899, p. 83).

OCCURRENCE: Very rare in lot 86 which has yielded a damaged shell and a fragment of this form (A.M.N.H. No. 27551).

TROCHONEMATIDAE

GUIDONIA De Stefani, emend.

HISTORY: The history of this generic name is so involved and so little known that it needs to be told here at some length. De Stefani (1880a, p. 496) proposed it for "*Turbo* or *Trochus Songavatii* Stoppani and for a group of other infraliassic and liassic forms, as *Turbo depauperatus* Lycett, *Neritopsis? Oldae* Stoppani, *Trochus Deslongchampsi* Moore, *T. carinatus* Moore, *T. rotulus* Stoliczka." From De Stefani's passages on both the genus and *G. songavatii* (Stoppani) it would seem that it was this species which he had primarily in mind and which, had he been aware of the necessity to establish a type species, he would have chosen as such. One of the reasons for De Stefani's interest in this species was undoubtedly its importance as an index fossil. He (*loc. cit.*) calls it "one of the most characteristic [species] of the Upper Triassic," adding (1880a, p. 497) that it has been found "in una infinità di luoghi nel Trias superiore," and he praises it in another paper (1880b, p. 83) as the "gemma paleontologica" among the Triassic fossils of the marbles of the Apuan Alps (a part of the northern Appenines), which permits their correlation with the "Hauptdolomit" of the Alps.[2]

However, the synonymy of Stoppani's species is quite involved. When discussing it, De Stefani not only considered *Delphinula escheri* Stoppani (1865, p. 256, pl. 59, figs. 12–14) a synonym of *Turbo songavatii*, but, following an earlier hint by Meneghini, also *Turbo solitarius* Benecke (1866, p. 155, pl. 2, figs. 4, 5). The synonymy of the latter species, already recognized by von Ammon (1878, pp. 26, 29), has been admitted by most of the

[2] Fifteen years earlier Stoppani (1865, p. 256) had called his *Delphinula escheri*, considered by most though not all authors a synonym of *Turbo songavatii*, "une [espèce] des plus repandues et par conséquence une des plus charactéristiques de la dolomie à *Megalodon Gümbelii*" (part of the Norian "Hauptdolomit; see von Arthaber, 1905, pp. 332, 399, 403). Von Ammon (1878, pp. 31, 32) also called *Turbo solitarius* "ein in den Südalpon ziemlich verbreitetes Fossil des Hauptdolomits, das . . . stellenweise in grosser Individuenzahl auftritt."

authors following De Stefani (see Bassani, 1893, p. 4; De Lorenzo, 1894, p. 55; Kittl, 1900, p. 51; Marinelli, 1902, pp. 156, 157; Tommasi, 1903, p. 111; Galdieri, 1905, p. 10; Del Campana, 1908, p. 477; Di Stefano, 1912, pp. 95, 96; Desio, 1927, p. 45). This is important since *T. solitarius* was much better described and illustrated by Benecke and especially by von Ammon than *T. songavatii* by Stoppani. All the authors quoted (except De Lorenzo who erroneously dates Benecke's paper as of 1865) acknowledge the priority of Stoppani's name over Benecke's but not all respect it. Von Ammon (1878, p. 30) decided in favor of *solitarius* as "the name recently almost generally accepted." In this attitude and in its motivation he was followed by De Lorenzo, Galdieri, and Di Stefano,[1] whereas Bassano, Marinelli, and Del Campana followed De Stefani's example in rejecting *solitarius* as a junior synonym of *songavatii*, or of *contabulatus*, respectively (see below), Del Campana emphasizing "che alla pratica debba essere anteposta la giustizia."

Meanwhile, the issue of *songavatii* versus *solitarius* lost some of its point when Bassani (1893, p. 4) listed *Trochus contabulatus* Costa (1864, p. 232, pl. 5, fig. 4) in the synonymy of *Guidonia songavatii* (Stoppani). Since Bassani took the dating "1860–1865" of the whole of Stoppani's "Paléontologie Lombarde" at face value, it escaped his attention that *T. songavatii* could not have been published before 1865[2] and that *contabulatus* therefore antedates *songavatii*. De Lorenzo and Di Stefano also consider *contabulatus* and *solitarius* synonyms, but from their peculiar angle favor the latter name, and Tommasi ignores Costa's name altogether. Only Marinelli and, after him, Del Campana and Desio draw the correct nomenclatorial consequence and name the species *Pleurotomaria*, or *Worthenia, contabulata*.

Complex as these vicissitudes of the nomenclature are, they do not yet tell the full story of the confusion prevailing with regard to the synonymy of "*Turbo solitarius*." There exists still another species of Costa's (1864, p. 233, pl. 5, fig. 3), *Trochus lineolatus*, considered by Galdieri (1905, p. 10), justly it seems, as a specimen of *T. contabulatus* with its shell preserved. Furthermore, Stoppani created, in addition to *Turbo songavatii*, four more species, viz. *Neritopsis? oldae* (1860, p. 39, pl. 2, figs. 6–8), *Delphinula escheri* (1865, p. 256, pl. 59, figs. 12–14), *Delphinula inzini* (1865, p. 257, pl. 59, fig. 20), and *Pleurotomaria inzini* (1865, p. 256, pl. 59, figs. 9–11), all of which are, in whole or in part, with or without question, included by some authors in this synonymy. Among these species of Stoppani's, *Delphinula escheri* is particularly important because Kittl considered that this name should be used for the *contabulatus songavatii-solitarius* group, whereas Tommasi considers *Delphinula escheri* even generically distinct from that group, referring it, though doubtfully, to Koken's genus *Schizogonium*. Galdieri (1908, p. 72), on the other hand, unites *escheri* with *T. songavatii* and following Kittl uses the name *escheri* for this group from which, however, he separates *solitaria*, contrary to the opinion of all other authors and to his own paper of 1905.

It is neither possible nor necessary to settle all these thorny problems within the scope of the present report. Here it is sufficient to establish the synonymy *Trochus contabulatus* Costa-*Turbo songavatii* Stoppani-*Turbo solitarius* Benecke. Identity of the last two names has long been generally recognized; their identity with *Trochus contabulatus* Costa is convincingly asserted by Di Stefano (1912, p. 97). Thus the species under discussion is correctly named *Guidonia contabulata* (Costa).

To return to the genus *Guidonia*, Stoliczka (1861), Moore (1867a, 1867b), and von Ammon (1878) referred the species concerned to *Trochus*. Stoppani (1860, 1865) called one of them a *Neritopsis?*, referred two others to *Delphinula*, but *songavatii* to *Turbo*, as did Benecke (1866) with regard to his *T. solitarius*. De Stefani correctly felt that they could not well belong to any of these genera. Thus he proposed a new generic name and exemplified his conception of this new genus by enumerating some species he referred to it, first of all *T. songavatii* Stoppani. His diagnoses, however, must be considered rather poor. In the original of 1880 De Stefani listed the staircase profile of the whorls, the oval-

[1] Koken (1913, p. 26), in his usual pontifical mood, ignores all previous papers except his own and Kittl's, that is, the opinions of all the Italian authors quoted above, and also uses Benecke's specific name.

[2] See Kittl, 1900, p. 52.

oblong aperture, and the slightly convex base as distinctive characters of his new genus. Later (1889, p. 20), in pointing out the differences of *G. songavatii* and of the other species considered by him congeneric with it from the genus *Turbo*, he listed their distinctive features as follows: shell nearly rectangular, not umbilicate (see 62, footnote 2), with very convex base, rectangular, staircase-like, rapidly increasing whorls, and round aperture, without solid operculum. With regard to the last, negative character Kittl (1900, p. 52) wondered somewhat maliciously how it was found out. He censored De Stefani also for not paying attention to the growth striae and stated in this connection that "they are curved back, in a deep sinus, towards the supramarginal keel; therefore, the latter represents a slit keel and refers the fossil to the pleurotomariids."[1] The shell shape, with its two lateral edges, proves to Kittl that, within this family, this species ("*Worthenia escheri*" and its synonyms, as enumerated above), is best placed in the genus *Worthenia*. Although Kittl was the first to refer the group under discussion with precision to the Pleurotomariidae and in particular to *Worthenia*, such reference had already been made six years earlier by De Lorenzo (1894, p. 55), but was obviously unknown to Kittl when he wrote his paper on Triassic gastropods of the Bakony Forest. De Lorenzo, in support of his reference of *G. solitaria* (=*contabulata*=*songavatii*) to *Pleurotomaria* (*Worthenia*), quotes Costa, who (1864, p. 233) had merely noted that his *Trochus contabulatus* resembles a certain *Pleurotomaria* figured by Goldfuss, unspecified passages in geological works by Lepsius (1878)[2] and Bittner (?year), and also a review of "De Stefani's paper" by Koken.[3] Morphologically he bases this reference on the "low form of this species, with staircase-like spires, without umbilicus, [on] the rapidly increasing body whorl, [and on] the angular whorls provided with spiral costae." He makes no mention of growth striae but simply states that "the slit band appears, as a smooth keel, at the edge of the whorls between the two sutures and always projects more than the lateral keel beneath it." This last statement is, however, not supported by Benecke's and von Ammon's illustrations of *G. solitaria*.

After Kittl[4] and apparently independently of him, Tommasi (1903, p. 112) also referred *Turbo songavatii* and three of Stoppani's species from the "Hauptdolomit" (*Turbo pusillus*, *Delphinula inzini*, and *D. meriani*) to the genus "*Worthenia* Koninck (1883), as later amended by Kittl," stating that by their characters and by their general habitus they fit well in that genus.[5] However, in contradistinction from De Lorenzo, he follows up this general statement with a meticulous diagnosis of *T. songavatii*, quoted below.

Thus all three authors (De Lorenzo, Kittl, and Tommasi) referred the species and its synonyms to *Worthenia* apparently independently of one another. What seems even more astonishing is that all three[6] overlooked the fact that *Guidonia* De Stefani, 1880, antedates *Worthenia* de Koninck, 1883. Nor was this fact discovered by any of the authors dealing with this subject after Tommasi, all of whom (Galdieri, 1905; Del Campana, 1908; Galdieri, 1908; Di Stefano, 1912; Koken, 1913; Desio, 1927; Mazzocca, 1942, pp. 221, 223), referred the species under discussion to *Worthenia*. None apparently became aware of the fact that *Guidonia*, as the older name, must take precedence over *Worthenia*. Rather the former name was relegated to obsolescence by Kittl's and Tommasi's authority It

[1] "[Die Anwachsstreifen] krümmen sich zum supramarginalen Kiele tiefbuchtig zurück, welcher letztere daher einen Schlitzkiel darstellt und das Fossil zu den *Pleurotomariiden* verweist."

[2] Closer examination of his book reveals that all that can be quoted from it in support of reference of *Turbo solitarius* to *Pleurotomaria* is the addition, in one out of 11 places in which this species is mentioned, namely, on p. 94, of the words "(oder [or] *Pleurotomaria?*)" to the generic name *Turbo*.

[3] Despite a painstaking search of all the periodicals believed to come into consideration for the period 1880 to 1894 I have been unable to locate this review.

[4] Marinelli (1902, pp. 156, 157) based reference of *contabulatus* to *Pleurotomaria* merely on De Lorenzo's (1894) authority.

[5] Tommasi, in a footnote, quotes Tornquist's (1901, p. 137) reference of *solitaria* to *Worthenia*. In this reference Tornquist, who dated his preface January 1, 1900, cannot have been influenced by Kittl, but he may have been by De Lorenzo or by one of the authors quoted by De Lorenzo.

[6] Tommasi even, although he quoted the dates of both De Stefani's paper and the establishment of *Worthenia* correctly on two consecutive pages.

does not appear in Cossmann's "Paléoconchologie comparée," and its doom seemed to be definitely sealed when Diener (1926, p. 15) disposed of it as a "*nomen invalidum, teste* Galdieri (1908)." Wenz (1938, p. 127) lists it, with two question marks, as a most doubtful synonym of *Worthenia*. A letter from Dr. J. Brookes Knight, dated Washington, D. C., October 12, 1949, to the writer, suggested that *Guidonia* might be a possible senior synonym of *Worthenia* and thus started its revival.

DISCUSSION: The search for the generic affinities of the Peruvian species here dealt with was guided by their great similarity with certain European species included by De Stefani in his genus *Guidonia*, especially *G. songavatii* (=*contabulata*=*solitaria*) and *G. rotula*,[1] and by the fact that there is definitely no slit band in these Peruvian species. Where individual growth striae are well preserved in the latter, as in syntype B and the paratypes A.M.N.H. Nos. 26500:14, 26500:18, 26500:19, 26500:23, 26500:25, and 26500:30 of *G. peruviana*, syntypes C and B of *G. planetecta*, syntype A and paratype A.M.N.H. No. 27092:11 of *G. intermedia*, paratypes A.M.N.H. No. 26501:43 and 26501:49 of *G. parvula*, and syntype A and, best of all, syntype C of *G. bifasciata*, they can be seen either to run perpendicularly across the main keels, as in A.M.N.H. Nos. 26500:29 and 26500:18 (pl. 4, figs. 3, 15), or to be hardly or not at all deflected from their ordinary, steeply backward oblique course by crossing them, as in A.M.N.H. Nos. 27091:9 and 27091/1:3 (pl. 4, figs. 37, 25), A.M.N.H. Nos. 27092:11 and 27092/1:2 (pl. 4, figs. 43, 52, 60), A.M.N.H. No. 26501:49 (pl. 4, fig. 63), and A.M.N.H. No. 26502:21 (pl. 4, fig. 76). Nowhere do they form forward concave lunulae which alone would indicate a slit band. Although the growth striae sometimes, as in A.M.N.H. Nos. 27092:13 and 26502:21 (pl. 4, figs. 50 and 76, respectively) assume a slightly sinuous course between the two main keels, they by no means form a forward concave lunula there, as they do, for example, in the genus *Schizodiscus* Kittl[2] (1891, p. 211; Wenz, 1938, p. 134), where the slit band occupies the space between the two main keels.

If the same characters are examined in the European species for which De Stefani proposed his genus *Guidonia*, no clues can be found in the original descriptions and figures of *Turbo depauperatus* Lycett (1863, p. 99, pl. 45, fig. 13) and *Trochus deslongchampsi* Moore (1867b, p. 553,[3] pl. 16, fig. 15). *Trochus carinatus* Moore (1867a, p. 207, pl. 4, figs. 24, 25) was proved by Tate (*fide* Wilson *in* Wilson and Crick, 1889, p. 304) to be a synonym of *Pleurotomaria helicinoides* Roemer, in which Wilson (*loc. cit.*, and pl. 9, fig. 13) indeed describes and figures a slit band. The growth striation of *Trochus rotulus* Stoliczka (1861, pl. 2, figs. 7a–c) seems to agree well with that of the Peruvian forms, as described above.[4] Stoliczka's species has definitely no slit band, nor has the form from the English Marlstone illustrated, under the same specific name, by Wilson (*ibid.*, especially fig. 12c). Unfortunately, the situation is far less clear for the group of forms often described and illustrated in the Italian, Austrian, and German literature under the specific names *contabulatus*, *songavatii*, and *solitarius*, on which De Stefani primarily based his genus *Guidonia*. *Neritopsis? oldae* Stoppani, also included in this genus by its author, is said by Stoppani (1860, p. 39) to have "des lignes d'accroissement flexueuses et bien marquées sur la partie antérieure du gradin [obviously meaning the apical face of the body whorl]" and there they can well be seen in Stoppani's figure 8. Despite the fact, however, that *N.? oldae* is the first published of all the species referred by De Stefani to *Guidonia*, it may be

[1] "*Rotulus*," meaning a little wheel, is not an adjective but a noun, used by Stoliczka in apposition. Therefore, under the Rules its gender need not be changed if the trivial name is transferred from a masculine generic name to a feminine one. Since *rotula* is a collateral form of *rotulus* and the one quoted first by some dictionaries, it seems desirable to take advantage of this fact to escape the dissonance "*Guidonia rotulus*."

[2] This name is preoccupied by one given by John M. Clarke (*in* Hall and Clarke, 1888, p. 207) to a Devonian phyllopod. The name **Kittlidiscus** (type: *Pleurotomaria plana* Klipstein, 1943, p. 170, pl. 14, fig. 13) is here proposed to replace Kittl's homonym.

[3] Here the growth striae are merely characterized as "very close, angulated."

[4] NOTE, ADDED SEPTEMBER, 1951: When I was in Vienna in June, 1951, Stoliczka's holotype could not be located in the collections of the Naturhistorisches Museum. It must be presumed that it is in those of the Geologische Bundesanstalt; if so, it was then inaccessible owing to war damages.

best to leave it out of consideration, following Kittl's (1900, p. 53) advice.

With regard to the *contabulatus-songavatii-solitarius* group we must face De Lorenzo's and Kittl's descriptions and illustrations and those of Galdieri (1908, p. 72, pl. 2, fig. 7) and Di Stefano (1912, p. 96) to the effect that there is a slit band. Considering the unequivocally opposite condition in the Peruvian forms, the shell shape of which strongly suggests congenerity, some doubt is left as to whether the views of those authors may not have been due to errors of observation. Since neither of De Stefani's diagnoses of *Guidonia* is of any avail in this respect, a careful scrutiny of the literature is needed in an attempt to clear this problem. The oldest descriptions and illustrations, those by Costa, contribute nothing to its solution. Stoppani (1865, p. 256) mentions in the description of *Delphinula escheri* "des stries d'accroissement très-fines, regulières [qui] ornent tout l'extérieur de la coquille," and in that of *D. meriani* (1865, p. 257) just "plis d'accroissement." Neither of these passages points to the presence of a slit band. Two of his illustrations might even be interpreted as excluding it. Figure 14 of plate 59, representing a specimen of *D. escheri* [excluded, it is true, by von Ammon (1878, p. 26) and Di Stefano (1912, p. 97) from the synonymy of *Worthenia solitaria*] seems to show growth striae running perpendicularly across the upper keel, then steeply obliquely backward over the lateral whorl face. Figure 19 of the same plate, illustrating *D. meriani*, a species considered by Tommasi (1903, p. 115, pl. 18, fig. 15) congeneric with *Turbo songavatii*, shows growth lamellae running nearly perpendicularly across the lateral whorl face; there is no indication of a selenizone on the heavily tuberculate upper keel. Benecke (1866, p. 155) does not mention growth striae in his text, and it is difficult to decide if what could be interpreted as such striae in his drawings (pl. 2, figs. 4, 5) is not merely hatching. The same holds true for Bassani's (1893) description and figure 1a, respectively. Von Ammon (1878, p. 28) records "a very delicate growth striation bent backward" in specimens provided with the test, but they can be seen in his figure 10g on the apical face of the body whorl only. De Lorenzo (1894, p. 55) states the upper keel of *Turbo solitarius* to be a slit band keel but gives no details whatever that could support his assertion.

Kittl's (1900, p. 52) far-reaching conclusions were based on the following observations: "The growth striae can well be followed on shell imprints, whereas the apertural slit can often be recognized in the apertural region of casts."[1] Kittl states that he examined specimens good in both respects from both the Bakony and southern Tyrol but that he illustrates (*op. cit.*, pl. 3, figs. 13–15) only Bakony specimens. All three of these drawings show indeed a break in the course of the growth striae on the upper keel, but only in figure 15 does this break assume a shape that might suggest a slit band. This figure 15 is excluded by Di Stefano (1912, pp. 96, 97) from the synonymy of "*Worthenia solitaria* Ben." Di Stefano is inclined to unite it with the specimen illustrated under the name *Delphinula escheri* in Stoppani's (1865) figure 14 (and with some figured by other authors) to a species which he separates from Stoppani's figures 12 and 13, included by him in the synonymy of *Worthenia solitaria*, on the strength of its higher body whorl and chiefly its lack of a lower keel. He hesitates, however, to apply the trivial name *escheri* to this species. This distinction by Di Stefano might be important for our problem, especially in connection with that made by Tommasi (1903, pp. 112 ff.) between Stoppani's species *Turbo songavatii* and *Delphinula escheri*. Tommasi does not separate Stoppani's figure 14 from his drawings 12 and 13 of the latter species, but he considers *escheri* not only specifically but generically different from *T. songavatii*, referring the latter to *Worthenia*, as already mentioned, and *D. escheri*, though doubtfully, to *Schizogonium* Koken. What interests us here most in this distinction is that Tommasi mentions in his very elaborate description of "*Worthenia*" *songavatii* (p. 112) "fine, oblique growth foldlets and striae" but not lunulae or the like, but in that of *Schizogonium* (*?*) *escheri* (p. 116) he describes unequivocally a selenizone: "Growth folds, the finer and denser the farther from the aperture, cross the helicoidal

[1] To this it might be objected that heavy keels often break out at the anterior ends of gastropods regardless of whether or not they carry a slit band.

lines but do not run a straight course; for in the apical part of the whorls they are bent to form a backward concave arc, then they cross the upper keel where they assume the shape of a crescent directed in the opposite sense, and behave between the two keels and on the base as they do in the apical part." Lunulae seem indeed to be recognizable in Tommasi's figure 17 of "*Schizogonium (?)*" *escheri*, whereas his side view 8a of *Worthenia songavatii* permits no reliable observation of growth striae. However, his photograph 15a of an undoubtedly congeneric species, *W. meriani*, shows growth striae the course of which is even more reminiscent of paratype A.M.N.H. No. 26500:2 of our *Guidonia peruviana* (pl. 4, fig. 5) than of Stoppani's (1865, pl. 59, fig. 19) drawing of *Delphinula meriani*. Tommasi's reference of *escheri* to *Schizogonium* is certainly untenable[1] and has not been accepted by any later author. He may be right in that the group here dealt with may well include forms belonging to two different, homeomorphic genera, one of which might be a pleurotomariid, but not the other.[2]

Continuing our survey of the literature, we find in Del Campana's (1908, p. 479) paper a description of the growth striae of *Worthenia contabulata*,[3] but no mention of lunulae. Galdieri's (1908, p. 72) description of *Worthenia escheri* (considered by him specifically but not generically distinct from *W. solitaria*) is more detailed in this respect. It states that "dense and fine growth striae are running, on the whole, obliquely backward, except immediately beneath the main keel where they are directed forward and downward. The strongest ones thus produce on that keel light forward concave, crescent-shaped prominences." This description again fits our pseudo-lunulae (see below, and pl. 4, fig. 5) better than true lunulae. Galdieri's drawing (1908, pl. 2, fig. 7) shows about the same aspect as Kittl's figure 15, referred to above, except that in the former several growth striae (or rather interstices between growth folds) stand out in bolder relief. Di Stefano (1912, p. 96), in his description of *Worthenia solitaria*, goes even farther than Galdieri in explicitly mentioning a slit band: "The growth striae bend strongly backward above and below the main keel on which they form a sinus: Therefore, the shell was provided with a slit band riding on the keel and slightly convex, as has, moreover, been observed by other authors also." The course of the growth striae in Di Stefano's drawing (pl. 17, fig. 9) of a shell with a biconical body whorl is indeed the same as in Kittl's and Galdieri's drawings referred to above.

The illustrations of these three authors seem to furnish documentary evidence for the presence of a slit band in all, or at least some, of the forms under discussion. Against it must be held the fact that two such meticulous scholars and keen observers as von Ammon and Tommasi, although dealing with the growth striae of "*Trochus*" *solitarius* and "*Worthenia*" *songavatii*, respectively, do not mention any slit band. In the case of Tommasi this fact, confronted with his explicit description of a selenizone in "*Schizogonium (?)*" *escheri*, permits no other interpretation than that, by his observations, there is no slit band in *songavatii*, a species considered by him a senior synonym of *solitaria*.

In addition to this more or less negative argument, the Peruvian material itself also furnishes positive evidence against the presence of a slit band in the forms concerned, strongly supported, it is true, by the drawings of Kittl, Galdieri, and Di Stefano. Where individual growth striae are well observable in the following species (e.g., in the specimens A.M.N.H. Nos. 26500:29 and 26502:21) there is no room for any doubt that there is no selenizone. However, the aspect thoroughly changes where bundles of growth striae or coarse growth folds are developed instead. As seen best in paratype A.M.N.H. No. 26500:2 of *G. peruviana* (pl. 4, fig. 5), a specimen not only undoubtedly conspecific with, but even from the same lot as, syntype

[1] Primarily for the fact, of which Tommasi was well aware, that the lower keel lacks the strong thorns which constitute a distinctive character of Koken's genus.

[2] Tommasi's (1903, p. 117) tentative suggestion that the generic name *Guidonia* might be applied to the two species (*escheri* and *diadema*) which he doubtfully refers to *Schizogonium* would immensely increase the prevailing confusion. For it is just the *songavatii-solitaria* group, separated by Tommasi even generically from the two above-named species, for which De Stefani proposed that generic name.

[3] "Apically the whorls are crossed by many fine, sigmoidal striae which appear also on the sides of the whorls and which must, in my opinion, be considered growth striae."

B of that species (pl. 4, fig. 3), these bundles and folds in crossing the strongly projecting keels produce a peculiar imbrication and suffer a break in direction quite similar to that illustrated by the three afore-mentioned authors. The interspaces between those folds show a distinct forward concavity, thus indeed simulating lunulae. It is proposed to call such structures pseudo-lunulae in contradistinction from true lunulae which in their entirety constitute a selenizone indicating a slit band. If there were any doubt that what can be seen in figure 5 of plate 4 are not true lunulae, the fact that they are present on the lower keel as well as on the upper should definitely dispel it.

If all these arguments *pro* and *con* are duly weighed, the question whether the forms of the *contabulatus-songavatii-solitarius* group are pleurotomariids, or some are and some are not, must still be considered unanswered. The safest way to decide would be a reëxamination of Costa's types of *Trochus contabulatus* and Stoppani's of *Turbo songavatii*. But the former are for the time being and probably for some years to come inaccessible, since their repository, the Museo Geo-Paleontologico of Naples, suffered heavy damages during World War II which it will take considerable time to repair (letter from Prof. Geremia D'Erasmo of the University of Naples, dated Naples, September 25, 1950, to the author). Stoppani's types, which had been kept in the Museo Civico di Storia Naturale of Milan, were definitely lost in a fire caused by an air raid during the same war (letter from Prof. Sergio Venzo of that museum, dated Milan, November 22, 1949, to the author). Prof. Ardito Desio of the University of Milan most kindly secured topotypes from Songavazzo, where Stoppani found the types of his *Turbo songavatii*, but, as he wrote me on July 21, 1950, all of them are casts or imprints covered or lined, respectively, with crystallized calcite[1] and show no indication of growth striae. I have not been able to obtain from Naples any topotypes of *Trochus contabulatus* Costa.

NOTE, ADDED SEPTEMBER, 1951: Comparative research carried out in June, 1951, in Vienna and Munich on some of the specimens illustrated by Kittl (1900) and von Ammon (1878), respectively, fully confirmed the view expressed above that at least some of the European *Guidoniae* have essentially the same growth striation as the Peruvian ones, thus cannot have had a slit band, and are therefore not pleurotomariids.

1. Examination of the putty cast of "*Worthenia escheri*" from the Hauptdolomit of the Esztergár Valley, at the foot of Papod Mountain, illustrated in Kittl (1900, pl. 3, fig. 13) and of other conspecific specimens from the same locality, all in the collections of the Naturhistorisches Museum of Vienna, clearly proved that the pattern of their growth striae is essentially the same as in the Peruvian *Guidonia* species. This can particularly well be recognized in the posterior portion of the exposed part of the body whorl of the specimen on which Kittl's above drawing is obviously based; that portion shows also the denticulation of the upper main keel so common in this genus and especially well developed in its type species, *G. rotula*. The appearance of a sinus formed by the growth striae on the upper main keel, as shown in Kittl's drawing, is caused either by an accident of preservation or by pseudo-lunulae.

2. Among the specimens of *Turbo solitarius* Benecke figured by von Ammon (1878, fig. 10), only the one from which the cast depicted in his figure 10c was taken could be located in the Palaeontologische Staatssammlung of Munich. The others must be considered lost owing to the destruction of the last war. In a new cast taken from the same impression the growth striae can clearly be seen in the posteriormost part of the preserved portion of the body whorl where they run steeply obliquely backward right down from the upper main keel, without any trace of a selenizone on that keel.

DESIGNATION OF TYPE SPECIES: The vicissitudes of the history of the *contabulatus-songavatii-solitarius* group and of some closely related species and the uncertainties prevailing as to some of their essential characters[2]

[1] Von Ammon (1878, p. 32) reports similar conditions of preservation. Several other authors (e.g., Benecke, 1866, p. 155; Kittl, 1900, p. 152; Marinelli, 1902, p. 157; Tommasi, 1903, p. 112) also mention the fact that mostly only casts or imprints of the species concerned are found. According to Tommasi the specimens, when prepared from the matrix, usually leave their tests behind.

[2] For example, it cannot even be decided from the

are here reported at length merely to prove two things: first, that for seven decades confusion has been piled upon confusion, and second, that the fate of Costa's and Stoppani's types leaves only slim hope for disentanglement. This situation renders the species *G. contabulata* (=*songavatii*=*solitaria*), although it is reported to be very common and to make an excellent index fossil of the "Hauptdolomit" and is geologically older than all the other species (except *Neritopsis? oldae*) included by De Stefani in this genus, unfit as a type species. *Trochus rotulus* Stoliczka, on the other hand, is Liassic in age and is, according to its author, very rare, but there is no uncertainty about its characters. It has clearly no slit band. It is undoubtedly congeneric with the Peruvian species here dealt with. Morphologically it occupies a central position within the genus as such and is also intermediate between the two groups distinguishable within the Peruvian *Guidoniae*, represented by *G. peruviana* on the one hand and by *G. parvula* and *G. bifasciata* on the other. Therefore and since no type species has, as far as I could ascertain, hitherto been selected, *Trochus rotulus* Stoliczka (1861, p. 173, pl. 2, fig. 7) is here designated type species of *Guidonia* De Stefani (1880a, p. 496).

literature whether or not *G. contabulata* (=*songavatii* =*solitaria*) has an open umbilicus. The creator of the genus, De Stefani (1889, p. 20), calls it "non ombilicata," as does De Lorenzo (1894, p. 55), whereas the only usable early illustrations, those of Benecke (1866, pl. 2, fig. 5) and von Ammon (1878, figs. 10d, f), clearly show an open umbilicus. Nothing can be found in this respect in Kittl's (1900) text nor in his figures, but Tommasi (1903, p. 112), who analyzed these species more carefully than any author before him, calls "*Worthenia*" *songavatii* "imperforata, non ombelicata." His figure 8b, however, looks as if the umbilicus was plugged, be it by matrix or by a callosity. Di Stefano (1912, p. 96) in his turn attributes a "falso stretto ombellico" to *Worthenia solitaria*.

As another example of the prevailing confusion, Tommasi (1903) and Di Stefano (1912) seem to entertain quite different conceptions of *Delphinula escheri* Stoppani. To the first author it includes all three of the specimens figured by Stoppani; to the second, only one of them. Furthermore, Tommasi attributes two keels to that species, whereas the absence of the lower keel is to Di Stefano its most distinctive character. Most important, Tommasi keeps Stoppani's name for this species, considered by him even generically different from *songavatii*, whereas Di Stefano would reserve the name *escheri* for that part of Stoppani's species that he includes in the synonymy of *solitaria* (=*songavatii*).

DIAGNOSIS OF GENUS: On the strength of the evidence available, including that furnished by the new Peruvian species, the following amended generic diagnosis is here proposed for *Guidonia:* Small to moderately large, turbinate shells consisting of from three to eight volutions, mostly wider than high, with staircase profile, comparatively large body whorl, low or even depressed spire, convex base, and funnel-shaped umbilicus of varying width, encircled by a more or less pronounced ridge. Both apical and lateral bands of the whorls more or less concave. Aperture subpentagonal in outline, with subcircular lumen; inner lip thickened and widely reflexed over the umbilicus, sometimes concealing it in part. Main elements of ornamentation are two more or less prominent revolving keels bordering the lateral whorl face, the lower one of which is exceptionally developed as a twin keel. In addition, there are sometimes a subsutural keel, the strength of which and distance from the suture vary, and (though not in all species) a finer revolving ornamentation all over the conch or on the base only, where in some species it develops into a series of lirae alternating with threads. Transverse ornamentation consists of rather strong growth striae or lamellae. They mostly run obliquely backward and are sometimes deflected to a perpendicular course by crossing the main keels. On the lateral band they sometimes become slightly sinuous. In crossing the revolving keels they produce fine beads or, if they unite in bundles to form coarse growth folds as they often do, equally coarse denticulations which may simulate lunulae. On the base the growth striae assume a more or less radial direction, sometimes uniting around the umbilicus into short radial folds which exceptionally stud the circumumbilical ridge with strong beads. Nucleus depressed, as a rule, only exceptionally planospiral; not only the embryonic but later volutions are sometimes slightly alloiostrophic.

FAMILY RELATIONSHIP: The type species, *G. rotula*, *G. contabulata*=*songavatii*=*solitaria*, and some of the new Peruvian species, chiefly *G. peruviana*, closely resemble *Trochonema umbilicatum* (Hall) (see Knight, 1941, p. 357, pl. 41, figs. 2a–e), the type species of *Trochonema* Salter. If the immense

time gap between that Middle Ordovician species and the Late Triassic and Liassic *Guidoniae* is taken into account, then the possibility that this resemblance may be merely homeomorphic must certainly be considered. In this case a new family may have to be established to accommodate the forms under discussion. As long as the question of homeomorphy cannot be decided, *Guidonia* may at least tentatively be included in the Trochonematidae.[1]

STRATIGRAPHIC AND GEOGRAPHIC RANGES: In the belief that uncertainty as to congenerity may prevail with regard to some, but certainly not all, forms of the *contabulata-songavatii-solitaria* group, *Guidonia* may be stated to occur in the Norian ("Hauptdolomit") of the Alps,[2] of both northern (Alpe Apuane) and southern (Naples region) Appenines, of Sicily, and doubtfully of the Bakony Forest of Hungary; in the Rhaetian ("Grenzdolomit") of the Monte Nota, near Lake Garda in the southern Alps; in the Late Triassic of central Peru; and in the Liassic of the northern Alps (Hierlatz limestones, which yielded the type species) and of England (Forest Marble, Marlstone Rock).

REMARKS ON *Trachybembix* BÖHM: What has been said above about pseudo-lunulae may obtain to some degree in the genus *Trachybembix* J. Böhm (1895, p. 220), as whose type species *Pleurotomaria junonis* Kittl (1895, p. 114, pl. 1, figs. 15–27) was designated by Wenz (1938, p. 150[3]). Both Kittl and Böhm include *Trachybembix* in the Pleurotomariidae, but Wenz does so only with a question mark. It may indeed seriously be questioned if this genus has a true slit band. To judge by the previous literature, no open slit has ever been observed in any of its specimens, nor do Kittl's or Böhm's illustrations show anything that might justly be called a slit band. In his description of *T. junonis*, the genotype, Kittl (1895, p. 114) speaks of a "Schlitzkiel, zu welchem sich die Zuwachsstreifen etwas zurückbiegen," which means that the growth striae are somewhat bent backward towards the supposed slit keel. However, careful examination of his drawings (1895, pl. 1, figs. 14–17), which are so accurate as to allow one to form an opinion even without examining the originals, prove this backward bend to be in this genus also merely a phenomenon of perspective caused by the necessity for the growth striae to cross over the strongly projecting upper keel.[4]

Apart from this analogy with *Guidonia*, because of the occurrence of suspected pseudolunulae in *Trachybembix* also, the latter genus comes into consideration here because the last two of the named species dealt with below, *G. parvula* and *G. bifasciata*, undoubtedly resemble it in some respects, thus suggesting relationship between *Trachybembix* and *Guidonia*. It is believed that *Trachybembix* should be referred to the same family, whether this be the Trochonematidae or a new one. Should such a relationship really exist between the two genera, *Trachybembix*, known only from the Ladinian Marmolata and Esino limestones, must be considered the ancestral genus.

REPRESENTATION OF *Guidonia* IN PERU: Although *G. parvula* and *G. bifasciata* appear thus to be morphologically somewhat transitional to the older genus *Trachybembix*, they are not dealt with first. Rather it seemed advisable to start the following descriptions of species with the smooth *G. peruviana* (which also exhibits the greatest similarity with the most common form of this genus, *G. contabulata = songavatii = solitaria*), then to proceed to two species transitional between *G. peruviana* and *G. parvula*, and to deal last with the

[1] For the sake of completeness it should be mentioned that Koken (1897, p. 60, pl. 11, figs. 12, 13) referred a species from the Carnian Hallstatt limestones, "*Trochonema*" *mojsvari*, not only to this family but even to the genus *Trochonema*. Later that species was made by Cossmann (1915, p. 97) the genotype of a new genus, *Hallstadtia*, which Cossmann and, following him, Wenz (1939, p. 510) place in the Lacunidae. *H. mojsvari* is indeed quite different from *Guidonia*.

[2] It is most common in the southern Alps but recorded by von Ammon (1878, p. 29) from one locality of the northern Alps also.

[3] Here the generic name is misspelled "*Trachybembyx*."

[4] In this connection Böhm's (1895, p. 221) statement, taken over by Wenz (*loc. cit.*) in his generic diagnosis of *Trachybembix*, that "the upper lateral keel [of the type species, *T. junonis*] carries the groove-shaped slit band bordered by two sharp keels," requires explanation. To judge by the present material, which permits of similarly deceptive observations, those "two sharp keels" are merely two of the many "delicate revolving lines" ("zarte Spirallinien") present, according to Böhm's description, all over the surface, which happen to be situated on the edges of the upper lateral keel.

latter species and the closely related *G. bifasciata*. All five species are closely linked with one another by transitions and constitute a morphologic series.

In addition to the specimens and fragments referred to these five species about 425 more (mostly from lot 86, with a few from lots 70 and 71) are too poorly preserved for specific identification (A.M.N.H. Nos. 26503, 26503/1, 26503/2). Furthermore, a few poorly preserved specimens in lot 16A are also referred, though doubtfully, to this genus (A.M.N.H. No. 27188). All these specimens total more than 1000 individuals. Of these by far the greatest number is concentrated in lot 86. The genus is not so rare in lot 70, but is represented by only a few specimens in lot 71 and only quite sporadically in lots 26 and 48.

Guidonia peruviana, new species

Plate 4, figures 1–3, 5–9, 11–18, 20, 32, 42

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26500:12	0.95 mm.	132½	12	*ca.* 140°
26500:13	1.48	128½	11½	125°
26500:17	2.89	128½	10½	121°
26500:20	2.95	131	12	125°
26500:22	3.07	132½	11	125°
26500:21	3.11	128	10½	127°
26500/1:1	4.67	108	10½	114°
26500:4	6.15	120	10	113°
26500:3	*ca.* 6.3	*ca.* 107½	*ca.* 13½	85°
26500:5	6.89	103½	16	87½°
26500:7	7.03	108½	13	97°
26500/1:2	7.03	114	14	95°
26500:6	*ca.* 7.4	*ca.* 104	*ca.* 11½	89°
26500:1 (syntype A)	7.87	103	14	78°
26500:9	*ca.* 8.0	*ca.* 106	*ca.* 17	91°
26500:11	*ca.* 8.36	*ca.* 103	*ca.* 14	77°

As is to be expected in a shell with a blunt, depressed nucleus, W and more decidedly π are seen in the table to decrease with growth. The fact that the decrease of the pleural angle seems sometimes arrested or even reversed, chiefly at the medium growth stages, seems to be due to the development of more prominent keels which make for a wider pleural angle. The height of the spire, on the other hand, increases above a total height of the shell of about 6 mm., whereas it remains fairly constant until then.

SELECTION OF TYPES: In addition to specimen A.M.N.H. No. 26500:1 which as the best preserved among the largest shells present is selected as syntype A, the fragment A.M.N.H. No. 26500:29 is designated syntype B for showing best the course of the growth striae (see above, p. 61).

DESCRIPTION: Since the generic characters have been pointed out above, the description of this species and of the following ones can to a large extent be restricted to distinctive specific characters.

The shell consists of up to four volutions. Its profile is characterized by only gently sloping or almost horizontal apical bands and almost perpendicular lateral ones. Thus the staircase to which the profile of the spire may be likened consists of only a few comparatively high steps. In earlier stages the lower main keel is as a rule concealed by the following whorl. As soon as it emerges from this concealment, it causes the suture to appear deeply channeled, mostly where the subsutural keel, which as a rule is only indistinct and might be called a torus rather than a keel, is well developed, as in paratype A.M.N.H. No. 26500:9 (figs. 6, 7). In maturity, both lateral main keels are strong and prominent. In both respects they may equal each other, or one may slightly exceed the other, paratypes A.M.N.H. Nos. 26500:2 and 26500:9 (figs. 5–7) being examples of shells in which the upper one projects farther than the lower. The first of these paratypes (no. 2) illustrates well another distinctive character of the present species: the upper lateral keel is frequently turned up like a hat rim so as to increase the concavity of the apical band and to conceal it from sight in side view (figs. 5, 7). The base is markedly higher than the rest of the conch and quite bulged, particularly so in adults. In basal view the conch tends to assume a slightly elliptical shape. The umbilicus is rather narrow, as compared with other species of this genus. Its width decreases with growth, from about one-third of the diameter of the base in the youngest shells to about one-sixth or even less in the oldest, if the part of the umbilical opening concealed by the reflexed inner lip is included. In the young the umbilicus is encircled by a distinct though blunt edge which becomes less clearly defined and broadly rounded in maturity. In basal view a more or less pronounced furrow is seen to accompany the peripheral keel at the

inner side. Mostly it is narrow as in paratype A.M.N.H. No. 26500/1:3 (fig. 42), but it is quite wide and deep in some shells, for example, paratype A.M.N.H. No. 26500:9 (fig. 13), thus lending a somewhat inflated aspect to the central area of the base. In some shells and fragments (A.M.N.H. Nos. 26500:15, 26500:16, 26500:20, and 26500:23) the well-defined circumumbilical ridge is on the outer side accompanied by a second revolving ridge which marks about the first third of the distance between circumumbilical ridge and peripheral keel. Paratype A.M.N.H. No. 25600:16 is shown in figure 9 as an example for this character, which is quite different from the much more elaborate revolving ornamentation found on the bases of the following species. No real ornamentation of this kind is found anywhere on the shells of the present one.

Although the outer lip does not seem to be fully preserved in any of the shells examined, the shape of the aperture can be recognized in many individuals (syntype A and paratypes A.M.N.H. Nos. 26500:9, 26500:11, and 26500/1:2; figs. 2, 7, 12, 17) to be that peculiar to this genus. Paratypes A.M.N.H. Nos. 26500/1:3 and 26500:9 show the thickened and reflexed inner lip particularly well; here its margin is developed as a distinct ridge encircling a crescent-shaped depression (figs. 32, 7).

Growth striae or growth folds are recognizable in many shells. Individual growth striae are best seen in syntype B (A.M.N.H. No. 26500:29) and in paratype A.M.N.H. No. 26500:18 (figs. 3, 15). Their behavior in crossing the lateral main keels, so important for a correct taxonomic reference of these forms, is dealt with above (pp. 61, 62). Some other individuals, for example, paratypes A.M.N.H. Nos. 26500:16 (fig. 9), 26500:25, and 26500:30, show the course of the growth striae on the base best; here it becomes slightly sigmoidal, owing to the fact that they form first a gently forward concave arch and switch then to a more radial direction. The course of the growth striae on the apical band is seen best in paratype A.M.N.H. No. 26500/1:3 (fig. 18). The striae tend to unite in bundles which exhibit the same directional characters as the former, but much more conspicuously so. In some shells, for example, paratype A.M.N.H. No. 26500:2 (figs. 5, 11), these bundles form more or less homogeneous, blunt folds all over the whorl, particularly on its apical and lateral faces, and produce irregular teeth in crossing the lateral keels. In the apical view of the paratype just mentioned (fig. 11) these teeth can be seen to slope gently apicad but rather abruptly orad, thus lending a saw-like appearance to the keel. From three to eight such folds, which are separated from one another by much narrower furrows, can be counted per quarter whorl. Rarely, for example, in A.M.N.H. No. 26500:30 (fig. 20), such growth folds appear on the base also. Paratype A.M.N.H. No. 26500/1:3 deserves special mention for showing, most distinctly in its anteriormost part, sickle-shaped growth folds which run down the wall of the umbilical funnel (fig. 42).

EARLIEST ONTOGENETIC STAGES: The nucleus is depressed but cannot be said to be strictly planospiral. A rounded shoulder appears in the middle of the second whorl and changes into a quite marked keel at the beginning of the third; almost simultaneously the lower lateral keel also appears. The two first volutions are smooth; growth striae seem to appear only on the third.

REMARKS: Of all the *Guidonia* species of this assemblage the present one resembles *G. contabulata* (Costa; for its synonymy see above, p. 57) most closely. Costa's protograph (1864, pl. 5, fig. 4) inspires little confidence as to its accuracy, but Stoppani's (1865, pl. 59, fig. 7), Benecke's (1866, pl. 2, figs. 4, 5), and von Ammon's (1878, figs. 10a–f) drawings combined give a sufficient base for comparison. To judge by these illustrations, the European species differs at the same size from the Peruvian by its wider apical band, considerably wider pleural angle, lower base (except in Benecke's fig. 5), and by the revolving striation seen in Stoppani's and Benecke's figures on the lateral face of the body whorl. The same striation can be recognized in Costa's drawing of his probably conspecific *Trochus striolatus* (1864, pl. 5, fig. 3) all over the body whorl. It is here assumed that *G. contabulata* (= *songavatii* = *solitaria*) has an open umbilicus. Should there be none, as De Stefani, De Lorenzo, and Tommasi assert, its absence would constitute still another difference from *G. peruviana*.

This species also resembles the type species of *Guidonia*, *G. rotula*, to a remarkable extent, especially in shell shape, but Stoliczka's species has much thinner keels and exhibits a revolving ornamentation all over the shell and growth striae which seem to run perpendicularly across the lateral band, not steeply obliquely backward as in the present species.

The similarity in shell shape of the European *Guidoniae* with the genus *Worthenia*, which accounts at least in part for their reference to the latter genus by so many authors, holds true for *G. peruviana* also. *W. subgranulata* (Münster) (see Kittl, 1891, p. 185, pl. 2, figs. 12–15), *W. coronata* (Münster) (*ibid.*, p. 184, pl. 2, figs. 3–11), *W. apunctata* Kittl (1895, p. 112, pl. 1, fig. 9), *W. plutonis* Kittl (*ibid.*, p. 113, pl. 1, fig. 10), and *W. exsul* Koken (1892b, p. 191, pl. 12, figs. 14–16) are true "*Wortheniae*" from the Triassic of the Alps which resemble in some respects the present species, but this resemblance is merely homeomorphic, since *G. peruviana* lacks a slit band.

For comparisons with congeneric species, see discussions of those species below.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26500	110
70	26500/1	8
	Total	118

If a proportionate part of the approximately 425 *Guidonia* specimens specifically undetermined be added to the sum of the above two figures, the estimated total is about 200 individuals.

Guidonia planetecta, new species

Plate 4, figures 19, 21–31, 33–35, 37, 38, 44, 45

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27091/1:8	*ca.* 1.06 mm.	*ca.* 147½	*ca.* 5½	134°
27091/1:1	1.23	150	7½	146°
27091/3:1	1.23	152½	4	142°
27091:1	*ca.* 1.26	*ca.* 147	*ca.* 4½	*ca.* 150°
27091/1:7	*ca.* 1.29	*ca.* 148	*ca.* 6	*ca.* 145°
27091:2	*ca.* 1.34	*ca.* 146	*ca.* 5½	*ca.* 150°
27091:3	*ca.* 1.46	*ca.* 136½	*ca.* 6	*ca.* 145°
27091:4	*ca.* 1.57	*ca.* 130½	*ca.* 6½	138°
27091/1:2	*ca.* 1.79	*ca.* 150	*ca.* 7	*ca.* 145°
27091/2	*ca.* 1.96	*ca.* 140	*ca.* 8½	*ca.* 150°
27091:5	*ca.* 1.96	*ca.* 155½	*ca.* 8½	147½°
27091:6	*ca.* 2.18	*ca.* 138½	*ca.* 7½	138°
27091:7[1]	*ca.* 2.41	*ca.* 149	*ca.* 7	*ca.* 130°
27091/1:3 (syntype B)	2.63	130	7½	152°
27091:8 (syntype A)	3.32	137½	8½	125°
27091:10	4.24	113	8½	117°
27091:11	*ca.* 4.3	*ca.* 114½	*ca.* 8½	129°
27091:12	4.43	125	11	126°
27091:9 (syntype C)	4.55	119	8	121°
27091/1:4	4.67	135½	10½	127°
27091/1:5	4.92	133½	10	140°
27091/1:6	*ca.* 5.9	*ca.* 129	*ca.* 9½	110°
27091:13	6.15	130	10	125°

The same general growth trends can be deduced from this table as from that of *G. peruviana* except that the increase of the height of the spire is more pronounced at earlier stages, but slows down later. A comparison of both tables, taking duly into account that in sizes of individuals measured the whole table on *G. planetecta* corresponds to the upper half only of that on *G. peruviana*, clearly shows that the values for W and π are markedly higher in *G. planetecta*, as far as development can be followed, whereas those for h are lower than in the preceding species only in the earlier stages, up to a total height of about 4 mm. Owing to the fact that the increase of h is somewhat arrested at the latest stages observed, the conch tends to assume in basal view an elliptical rather than circular aspect, as in syntype A (fig. 35), since then the increase in width is more apparent. This trend of the base towards an elliptical shape is recognizable, at least occasionally (e.g., paratype no. 24 of *G. parvula*, see table of dimensions of that species), in other species of this genus, but it seems to be more conspicuous in the present one.

The differences in dimensions merely bear out the fact that the top of the conch is considerably flatter and the conch itself is markedly wider in *G. planetecta*. The specific name was chosen to indicate the first of these two distinctive characters.

SELECTION OF TYPES: The best-preserved among the medium-sized specimens (A. M.-

[1] Omitting attached parts of following whorl.

N.H. No. 27091:8) has been selected as syntype A. Since two important specific characters are better exhibited by two other individuals (A.M.N.H. Nos. 27091/1:3 and 27091:9), they are designated syntypes B and C, respectively. The former shows excellent growth striae and well illustrates the flatness of the spire; the latter shows the alloiostrophy of the spire and good growth striation.

DESCRIPTION: As seen, for example, in syntype A (figs. 29, 30) and the incomplete small shell A.M.N.H. No. 27091/3:1 (fig. 22), the nucleus is clearly planospiral. In the latter individual it even seems to be sunk slightly below the level of the apical band of the surrounding first post-nuclear whorl. The suture is distinctly engraved even at this earliest stage and becomes deeply channeled as soon as the lateral face of the first post-nuclear volution begins to emerge. Simultaneously a distinct shoulder, which in the third whorl becomes ever sharper and changes into a true keel, and a low torus along the inner circumference of the apical band develop; the latter makes in this individual the suture appear even deeper.

The flatness of the top and depressed character of the spire, which are most distinctive of the shell shape of this species, are more pronounced the smaller the size of the conch. They show best in syntype B and paratype A.M.N.H. No. 27091/3:1 (figs. 19, 22), and in paratype A.M.N.H. No. 27091/2, but also in some of the smaller shells from lot 86 (A.M.N.H. Nos. 27091:15, 27091:16, and 27091:18). In all these individuals virtually no spire is visible in apertural view. The same would hold true for larger shells, such as syntypes A and C, if the penultimate volution were the last. Another outstanding feature that is most conspicuous in the present species, although occasionally to be observed in congeners, is the alloiostrophy not of the nucleus but of the spire as a whole, the axis around which the conch is coiled undergoing a slight bend in the body whorl. This character is well illustrated in the apertural view of syntype C (fig. 38), in which the apical bands of the penultimate and body whorls can clearly be seen to stand at an angle rather than to run parallel in space. As a consequence of the low and depressed spire, the body whorl appears large in comparison, the more so the earlier the growth stage. Even in the largest shells present the base, which is inverted conical, is still somewhat higher than the part of the conch which is above the periphery. The deep, funnel-shaped umbilicus is wider than in *G. peruviana;* its diameter is about one-half that of the base in small shells (syntype B, paratypes A.M.N.H. Nos. 27091/2, 27091/3:1) and about one-third (syntype C) or, exceptionally, one-fourth (syntype A) in larger ones. The ridge encircling it is neatly defined in the young (e.g., paratype A.M.N.H. No. 27091/2 and syntype B, figs. 31, 33) but less so in maturity (syntypes A and C, figs. 35, 45). The characters of the aperture are those of the genus. The aperture differs from that of *G. peruviana* merely by being somewhat depressed, which is quite in line with the general shell shape. The inner lip is clearly reflexed.

The whorl profile is characterized by the prominence and sharpness of the two main keels, between which the rather narrow, concave lateral band is deeply embedded, mostly so in the young (e.g., syntype B; figs. 19, 25), where it tends to slope more distinctly outward than it does in later stages. In the younger shells the lower main keel projects markedly farther than the upper, but this difference diminishes or disappears entirely with growth. The apical band is also concave, the more so the stronger the upper main keel, practically horizontal in earlier stages, and sloping only a little in maturity. The subsutural torus mentioned in the description of the earliest stages develops only exceptionally, as in paratype A.M.N.H. No. 27091:14, into a true keel, thus making for even deeper concavity of the apical band (figs. 26, 27).

The furrow accompanying the lower main keel on its inner side, thus separating it from the outer zone of the base, is clearly defined in some shells, for example, in all three syntypes (figs. 33, 35, 45), less so in others, particularly adults.

In paratypes A.M.N.H. Nos. 27091/3:1 (fig. 23), 27091/1:7, 27091:14 (fig. 28), and 27091:15 a faint and dense revolving striation is perceptible on the base. In syntype A it is even finer (fig. 35). In all these shells it differs, however, in density from that found in all the following species and in delicacy from that of *G. parvula* and *G. bifasciata.*

Growth striae can well be seen in many specimens, best in syntypes B and C and paratypes A.M.N.H. Nos. 27091/2 and 27091:14. In all these individuals, particu-

larly in syntype B and paratype A.M.N.H. No. 27091:14 (figs. 25, 27), these striae cross the main keels without much deflection from their general course, which is that of the genus, and produce, particularly on the lower keel, fine beads that may occasionally create the perspective illusion termed pseudo-lunulae (p. 62). As in the preceding species, the growth striae sometimes, as on the apical band of the body whorl of syntype C (fig. 44), unite into bundles but never become so pronounced and coarse as in *G. peruviana*. In the small paratype A.M.N.H. No. 27091/3:1 and in syntype A only, about 16 such bundles form a quite regular pattern of short radial folds around the umbilicus (figs. 23, 35). In syntype A they are clearly restricted to the inner zone of the base. An indication of this ornamentational pattern is found in the posteriormost part of the base of paratype A.M.N.H. No. 27091/2 also (fig. 31). This pattern is, however, quite different from that found in *G. parvula*.

REMARKS: The flat top and the greater width readily distinguish this species from *G. peruviana* as well as from *G. contabulata* (Costa) and from the type species, *G. rotula*. Other distinctive features pointed out in the above description serve to distinguish *G. planetecta* from the following as well as from the preceding species.

The circumumbilical folds occasionally found in the present species are somewhat reminiscent of, though much less pronounced than, those of *?Worthenia basifalcata* (see above, p. 19, and pl. 1, figs. 16, 17).

There is a high degree of similarity between juveniles of this species and of some species of *Solariella* (*Eosolariella*), chiefly of *S.* (*E.*) *brevispira*, which are found associated in lots 70 and 86. For the differences that make distinction possible, see page 92, and for comparison of juveniles of this species with the two juvenile forms of *?Hyperacanthus* described in the present report, see page 39.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27091	80
70	27091/1	17
48	27091/2	1
26	27091/3	2
	Total	100

Adding to this sum a proportionate part of the specifically undetermined *Guidonia* specimens, the total number of individuals belonging to this species can be estimated at about 150.

Guidonia intermedia, new species

Plate 4, figures 36, 39–41, 43, 46–48, 50, 52, 53, 58–60

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27092:1	1.46 mm.	138	7½	135°
27092:2	1.96	137	13	128°
27092:3[1]	2.24	131	10	137°
27092/1:1	*ca.* 2.46	*ca.* 140½	*ca.* 10½	138°
27092:4	2.56	139	11½	130°
27092:15	2.80	134	10	140°
27092:6[1]	*ca.* 2.82	*ca.* 136½	*ca.* 11½	133°
27092:14	3.49	138	8½	126°
27092:7	3.65	125	9	131°
27092:8	*ca.* 3.73	*ca.* 123½	*ca.* 9	118°
27092/1:2 (syntype A)	4.15	114	10½	99°
27092:9 (syntype B)	5.66	106½	13	101½°
27092:10	*ca.* 7.63	*ca.* 103	*ca.* 13	83½°
27092:16	7.87	112½	15	88½°
27092/1:3	*ca.* 8.0	*ca.* 114	*ca.* 15½	90°

Although the general growth trends shown by this table are the same as in the two preceding species of the genus, the rates of growth are somewhat different. Thus the decrease of W becomes definite only after a total height of about 3½ mm. is reached, and that of π only a little later, from a total height of about 3¾ mm. On the other hand, h clearly increases in the earliest stages, remains more or less constant through the middle ones, and resumes its increase only above a total height of about 4 mm. W is smaller in this species than in *G. planetecta*, as far as comparison is feasible, but as a rule greater than in *G. peruviana*. Also π is in general somewhat smaller than in *G. planetecta*, but only up to a total height of about 3½ mm. is it markedly greater than in *G. peruviana*. The spire, however, is higher than in *G. planetecta* throughout development, but, except in the very latest stages, lower than in *G. peruviana*. Thus the present species may be said to be intermediate in its measurements between the two preceding ones, thus justifying its specific name (originally chosen because it is intermediate in ornamentation of the base between *G. peruviana* and *G. parvula*) in still another sense.

[1] Omitting attached parts of following whorl.

SELECTION OF TYPES: Specimens A.M.N.H. Nos. 27091/1:2 and 27092:9 are designated syntypes A and B, respectively. They are the most characteristic shells; the former exhibits the course of the growth striae well, whereas the latter is best preserved among the larger individuals present.

DESCRIPTION: As in the section on dimensions, the distinctive characters of this species can best be appreciated on the strength of its differences from *G. peruviana* and from *G. planetecta*.

The nucleus is much depressed but it cannot strictly be called planospiral. The shoulder both appears, and develops into a distinct keel, somewhat later than in *G. planetecta*. Alloiostrophy of the spire, first reported in the description of *G. planetecta*, is recognizable in both syntypes (figs. 39, 52, 60), most distinctly in syntype A, of which the body whorl embraces the penultimate whorl first slightly above and then along its lower main keel. Approaching the aperture the body whorl slopes markedly below that keel so as gradually to reveal the outer zone of the base of the preceding whorl (fig. 52).

Profiles of the conch and of its successive volutions are best illustrated by the natural cross section of paratype A.M.N.H. No. 27092:3 which is broken in half (fig. 41). The shell profile on the whole is less depressed than in *G. planetecta*, but more so than in *G. peruviana*. Both apical and lateral bands of the whorls are gently concave, but the apical band slopes, except for the early stages, more perceptibly outward, and the lateral band is markedly higher and more nearly vertical than in *G. planetecta*, thus accounting for the presence of a spire at a stage at which it is still practically nonexistent in the preceding species. In all these respects the present species approaches *G. peruviana*.

It remains, however, clearly distinct from the latter not only in its altogether wider and more depressed shell shape but in the peculiarities of its base. Its outer zone, which is neatly encircled by the always distinct, though shallow furrow accompanying the peripheral keel on its inner side, is flatter than, and the inner one never bulged at the same degree as, in *G. peruviana*. Furthermore, a well-defined circumumbilical ridge persists up to a comparatively late stage (syntype A; fig. 59). The umbilicus is about as wide as, if not wider than, in *G. planetecta* and markedly wider than in *G. peruviana*. Its width decreases in the course of development from about one-half of the diameter of the base, as in paratype A.M.N.H. No. 27092:3, to about two-fifths, as in syntype A, then to about one-third, as in syntype B. About the same width of the umbilicus is found even in the largest paratype, A.M.N.H. No. 27092/1:13, although it is here concealed to a considerable extent by the widely reflexed inner lip. Most distinctive of the base of *G. intermedia* is its revolving ornamentation, consisting of three or four lirae which are more or less equally distributed over the zone between the circumumbilical ridge and the peripheral furrow, mentioned above (syntypes A, B; figs. 59, 47). These lirae are rather weak, so as to be distinct only in well-preserved shells. This basal ornamentation clearly differs from the twin ridges occasionally occurring in *G. peruviana* as well as from the denser and finer revolving ornamentation found in some specimens of *G. planetecta* and from the much more pronounced revolving keels on the bases of *G. parvula* and *G. bifasciata*.

On the other parts of the shell the revolving ornamentation consists of the two lateral main keels, which are mostly equally strong, and in some of the largest individuals (syntype B and paratypes A.M.N.H. Nos. 27092:16 and 27092/1:3) of a subsutural keel which in syntype B assumes the aspect of a flat narrow band (fig. 46). In two fragments (paratypes A.M.N.H. Nos. 27092:11, 27092:12) a faint third lateral keel is recognizable, in 27092:11 slightly below, in 27092:13 somewhat above, the middle of the lateral band (figs. 43, 58). The rather small shell A.M.N.H. No. 27092:15 carries such a keel between the two other keels; though markedly weaker, it is quite well developed (fig. 36). This unique character is, however, believed to fall within the range of individual variation.

Growth striae can well be seen in many shells, best of all in the fragment A.M.N.H. No. 27092:11 and in syntype A (figs. 43, 52, 53, 59, 60). In both specimens they cross the main keels without being considerably de-

flected from their course, which is the one common in this genus, and produce fine denticulations or, where they combine in bundles, heavier but irregular teeth. In syntype A all the growth striae are uniformly fine, whereas in the fragment A.M.N.H. No. 27092:11 stronger, almost lamellar striae alternate with intercalated finer ones. In syntype A beads similar to those of the keels are produced on the circumumbilical ridge. Bundles of growth striae form definite folds (never as coarse as in *G. peruviana*) in some shells (syntype A and paratype A.M.N.H. No. 27092:10); in both they are recognizable best on the apical bands, to which they lend a slightly undulating aspect (figs. 48, 60), but they can here and there even be followed down the walls of the umbilical funnel. Finally, the fragment A.M.N.H. No. 27092:13 (fig. 50) should be mentioned for exhibiting on its lateral band the same slight sinuosity of the growth striae as a shell fragment of *G. bifasciata* (A.M.N.H. No. 26502:21), described below.

As seen in the apertural views of both syntypes (figs. 40, 53) the aperture shows nothing beyond the generic characters that deserves special mention.

REMARKS: Comparison of *Guidonia intermedia* with *G. peruviana* and *G. planetecta* and to a limited extent with *G. parvula* and *G. bifasciata* is integrated in the discussion of its dimensions and in its description. For further comparisons with the two last-named species, see the discussions of them below. *Guidonia intermedia* differs from both *G. rotula* and *G. contabulata* by its markedly lower spire, higher base, heavier main keels, and by the distinct, rather widely spaced revolving ornamentation of the base.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27092	50
70	27092/1	3
	Total	53

Addition of a proportionate part of the *Guidonia* specimens left specifically undetermined raises the total number of individuals of this species from 53 to nearly 90.

Guidonia parvula, new species

Plate 4, figures 49, 51, 54–57, 61–75, 79, 80

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26501:53	*ca.* 0.78 mm.	*ca.* 139½	*ca.* 7	135°
26501:55	0.84	146½	6½	132°
26501:3	*ca.* 1.12	*ca.* 140	*ca.* 5	*ca.* 130°
26501:4	1.29	135	8	132°
26501:5	1.34	133½	6	126°
26501:6	1.57	121½	10½	120°
(syntype A)				
26501:7	1.57	116	14½	120°
26501:45	1.62	145	10½	136½°
26501:8	1.71	118	13	126°
26501:9	1.85	118	9	124°
26501:46	2.13	142	8	124°
26501:47	2.18	138½	10½	*ca.* 135°
26501:10	2.18	120½	10½	126°
26501:48	2.30	131½	10	118°
26501:11	2.30	124½	10	112°
26501:13	2.30	117	12	111°
26501:15	2.41	125½	7	114°
26501:12	2.52	121	11	111°
26501:14	2.80	110	11½	115°
26501:27	2.80	118	9	117°
26501:17	2.82	122	9	116°
26501:16	2.99	116½	11	106°
26501:18	3.24	118	13	103°
26501:21	3.32	107½	12½	98°
26501:23	3.32	117½	7½	109°
26501:24[1]	3.49	112	12	106°
26501:22	3.57	109½	11½	105½°
26501:25	3.82	106½	13	93°
26501:30	3.90	119	13	114°
26501:26	3.98	106	13½	100°
26501:29	3.98	107½	14½	96½°
26501:31	4.15	102	13	83°
26501:34	4.30	117	14½	96°
26501:33	4.55	108	16	90°
26501:38	4.92	102½	15	81°
26501:2	5.04	105	14	89°
(syntype C)				
26501:1	5.17	112	13	96°
(syntype B)				
26501:35	5.35	99	14	89°
26501:36	5.41	100	18	86°
26501:40	6.15	104	12½	86°
26501:39	6.58	98	12	86°

This table shows the same growth trends as prevail in the preceding species; W and π tend to decrease, and h tends to increase, with growth, but the last trend is especially clearly recognizable only in the earliest stages and again after a total height of about 4 mm. is passed. In the two largest measured shells, however, the spire is comparatively less high. Of all the species of this genus here dealt with,

[1] Abnormal growth; strongly elliptical in basal view.

the present is the only one in whose latest stages H almost equals, or even slightly exceeds, W.

SELECTION OF TYPES: A.M.N.H. Nos. 26501:6, as the best representative of the juveniles, 26501:1, as the best-preserved mature shell, and 26501:2, which shows best the details of the ornamentation of the base, are designated syntypes A, B, and C, respectively.

DESCRIPTION: The turbinate shell consists of up to five volutions. Both spire and base are flatly conical. The lateral band, bordered by the two main keels, occupies as a rule about two-thirds of the height of the spiral whorls and a little more than a third of that of the body whorl. The apical band rises at an angle of about 30 degrees from the shoulder towards a subsutural torus which in the course of development becomes a true keel and is then separated from the suture by a more or less narrow, horizontal band ("Nahtfacette" Kittl, "rampe" Cossmann). Only in some specimens (syntype B and paratypes A.M.N.H. Nos. 26501:30 and 26501:34) does this subsutural band become a little broader, thus making the specimens in this respect transitional to *G. bifasciata*, the other distinctive characters of which they do not, however, share. For most of the length of the spiral whorls the lower lateral keel is concealed by the following volution. It emerges from this concealment only towards the end of the penultimate whorl of mature shells and is then separated by a distinctly channeled suture from the subsutural band of the body whorl. The lateral band is concave, as is the apical one. In most shells the lower main keel marks the greatest width of the whorl profile; only exceptionally both main keels project equally far. The base is convex and well rounded. The diameter of the umbilical opening is about half that of the base in the young and about one-third in medium-sized and full-grown shells. The circumumbilical ridge is well defined not only in juveniles but also in adults, in which it is more or less accentuated by the beads produced by growth folds. The characters of the aperture are those of the genus.

The ornamentation is dominated by the two lateral main keels which are about equally strong and the strength of which is never fully reached by the subsutural keel. Only in the few shells mentioned above for their more pronounced subsutural bands (syntype B and paratypes A.M.N.H. Nos. 26501:30 and 26501:34) does the uppermost keel become quite conspicuous. Four specimens only, all rather small (paratypes A.M.N.H. Nos. 26501:41, 26501:44, 26501:46, and 26501:50), stand out by having the lower main keel developed as a twin keel. This unusual feature, best seen in paratype A.M.N.H. No. 26501:40, is illustrated in figure 49. It seems to be caused by a shift of the outermost revolving lira of the base so close to the peripheral keel as almost to merge with it. A similar development may have misled Böhm (1895, p. 221) into his belief that the upper lateral keel of *Trachybembix junonis* consists of two sharp keels with a groove-shaped slit band between them. Paratypes A.M.N.H. Nos. 26501:41 and 26501:52 are furthermore exceptional in carrying between the two lateral main keels a third weaker keel. In the first of the paratypes just mentioned this middle keel is less pronounced than that of specimen A.M.N.H. No. 27092:15 of *G. intermedia* (p. 70), but in paratype A.M.N.H. No. 26501:52 (fig. 51) it is much stronger than in the latter.

The keels discussed so far are the main elements of the revolving ornamentation of this species. Second in prominence are spiral keels on the base, from three to six of which can be counted between the circumumbilical ridge and the peripheral keel. The fewer there are, the stronger. Normally there are three in small shells like syntype A (fig. 62) and five in larger ones like syntype B (fig. 65), but sometimes six can be counted, as in syntype C, of about the same size as syntype B, and in the medium-sized paratype A.M.N.H. No. 26501:30 (figs. 80, 73). Rarely, only three such keels are present in large shells (in the largest paratype A.M.N.H. No. 26501:39), where they are accordingly unusually strong (fig. 67). It has these features in common with the following species, but its other characters (shell shape, narrowness of subsutural band) seem to refer it to the present one.

The above count does not, however, include the finest elements of the revolving ornamentation which are encountered on the base as well as on the rest of the conch and

which might best be termed threads or striae. Where preservation permits their observation on the base, one each as a rule is intercalated between two keels, except in the outermost and innermost zones where broader intervals between the respective keels and the peripheral keel on the one hand[1] and the circumumbilical ridge on the other allow for more, there being mostly two in the outermost zone and from two to three in the innermost one. In the shell with the most elaborate ornamentation of the base (syntype C) two more such striae are recognizable on and even inside of the circumumbilical ridge. Thus up to 10 such striae can be counted on the base. It must, however, be admitted that, since the revolving keels usually decrease in strength outward, distinction between them and the threads here dealt with becomes somewhat difficult, if not arbitrary, in the outermost zone of the base (in syntype C, which is distinguished by particularly fine keels). Where preservation permits, as in paratype A.M.N.H. No. 26501:30, such revolving threads can be recognized not only between but also on the keels of the base, lending sometimes a split appearance to the latter (fig. 73).

Such revolving threads are present above as well as beneath the periphery. From five to seven or eight can be counted on the lateral bands of the body whorls of syntypes B and C and paratype A.M.N.H. No. 26501:30 and about as many on the apical ones. They are somewhat finer than those on the bases. They seem to be preserved best in the shell fragment A.M.N.H. No. 26501:51 in which, in addition to six such threads on the lateral band which gradually decrease in strength upward, five even finer ones can be counted on the shoulder keel. The revolving striation seems to be equally fine, though not so well seen on the apical band. Five or six, comparatively far coarser threads (some of which may be keels) are seen on the small triangular fragment which is the only preserved part of the base of this specimen.

The course of the growth striae can well be followed in paratypes A.M.N.H. Nos. 26501:43 and 26501:49 (figs. 66, 63). They run almost continuously obliquely backward and are deflected from this course less than in any of the preceding species of this genus by crossing the lateral keels. In general the revolving striation tends in the present species to obliterate individual growth striae. Where these unite into bundles, they show as blunt folds only faintly, if at all, on the lateral faces of the whorls, but more distinctly on the apical faces and on the bases. As seen best in syntype C (figs. 74, 79) and to a lesser degree in paratype number A.M.N.H. No. 26051:30 they sometimes lend a somewhat undulating aspect to the concave band bordered by the subsutural and upper lateral keels. Here they are most pronounced immediately below the subsutural keel, but they decrease in distinctness downward. Seven such growth folds per quarter whorl can be counted in syntype C. Where present, they produce a rather indistinct denticulation on both subsutural and shoulder keels. Once more these transverse folds become conspicuous around the umbilicus where they crowd together, forming slightly orad concave arcs, and combine in a lattice pattern with the revolving ornamentation of the innermost zone of the base. They form thick, rounded knobs on the circumumbilical ridge, thus reënforcing it and rendering it more conspicuous, and continue, gradually vanishing, down the umbilical wall. In the opposite direction, they continue straight and radially over about half the distance between umbilical edge and periphery. This pattern of ornamentation is best observed in paratype A.M.N.H. No. 26501:30 and in syntype C (figs. 73, 80). Nine such circumumbilical folds can be counted in the anterior half of the body whorl of the former and 12 in those of syntypes C and B; in the last they are less pronounced.

EARLIEST ONTOGENETIC STAGES: The nucleus, best observed in paratype A.M.N.H. No. 26501:37, is almost planospiral and slightly alloiostrophic. The shoulder becomes pronounced towards the end of the second whorl, assumes edge character in the third, and develops a keel soon afterward. In these earliest whorls the lateral band slopes as a rule much more than in later ones. All sculptural elements, including first indications of spiral and growth striations, are recognizable

[1] In syntype B the outermost keel of the base is separated also from the following one by a wider than usual interval.

in the fourth volution, but transverse folds develop only in the fifth (figs. 68, 71). Revolving keels can be recognized on the base as early as on the third volution, where they are observable in paratypes A.M.N.H. Nos. 26501:53–26501:55 and, most distinctly, in paratype A.M.N.H. No. 26501:4 (for sizes see above table of dimensions).

REMARKS: This species differs essentially from *G. contabulata* as well as from *G. peruviana* and its close allies, *G. planetecta* and *G. intermedia*, by its less staircase-like shell profile and the distinct revolving ornamentation of its base. Its profile also rises in steps (as it is bound to do in a gastropod with well-defined shoulder), but more gently, these steps being lower and less steep, thus lending the spire a more flatly conical aspect compared to the more cylindrical one in those species. The base is also less convex in *G. parvula* than in *G. peruviana* and never bulged, as it is sometimes in that species, and the umbilicus is somewhat wider and keeps a clearly defined encircling edge throughout development, whereas this edge tends to become indistinct in *G. peruviana*. All this combines with the elaborate ornamentation to lend a neat, so to say, geometrical aspect to the base of the present species which is lacking in *G. peruviana*. Furthermore, the revolving threads found here above the periphery as well as beneath it also help to distinguish the two species. Eventually, the conch of *G. parvula* is in maturity less wide than that of the aforementioned species.

Whereas the apical and lateral bands are smooth in the preceding species, they carry a fine revolving ornamentation in *G. parvula*, as they do in the type species, *G. rotula*. On the other hand, the present species differs from *G. rotula* by the more distinct ornament of the base. Furthermore, the main keels are heavier and project farther and the concavity of the lateral band is much more pronounced than in the type species.

Guidonia bifasciata, which in the present assemblage most closely resembles *G. parvula*, and at the same time is most different from *G. peruviana* and its allies, is compared below with *G. parvula*.

While *G. parvula* exhibits the closest similarity to the geologically younger *G. rotula*, it somewhat approaches the geologically older genus *Trachybembix* Böhm, hitherto known only from the Ladinian, in the very characters of the shell shape by which it deviates from the three preceding species. It resembles in particular *T. junonis* (Kittl), type species of that genus, as illustrated by Kittl (1895, pl. 1, figs. 16, 17).[1] Besides being much smaller, it differs from *T. junonis* by the pronounced revolving ornamentation of the base and from *T. jovis* (Kittl, 1895, p. 115, pl. 1, fig. 14) by its much narrower umbilicus, just as does *T. junonis*.

Despite some resemblances in ornamentation the present species is readily distinguished by the lack of a slit band from those doubtfully referred above (pp. 16, 20) to the genus *Worthenia*. This holds true also for *?W. basifalcata* Körner which has similar but fewer and heavier circumumbilical folds.

For comparison of small juveniles of this and other species of this genus with equally small ones of *Solariella* (*Eosolariella*) *pusilla*, see page 90.

OCCURRENCE: Occurs in lot 86 only, where it is quite common; about 250 specimens and fragments can with certainty be referred to this species. Addition of a proportionate part of the shells identified merely as *Guidonia* sp. indet. raises the figure a little over 400. Thus this is the most common representative of the genus in the Peruvian fauna (A.M.N.H. No. 26501).

Guidonia bifasciata, new species

Plate 4, figures 76–78, 81–85; plate 5, figures 1–3, 7, 8, 14, 15, 21, 22

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26502:24	2.66 mm.	122	12½	120°
26502:1 (syntype A)	2.80	102	15	94°
26502:22	2.90	128½	*ca.* 10	116½°
26502:23	3.24	119	10½	115°
26502:2	3.24	107½	13	*ca.* 100°
26502:3	3.65	104½	11½	102°
26502:25	3.73	104½	11	93°
26502:26	3.73	113½	11	115°
26502:6	*ca.* 3.9	*ca.* 108½	*ca.* 10½	96°
26502:5	4.30	108½	14½	97°

[1] It is doubtful whether the flatly conical, much less gradate shell, figured by Böhm (1895, pl. 9, fig. 11) as *T. junonis* is conspecific with Kittl's types.

A.M.N.H. Nos.	H	W	h	π
(syntype B)				
26502:7	*ca.* 4.3	*ca.* 105½	*ca.* 8½	102°
26502:9	*ca.* 4.3	*ca.* 117	*ca.* 11½	100°
26502:8	4.55	105½	9½	103°
26502:10	4.92	112½	7½	110°
26502:27	5.29	108	14	99°
26502:11	*ca.* 5.53	*ca.* 110	*ca.* 11	92°
26502:12[1]	6.15	116	?6	108°
26502:13	6.30	112½	9½	96°

Within the above sample the shells considered most characteristic of this species, among them both syntypes A and B, stand out by comparatively high spires and low pleural angles. There are, however, others with comparatively depressed spires and wide pleural angles; contrary to what is usual in this genus, the lowest spires (with $h < 10$) are found in four out of the six largest specimens measured. It seems that two different shell shapes, one characterized by greater width, wider pleural angle, and lower spire, the other by lesser width, narrower pleural angle, and comparatively higher spire, occur in this species, the distinctive characters of which are, however, shared by all examined shells. Thus no growth trends as in the several preceding species can safely be deduced from the above table. It is true that values exceeding 120 for W and 115 degrees for π occur only below a total height of 3 mm., but otherwise the same ratios can be encountered at very different growth stages without any clear rules governing their increase or decrease. Since the relative width of the conch does not decrease with growth, as it does in *G. parvula*, the largest shells of the present species exceed those of the former in absolute width.

SELECTION OF TYPES: In addition to specimens A.M.N.H. Nos. 26502:1 and 26502:5, which are designated syntypes A and B as the best representatives of small- and medium-sized shells, the incomplete body whorl A.M.N.H. No. 26502:21 is selected as syntype C for excellently exhibiting the growth lamellae.

DESCRIPTION: The greater height reached by the spire at a comparatively early stage seems to account for the more steeply conical aspect of small shells of the present species, as compared to those of *G. parvula*. In larger shells this difference is, of course, less noticeable. Most characteristic, however, of *G. bifasciata* is the altogether stronger development of the apical parts of the whorls. Viewed from above, they consist of two concentric rings[2] of equal or nearly equal width, of which the inner is bordered by the suture and the subsutural keel and the outer by the subsutural and upper lateral keels. In the small syntype A the inner ring appears to be even a little wider than the outer (pl. 5, fig. 14). In other shells both are about equally wide, or the outer is clearly wider than the inner, as in syntype B and paratype A.M.N.H. No. 26502:20 (pl. 5, fig. 21; pl. 4, fig. 85). The last aspect is encountered in some individuals of *G. parvula* as well which, however, do not share the other distinctive features of the present species. Owing to the stronger development of the subsutural band the outer apical band is of necessity steeper than in *G. parvula*, and the apical whorl face rises from shoulder to suture in two steps (syntype B, pl. 5, figs. 7, 8) rather than in one step as it does in typical shells of the preceding species. Furthermore, since a greater part of the whorl height is absorbed by its apical part, less is left for the lateral band which is restricted to just a third of the height of the body whorl, as in syntype B (pl. 5, fig. 7), or to even less, as in syntype A (pl. 5, figs. 1–3). Correspondingly, the outer apical band attains about half the height of the lateral one in syntype B and about two-thirds in syntype A. Both lateral main keels project as a rule about equally far in this species (syntype B; pl. 5, figs. 7, 8) or, exceptionally, the upper one projects even farther than the lower (syntype A; pl. 5, fig. 3). Thus the lateral band is cylindrical rather than a cone frustum, as it is in *G. parvula*. Another distinctive character of this species is the comparative smallness of the umbilical opening, the diameter of which measures mostly about one-third of that of the base and even less in the largest shells (paratype A.M.N.H. No. 26502:13 pl. 4, fig. 84). Contrary to what has been observed in other species of this genus, the nar-

[1] Very worn.

[2] The presence of these two bands is alluded to in the specific name.

rowest umbilicus, attaining only one-fourth of the diameter of the base in width, has been found in syntype A, one of the smallest shells measured.

In ornamentation, too, *G. bifasciata* exhibits some distinctive features. As seen in both syntypes A and B (pl. 5, figs. 1–3, 7, 8), the subsutural keel tends to equal the lateral ones in strength and prominence, thus making the two-stepped aspect of the upper part of the whorl profile even more apparent. Also all three of these main keels are stronger and more prominent than in typical shells of *G. parvula*. This fact adds to the impression that the lateral band is narrower. Furthermore, there are as a rule not more than three or four revolving keels on the base between circumumbilical ridge and peripheral keel. Syntype C and paratypes A.M.N.H. Nos. 26502:14 and 26502:28, on the bases of which five or even six keels can be counted, are only seeming exceptions to this rule, the supernumerary keels being overdeveloped revolving threads, intercalated in the outermost and innermost zones of the base and readily distinguishable from the other keels by their lesser strength. These keels are also markedly heavier and, where well preserved, sharper than they usually are in *G. parvula*. Its largest paratype (A.M.N.H. No. 26501:39) has this peculiarity of ornamentation in common with *G. bifasciata*, but since it lacks the other distinctive characters of this species, it has been left with *G. parvula*. The revolving keels are either equally distributed over the base or vary in both strength and the intervals between. In many of the larger shells, as in the paratypes A.M.N.H. Nos. 26502:8, 26502:27, 26502:11, and 26502:13 (pl. 4, fig. 84), the keel next to the circumumbilical ridge is markedly the strongest and is separated from the ridge, from the following keel, or from both by conspicuous grooves both wider and deeper than the other interspaces between the basal keels. As in *G. parvula*, revolving threads finer than the keels can be recognized on the base intercalated between, or superimposed on, the keels. In the latter case they lend a fissured aspect to the keels, as in syntype B, which also shows one such thread intercalated both in the outermost and innermost zones of the base (pl. 5, fig. 22). A delicate revolving striation is recognizable also above the peripheral keel, on the lateral as well as on the apical whorl faces, best in syntype B (pl. 5, figs. 7, 8, 21) and in paratypes A.M.N.H. Nos. 26502:17, 26502:18 (pl. 4, figs. 78, 82), 26502:20 (pl. 4, fig. 85), and 26502:25. From five to seven threads can be counted on the lateral and outer apical bands and somewhat fewer on the subsutural band. Occasionally, as in paratype A.M.N.H. 26502:25 (pl. 4, fig. 77), one each among those on the apical and lateral bands stands out by being stronger than the others. Altogether, above the periphery this revolving ornamentation seems to be more delicate in this species than in *G. parvula*.

The growth striation can best be observed in syntypes A and C (pl. 5, figs. 1–3, 14; pl. 4, figs. 76, 81). In both they show the course common in this genus and are most conspicuous on the three keels by producing fine beads. Per quarter whorl 11 such beads can be counted in syntype A, but as many as 20 in syntype C which is considerably larger. Only in two otherwise poorly preserved fragments (A.M.N.H. Nos. 26502:4, 26502:14) are faint indications of pseudo-lunulae recognizable between those beads which are here somewhat coarser and reminiscent of the teeth occurring on the keels of *G. peruviana*. Syntype C is cited in the section on the genus as the finest example of the undeflected crossing of the growth lamellae over the main keels. In this specimen they produce beads finer than those on the main keels on the outermost revolving keels of the base (pl. 4, fig. 81). Bundles of growth striae are best seen all over the whorl in the shell fragment number 16, on the apical bands of paratypes 10 and 18, and in the circumumbilical regions of the same two individuals and of paratype 25, but only in paratypes 18 (pl. 4, fig. 83) and 25 do they stud the circumumbilical ridge with nodes similar to, though less conspicuous than, those encountered in *G. parvula*. Fragment number 19, from a comparatively large shell, is remarkable for showing crowded sickle-shaped growth folds on the wall of the umbilical funnel.

EARLIEST ONTOGENETIC STAGES: The nucleus is not perfectly preserved in any of the shells examined. However, in syntype A and

paratype 27 it can be recognized as depressed, though not planospiral, and only slightly alloiostrophic. The main elements of the sculpture seem to appear earlier than in *G. parvula*. The shoulder is marked by a pronounced edge in the second volution, and the subsutural keel develops in the third where in syntype A growth striae are already far enough advanced to produce distinct denticulations on the keels (pl. 5, figs. 1–3, 14).

REMARKS: This species is most closely allied with the preceding one with which it is compared in the above description. That some individuals of one species exhibit certain distinctive characters of the other suggests that divergence between them set in geologically speaking only a short while before the lifetime of the fauna fossilized in lot 86. From *G. peruviana* and its allies, *G. planetecta* and *G. intermedia*, as well as from *G. contabulata* and *G. rotula*, the present species is readily distinguished by its subsutural band, pronounced subsutural keel, and the comparatively heavy revolving ornamentation of its base. For comparison with *Trachybembix junonis* the differences between *G. parvula* and *G. bifasciata* should be added to those distinguishing *G. parvula* from *T. junonis*.

What has been said above (p. 74) about the distinction of *G. parvula* from the Peruvian species doubtfully referred to *Worthenia* holds equally true for *G. bifasciata*. The latter can by its higher spire and the lack of pronounced circumumbilical folds, even more readily be distinguished from *?W. basifalcata*.

A certain resemblance of this species to *Homalopoma subcinctum* is dealt with below (p. 107).

OCCURRENCE: Common. Restricted to lot 86, where this species is represented by 105 specimens and fragments safely referred to it. If a proportionate part of those left specifically undetermined be added, the total would be about 175 (A.M.N.H. No. 26502).

Guidonia sp.

DESCRIPTION: A few poorly preserved internal molds occurring in lot 16A, the largest of which (no. 1) may have attained about 12 mm. in height and almost 15 mm. in width, exhibit the characteristic whorl profile and the funnel-shaped open umbilicus which the five preceding species have in common. They are therefore, though doubtfully, also referred to *Guidonia*.

The afore-mentioned specimen is remarkable not only for considerably exceeding in size the supposedly congeneric forms hitherto dealt with, the largest shells of which measure in greatest dimension between only 8 and 9 mm., but also for its decidedly elliptical outline. A diameter drawn at a right angle to the greatest width reaches only 70 per cent of W, whereas it measures almost 76 per cent of W in the paratype A.M.N.H. No. 26501:24 of *G. parvula*, noted above for the strongly elliptical shape of its base.

OCCURRENCE: Occurs in lot 16A only, where four specimens and fragments can be recognized. More may be present but they are worn beyond recognition (A.M.N.H. No. 27188).

ANOMPHALIDAE

ANOMPHALUS MEEK AND WORTHEN

Knight (1933, p. 43) has proved Cossmann's 1912, p. 79) genus *Antirotella* (type species: *Rotella heliciformis* Goldfuss) to be one of several synonyms of *Anomphalus*, whereas Wenz (1938, p. 250) treats *Antirotella* as a subgenus of *Anomphalus*.

Knight's example is here followed in placing *Rotella helicoides* Münster, referred by Klipstein to *Euomphalus*, by Kittl to *Umbonium*, but by Cossmann (1918, p. 80) to *Antirotella*, and two other species in Meek and Worthen's genus. However, most of the individuals dealt with under this generic heading are juveniles whose umbilicus is still entirely open; they belong to two different species. Only three specimens, which cannot be considered conspecific with either and which exhibit such peculiar characters that even their reference to this genus is doubtful, show the plugging of all or most of the umbilicus by a callus, as characteristic of mature individuals of *Anomphalus*.

The three species distinguished below total only 18 specimens, thus leaving *Anomphalus* and the Anomphalidae, which are represented by no other genus, among the rare genera and families within the Peruvian material.

Anomphalus helicoides (Münster)

Plate 5, figures 4–6, 9, 10, 13, 16, 17

Rotella helicoides MÜNSTER, 1841, p. 117, pl. 13, fig. 5.

Euomphalus helicoides; KLIPSTEIN, 1843, p. 202, pl. 14, fig. 13.

?Euomphalus sphaeroidicus KLIPSTEIN, 1843, p. 201, pl. 14, fig. 11.

?Euomphalus reconditus KLIPSTEIN, 1843, p. 202, pl. 14, fig. 14.

Euomphalus sphaeroidicus Klipstein sp.; LAUBE, 1868, p. 74, pl. 25, fig. 12.

Rotella sphaeroidica Klipstein sp.; LAUBE, 1869, p. 27, pl. 32, fig. 7.

Umbonium helicoides Münster; KITTL, 1891, p. 242, *cum synon., pro parte*, pl. 6, figs. 1–3.

Umbonium helicoides Münster sp.; PRINCIPI, 1910, p. 22, pl. 1, fig. 16.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27548:1	0.67 mm.	175	$8\frac{1}{2}$	153°
27548:2	0.67	$166\frac{1}{2}$	*ca.* 6	148°
27548:3	*ca.* 0.78	*ca.* $164\frac{1}{2}$	*ca.* 7	139°
27548:4	1.01	150	$5\frac{1}{2}$	142°

From the above table it would seem that not only W and π but h decrease with growth.

DESCRIPTION: Shell shape depressed, almost discoidal. None of the specimens present (all of which, it is true, are extremely small) consists of more than two and a half volutions. In all but four (including nos. 1, 2) the apex is perforated, a fact that seems to indicate that the nucleus is particularly delicate in this genus. The spire is flatly conical but very low and somewhat sunk into the body whorl from which it is separated by a deeply engraved suture. In all the whorls there is a distinct though rounded shoulder separating a flat apical band from a moderately convex lateral face, but there is no clear boundary between the latter and the gently convex, ring-shaped base which leaves a wide "perspectivic" umbilicus open through which the lower faces of all the preceding volutions can be seen. The umbilicus measures in diameter about a fourth of that of the base in specimens numbers 2 and 5 (figs. 17, 13), but a full third of it in the largest measured specimen (no. 4, fig. 5). The aperture (figs. 6, 10) is subcircular.

In the anteriormost part of specimen number 3, which otherwise agrees well with number 4, the body whorl is bent down as if to become detached, but this may be owing to a lesion of this individual shell.

No growth striation nor any other ornamentation can be recognized in the juveniles under examination.

The nucleus is flattened (figs. 4, 9, 10).

REMARKS: The Peruvian specimens, although much smaller, agree fairly well with Klipstein's, Laube's, and Kittl's illustrations of juveniles of Münster's species, best of all with Laube's (1868) figure 12 and Kittl's figure 3. They share with them the wide-open umbilicus of the juvenile stage which seems to refute, as it were, the generic name.

Anomphalus helicoides (Münster) is compared with *A. biconcavus* and *A. amorphus* in the discussions of those two species. From *Ptychomphalina* sp. indet. 2, *A. helicoides* differs, although somewhat similar in shell shape, in the lack of a slit band, in the flatter, slightly sunk spire, and in the less truncate base. *Solariella* (*Eosolariella*) *brevispira*, which is associated with *A. helicoides* in lot 86, resembles it at first sight quite considerably, as does *S.* (*E.*) *distincta* to a lesser extent (see pp. 92 and 93).

OCCURRENCE: Represented by 11 specimens in lot 86 only (A.M.N.H. No. 27548).

Anomphalus biconcavus, new species

Plate 5, figures 11, 12, 18–20

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27549:1 (holotype)	0.39 mm.	$271\frac{1}{2}$	[1]	*ca.* 200°
27549:2	0.52	260	[1]	*ca.* 196°
27549:3	0.45	$312\frac{1}{2}$	[1]	*ca.* 200°
27549/1	0.59	$260\frac{1}{2}$	[1]	*ca.* 180°

With the exception of specimen A.M.N.H. No. 27549:3, the W/H ratio somewhat decreases in the above series. However, the measured specimens are so nearly the same size that no reliable inference as to growth trends can be drawn.

SELECTION OF TYPE: The largest and best-preserved specimen (A.M.N.H. No. 27549/1 from lot 33) was originally selected for holotype but was inexplicably and irretrievably

[1] Top concave.

lost before it could be photographed. Therefore, specimen A.M.N.H. No. 27549:1, the smallest present, but the only complete one among those from lot 48, is designated holotype.

DESCRIPTION: The shell consists in the holotype of the protoconch and two and a quarter volutions. It is disk-shaped, the width attaining from two and a half to more than three times the height, slightly concave on the apical side and much more deeply so on the basal. In all three specimens from lot 48 the apex is perforated at various degrees, obviously for the same reason as in *A. helicoides*. The diameter of the "perspectivic" umbilicus equals somewhat more than a third of the total width. The penultimate whorl somewhat overtops the innermost one, and the outer whorl the penultimate one. They are separated by distinctly though not deeply engraved sutures. The whorl profile is more or less depressed, chiefly in paratype A.M.N.H. No. 27549:3 (fig. 20), and well rounded, but an upper shoulder and, at least in the holotype, also a faint peripheral shoulder can be recognized. The aperture is subcircular to transversely elliptical in outline.

All shells present are smooth on the whole. Only in the holotype can fine growth striae be followed over most of the body whorl. They form a forward concave sinus on the upper shoulder, then run obliquely forward across the lateral whorl face and, after crossing the blunt peripheral edge, in a shallow, forward convex arc across the lower face.

The nucleus is flat and sunk.

REMARKS: Although the extremely small shells under examination, with their umbilici wide open, look like euomphalids, they are undoubtedly so closely related to the preceding species that they must be considered congeneric. Their reference to *Anomphalus* is supported by their even closer affinity to a St. Cassian species, *Euomphalus complanatus* Klipstein (1843, p. 202, pl. 14, fig. 12), which is listed by Kittl (1891, p. 242), though doubtfully, among the synonyms of *A. helicoides*. However, the distinctive characters given most clearly in Klipstein's description for the shell shape of his species affect its very earliest stages and are therefore believed to be of specific significance. The present species cannot be considered conspecific with *A. complanatus*, from which it markedly differs by even greater width, a higher degree of depression, and by an apical shell face which is not only flattened, as it is in Klipstein's species, but even concave. This difference also is one affecting the earliest ontogenetic stages and is therefore granted specific value. From the preceding species, *A. helicoides*, *A. biconcavus* differs even more, though in a similar way, than from *A. complanatus* which is transitional between them.

For a comparison with *?A. amorphus*, see the discussion of that species below.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27549	3
33	27549/1	1[1]
	Total	4

?Anomphalus amorphus, new species

Plate 5, figures 23–30

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27550:1	*ca.* 1.34 mm.	*ca.* 154	*ca.* 4	165°
27550:2	*ca.* 1.34	*ca.* 158½	? 0	?180°
27550:3 (holotype)	*ca.* 1.68	*ca.* 183½	[2]	*ca.* 195°

The above measurements seem to indicate a tendency, increasing with growth, of the outer whorl to overtop the apical faces of the earlier ones; this trend accounts for the change of the apical shell face from slightly convex through plane to slightly concave. Furthermore, the shell grows faster in width than in height; thus the shell shape, as seen in apical and basal views (figs. 27–30) becomes elliptical rather than circular with growth. This trend is confirmed by the increase of W, as shown in the above table.

DESCRIPTION: In specimens numbers 2 and 3 the apex is perforated; it looks as if the inner volutions had been resorbed. In specimen number 1, on the other hand, what seems to be the spire is obscured by superimposed shell substance. Thus the earliest ontogenetic stages cannot be studied in any specimen, nor can the number of volutions be given.

[1] Must be considered lost, at least for the time being.
[2] Top slightly concave.

The outer whorl exhibits in all three shells present a flat or even concave apical face. It is separated by a more or less distinct, rounded shoulder from the lateral one which slopes at a gradient increasing with growth and attaining about 60 degrees in the anteriormost part of the holotype towards the periphery, marked by a sharp edge. Beyond it is the obtusely conical base; only in the holotype can a blunt circumumbilical ridge be recognized. The umbilicus measures in diameter a little less than a third of the total width. In the holotype it is concealed only in part by a callosity originating from the inner lip (fig. 28), whereas it is nearly or entirely plugged by such callosities in the two paratypes (fig. 30). In the holotype the aperture is rhombic in outline, with a transverse-elliptical lumen the longer axis of which runs somewhat obliquely from the upper left to the lower right.

Not only on the base but in its other parts the conch seems to be encrusted with shell substance. This causes on the holotype the appearance of rather indefinite, irregularly distributed tubercles and adds to the generally amorphous aspect of this species, indicated in its name.

Under these circumstances no growth striae are observable.

REMARKS: The plugged umbilici suggested tentative reference of this rather strange form to *Anomphalus*. The perforation of the apices of the majority of the shells is a character which it has in common with *A. helicoides* and *A. biconcavus*, and which supports reference to the same genus. Strangely enough, only this species, considered only doubtfully an *Anomphalus*, exhibits the characteristic generic feature indicated in the name. Obviously this is accounted for by the fact that it attains more than twice the size of the two preceding species.

One may easily assume that this form represents the mature, or at least a less immature, stage of both *A. helicoides* and *A. biconcavus*, represented by juveniles only, or of either of them, preferably *A. biconcavus*, the apical face of which is also flat or even slightly concave and of which the holotype also shows an indication of a peripheral edge. However, the shell shape of even the largest specimens of the two preceding species is extremely regular and neat, as it were, and shows no indication of the irregularity characteristic of the present form. Also their bases are truncate, not obtusely conical as is the base of *?A. amorphus*. In *A. biconcavus* in particular the peripheral edge develops at about the middle of the lateral whorl face but not at its boundary with the base as in the present species.

OCCURRENCE: Represented by three individuals in lot 86 only (A.M.N.H. No. 27550).

PARATURBINIDAE

CHARTRONIELLA COSSMANN, EMEND.

In 1915 (p. 40) Cossmann included the St. Cassian species *Turbo subcarinatus* Münster (Kittl, 1891, p. 236, *cum synon.*, pl. 5, figs. 21–26) in his genus *Chartroniella* (cf. Kutassy 1937, p. 23,[1] and Wenz, 1938, p. 262).

The two species found in the Peruvian Triassic, the first of which has been previously described and figured by Jaworski (1923, p. 140, pl. 4, fig. 11) as a *Eucyclus*,[2] also belong to *Chartroniella*, although the shape of the mature shell of the first does not agree with Cossmann's generic diagnosis, repeated with slight modifications by Wenz. According to both these authors the conch would be "almost as high as wide" and the "spire short" in this genus, whereas the largest shell present of *C. pacifica* is almost twice as high as wide, and its spire occupies almost half the total height. This is one more example of a much too narrow circumscription of the genus, based solely on the type species, as encountered in many generic diagnoses, particularly Wenz'. In consequence, reference, be it ever so well founded, of additional species to the genus almost regularly requires diagnostic emendation.

This genus, represented in 10 different lots, seems to be not so rare in the material under examination, but more or less complete shells are extremely rare. Paradoxically, the very thickness of the test, as emphasized by both Cossmann and Wenz, accounts for this. The middle layer, which is obviously the thickest, is usually destroyed in the course of acid

[1] There the specific name is erroneously given as "*subcoronatus*."

[2] Since this was written, Cox (1949) has published other specimens of Jaworski's species, though under another name, referring them to *Eucyclus*, and the second of the two following species.

treatment, causing the comparatively thin outer and inner layers to separate. Thus detached, the outer layer is so fragile as to remain entire only very rarely.

In addition to 38 specimens and fragments referred to the two following species, a single poorly preserved shell fragment from lot 69 (A.M.N.H. No. 26509) is also, though doubtfully, included in this genus.

Chartroniella pacifica (Jaworski)

Plate 5, figures 31–41, 45–47, 54

Eucyclus pacificus n. sp., JAWORSKI, 1923, p. 140, pl. 4, fig. 11.

Eucyclus harrisoni sp. nov., COX, 1949, p. 37, pl. 2, figs. 17, 18.

Chartroniella wortheniiformis sp. nov., COX, 1949, p. 36, *pro parte*, fig. 14, *non* figs. 13, 15.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26530:1	9.0 mm.	80	33½	56°
26530:2[1]	*ca.* 9.7	*ca.* 86	*ca.* 38	63°
26530/8:1	22.0	*ca.* 82	*ca.* 30½	*ca.* 60°
26530/8:2	23.8	*ca.* 84	36½	*ca.* 55°
26530/8:3	*ca.* 25.0	*ca.* 80½	*ca.* 33½	57°
26530/5	*ca.* 34.0	?	*ca.* 30½	59°
26530/1:1	*ca.* 53.0	55	*ca.* 43½	*ca.* 46°[2]

From the table the width and the pleural angle can be seen considerably to decrease, but the height of the spire to increase, at the latest growth stage, observed in a single complete shell more than twice as large as the average and more than one and a half as large as the second in size.

DESCRIPTION: Shell consisting of up to eight whorls, turbinate, somewhat turreted. Whorl profile except for the nuclear volutions (see below) decidedly angular, owing to the sharp and prominent keel which separates the apical and lateral faces; in later growth stages, however, this keel gradually loses its prominence and becomes rounded (figs. 37, 39). In the spiral whorls the apical band, which is conical and rises at an angle of about 45 degrees, occupies about two-thirds of the height. In profile the lateral band is somewhat reëntrant in the earlier whorls, but tends to become more or less vertical later. In all cases, it forms a slightly concave groove between the shoulder and supersutural keels. The sutures are only shallowly engraved. The body whorl becomes quite ventricose in full-grown shells (figs. 37, 39). The apical band remains clearly separated from the lateral one, as is the latter by a rounded but distinct edge from the base, although the keel accentuating that edge in earlier stages has now disappeared. The base is wide, obliquely truncate, and only a little convex. The aperture is strongly oblique, almost circular, with a continuous peristome. The outer lip, which is not preserved entirely in any specimen present, is thin, except for the site of the shoulder keel where it is somewhat reenforced. The inner lip is rather wide, reflexed over the columella, and continuing as a rather sharp crest towards the ceiling of the aperture. On its inner side it is separated by a shallow, almost perpendicular furrow from the callus which conceals the umbilicus and extends as far as the upper end of the aperture. The columella is corkscrew-shaped and hollow (fig. 34).

The main elements of the revolving ornamentation are the shoulder and supersutural keels. Throughout development, the former is stronger and projects farther and is thus much more conspicuous than the latter. This is particularly true if the supersutural keel is in part concealed by the succeeding whorl, as is the case in the first post-nuclear volutions and sometimes even at a somewhat later stage. Except in the latest stages, the shoulder keel is accompanied on its inner side by a shallow depression of the apical whorl face. The crossing of the growth striae lends a finely beaded appearance to the keels in earlier stages. Later, however, the striae in crossing the keels unite in bundles which form from 30 to 35 coarse tubercles or teeth per whorl on the keels, conspicuously so on the shoulder keel. At an even later stage, observable only in the largest shell present (A.M.N.H. No. 26530/1:1; figs. 37–39), the keels dissolve into a row of such tubercles which simultaneously become elongated in a diagonal sense. On the last half whorl these tubercles become less and less pronounced on the upper keel and disappear altogether on the lower one, leaving only a blunt, rounded shoulder in its place.

In addition to the keels, a revolving stria-

[1] Exclusive of a fragment of the last whorl present.

[2] Measured from penultimate whorl up; if measured from last whorl up, only *ca.* 38°.

tion is observable all over the whorl where preservation permits, best in the fragments A.M.N.H. Nos. 26530/4:1, 26530/4:2, and 26530/8:6 (figs. 36, 40, 54). It is better developed on the apical and lateral faces than on the base. As many as 10 such revolving threads, which gradually increase in strength towards the shoulder, can be counted on the apical face and three or four even finer ones between the main keels. Occasionally, as in the fragment A.M.N.H. No. 26530/4:1 (fig. 36), these revolving lines can also be seen to assume a beaded appearance, where crossed by growth striae. Contrary to Jaworski's (1923, p. 140) observation on its early disappearance, this revolving striation persists (specimen A.M.N.H. No. 26530/8:2) up to a height of the shell of about 24 mm. It is, however, no longer present on the penultimate and last whorls of the largest individual (A.M.N.H. No. 26530/1:1).

Perhaps most characteristic of this species is the dense and somewhat lamellar growth striation (Jaworski, 1923, pl. 4, fig. 11). The striae, best observable in the little fragment A.M.N.H. No. 26530/8:6 (fig. 54) and in the largest individual, A.M.N.H. No. 26530/1:1 (figs. 37–39), run strongly obliquely backward all over the apical and lateral whorl faces, deflected from their general direction only where crossing the two main keels. Then they are inclined at an angle of 60 degrees or more, whereas their general direction corresponds to one of 45 degrees or less. They develop into coarse lamellae in some specimens (A.M.N.H. No. 26530/3:1; fig. 31). On the base (fig. 35) they continue in the course assumed in crossing the lower main keel, converging towards the margin of the umbilical callus.

EARLIEST ONTOGENETIC STAGES: In only a few of the specimens present, best in A.M.N.H. Nos. 26530:1, 26530/8:1, and 26530/8:2 can the nucleus be observed as blunt and the embryonic whorls as rounded. The shoulder keel appears on the third volution only.

REMARKS: From Jaworski's description and his excellent drawing, there can be no doubt as to the identity of the species described above with the single fragmentary conch he studied. "Base and aperture [being] unknown [to him]," as he states in his description, Jaworski was misled by some quite superficial similarities into assigning this form to the genus *Eucyclus*, although he clearly recognized the essential difference in the course of the growth striae, which change to a more or less perpendicular direction at the shoulder keel in the genus *Eucyclus*, whereas in the present species they continue, after crossing it, in their former direction. Had Jaworski had an opportunity to see the base and aperture of this form, as shown in figures 35, 38, and 39 of the present report, he certainly would not have assigned it to *Eucyclus* or even to the Amberleyidae (see also below, p. 87, footnote 1).

"The aperture is not preserved intact" in any of Cox' specimens of his *Eucyclus harrisoni* (*loc. cit.*, in synon.). This may account for his following Jaworski's example in referring his species to *Eucyclus*. This misinterpretation is the more surprising since Cox recognized the following species as a *Chartroniella*. There can be no doubt as to the conspecificity of Cox' specimens with Jaworski's and those here described. The latter, which permit a close study of the ontogeny, definitely refute Cox' assumption of an essential difference between Jaworski's single specimen and his. Rather the stage at which conspicuous tubercles form on the main keels is subject to considerable individual variation. Thus of two specimens in the same lot of about the same size, one (A.M.N.H. No. 26530/8:5) shows only inconspicuous crenulations of the shoulder keel at a stage where this keel bears quite heavy tubercles in the other (A.M.N.H. No. 26520/8:3).

The characters described above agree with Cossmann's generic diagnosis of *Chartroniella*, thus justifying the assignment of the present species to his genus. However, comparison with his type species, *C. digoniata* from the Liassic of France (Cossmann, 1915, pl. 2, figs. 6, 7), is rendered difficult by the wide difference in size.

In addition to Kittl's and the earlier authors' descriptions and illustrations of *Turbo subcarinatus* Münster, the only Triassic form referred by Cossmann to this genus, two topotypes of that species from St. Cassian in the Yale collection could be compared with the Peruvian form. Both have in common the strongly backward course of the growth

striae and the disappearance of the lower main keel on the body whorl, explicitly mentioned by Kittl (1891, p. 237), but there are, on the other hand, considerable differences. The "keels" of the St. Cassian species are much less pronounced; they may or may not be present or may be just indicated; even where they are present, the growth striae show no deflection when crossing them. Also the shell shape is altogether different. Münster's species has a much more ventricose body whorl and seems hardly ever to assume the somewhat turreted aspect of *C. pacifica*. Thus the congenerity of both may still be open to doubt.

The other species of *Chartroniella* represented in the Peruvian material, *C. wortheniaeformis*, is compared below. Otherwise *C. pacifica* exhibits such characteristic features that no comparison with any other form of the present fauna is required.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. NOS.	NO. OF SPECIMENS
22	26530	5
26	26530/1	4
29	26530/2	5
33	26530/3	3
38	26530/4	3
42	26530/5	1
51	26530/6	1
67	26530/7	3
No. 49[1]	26530/8	7
Total (including fragments)		32

Chartroniella wortheniaeformis Cox

Plate 5, figures 42–44, 48, 55

Chartroniella wortheniiformis[2] sp. nov., COX, 1949, p. 36, *pro parte*, pl. 2, figs. 13, 15, *non* fig. 14.

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26531:1	17.0 mm.	122½	29	93°

DESCRIPTION: Shell in the most characteristic specimen (A.M.N.H. No. 26531:1) consisting of six whorls, flatly conical, turbinate, and decidedly elliptical in outline, when viewed from above or below. The spiral whorls exhibit a conical apical face which rises at an angle of about 30 degrees and shows a flattened torus at the top and a furrow at the bottom. The characteristic profile so produced is best illustrated by the little fragment A.M.N.H. No. 26531/1 (fig. 43). The furrow accompanies the strong and markedly projecting upper keel at its inner side. Between it and the lower keel, which is much weaker and projects much less, the lateral band is deeply sunk so as to appear in profile as a deep furrow. The apical face occupies more than two-thirds of the whorl height, but the lateral band, which about equals the shoulder keel in breadth, only about a sixth. In the spiral whorls the lower keel appears even weaker and less prominent because it is in part concealed by the following volution. In the body whorl it is quite conspicuous, though markedly weaker and projecting considerably less than the upper one. The sutures are only quite shallowly engraved. The base is truncate and even flatter than in *C. pacifica*, the aperture transversely elliptical rather than circular. The peristome, the lips, and the umbilical callus seem to be like those in the preceding species, except that the outer lip is affected to a higher degree by the shoulder keel which is here markedly stronger.

In this species also the two main keels are the predominating sculptural elements. They are finely beaded owing to the crossing of the growth striae. These transverse denticulations become somewhat coarser only in the anterior part of the last whorl of specimen A.M.N.H. No. 26531:1, but even taking this fact into account the denticulation of the keels of this species is altogether more regular, finer, and denser than in *C. pacifica*. The growth striae exhibit a more distinctly lamellar character in the present species. Their course is essentially the same as in *C. pacifica*, but in *C. wortheniaeformis* they form forward hooks in crossing the subsutural torus, which tend in the shell mentioned above to form, here and there, diagonally elongated tubercles (fig. 55).

A fine revolving striation is restricted to the earliest post-nuclear stage (second and third volution) of that shell, where three blunt striae can be recognized on the apical whorl face; it persists somewhat longer in

[1] As distinct from lot 49 (see p. 4).

[2] Since Cox' specific name is meant to suggest a *Worthenia*-like shell shape, it should be spelled *wortheniaeformis*, not *wortheniiformis*.

specimens A.M.N.H. Nos. 26531/2:1 and 26531/2:2. In the former four such secondary keels can be seen still in the fourth volution, all in the lower half of the apical whorl face.

EARLIEST ONTOGENETIC STAGES: In this species, too, the nucleus is obtuse, and the embryonic whorls are rounded. The shoulder keel appears first at the beginning of the third whorl.

REMARKS: This is another case in which a previously given specific name must yield to Cox', and the selected holotype must be relegated to the rank of a simple specimen. However, the description and the illustrations were left as previously prepared. Since Cox unfortunately does not indicate which of his four figured specimens is his designated holotype, it must be assumed to be the one showing the aperture (his fig. 15).

Some of the differences that serve to distinguish this species from *C. pacifica* are integrated in the above description, but it might be well here to recapitulate all of them: *C. wortheniaeformis* is wider than high, whereas the opposite ratio prevails in the preceding species. Furthermore, its shell shape is flatly conical, it has a much wider pleural angle, and in apical or basal view appears elliptical rather than circular. Its conical whorl face shows a subsutural torus, not observed in *C. pacifica*, and a more pronounced groove accompanying the shoulder keel at its inner side. That keel is heavier and projects farther, and the lateral band is much narrower and more deeply sunk between the main keels. The growth striae are more distinctly lamellar, form forward hooks or even tubercles in crossing the torus, and produce a denser, finer, and more regular denticulation on the main keels. Finally, the revolving striation disappears at an earlier stage than in *C. pacifica*. On the strength of these distinctive characters the specimen illustrated in Cox' figure 14 is believed to belong to *C. pacifica* rather than to *C. wortheniaeformis*.

No species in the present fauna other than *C. pacifica* requires comparison with *C. wortheniaeformis*, but its superficial resemblance to *Lepidotrochus bittneri* Koken (1897, p. 61, fig. 12, pl. 11, fig. 8) from the Hallstatt limestones should be mentioned. However, closer examination of the shell profile of Koken's species shows essential differences, and the two forms are not even congeneric, despite certain similarities in shell shape and growth striation. On the other hand, the agreement between *C. wortheniaeformis* and *C. pacifica* in all essential characters leaves no doubt but that the former is also a *Chartroniella*.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26531	3
51	26331/1	1
No. 49[1]	26531/2	2 (doubtful)
		—
Total (including fragments)		6

AMBERLEYIDAE

EUCYCLUS EUDES-DESLONGCHAMPS

Cossmann (1915, p. 52) and, following his example as usual, Wenz (1938, p. 264) consider *Turbo ornatus* Sowerby the genotype of *Eucyclus*. This is, however, inconsistent with the fact that Eudes-Deslongchamps (1860, p. 141), when creating this genus, formally designated his species *E. obeliscus* (*ibid.*, p. 143, pl. 11, fig. 9) as the type.

In the Peruvian material this genus is represented by a single form, occurring only in lots 48 and 51. Its ornamentation is so peculiar that I originally considered making it the type of a new genus, but since most of the same peculiar features can be found in some Liassic species of *Eucyclus* from France and Lombardy, the following form is, at least for the time being, left with Eudes-Deslongchamps' genus.

Eucyclus denticulatus, new species

Plate 5, figures 49–53, 56–61

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26515:6	1.1 mm.	110	30	*ca.* 65°
26516:7	1.4	?	40	62°
26515:8	1.7	85	43	64½°
26515:9	2.2	80	48	60°
26515:1 (syntype A)	2.9	49	49	62°
26515:2	?	?	?	67°

[1] As distinct from lot 49 (see p. 4).

The two largest fragments present (specimens nos. 3, 4, syntypes C, D) belong to shells which, when complete, must have measured between 6.5 and 7.5 mm. in height and between 3.3 and 4.2 mm. in width.

The constant decrease in W, as well as the increase in h, seen in the table of dimensions, is due to the obtuseness of the apex which influences both ratios the more the smaller the shell size. The remarkable increase in pleural angle shown at the bottom of the table seems to be due to the strong development at that stage of the teeth of the upper lateral keel.

SELECTION OF TYPES: Although the total number of specimens present (including fragments) is not so small (25), most of the fairly complete ones (e.g., nos. 6–9) are juveniles. There is only one tolerably complete shell of medium size (no. 1). Full-sized shells are incomplete or represented by fragments only, but some of them show the specific characters far better than the complete shell. Therefore, in addition to the latter, which is designated syntype A, specimens nos, 5, 3, and 4 are selected as syntypes B, C, and D, illustrating the early and mature ornamentation and the nuclear and apertural characters, respectively.

DESCRIPTION: Shell small, conical-turbinate in shape, consisting of up to six whorls which are markedly angular in profile and separated by deeply channeled sutures. Apex obtuse, nuclear volutions rounded and smooth; the spiral ones exhibit a wide, gently sloping apical face and a perpendicular, concave lateral one which is bordered by the two main keels. Base rather high, conical, somewhat concave in its lower part, not umbilicate. Aperture ear-shaped, with an approximately rectangular angulation at its upper end and a short, rather wide anterior notch. The outer lip follows the three strong prominences of the shell profile, caused by the two main keels and the subsutural row of tubercles. The inner lip is thickened and throughout its length widely reflexed over the columella which is markedly thick, not perforated, and almost straight and perpendicular (syntype C; fig. 59).

In maturity the ornamentation of this species is decidedly dominated by the two main keels delimiting the concave lateral whorl face; they appear first as indistinct edges on the third volution and are fully developed on the fourth. Without regard to the heavy tubercles of the upper keel, both keels project about equally far but, except in syntype D, the upper is markedly thicker than the lower keel. The concavity of the band between them considerably increases with growth. In addition to these two main keels, a subsutural row of tubercles, best seen in syntypes B and C and in paratypes 10 and 11 (figs. 57–59, 49, 61), develops on the later whorls. There are as many as 11 more revolving keels on the base, all less prominent than the lateral ones and gradually decreasing downward in both strength and distance from one another. Ten can be counted in syntype C and 11 in syntype D (figs. 59, 56). The interspace between the uppermost keel of the base and the lower main keel assumes in some shells (syntype C and paratype 11) the aspect of a rather deep furrow.

The transverse ornamentation is governed by the costation which appears on the third volution and is fully developed on the fourth (syntype B; figs. 51, 57). According to size, there are from 16 to 20 strong, rather sharp ribs per whorl. On the apical faces they are present, with rare exceptions, throughout development, but on the lateral faces only in the earlier ontogentic stages; here they later change into blunt folds which become less and less distinct with growth, being overgrown by the numerous growth lamellae. At first the direction of these ribs is radial or slightly rursiradiate on the apical whorl faces, but more decidedly so on the lateral ones (syntype A; figs. 52, 53). Later this relation is reversed. The costae assume a backward direction on the apical band but run perpendicularly across the lateral one (syntype B; figs. 51, 57). This pronounced break in direction constitutes an outstanding character of the mature ornamentation of this species. Even more distinctive are the sharp and prominent teeth produced by the ribs in crossing the upper main keel which can be recognized in basal view to point slightly forward (paratype 10; figs. 49, 50). These teeth suggested the specific name. From about the fourth whorl on they mark the maximum width of the whorl profile. Less prominent, rather blunt tubercles are produced by the ribs on the lower main keel, as long as it is reached

by them. In maturity, however, only the much finer and much more numerous beads produced by the crossing of the growth lamellae show on this lower lateral keel. Other minor tubercles develop on the ribs in the upper half of the apical whorl face or exceptionally, as in paratype no. 10, immediately below the suture. In this individual these upper tubercles are transversely elongated and also assume a somewhat tooth-like appearance (fig. 49). In paratype 11, on the other hand, they are spirally elongated to such an extent as to amalgamate into a heavily tuberculate subsutural keel (fig. 61).

There are as many as 40 sharp growth lamellae per quarter whorl and from six to eight to every costa, or tooth of the upper main keel. They add another spectacular feature to the ornamentation of this species and contribute most to its complexity. They run in the same direction as the ribs and exhibit in later stages the same characteristic break in direction on the upper main keel. Preservation permitting, they can be followed all over the shell, at least in later ontogenetic stages, but they are as a rule most conspicuous on the lateral band where they assume a slightly crescent-like shape and where two or three or more tend to radiate from each tooth of the upper main keel. Exceptionally, as in fragment no. 10 (fig. 49), such bifurcation or trifurcation of growth lamellae can be observed on the subsutural tubercles as well, so that here the ribs tend to dissolve into bundles, or tassels, of growth lamellae even on the apical whorl face. The growth lamellae maintain their sharpness and distinctness in the intervals between the lower main keel and the first basal keel and to an only slightly lesser degree between the first and second basal keels (syntypes C and D; figs. 56, 59). They continue in a radial direction, gradually decreasing in distinctness, all the way down the base. They show more clearly between keels than on them, but can be recognized to produce a fine denticulation of the basal keels also. In syntype D the growth striae tend to unite in bundles which form irregular folds in the lower part of the base.

As the last and least conspicuous ornamentational feature a fine and dense revolving striation should be mentioned. As a rule, it is observable on the apical faces of the whorls only, best in syntype B and in some juveniles, and finely denticulates the transverse ribs in crossing them.

REMARKS: With the species considered most characteristic of the genus *Eucyclus*, as exemplified by *E. ornatus* (Sowerby),[1] the present one has in common the shell shape, the whorl profile, and the shape of the aperture (compare our fig. 59 with Hudleston's fig. 16). The similarity in shell shape and whorl profile becomes particularly clear in the earlier stages of Hudleston's var. *abbas* of Sowerby's species. These forms, mostly from the Inferior Oolite (=Bajocian), show none of the following characteristics of *E. denticulatus:* the strong transverse costation of the upper parts of the whorls, the sharpness and strength of the growth lamellae, the pronounced break, in the adult stage, in the direction of both ribs and growth lamellae on the upper main keel, and the peculiar bifurcation and trifurcation of growth lamellae at the tubercles of the revolving keels.

Most if not all of these characters are found in a group of Liassic species first described and figured by Martin (1859, pp. 73, 75, pl. 1, figs. 37, 38, pl. 2, figs. 6, 7; 1859a, pp. 382–383, pl. 1, figs. 7–9) from the Côte d'Or of France, best in *E. tricarinatus*, illustrated by Martin (1859, p. 75, pl. 2, figs.6, 7, as *Purpurina tricarinata*) from that region, by Cossmann (1902, p. 194, pl. 4, figs. 13, 14) from the Vandée, by Dareste de la Chavanne (1912, p. 581, pl. 16, figs. 13, 13a) from the Nivernais, and by von Bistram (1903, p. 58, pl. 4, figs. 17, 18) from the Val Solda of Lombardy, Italy.[2] Only the strong development and the sharpness of the teeth of the shoulder keel readily distinguish the present form from *E. tricarinatus*.[3] It should be noted that all

[1] See, under the generic name *Amberleya*, Hudleston, 1892, p. 279, pl. 21, figs. 13–18, pl. 22, figs. 1, 2.

[2] Von Bistram considers the species named by Martin *Turbo subcrenatus, T. cristatus, T. triplicatus*, and *Purpurina tricarinata* all synonyms of Martin's *T. decoratus*, but since Cossmann (*loc. cit.*) maintains *E. tricarinatus* as an independent species, this name is here applied to the form described by von Bistram and said by him to agree most closely with *P. tricarinata*.

Quite recently, *E. tricarinatus* has been recorded by F. Anelli (1949, p. 75) from the Rhaetic of the Prealps near Bergamo (northern Italy).

[3] An indication of thorns on the shoulder keel is seen also in some younger Jurassic species, e.g., *E. orbigny-*

those Liassic forms are of a similarly small size. They could be recognized as a group of subgeneric rank within *Eucyclus*, but this is not believed to be sufficiently warranted, especially since Cossmann, who generally did not hesitate to establish subgenera and sections, has not seen fit to propose a subgeneric or even sectional name for the group.

The sharpness of the growth lamellae and their break in direction[1] are found in some Upper Triassic *Eucyclus* species from the northern Calcareous Alps of Austria, namely, *E. egregius* Koken (1896, p. 96; 1897, p. 73, pl. 19, fig. 15) and *E. striatus* Koken with two varieties[2] (1896, p. 96; 1897, p. 73, pl. 20, figs. 2–5). These species lack the pronounced transverse costation of those discussed above and represent still another group within the genus *Eucyclus*, which may eventually be raised to subgeneric rank.

Two other Triassic species, *Astralium turritum* Kittl (1900, p. 19, pl. 2, fig. 7) and *Turbo rectecostatus* von Hauer (1851, pl. 20, fig. 10; von Arthaber, 1905, pl. 34, fig. 12; Frech, 1909, pl. 7, figs. 6, 7), believed by Cossmann (1915, p. 53) and Jaworski (1923, p. 141), respectively, to be closely related to the *Eucyclus* species of the same period, differ so widely from the species here discussed that no detailed comparison is needed.

Being the only *Eucyclus* within the Peruvian material, and a very characteristic one at that, the present species requires no delimitation from any other form dealt with in this report. This holds particularly true for *Chartroniella pacifica* (Jaworski), erroneously assigned to the genus *Eucyclus* by that author (see p. 82), and for "*Eucyclus*" *tricarinatus* Cox (1949, p. 38, pl. 2, fig. 16), which is a *Promathilda* (see p. 203).

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26515	25
51	26515/1	1[3]
Total (including fragments)		26

TROCHIDAE

This family is represented in the material under study by the five genera *Solariella*, *Solarioconulus*, *Callotrochus*, *Calliostoma*, *and Amphitrochus*. For some new species of *Solariella*, *sensu lato*, and of *Calliostoma*, *sensu lato*, and for some previously described species of these two genera the new subgenera *Eosolariella* and *Eocalliostoma*, respectively, are here proposed.

Of these five genera only *Solariella* (*Eosolariella*) is common in the Triassic of Peru, with about 270 individuals. *Solarioconulus*, with 32 individuals, is a poor second, and *Calliostoma* (*Eocalliostoma*), with only nine individuals, is rare. *Callotrochus* and *Amphitrochus*, with four and two specimens (fragments), respectively, are even very rare. With altogether 317 specimens, this family ranks in abundance only sixth among the gastropod families of the late Triassic of Peru.

In addition to the 11 species (two left unnamed and possibly each including individuals belonging to two different species) referred to the above-named genera, a single small and poorly preserved cast in lot 86 may be a trochid but cannot be even generically determined (A.M.N.H. No. 27534).

SOLARIELLA WOOD

EOSOLARIELLA, NEW SUBGENUS

Cossmann (1918, p. 260) admits Wood's *Solariella* merely as a subgenus of *Eumargarita* Fischer (= *Margarites* [Leach *in*] Gray; see Wenz, 1938, p. 269), whereas Wenz

anus (Hudleston, 1892, p. 285, pl. 22, figs. 7, 8) and *E. pagodiformis* (Hudleston, 1892, p. 287, pl. 22, fig. 9), but they are compressed in the spiral sense, not laterally as in the present form. Spines occur also in two congeneric species, *E. dilleri* (Stanton, 1895, p. 68, pl. 12, figs. 7–9) and *E. morganensis* (Stanton, 1895, p. 66, pl. 12, fig. 13) from the Lower Cretaceous of the Pacific coast of North America, but otherwise these much younger forms hardly resemble *E. denticulatus*.

[1] Although the latter feature is clearly visible in Koken's (1897) figures 15 (pl. 19) and 2–4 (pl. 20), no mention of this character can be found in his descriptions. It seems that the only author who was aware of it was Jaworski (1923, p. 140), who pointed out its absence in his "*Eucyclus*" *pacificus;* however, this did not protect him from erroneously referring his species to Koken's group of *Eucyclus striatus* (see above, p. 82).

[2] Of these, the var. *simplex* (*ibid.*, fig. 5), the growth striation of which follows an entirely different pattern, is believed not to belong to this species or even to the same genus.

[3] A worn but easily identifiable fragment.

(1938, p. 274) recognizes *Solariella* as an independent genus. Cossmann, however, excludes from *Solariella* the smooth Triassic forms referred by earlier authors to *Margarita*,[1] but credits *Margarita turbinea* von Ammon (1893, p. 191, fig. 22) with deviating the least from the true Margaritinae. The latter constitute a subfamily of the Trochidae which, according to Cossmann (1918, pp. 253, 254), includes *Eumargarita* (= *Margarites*), with *Solariella* as one of its subgenera, and four more genera which need not be considered here.

The fact that Cossmann dealt with von Ammon's species in discussing *Solariella* but not *Eumargarita* proves that he considered the former genus the one which that species approaches most closely. His opinion is here followed, although it cannot be denied that *M. turbinea* comes fairly close to some forms of *Eumargarita*, or *Margarites* for that matter, as well, and that distinction between these two genera seems in some cases somewhat artificial.

The above question had to be decided within the scope of the present report because among all the species found in previous literature von Ammon's is the one which several small trochids in the Peruvian material, and particularly one named *S.* (*E.*) *pusilla* below, resemble most closely. Von Ammon described his *Margarita turbinea* from the Rhaetian "Grenzdolomit" of the Monte Nota on Lake Garda, Italy. After Cossmann had already recognized the close affinity of von Ammon's species to *Solariella*, it is now included in that genus (*sensu lato*). However, *Margarita turbinea* seems to deviate too far from *S. maculata* Wood (see Wenz, 1938, p. 274, fig. 579) from the Pliocene of England, the type species of *Solariella*, to be included in *Solariella, sensu stricto*. Therefore a new subgenus *Eosolariella* is here proposed to accommodate von Ammon's species and those from Peru dealt with below.

ADDITION, SEPTEMBER, 1951: Examination of the type of *Margarita turbinea* von Ammon in the Palaeontologische Staatssammlung of Munich (June, 1951) fully confirmed congenerity of that species with those here referred to the new subgenus *Eosolariella*.

DIAGNOSIS: Very small to medium-sized *Solariellae* with turbiniform shells, large body whorls, moderately wide to wide umbilici, and well-rounded apertures. Both lips thin, the inner one not reflexed. Profile somewhat angular in earliest volutions but rounded in later ones. Spire conical and slightly turreted, sometimes depressed and a little sunk. Base mostly comparatively high, sometimes rather low and somewhat flattened. Surface smooth, except for slightly sigmoidal growth striae which run steeply obliquely backward.

TYPE SPECIES: *Margarita turbinea* von Ammon (1893, p. 191, fig. 22; the larger specimen, illustrated in figs. 22/1 and 3, is hereby designated the holotype of the type species).

DISCUSSION: From the known subgenera of *Solariella*, as listed by Wenz (1938, pp. 274, 275), except *Bowdengaza* Woodring, the new subgenus is readily distinguished by its larger body whorl and higher base. Woodring's subgenus also possesses both these characters but differs clearly from ours in its peculiar subsutural transverse ornamentation. From *Solariella, sensu stricto*, the new subgenus also differs (in addition to differences in shell shape pointed out above) by usually lacking a circumumbilical edge.

For the sake of completeness it should be stated that the two species from the Hallstatt limestones referred to *Solariella* by Koken (1897, p. 58, pl. 10, figs. 13, 14, text fig. 10), *S. aspera* and *S. trochiformis*, seem to belong not to this genus but to *Amphitrochus* Cossmann, 1909 (see below, p. 101). The same may apply to *Solariella nodifera* Kutassy (1927, p. 165, pl. 6, fig. 5). Thus the new subgenus, hitherto know from the southern Alps only and now found in the Andes of Peru, is the only (late) Triassic group within *Solariella, sensu lato*, and the oldest one. This fact is alluded to in its name.

In the Peruvian material it is represented by three species totaling 270 individuals. It is thus quite common in the late Triassic of Peru and is certainly the most abundant of the genera and subgenera of the family Trochidae present.

[1] By these he obviously means *Delphinula? laevigata* Münster and *Euomphalus spiralis* Münster, both of which Kittl (1891, p. 76, pl. 5, figs. 36–39), following Zittel's example, treats as one species under the designation *Margarita laevigata*. Cossmann (1918, p. 37), however, refers these Münster species to the genus *Crossostoma* Morris and Lycett.

Solariella (Eosolariella) pusilla, new species

Plate 6, figures 1–10, 14–16

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27690/3:1	0.78 mm.	107	10½	*ca.* 108°
27690:25	0.84	110	13½	109°
27690:26	0.84	126½	13½	113°
27690:1	0.90	106	15½	98½°
27690:2	0.90	112½	15½	105°
27690:3	*ca.* 0.90	*ca.* 118½	*ca.* 12½	110°
27690/3:11	*ca.* 0.92	*ca.* 121	*ca.* 12	115°
27690:4	*ca.* 1.01	*ca.* 100	*ca.* 16½	94°
27690:5	*ca.* 1.01	*ca.* 100	*ca.* 14	100°
27690:27	*ca.* 1.01	*ca.* 116½	*ca.* 11	110°
27690/3:2	1.01	113	11	107°
27690:6	*ca.* 1.06	*ca.* 115	*ca.* 16	100°
27690:7	1.06	94½	16	94½°
27690/2:2	*ca.* 1.06	*ca.* 105½	*ca.* 10½	105°
27690/3:12	1.06	121	10½	115°
27690:8	*ca.* 1.09	*ca.* 100	*ca.* 10½	102°
27690:9	1.09	107½	15½	100°
27690/2:3	1.18	107	14½	108°
27690:11	*ca.* 1.18	*ca.* 90½	*ca.* 19	78°
27690:17	*ca.* 1.18	*ca.* 95	*ca.* 14½	101°
27690:12	1.23	102½	15	105°
27690:13	1.23	107½	13½	108½°
27690:14	*ca.* 1.23	*ca.* 97½	*ca.* 13½	95°
27690/3:4	1.23	113½	13½	120°
27690/1	*ca.* 1.29	*ca.* 104½	*ca.* 13	103°
27690:15	*ca.* 1.29	*ca.* 95½	*ca.* 13	94°
27690:18	1.31	111½	14½	116°
27690/2:4	*ca.* 1.40	*ca.* 86	*ca.* 16	91°
27690/2:5	*ca.* 1.40	*ca.* 97	*ca.* 10	107°
27690:19	1.40	96	18	97°
27690/2:10	1.46	107½	11½	106°
27690/3:5	*ca.* 1.46	*ca.* 110½	*ca.* 11½	?108°
27690:20	*ca.* 1.46	*ca.* 98	*ca.* 15½	93°
27690/3:7	*ca.* 1.51	*ca.* 107½	*ca.* 11	108°
27690:21	1.51	89	15	86½°
27690:22	1.51	89	18½	98°
27690/2:6	1.51	100	9½	110°
27690:23 (holotype)	1.62	100	17	100°
27690:24	*ca.* 1.68	*ca.* 93½	*ca.* 16½	90°
27690/2:7	1.85	94	15	93°
27690/3:8	*ca.* 1.85	*ca.* 115	12	105°
27690/2:8	2.07	97½	15	100°
27690/3:9	*ca.* 2.18	*ca.* 96	*ca.* 9	110°
27690/3:10	*ca.* 2.24	*ca.* 105	*ca.* 10	110°
27690/2:9	*ca.* 2.24	*ca.* 98	*ca.* 14½	105°
27690/3:13	*ca.* 3.15	*ca.* 97½	*ca.* 16	*ca.* 106°

As seen from the table, the width of the shell exceeds its height in the majority of the measured individuals, sometimes quite considerably, for example, by 21 per cent, or a little more than one-fifth, in paratypes A.M.N.H. Nos. 27690/3:11 and 27690/3:12. The height of the shell equals or even exceeds its width in about one-fourth only of the individuals measuring up to 1.31 mm. in height, but in more than two-thirds of the larger ones, with the minimum width (86) occurring at a height of 1.40 mm., which marks the lower limit of the larger size group. Otherwise both wider and less wide shells can be found at almost any size, there being no steady decline of the width with growth. Nor does the height of the spire steadily increase; rather both lower and higher spires occur at almost all sizes. However, the maximum values for h are found at total heights between 1.18 and 1.51 mm. (paratypes A.M.N.H. Nos. 27690:11, 27690:19, and 27690:22), that is, in medium-sized shells, and the minimum values mostly also at medium sizes (paratypes A.M.N.H. Nos. 27690:8; 27690/2:2, 27690/2:5, 27690/2:6, and 27690/3:12), but also in two of the four largest measured specimens (A.M.N.H. Nos. 27690/3:9, 27690/3:10). In close connection with the variations in width of the shell and height of the spire, the pleural angle also varies without following any steady growth trend. Both minimum and maximum are found near the middle of the table rather than near the ends, the former significantly in the individual (A.M.N.H. No. 27690:11) with the highest spire, the latter in paratype A.M.N.H. No. 27690/3:4; nearly the same width is attained by the pleural angle of paratype A.M.N.H. No. 27690:18 (fig. 4).

SELECTION OF TYPE: The largest of several complete and well-preserved specimens (A.M.N.H. No. 27690:23) is designated holotype.

DESCRIPTION: Shell shape as characterized in the subgeneric diagnosis. In the larger individuals the conch consists of four to five volutions, including the embryonic ones. In the profile of the early post-embryonic whorls a more or less horizontal apical face is separated by a distinct though rounded shoulder from the lateral one which is almost cylindrical. With growth, however, the whorl profile becomes more and more rounded and gibbous, and simultaneously both the apical band and the shoulder usually become less distinct. Only exceptionally (paratype A.M.N.H. No. 27690/2:7) they remain quite pronounced up to a comparatively late stage. At any rate, they can well be recognized even at the latest observable stages (in the holotype and in the largest paratype, A.M.N.H. No. 27690/3:10; figs. 6–8, 1, 3). The sutures

are deeply engraved. The base is comparatively high, well rounded, and perforated by the umbilicus which faces strictly downward and the width of which seems to increase with size. The diameter of the umbilicus equals about one-sixth of that of the base in the smaller paratypes A.M.N.H. Nos. 27690:9 and 27690:12 (fig. 14), and attains nearly or fully one-fourth of it in the holotype (fig. 16) and in the largest paratype (A.M.N.H. No. 27690/3:10; fig. 2), respectively. The aperture is broadly elliptical or subcircular, without angulations at either end; both outer and inner lips are rather sharp. In many specimens the inner lips seem to be reflexed; careful examination reveals, however, that this appearance is caused merely by the strong curvature of the umbilical funnel.

There is no ornamentation other than growth striae. They can be studied only exceptionally, best in the anteriormost part of the body whorl of the holotype (fig. 6), where they follow a steeply backward oblique and very gently sigmoidal course from the suture all over the lateral whorl face, but they cannot be recognized on the base.

EARLIEST ONTOGENETIC STAGES: The nucleus is best preserved in paratypes A.M.N.H. Nos. 27690/22 (fig. 5) and 27690/24 and can be seen to be small, somewhat pointed, and slightly eccentric. The embryonic volutions are somewhat inclined towards the axis of the shell. Their shoulder is even more pronounced than that of the first post-embryonic volution, and their apical and lateral faces are not nearly, as in the latter, but strictly horizontal and vertical, respectively.

REMARKS: Of the Peruvian species referred to *Eosolariella* the present one resembles most closely the type species of this subgenus, *S. (E.) turbinea* (von Ammon). It differs from it by smaller size, which has suggested its specific name, and in shell shape by the lower spire[1] and somewhat wider umbilicus.[2]

[1] In both the holotype (see above) and the figured paratype of von Ammon's species, h amounts to 25½, as compared to a maximum of 19 in the present one.

[2] About one-sixth (in small shells) to one-fourth (in larger ones) of the diameter of the base in *S. (E.) pusilla*, as compared to less than one-sixth in the holotype of *S. (E.) turbinea*, although it attains about eight times the size of our largest paratype.

Solariella (Eosolariella) pusilla is compared with S. (*E.*) *brevispira* and *S. (E.) distincta*, the two other Peruvian forms of the genus, in the discussions of the two last-named species.

Small juveniles of various species of the genus *Guidonia*, particularly of *G. parvula*, sometimes strikingly resemble in shell shape and in appearance of the umbilicus equally small juveniles of *S. (E.) pusilla* but can be distinguished by the angularity of the whorl profile which, even at a very early stage, foreshadows the two prominent lateral main keels, by the early presence of a circumumbilical ridge and, in the case of *G. parvula*, by the fine revolving ornamentation of the base which also appears at a very early stage.

There is, finally, a certain similarity in shell shape between this species and the two juvenile forms doubtfully referred above (pp. 37, 38) to the genus *Hyperacanthus*. The latter can, however, readily be distinguished from *S. (E.) pusilla* by their planospiral embryonic volutions with a sunk nucleus, larger body whorl, narrower umbilicus, and the presence on the later volutions of two lateral keels which cause the profile to be angular rather than rounded and, preservation permitting, of indications of the spines peculiar to the genus *Hyperacanthus*.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27690	110[3]
71	27690/1	1
78	27690/2	54
86	27690/3	33
	Total	198

This species is the most abundant of this genus and of the family Trochidae altogether in the present material.

Solariella (Eosolariella) brevispira, new species

Plate 6, figures 11–13, 17–19, 24–26

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27691/1:1	*ca.* 0.45 mm.	*ca.* 150	*ca.* 4	*ca.* 142°
27691/3:1	0.62	145½	*ca.* 6	126°
27691/1:2	0.67	158½	4	135°
27691/3:2	*ca.* 0.73	*ca.* 154	*ca.* 7½	130°
27691/4:1	*ca.* 0.78	*ca.* 135½	*ca.* 7	*ca.* 125°

[3] Mostly small juveniles.

A.M.N.H. Nos.	H	W	h	π
27691/1:3	*ca.* 0.84	*ca.* 140	*ca.* 6½	133°
27691/4:2	*ca.* 0.90	*ca.* 143½	*ca.* 6	137°
27691/4:3	*ca.* 0.95	*ca.* 135½	*ca.* 6	128°
27691/3:3	*ca.* 1.06	*ca.* 131½	*ca.* 9	126°
27691/3:5	*ca.* 1.06	*ca.* 131½	*ca.* 8	129°
27691/3:6	1.12	120	6½	129½°
27691/3:7	*ca.* 1.12	*ca.* 120	*ca.* 10	119°
27691/3:8	*ca.* 1.12	*ca.* 130	*ca.* 10	123°
27691/3:9	1.12	145	10	141°
27691	1.12	125	10	122°
27691/2:1	1.12	110	10	121°
27691/4:4	*ca.* 1.18	*ca.* 124	*ca.* 8	127°
27691/1:5 (holotype)	1.34	128½	*ca.* 8½	132°
27691/3:10	*ca.* 1.74	*ca.* 115[1]	*ca.* 5½	131°

In this species there seems to be a certain tendency of W to decrease, and of h to increase, with growth; at least the minimum value for W (110) and the maximum value for h (10) are found in specimens 1.12 mm. high, that is, just above medium size, whereas in specimens not attaining 1 mm. in height W does not fall below 135½ and h does not exceed 7½. The above trends are, however, far from steady, for the three largest measured specimens exhibit again greater widths and lower spires. Even more reservations must be added to the statement that π also tends in general to decrease with growth. It is true that the widest pleural angle (142°) has been measured in the smallest specimen and the least wide (119°) in one of the specimens of which the height amounts to 1.12 mm. However, wider angles are encountered again in the three largest measured specimens, among them the holotype.

SELECTION OF TYPE: The best-preserved individual (A.M.N.H. No. 27691/1:5), which is believed to be most characteristic of this species, is designated holotype.

DESCRIPTION: This species can best be described by comparing it with *S.* (*E.*) *pusilla* from which, although otherwise very similar, it differs mainly by the slightly sunk and considerably lower spire, which suggested the specific name, less high body whorl, and somewhat less wide umbilicus. The shortness of the spire makes for wider pleural angles. Even where, as in paratypes A.M.N.H. Nos. 27691/3:3, 27691/3:5–27691/3:9, 27691, and 27691/2:1, h equals or even exceeds the minimum (9) in *S.* (*E.*) *pusilla*, the pleural angles are considerably wider than those of shells of *S.* (*E.*) *pusilla* with equally low spires. This makes ready distinction of both forms possible. The comparative lowness of both spire and body whorl, which accounts for the somewhat depressed shell shape, indicates that the shells grow more slowly in height than in width. A single specimen (A.M.N.H. No. 27691/3:10; fig. 11), which is also the largest present, exhibits the low spire and wide pleural angle characteristic of this species, but its comparatively high body whorl makes it somewhat transitional to *S.* (*E.*) *pusilla*. This growth trend is also responsible for the more distinctly elliptical aspect of individuals of the present species in apical and basal views (figs. 18, 21, 22, 25). The width of the umbilicus amounts to about one-sixth of the diameter of the base in the small paratype A.M.N.H. No. 27691/4:3 (fig. 18), but only to one-seventh or even less in the holotype (fig. 25) and in paratype A.M.N.H. No. 27691 (fig. 22). Thus, whereas the relative width of the umbilicus is about the same in specimens of both species measuring about 1 mm. in height, it tends to increase in *pusilla*, but to decrease in *brevispira*, later. This peculiarity may be due to the faster growth of the present species in width than in height, which increases the outer perimeter of the base more rapidly, thus reducing the relative width of the umbilicus. The fact that the spire is slightly sunk causes, at least in comparatively larger shells, the last suture to appear even deeper than in *S.* (*E.*) *pusilla*.

The characters of the aperture are the same in both species.

Growth striae cannot well be observed in any of the specimens present.

EARLY ONTOGENY: The nucleus, well observable only in paratype A.M.N.H. No. 27691 (figs. 12, 13), closely resembles that of *pusilla*. The same holds true for the embryonic and first post-embryonic volutions which in this species also exhibit more pronounced shoulders and steeper, less rounded lateral faces than the later ones. The apical bands, however, remain flat and well discernible through ontogeny (see, e.g., the holotype, figs. 24, 26), as only natural in view of the depressed shell shape and shortness of spire.

REMARKS: The differences separating this species from *S.* (*E.*) *pusilla*, pointed out in the

[1] Transitional to *S.* (*E.*) *pusilla*.

description, cause it to deviate more widely from *S.* (*E.*) *turbinea* than *pusilla* does. For a comparison of *brevispira* with *S.* (*E.*) *distincta*, see the discussion of that species.

Small juveniles of *S.* (*E.*) *brevispira* also closely resemble those of the genus *Guidonia*, chiefly of *G. planetecta*, with which they have the low spire in common. They can be distinguished, in addition to the differences used above for distinction of juveniles of *G. parvula* from those of *S.* (*E*). *pusilla*, by the lack of the fine revolving striation of the base present in *G. parvula* but not in *G. planetecta.*

Of all the Peruvian species of *Eosolariella*, *S.* (*E.*) *brevispira* most closely resembles *Anomphalus helicoides* (p. 78), with which it is associated in lot 86, but this latter form can be distinguished by greater width, lower, distinctly sunk spire, distinct though rounded shoulder of the body whorl, flattened base, and wider, "perspectivic" umbilicus.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. NOS.	NO. OF SPECIMENS
33	27691	1
48	27691/1	5
70	27691/2	4
78	27691/3	26
86	27691/4	17
	Total	53

Solariella (Eosolariella) distincta, new species

Plate 6, figures 23, 27–32

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27692/1:1	*ca.* 0.73 mm.	*ca.* 142½	*ca.* 15½	126°
27692:1	*ca.* 0.84	*ca.* 131	*ca.* 12½	125°
27692:2	*ca.* 0.90	*ca.* 131	*ca.* 10½	128°
27692/1:2 (syntype A)	*ca.* 0.90	*ca.* 131	*ca.* 19	123°
27692/1:3	*ca.* 0.95	*ca.* 123½	*ca.* 12	118°
27692:3	*ca.* 1.12	*ca.* 125	*ca.* 12½	126°
27692:4	*ca.* 1.18	*ca.* 143	*ca.* 14½	130°
27692:5 (syntype B)	*ca.* 1.23	*ca.* 127½	*ca.* 13½	125°
27692:6	*ca.* 1.29	*ca.* 126	*ca.* 13	121°
27692:7	*ca.* 1.40	*ca.* 128	*ca.* 12	125°

The measurements show a certain decrease of W with growth but are otherwise inconclusive as to growth trends, particularly in regard to h and π. The maximal and minimal values of W, h, and π are concentrated between the heights of 0.90 and 1.18 mm., that is, around the mean of 1.06½ mm. The minima of both W and π are found in one specimen (A.M.N.H. No. 27692/1:3), and their maxima in another (A.M.N.H. No. 27692:4).

SELECTION OF TYPES: Specimen A.M.N.H. No. 27692/1:2 exhibits the distinctive characters of this species best and is therefore designated syntype A. However, since its spire is extraordinarily high as compared with the average dimensions of the sample, a larger shell (A.M.N.H. No. 27692:5), the dimensions of which are more "typical," is designated syntype B.

DESCRIPTION: This species can best be described in a comparison with *S.* (*E.*) *pusilla* and *S.* (*E.*) *brevispira*. As indicated in the specific name, it is clearly distinct from both, sharing certain characters with each but combining them in its own way.

As shown in the dimensions, h ranges in *distincta* between approximately the same extremes as in *S.* (*E.*) *pusilla*, whereas in the ranges of W and π it comes much closer to *S.* (*E.*) *brevispira*. The greater relative height of the spire necessarily leaves less of the total height for the body whorl which is therefore even lower than in *brevispira*.

Thus an analysis of the dimensions of these three species fully confirms those characteristics which at first sight appear distinctive of *S.* (*E.*) *distincta:* a comparatively high, conical spire, somewhat sunk into the body whorl, and a rather low body whorl which, though also rounded in this species, exhibits a distinct, flat apical band even at the last observable stage and is flattened on the base. This flat, almost truncate character of the base is most pronounced in syntype A, where a distinct though rounded peripheral shoulder marks the boundary between it and the lateral face of the body whorl (figs. 27, 29).

That the base is lower than in *S.* (*E.*) *brevispira* can be seen best by comparing the apertural view of the holotype (fig. 26) with that of syntype B of *S.* (*E.*) *distincta* (fig. 32). Such comparison shows also that the above difference makes the aperture of *distincta* somewhat broader and lower than that of *brevispira*. In syntype A the depressed character of the body whorl even lends a transverse-elliptical rather than subcircular shape to the aperture (fig. 29). As in *S.* (*E.*)

brevispira, the faster growth of the shells in width than in height makes their apical and basal views distinctly elliptical (syntypes A and B; figs. 28, 31). Another feature which this species has in common with the preceding one is the remarkable depth of the last suture, caused by the fact that the spire is sunk; at least in syntype A, the apical face of the body whorl clearly rises above that suture (fig. 27). The width of the umbilicus measures more than one-fourth of the diameter of the base in syntype A (fig. 28), but only a little more than one-sixth in syntype B (fig. 31). In this species as in *brevispira*, but opposite to the trend observed in *S.* (*E.*) *pusilla*, the relative width of the umbilicus tends to decrease with growth, probably owing to the faster growth of the shell in width than in height. The above width of the umbilicus of syntype A of this species represents the maximum found in any species of this genus.

No growth striae could be studied in this species.

EARLY ONTOGENY: The nucleus can be seen in paratypes A.M.N.H. Nos. 27692:3 and 27692/1:3 (fig. 23) to project above the embryonic whorls and to be small and slightly eccentric, as in the two preceding species. The embryonic and early post-embryonic volutions also agree in their characters with those of *S.* (*E.*) *pusilla* and *S.* (*E.*) *brevispira*.

REMARKS: Specimens like syntype A, with a particularly wide umbilicus and a flattened base, considerably resemble *Anomphalus helicoides* (p. 78) in basal view, but the comparatively high, conical spire of the present species makes distinction easy.

Finally, the flattened base causes such specimens somewhat to resemble *?Ptychomphalina* sp. indet. 2 (p. 29), but the latter, in addition to having a slit band, differs by its more depressed shell shape, almost unbroken profile, more flattened base, and wider umbilicus.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	NO. OF SPECIMENS
78	27692	16
48	27692/1	3
	Total	19

SOLARIOCONULUS COSSMANN

This name was proposed by Cossmann (1918, p. 274) for a subgenus of his genus *Discordichilus*, based on the Silurian species *Trochus mollis* Lindström. Wenz (1938, p. 235) places *Discordichilus* in the Trochonematidae rather than in the Trochidae and lists *Solarioconulus* as a subgenus of Koken's (1896, p. 92; 1897, p. 59) genus *Tylotrochus*, which had been treated by Cossmann (1918, p. 275) as another subgenus of *Discordichilus*. It is, however, believed that *Solarioconulus* deserves generic status on an equal footing with *Tylotrochus* from which it differs in important characters. *T. konincki* (Hörnes, 1856, p. 29, pl. 3, fig. 3; Koken, 1896, p. 93; 1897, p. 60, pl. 11, figs. 1–3), designated the type species by Cossmann (*loc. cit.*), has a central depression of the base but no open umbilicus, and a distinct though not heavy, lattice-like ornamentation, whereas *S. nudus* (Münster; for synonymy, see below), selected by Cossmann as type species of *Solarioconulus*, is essentially smooth and has an open though narrow umbilicus. Furthermore it differs from Hörnes' afore-mentioned species by its characteristic shell shape, termed "solariiform" by Cossman. Thus *Solarioconulus* is here treated as an independent genus coordinate with *Tylotrochus*, as it was by Cossmann, rather than subordinate to the latter genus, as it was by Wenz.

In addition to three small shells which are doubtfully referred to the type species, *S. nudus*, three species of this genus are distinguished within the Peruvian material. However, although represented by four different forms, it reaches a total of only 32 individuals and is thus far less common than *Solariella*.

Solarioconulus ?nudus (Münster)

Plate 6, figures 20, 33–35

?Trochus nudus; MÜNSTER, 1841, p. 108, pl. 11, fig. 21.

?Trochus subdecussatus; MÜNSTER, 1841, p. 108, pl. 11, fig. 20.

?Trochus nudus Münster; LAUBE, 1869, p. 35, pl. 34, fig. 1.

?Trochus subdecussatus Münster; LAUBE, 1869, p. 33, pl. 33, fig. 9.

?Trochus nudus Münster; KITTL, 1891, p. 249, *cum synon.*, pl. 6, fig. 29, pl. 7, figs. 1–4.

?Discordichilus (*Solarioconulus*) *nudus* Münster; KUTASSY, 1937, p. 46, pl. 1, figs. 89, 90.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27528:1[1]	*ca.* 1.68 mm.[2]	*ca.* 103½	*ca.* 26½	*ca.* 106°[3]
27528:2	*ca.* 3.15[2]	*ca.* 84	*ca.* 21[2]	82°[3]

DESCRIPTION: These two specimens from lot 48 supplement each other very well. The smaller one (no. 1, fig. 20) has the body whorl badly crushed from beneath, a fact that thoroughly distorts its dimensions, but the spire is fully preserved. The larger one (no. 2) has only the body whorl and a little more than one-half of the penultimate whorl preserved. Specimen number 1, which attains only a little more than half the size of number 2, consists of five and a half volutions.

The profiles of both these shells are characterized by the well-marked though rounded upper shoulders of the whorls. The apical bands slope only gently in the earlier ones and become almost horizontal in the body whorls, whereas the lateral faces slope steeply, in the penultimate volution of the larger specimen almost perpendicularly. In the body whorl of the larger specimen a peripheral shoulder becomes ever more pronounced towards its anterior end the more flatly the lateral face of this whorl, still almost vertical at its beginning, slopes towards the shoulder. The body whorl of the smaller specimen shows an indication of a similar development but becomes too much deformed in the anterior part to permit any worthwhile observation. In the undistorted larger specimen the base is convex and rather high. In both shells it is perforated by an open umbilicus measuring about one-fifth of the diameter of the base in width. The aperture is well preserved in specimen number 2 (fig. 35); it is subcircular, with an angulation at its upper end and a slight truncation at the bottom; the inner lip is slightly and thinly reflexed.

Growth striae can be recognized on the body whorl (figs. 33, 35). They run rather steeply obliquely backward on the lateral face, then form a wide forward concave arc with its apex on the peripheral edge, and assume on the base a nearly radial direction. They are most distinct, and produce fine beads, on the upper shoulder.

EARLIEST ONTOGENETIC STAGES: In the smaller shell, with spire preserved, the embryonic volutions seem to be a little inclined towards the axis of the shell.

An extremely poorly preserved and very incomplete speicmen from lot 86 (A.M.N.H. No. 27528/1) of approximately the same size as A.M.N.H. No. 27528:1 greatly resembles the shells from lot 48 just described and may tentatively be considered conspecific.

REMARKS: In shell shape our specimens agree fairly well with Münster's holotype which is, however, corroded and deformed according to Kittl. The feature that characterizes the present form best within the forms from Peru referred to this genus, namely, the graduated shell profile, is well recognizable in Kittl's (*loc. cit.*, in synon.) figures 3 and 4 and in the larger of two topotypes of *S. nudus* in the Yale collection, but it does not show so well in Kittl's figure 29 nor in Laube's illustrations, quoted in the synonymy. The shells from lot 48 agree in profile best with Kittl's "obtuse variety" (his fig. 4) and in dimensions (if allowance is made for the deformation of our specimen number 2) with his "pointed variety" (his fig. 3). Since only a close reëxamination of the originals of Münster's, Laube's, and Kittl's illustrations could reliably show whether or not the characteristics of the Peruvian form are present in the true *Trochus nudus* Münster, our specimens are here only tentatively referred to this species.

Solarioconulus ?nudus (Münster) is compared with *S. elegans*, *ninacacanus*, and *infrequens* in the discussions of those species.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27528	2
86	27528/1	1 (doubtful)
	Total	3

[1] Badly crushed from beneath.

[2] Estimated.

[3] Measured from penultimate whorl up, π amounts to only 85 degrees.

Solarioconulus elegans, new species

Plate 6, figures 36–39, 41, 42

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27529:1	*ca.* 3.15 mm.	*ca.* 89½	*ca.* 29	64°
27529:2	*ca.* 3.73[1]	*ca.* 79	*ca.* 33½[1]	55°
27529:3	*ca.* 4.23	*ca.* 82½[2]	*ca.* 29½	71°[2]
27529:4	*ca.* 5.04	*ca.* 80½	*ca.* 29½	66°
27529:5 (holotype)	6.03	87½	30½	69°
27529:6	*ca.* 6.40	*ca.* 79	*ca.* 34½[3]	70°

The only trend that might be derived from the table is the increase of the pleural angle with growth, obviously due to the ever stronger development of the upper shoulder.

SELECTION OF TYPE: The best-preserved and second largest specimen (no. 5) is designated holotype.

DESCRIPTION: Shell, consisting of up to seven volutions (including the embryonic ones), trochiform and slightly graduated in profile, with shallowly engraved sutures. Most characteristic of this species is the whorl profile (figs. 36, 38). An apical band slopes at an angle of about 45 degrees to a well-rounded shoulder connecting it with the lateral whorl face, which is considerably steeper (gradient about 70°) and about twice as high. It is separated from the base by the peripheral shoulder which is marked by a strongly projecting and comparatively heavy keel. Above the keel, which can be seen in the body whorl only, the lateral face is slightly concave. The base is truncate and gently convex; its center is occupied by the open umbilicus of which the diameter in the holotype is somewhat more than one-fifth of that of the base. It is surrounded by a well-rounded edge. The aperture is obliquely subquadratic in outline, with a blunt angulation at its upper end and a pointed corner caused by the peripheral keel. Both lips are thin; neither seems to be completely preserved in the holotype. However, the upper part of the inner lip can be seen in the holotype, and much better in paratypes numbers 1, 2 and 4, to be more or less widely reflexed over the umbilical opening (fig. 41).

Rather coarse growth striae and folds can be observed in most specimens present, best in the holotype and in the body whorl fragment number 7 (figs. 36, 38, 39). They run from the suture at an angle of about 45 degrees backward to the upper shoulder, from there somewhat more steeply to the peripheral keel. After crossing the latter without any marked deflection, they run, on the base, in a shallow forward concave arc radially towards the umbilicus. The medium-sized, crushed individual number 8 is distinguished by a particularly fine and dense growth striation.

EARLIEST ONTOGENETIC STAGES: In the holotype the nucleus can be seen to be eccentric. In the crippled specimen number 6 the embryonic volutions seem to be slightly alloiostrophic, but this may be due merely to distortion.

REMARKS: From the type species of this genus, *S. nudus*, including the Peruvian specimens doubtfully referred to it above, as well as from the two following species the present one is readily distinguished by the pronounced keel marking the peripheral edge of the body whorl and by the slight concavity above that keel. A similarly sharp peripheral edge, which, however, does not seem to carry a true keel, can be seen in the single shell from St. Cassian on which Kittl (1891, p. 249, pl. 6, fig. 28) founded his *Trochus toulai*, but that specimen, with its strongly convex body whorl, its much more truncate base, and its umbilicus, which according to Kittl is "reduced to a narrow cleft," is otherwise quite different from *S. elegans* and cannot be considered conspecific.

Solarioconulus ninacacanus and *S. infrequens* are compared below.

OCCURRENCE: Represented in lot 86 only by 10 specimens, including fragments (A.M.N.H. No. 27529).

Solarioconulus ninacacanus, new species

Plate 6, figures 40, 43–50, 54, 55

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27530:1[4]	*ca.* 1.65 mm.	*ca.* 88	*ca.* 20½	75°
27530:7[4]	*ca.* 1.96	*ca.* 80	*ca.* 20	72°
27530:2	*ca.* 2.02	*ca.* 86	*ca.* 25	78°

[1] Estimated.
[2] Crushed.
[3] Spire distorted.
[4] Omitting attached parts of following whorls.

A.M.N.H. Nos.	H	W	h	π
27530:3	*ca.* 3.32	*ca.* 72½	*ca.* 32½	66°
27530:4 (syntype A)	*ca.* 6.15	*ca.* 84	*ca.* 34	72°
27530:5 (syntype B)	*ca.* 9.22[1]	*ca.* 77½	*ca.* 26½[1]	59°
27530:6	*ca.* 13.65	*ca.* 72[1]	*ca.* 27	62°

The table certainly shows a general trend of both W and π to decrease with growth, whereas h increases only up to medium size, then decreases.

SELECTION OF TYPES: The well-preserved specimen number 5 is selected for syntype B. Since the apex is missing, specimen number 4, in which it is complete, is designated syntype A.

DESCRIPTION: This form is undoubtedly closely related to *elegans* but differs too markedly to be considered conspecific. It is best described by pointing out these differences.

The shell, which in syntype A consists of altogether seven and a half volutions, is trochiform, but there is an essential difference in the profile of the whorls which are separated from each other by channeled sutures. There is only a narrow subsutural ledge ("Nahtfacette" Kittl, "rampe" Cossmann), hardly deserving the name of an apical band and observable only where preservation is favorable, for example, in syntype A (fig. 50). From this ledge the whorl profile changes by way of a well-rounded, high shoulder quite gradually into the steeply conical lateral face which slopes at angles of from 70 to 80 degrees. It is separated, in this species also, by a more or less pronounced peripheral edge from the base, but even where this edge is quite sharp, as it is in syntype A (figs. 47–49) and in paratypes numbers 9 and 10, it does not carry a keel as in *S. elegans*, nor is there ever the slight concavity observable in that species above that keel. Rather the profile of the body whorl is convex down to the boundary of the base (figs. 44, 46–49, 55). As a rule, the peripheral edge is visible only in the body whorl, but occasionally, as in syntype B (fig. 44), also in the penultimate one. The base is comparatively high and convex as in *elegans*, but the umbilicus is narrower; it measures only about one-sixth of the width of the base in diameter and is to a much larger extent concealed by the widely reflexed inner lip (both syntypes; figs. 40, 45). The aperture resembles that of *S. elegans;* its outline varies from subquadratic as in syntype A (fig. 48), to subcircular as in syntype B (fig. 46). In the former the peripheral edge, although not accentuated by a keel, is so pronounced as to be recognizable in apertural view as a distinct thickening of the outer lip.

The only ornamentation present consists of coarse growth folds, observable best in both syntypes and in paratypes numbers 3, 8 (fig. 54), and 11. From 12 to 15 of these folds as a rule can be counted per half whorl, but they are by no means uniform, coarser and weaker ones alternating quite irregularly. In syntype A this growth striation is markedly finer and denser than in the other individuals mentioned above (fig. 49). In the fragment A.M.N.H. No. 27530:8 the number of growth folds on the base, owing to intercalation of weaker ones, is almost twice that on the lateral whorl face. They run steeply obliquely backward from the upper suture down to the peripheral edge. In crossing the latter, they produce in some shells (paratype number 11 and syntype B; figs. 55, 44), quite heavy though blunt nodes. Then they run on the base in a radial, more or less straight direction, gradually vanishing, towards the umbilicus.

EARLIEST ONTOGENETIC STAGES: In both paratype number 2 and syntype A (figs. 43, 50) the nucleus can be seen to occupy a somewhat eccentric site and the embryonic volutions to be slightly inclined towards the axis of the shell.

REMARKS: Lacking a keel on the otherwise pronounced peripheral edge and having a narrower umbilicus, concealed to a wide extent by the reflexed inner lip, this species approaches *S. toulai* (Kittl; for reference, see above, p. 95) more closely than *elegans*, but it is also readily distinguishable from Kittl's specimen by its higher, convex base, which is not so truncate, and by its markedly narrower pleural angle. Another Kittl species which *S. ninacacanus* closely resembles is *S. lissochilus* (Kittl, 1891, p. 248, pl. 6, fig. 26), previously described by Laube (1869, p. 36, pl. 34, fig. 2) under the name *Trochus des-*

[1] Estimated.

longchampsi Klipstein. The present species differs, however, from this St. Cassian form by its higher body whorl and base, and from the single specimen for which Kittl (1891, p. 248, pl. 6, fig. 27) established his *Trochus funiculosus*, but which differs from *S. lissochilus* merely in the peculiar twin keel surrounding its umbilicus, by lacking such a keel.

From *S. nudus* this species differs by its more slender shell shape and by the lack of a distinct apical whorl face; therefore, its shell profile is much less gradate, if at all, than in the Peruvian specimens tentatively referred to the type species.

For a comparison with *S. infrequens*, see that species.

OCCURRENCE: Rare; occurs in lot 86 only, where it is represented by 15 specimens, including fragments (A.M.N.H. No. 27530).

Solarioconulus infrequens, new species

Plate 6, figures 51–53, 56, 57

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27531:1 (syntype A)	*ca.* 5.04 mm.	*ca.* 63½	*ca.* 34	58°
27531:2	*ca.* 8.49[1]	*ca.* 69½	*ca.* 29[1]	55°
27531:3 (syntype B)	*ca.* 9.47[1]	*ca.* 65½	*ca.* 35[1]	48°

From the table it can be seen that the pleural angle steadily decreases with growth.

SELECTION OF TYPES: In this species, too, the largest, otherwise well-preserved specimen (no. 3) lacks the upper part of the spire; therefore, specimen number 1, which has the apex completely preserved, is selected for syntype A. Specimen number 3 is made syntype B.

DESCRIPTION: *Solarioconulus infrequens* can be described best by comparing it with *S. ninacacanus*.

Solarioconulus infrequens, otherwise closely resembling *ninacacanus*, is markedly more slender and has a higher spire and, accordingly, a considerably more acute pleural angle. The height and slenderness of the spire can well be seen in the smallest and only complete specimen (syntype A; figs. 56, 57). Here its contrast with the large, somewhat gibbous body whorl causes the shell profile to appear slightly convexo-concave. The peripheral shoulder is quite rounded in this species and thus, though recognizable, much less pronounced than in *S. ninacacanus* or *S. elegans*. Except for this essential difference the whorl profile is about as in *ninacacanus*.

Solarioconulus infrequens is further distinguished by a retardation at later growth stages of the increase of the shell in width. As seen in figure 51, the body whorl of syntype B is not so much wider at its anterior end than at the posterior one as it should be in accordance with the over-all size increase of the shell.

Including the embryonic volutions, seven and a half volutions can be counted in syntype A. In syntype B, which when complete must have been almost twice as large, the number can be assumed to have been eight or nine. The base is less truncate and seems to be somewhat higher than in *S. ninacacanus*. The aperture is subcircular in all specimens present, since there is no pronounced peripheral edge that would produce an angularity at its lower right. The umbilicus measures about one-sixth of the width of the base in diameter, and a considerable part of it is concealed by the widely reflexed inner lip.

As can best be seen in syntype B (figs. 51, 53), there are growth folds of the same course and coarseness and in about the same density as in *ninacacanus* but since there is no pronounced edge, they fail to produce peripheral nodes.

EARLIEST ONTOGENETIC STAGES: Of the four individuals referred to this species only syntype A has the apex preserved; a slight inclination of the embryonic volutions can be recognized (fig. 57).

REMARKS: The lack of a pronounced peripheral edge in *S. infrequens* accounts for a remarkable similarity to *Heterospira simulatrix* (p. 180), but this latter species can be recognized to differ by its more convex whorl profile, especially the large, ventricose body whorl which shows no indication of a peripheral shoulder, the narrower umbilicus, and the much denser, finer, more regular, and slightly sigmoidal growth striation. Comparison of the shell shapes of the holotype of

[1] Estimated.

Heterospira simulatrix (pl. 11, figs. 15, 16) and of syntype A of *Solarioconulus infrequens* (figs. 56, 57) gives a good example of convergence within a fauna.

OCCURRENCE: Very rare; found only in lot 86, where it is represented by only four individuals (A.M.N.H. No. 27531).

CALLOTROCHUS KUTASSY

The name *Mesotrochus*, proposed for *M. triadicus* by Kutassy (1927, p. 151) originally as a subgeneric one under *Trochus*, turned out to be preoccupied and was therefore replaced by its author (*in* Wenz, 1938, p. 280) by *Callotrochus*. The latter is here granted generic rank, as it is by Wenz (*loc. cit.*).

This genus is represented in the material under study by only a few poorly preserved specimens.

Callotrochus sp. indet.

Plate 6, figures 58, 59

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27532:1	*ca.* 2.74 mm.[1]	*ca.* 85½	*ca.* 20½	82°
27532:2	*ca.* 3.73[1]	*ca.* 73½	*ca.* 28	61°

Except in measuring the pleural angles, the preserved parts of the body whorls have been omitted from the above measurements.

The smaller of the two specimens from lot 86 (no. 1) is so much stouter and has such a wider pleural angle and lower spire than the larger (no. 2) that the two might be considered as belonging to different species. Since, however, only the generic characters are of interest, they are here described and discussed together.

DESCRIPTION: Shell shape more or less flatly conical, with rather high, slightly concave base. The specimens examined may, when complete, have consisted of from four to five volutions, but only a small part of the last volution is preserved in both. Sutures shallow. At earlier stages a gently sloping apical face and a considerably steeper lateral one, with an indistinct shoulder between, can be distinguished in the whorl profile. Later, however, this shoulder disappears and finally the whorl profile tends to become slightly concave. As far as the aperture can be observed (fig. 59), it agrees in shape with that of *C. triadicus*, as illustrated in Kutassy (1927, fig. 76). The columella is somewhat sinuous, rather thick, and, in both shells examined, thinly perforated.

About five blunt, broad folds per quarter whorl can be seen to run obliquely backward across the penultimate and antepenultimate volutions of the larger specimen (fig. 58).

They can also be recognized on the preserved uppermost portion of the body whorl. On the badly corroded smaller specimen all that can be seen of this sculpture is one blunt node in the lower half of the antepenultimate whorl immediately above the suture.

The earliest ontogenetic stages are not preserved in either specimen.

REMARKS: Shell shape, lack of an umbilicus, and the ornamentation seem to justify reference of these specimens to Kutassy's rare genus, hitherto represented by the only specimen of the type species, *C. triadicus* from the Norian Dachstein limestone near Budapest (Kutassy, 1927, p. 152, pl. 5, fig. 7).

The material present is too poor for specific identification, and it can therefore not even be decided if one of the specimens, or both, might be considered conspecific with Kutassy's type which is about 10 times their size. They do not call for comparison with any other form in the Peruvian material.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27532	2
53	—	2 (lost)
	Total	4

CALLIOSTOMA[2] SWAINSON

Cox' (1949, p. 41) generic reference of a single small trochid from Hacienda Huanca to the above genus is believed to be well founded.

[1] Estimated.

[2] Despite Cossmann's (1918, p. 287) plea for the spelling "*Callistoma*," as proposed by Hermannsen (1846), Swainson's original spelling is here followed, as t was by Wenz (1938, p. 281).

Thus the two similar though not conspecific forms described below are here also referred to *Calliostoma*, as is Körner's "*Trochus* (*Tectus*)? n. sp. ind." from the Nevado de Acrotambo which undoubtedly belongs to the same genus and is perhaps conspecific with the form from lot 86 described below.

Cox bases the generic reference of his *C. interruptum* on "its apertural characters, notably the presence of the basal columellar tubercle, [which] are those of *Calliostoma s. lat.*" Cox seems to be of the opinion, arrived at by present writer also, that the forms from the Peruvian Triassic cannot well be placed in any of the many subgenera distinguished within *Calliostoma*, *sensu lato* (see Wenz, 1938, pp. 281–284), of which the hitherto known earliest occurrence is in the Lower Cretaceous.

EOCALLIOSTOMA, NEW SUBGENUS

The above-mentioned difficulties suggest the establishment of this new subgenus for the much older Peruvian forms.

DIAGNOSIS: Small trochids of the genus *Calliostoma*, *sensu lato*, with very shallowly engraved sutures and heavy transverse ribs which mostly tend in maturity to dissolve into subsutural and supersutural tubercles. The rows of these tubercles leave a more or less depressed middle zone of the whorl between them. Thus the costal whorl profile may become concave in maturity.

TYPE SPECIES: *Calliostoma interruptum* Cox (1949, p. 40, pl. 2, fig. 20).

Körner's above-mentioned form, here renamed **C. (E.) körneri,** new name, is not umbilicate, as Cox (1949, p. 4) assumes. Körner, in his description (1937, p. 211), tentatively calls the umbilicus "sehr eng, aber scheinbar offen." However, his figure 2c (enlarged six times) seems to refute his assumption, as it shows a hole in the umbilical callus but no true umbilical opening. Otherwise his description of the umbilical region seems to confirm that his shell agrees in these characters, as in others, with Cox' species and with the forms described below. It differs, however, from the former, in which the base is smooth, by the spiral ornamentation of the base.

Calliostoma (Eocalliostoma) concavum, new species

Plate 6, figures 60, 62–66

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26518:1	2.0 mm.	92½	53	50°
26518:2	?	?	?	52°
26518:3 (holotype)	3.0	80	41	?55°

SELECTION OF TYPE: The largest among the more or less complete shells present, which shows the mature stage best (specimen A.M.N.H. No. 26518:3), is designated holotype.

DESCRIPTION: Shell, consisting of up to four volutions, conical, with almost imperceptibly engraved sutures and decidedly truncate base, which is separated by a distinct edge from the rest of the conch. The intercostal whorl profile is flat in the earlier volutions but slightly concave in the body whorl of the holotype. The columella is thick and imperforate. The shape of the aperture is like a semicircle erected over an almost flat base line which slopes slightly to the right. The outer lip is not preserved in any specimen, the inner one is broadly thickened, with ridges on either side and a crescent-shaped, moderately deep notch between them which is widest near the lower end and simulates an umbilical niche. The two ridges converge downward to form the swelling characteristic of this genus, which, as Cox says in his species description, almost forms a rounded tubercle. In the present species this prominence is unfortunately not completely preserved in any of the specimens examined, but its presence is clearly indicated in both apertural and basal views of the holotype (figs. 66, 60). In an otherwise poorly preserved small fragment (paratype 4) only a faint and shallow umbilical niche can be recognized beyond the ridge bordering the columellar lip on its outer side.

The transverse ornamentation is dominant. It consists in the first post-nuclear whorls of 10 ribs which run in a more or less oblique backward direction straight over the whorl face. On the penultimate whorl of the holo-

type both the upper and lower ends of these ribs are thickened to form blunt tubercles. In the anterior half of this whorl (the posterior half is damaged) the middle sections of these ribs have almost disappeared and the tubercles have greatly increased in prominence, thus causing the costal profile to appear deeply concave. This feature is alluded to in the specific name. The tubercles of the lower row are markedly heavier and more distinctly elongated in the direction of the ribs than those of the upper row which are rounder and smaller (fig. 65). The lower tubercles in basal view lend a scalloped appearance to the periphery (fig. 60). A fine and dense growth striation runs over the spire parallel to the ribs. These growth striae assume a more or less radial direction on the base.

No trace of revolving ornamentation is found, but about five fine denticulations, indicating the presence of a revolving striation, can be recognized on some of the ribs of the penultimate whorl of the holotype.

EARLIEST ONTOGENETIC STAGES: As seen in the holotype (fig. 66), the nucleus is rounded, almost hemispherical, and the embryonic volutions are strongly alloiostrophic. The two nuclear volutions are round in profile and smooth.

REMARKS: The type species of this subgenus, *C. (E.) interruptum* Cox, differs from the present one in the markedly greater density of its transverse ornamentation, of which the elements are accordingly less heavy. In *C. (E.) körneri* (see p. 99) the transverse sculpture is also denser than in *C. (E.) concavum*, although less dense and heavier than in Cox' species, and the transverse folds do not, even at a considerably larger size, develop subsutural and supersutural tubercles. Thus the costal whorl profile is straight, not concave as in the present species, which also lacks the revolving ornamentation of the base present in *C. (E.) körneri*.

Another trochid of which the shell profile and transverse ornamentation somewhat resemble those of the present species is *Turcicula costellata* Koken (1897, p. 57, pl. 19, figs. 11, 12) from the Hallstatt limestones. It differs in being of considerably greater size and having a fine perforation of the columella and a higher, less truncate base which carries three quite pronounced revolving keels.

Finally the material dealt with in the present report includes two forms which, although sinistral and belonging to another family, the Cirridae, show a certain similarity in shell shape and ornamentation with this species. They are *Sororcula costata* and, to a lesser degree, *S. gracilis* and are both associated in lot 26 with *C. (E.) concavum*. The development of tubercles at both ends of the ribs and the concavity of the mature whorl profile thus produced, with about the same density of costation, account for the similarity in ornamentation. However, the apical angle is much more obtuse in the present species, and, more important, its embryonic characters are quite different from those distinctive of *Sororcula* and of the Hesperocirrinae in general, and its columella is solid, whereas it is hollow in *Sororcula*.

OCCURRENCE: In lot 26 only, where it is represented by three more or less complete shells and five fragments, two of them doubtful; altogether eight specimens (A.M.N.H. No. 26518).

Calliostoma (Eocalliostoma) ?körneri Haas

?Trochus (Tectus)? n. sp. ind.; KÖRNER, 1937, p. 210, pl. 14, fig. 2 (renamed *C. (E.) körneri* above).

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27695	2.46 mm.	52½/70½	29½	38°/55°

As this shell was badly crushed, both width and pleural angle were measured in apertural view, in which the conch appears most slender, and at an angle of 90 degrees to this position, in which it appears widest. The correct values may roughly correspond to the means of those given above.

DESCRIPTION: The conch, consisting of four or five volutions, is conical; the flat, oblique base is separated by a distinct but blunt peripheral edge from the lateral face of the last whorl. The outline of the shell profile is almost continuous and only little interrupted by the shallow sutures.

The aperture before having been crushed may have resembled that of *C. (E.) concavum*.

As the surface is very worn, rather heavy

transverse folds can be recognized only here and there; their number per whorl cannot even be estimated. Only one revolving ridge can indistinctly be recognized on the base, somewhat nearer to the center than to the periphery.

REMARKS: This poorly preserved shell somewhat resembles in shape Körner's from the Nevado de Acrotambo, but its preservation does not allow full identification. From both *C.* (*E.*) *interruptum* Cox and *concavum* it deviates in the same ways as Körner's form.

OCCURRENCE: A single specimen in lot 86 (A.M.N.H. No. 27695).

AMPHITROCHUS Cossmann

This genus, established by Cossmann in 1907 and unnecessarily renamed *Amphitrochilia* by him in 1909 (see Cossmann, 1918, p. 298), is believed to be represented in our material by two small shell fragments in lot 26 exhibiting its characteristic ornamentation, as seen best in the type species *A. duplicatus* Sowerby (see d'Orbigny, 1850–1855, p. 275, pl. 313, figs. 5–8). It is characterized, in the spiral whorls, by keel-like subsutural and supersutural rows of tubercles. In the body whorl the lower one of these is followed by another which marks the periphery so that there is a heavily beaded twin keel (see also Hudleston, 1894, p. 373, pl. 31, fig. 10).

As mentioned above, two Hallstatt species, "*Solariella*" *aspera* Koken and "*S.*" *trochiformis* Koken (1897, p. 58, text fig. 10, pl. 10, figs. 13, 14), are believed by Cossmann (1918, p. 300) most probably to belong to the present genus, and the same may hold true for "*Solariella*" *nodifera* Kutassy (1927, p. 164, pl. 6, fig. 5) from the Norian Dachstein limestone near Budapest. However, these three species carry only a single nodose keel rather than twin keels at the periphery. Should they really be referable to *Amphitrochus*, the fragments here dealt with would not represent the first known occurrence of this genus in the late Triassic.

Amphitrochus sp. indet.

Plate 6, figures 67, 68, 70, 71

DESCRIPTION: Both small shell fragments under study seem to belong to specimens nearly 10 mm. wide; their height cannot even be estimated. They are obviously from different specimens which are perhaps not even conspecific. Since only the generic characters are of interest, both fragments are dealt with together.

Both consist of a part of the outer zone of a decidedly truncate, nearly flat base and of the lower zone of the body whorl. In fragment number 1 a small portion of the upper zone of the lateral face is also preserved. The lateral face and the base meet at angles of about 75 degrees in fragment number 1 and of nearly 90 degrees in fragment number 2. In the former, the whorl profile is concave above the tuberculated twin keels.

Both fragments exhibit two rows of tubercles which are heavier in number 1 than in number 2; there are five of these tubercles to a quarter whorl in the first fragment and six in the second. Those of the upper row are connected by short ribs, which run steeply obliquely backward, with the corresponding ones of the lower row. On the other hand the tubercles of each row are interconnected by a keel which is, of course, markedly less prominent between the tubercles than are the tubercles themselves. The small portion of the lateral face above these twin keels which is preserved in fragment number 1 appears to be smooth. In basal view fine but distinct foldlets or growth striae, about four to every tubercle, can be seen to run strongly obliquely backward from the periphery into the outer zone of the base but not beyond it. In fragment number 1 the outermost ends of these foldlets lend a crenulated appearance to the lower of the twin keels.

REMARKS: Reference of these two fragments to the genus *Amphitrochus* is based on these ornamentational details. They are so unique in the present material that no other Peruvian form comes into consideration for comparison.

OCCURRENCE: Two small fragments in lot 26 (A.M.N.H. No. 27533).

TURBINIDAE

EUCYCLOSCALA Cossmann

Certain St. Cassian species described under the generic name *Scalaria*[1] by Laube and by

[1] Even where applicable, "*Scalaria*" would have to be replaced by "*Scala*" (see Wenz, 1940, p. 806).

Kittl (1892, p. 45) were later included by Cossmann (1895c, p. 742) in his *Eucycloscala*, with the approval of Koken (1897, p. 64) and Kittl (1899, p. 23).

Eucycloscala pascoensis, new species

Plate 6, figures 61, 69, 72–76

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26510:1	3.65 mm.	79	50	58°
26510:2 (holotype)	*ca.* 4.0	*ca.* 82	56	60°
26510/1:1	4.9	85	56	63°

The incomplete body whorl A.M.N.H. No. 26510/2 attains about 5 mm. in width and, as preserved, 3.6 mm. in height.

From the table it can be seen that W, h, and π all increase with growth.

DESCRIPTION: Shell turbiniform, rather sturdy, with deeply channeled sutures, consisting of up to four strongly convex volutions of which the profile is first rounded, then as the ornamentation develops becomes angular. The apical band appears in profile as a long, gentle slope. The lateral band is rather short and sharply separated by keels from both the apical band and the gently conical base. The greatest width of the conch is marked by the lowest of the three tuberculate keels in the largest shell present (A.M.N.H. No. 26510/2; figs. 75, 76) and in a fragment from lot 33 (A.M.N.H. No. 26510/1:3; fig. 69), but by the middle one in the largest specimen but one (A.M.N.H. No. 26510/1:1; fig. 74), and in the smallest fragment from the same lot (A.M.N.H. No. 26510/1:4). In the holotype and the other shell from lot 26 (A.M.N.H. No. 26510:1) the two lower tuberculate keels project about equally. There is no umbilicus. A shallow umbilical niche can be recognized only in specimen A.M.N.H. No. 26510/1:3 between the innermost keel of the base and the columella. The aperture also can best be studied in this specimen (fig. 69); it is almost circular, with a slanted upper external margin. The inner lip is thickened and somewhat reflexed over the columella. In the older shells the test of the basal part of the body whorl is markedly thickened, thus causing the aperture to assume a somewhat straitened aspect (see Kittl, 1892, pl. 5, fig. 32, of an individual of *E. binodosa*).

ORNAMENTATION: There are three strong revolving keels above the suture. The uppermost is somewhat below (or in the largest shell present slightly above) the middle of the apical whorl face and two are on the lateral face. They are about equally distant from one another, but the uppermost is markedly weaker than the others and hardly recognizable in the smallest specimen examined. The two lower keels are about equally strong, but in the most anterior part of the holotype the middle of these three keels becomes sharp and more prominent than the lower one (fig. 73). These three might be called the tuberculate keels, because they carry strong and sharp tubercles where they are crossed by the strong, transverse ribs which run obliquely backward all over the apical and lateral parts of the later whorls from suture to suture. They blunt off, however, after crossing the lowermost tuberculate keel and end abruptly at the keel separating the base from the lateral part of the whorl. Nine such transverse ribs can be counted per whorl in the holotype and in specimen A.M.N.H. No. 26510:1, 10 per whorl in the second largest shell present (A.M.N.H. No. 26510/1:1), and four on a third of the body whorl of the largest one (A.M.N.H. No. 26510/2).

The revolving keel separating the lateral band of the whorl from the base corresponds in site exactly to the suture, is the first nontuberculate keel and simultaneously the only one in the two smallest specimens present (A.M.N.H. No. 26510:1, 2). There is one more in the medium-sized shell A.M.N.H. No. 26510/1:1, and there are two more, i.e., altogether three, such basal keels in the fragments A.M.N.H. No. 26510/1:3 and A.M.N.H. No. 26510/2. Especially in the last, they are particularly heavy and reminiscent of those illustrated in Kittl (1892, pl. 5, fig. 29 of *E. elegans*, fig. 30 of *E. binodosa*) or in Laube (1868, pl. 23, fig. 1 of *E. binodosa*).

Neither growth nor revolving striation could be observed with any certainty in any of the specimens examined.

The earliest ontogenetic stages can be studied in the holotype (fig. 73). There is no

planospiral stage, but the bubble-shaped nucleus is rather high. The first two whorls are well rounded and smooth. Only then does ornamentation set in, first the revolving one, later the transverse one. (Körner, 1937, p. 210, reports the opposite sequence for his "*E.* cf. *elegans*.")

REMARKS: This interesting form comes fairly close to the only *Eucycloscala* hitherto recorded from the Triassic of Peru, Körner's (1937, p. 210, pl. 14, fig. 1) "*E.* cf. *elegans*," and to the well-known *E. binodosa* (Münster) from St. Cassian (Kittl, 1892, p. 49, *cum synon.*, pl. 5, figs. 30–32).[1] It is, however, clearly distinct from both and is believed to be a species worth naming, especially since it is represented, though scarce, in three different localities.

Körner's form from the Nevado de Acrotambo is also believed to deserve a specific name; **E. körneri,** new name, is herewith proposed. Although more slender and pointed than ours, it resembles it closely in shell shape and more so in whorl profile, but it differs essentially in ornamentation, having about twice as many transverse ribs (17–19 per whorl, as compared to 9–12) and base keels (4–6, as compared to 1–3); the latter are, however, much finer in *E. körneri.* Also there are only two tuberculate keels, as compared to three in *E. pascoensis.* I do not agree with Körner in putting his form in a closer relationship to *E. elegans* (Münster) than to *E. binodosa.* I believe that his form, as ours, approaches in its deeply channeled sutures much more the latter species than the former, the shell profile of which is almost continuously conical (see Laube, 1870, pl. 31, fig. 12 [stated to be excellent by Kittl, 1892, p. 49]; Kittl, 1892, pl. 5, figs. 28–29). The density of transverse ornamentation is considered less decisive.

Eucycloscala pascoensis is also believed to be closely related to *E. binodosa,* from which it differs most conspicuously by its sturdier shell shape, lower spire, and accordingly wider pleural angle. In all these respects, however, the St. Cassian specimen erroneously described and figured as *Trochus subcostatus* Münster by Laube (1870, p. 35, pl. 33, fig. 12), but proved by Kittl (1892, p. 49) to belong to *E. binodosa,* comes very close to the present species, from which it differs mostly by its denser transverse costation and by having, as have the typical representatives of *E. binodosa,* only two tuberculate keels instead of three. Otherwise both species are rather similar in ornamentation. Even the sharp tubercles at the crossing points of the revolving keels and transverse ribs as present in *E. pascoensis,* although not explicitly mentioned in Kittl (1892, p. 49, redescription of *E. binodosa*) show clearly in Laube (1868, pl. 33, fig. 12) as well as in some of many specimens from St. Cassian identified by Kittl himself as *E. binodosa,* in the collections of Peabody Museum of Yale University.

Eucycloscala is so distinctive a genus that the form under discussion requires no comparison with any forms referred to other genera in the present study. The only other *Eucycloscala* here dealt with is compared below.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26510	2
33	26510/1	5
No. 49[2]	26510/2	1
56	26510/3	1
78	26510/4	1 (doubtful)
	Total (including fragments)	10

Eucycloscala cf. baltzeri
(Klipstein, MS) (Kittl)

Plate 6, figure 77

Cf. *Scalaria Baltzeri* Klipstein sp.; KITTL, 1892, p. 52, pl. 5, figs. 45, 46.

DESCRIPTION: A spire fragment, consisting of more than three volutions and attaining 3.8 mm. in height and 2.6 mm. in width and exhibiting a pleural angle of 63 degrees, deviates from *E. pascoensis* by its much less deeply channeled sutures. This difference accounts for the less convex profile of the whorls

[1] The striking resemblance is notable, at least in side view, between Münster's species and "*Turbo*" *licas* d'Orbigny (1850–1855, p. 329, pl. 326, figs. 6, 7) from the Middle Liassic of the Department of Calvados, France. Should the latter species belong to *Eucycloscala,* it would bridge the gap seen by Cossmann (1915, p. 256) between the Triassic and Cretaceous representatives of this genus.

[2] As distinct from lot 49 (see p. 4).

and for the more continuously conical shell profile. Furthermore the ornamentation is denser than in *E. pascoensis*. Fourteen transverse ribs can be counted on the last preserved whorl. They run less decidedly backward than in *pascoensis* and are crossed by three more or less equally spaced revolving keels. Bead-like tubercles form at the crossing points. Neither base nor aperture is observable.

The early development seems to parallel that of *E. pascoensis*, but ornamentation seems to set in at a somewhat earlier stage.

REMARKS: In character of ornamentation and shell profile *E. baltzeri* Kittl from St. Cassian comes closest to the present fragment, but differs by its smaller pleural angle (of about 40°).

The much less deeply channeled sutures and the somewhat lower pleural angle serve to distinguish it from *E. körneri* (for reference see above) in addition, the ornamentation is different in some respects.

OCCURRENCE: A single fragment in lot 26 (A.M.N.H. No. 26512).

HOMALOPOMA CARPENTER

SUBGENUS BOUTILLIERIA COSSMANN

The Triassic species originally named *Turbo cinctus* and *Turbo reflexus* by Münster were later assigned by Zittel (1885, p. 187) to the genus *Collonia* Gray. Kittl (1891, p. 239) followed Zittel's authority, though fully conscious of the uncertainty of the generic position of Münster's forms. Both Cossmann (1918, p. 55) and Wenz (1938, p. 344) in limiting the stratigraphic range of *Collonia* to the uppermost Cretaceous and the Tertiary, clearly exclude the St. Cassian species from it, and rightly so, since they are quite different from the genotype *C. marginata* (Lamarck) (see Cossmann, 1918, p. 56, fig. 30; Wenz, 1938, p. 344, fig. 809).

After originally listing the following species under the designation "*Collonia*" *subcincta*, I am now following Cox' (1949, p. 41) example in referring it to the genus *Homalopoma* to which it shows the closest affinity, although it is much older than the type species, the recent *H. sanguineum* (Linné). If compared with the type species of the various subgenera of Carpenter's genus, as figured by Wenz (1938, pp. 341–342, text figs. 799–804), it seems to come closest to *Boutillieria* Cossmann[1] which is also the one that appears first, namely, in the Aptian. Still the gap in the stratigraphic range of this genus and subgenus, from Upper Triassic to Lower Cretaceous, remains a staggering one.

In addition to six small shells readily referable to *H. (B.) subcinctum*, a fragment of the body whorl of a considerably larger shell in lot 86 belongs to this genus.

Homalopoma (Boutillieria) subcinctum (d'Orbigny)

Plate 6, figures 83–85, 94, 95

Turbo cinctus; MÜNSTER, 1841, p. 115, pl. 12, fig. 28.

Turbo subcinctus D'ORBIGNY, 1850a, p. 192.

Turbo subcinctus d'Orbigny; LAUBE, 1870, p. 22, pl. 31, fig. 13.

Collonia cincta Münster; KITTL, 1891, p. 239, *cum synon.*, pl. 5, figs. 31–33.

?Collonia cincta Mstr.; BROILI, 1907, p. 85, pl. 10, fig. 18.

Collonia cincta Münster spec.; HÄBERLE, 1908, pp. 319, 467, pl. 2, figs. 13–16.

Collonia cincta Münster; KÖRNER, 1937, p. 209.

Homalopoma cimana COX, 1949, p. 41, pl. 2, figs. 21, 22.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26543	1.65 mm.	109	31½	89°
26543/1	3.15	89	38	71°
26543/2:1	3.6	83	42	84°
26543/2:2	5.2	92	41	70°

W and π tend to decrease, and h tends to increase, with growth.

DESCRIPTION: Shell turbiniform, consisting of up to four and a half whorls which are separated from one another by rather deep, neatly channeled sutures. Whorl profile rounded, but with an almost horizontal apical band which forms a right angle with the lateral face of the preceding whorl. Base flatly conical; no umbilical opening, only a narrow umbilical niche. Aperture almost circular, slightly truncated below; outer lip not

[1] *Pareuchelus cancellato-costatus* Sandberger from the Oligocene of the Mainz basin also closely resembles *H. (B.) subcinctum*, except for the distinctive generic characters of the aperture.

preserved, columellar one thickened and reflexed over the umbilical niche.

Revolving keels are the dominant sculptural element. There is a subsutural keel separating the apical band from the lateral part of the whorl surface on which there are four more keels.[1] The uppermost of these is the weakest. The three others are about equally strong in the largest specimen present (figs. 84, 85), but in two smaller shells (A.M.N.H. Nos. 26543 and 26543/1; fig. 83) the second of the three keels seems somewhat to exceed the others in strength. The third of the lateral keels (fourth from the suture) marks the point of the greatest width of the whorls. The distance between the first and the subsutural keel is the smallest. The three others are about equally distant from one another in the largest shell present (figs. 84, 85), whereas in two smaller ones (fig. 83) the band bordered by the second and third is higher than the others. Beyond the fourth lateral keel there follow, on the base, six concentric, densely set, revolving keels, the innermost of which surrounds the umbilical niche.

The transverse ornamentation consists of a dense and fine growth striation. The single striae are comparatively prominent and might be called growth lamellae. They follow a steep, backward oblique course on the penultimate volution and become much more oblique on the body whorl. As a rule, they keep this oblique backward direction all over the apical and lateral faces of the whorl, except for slight twists, discernible under the microscope only, caused by the crossing of the main keels. Only in the most anterior part of the largest specimen present (A.M.N.H. No. 26543/2:2) do they clearly change, between the second and third lateral keels (third and fourth from the suture), to an obliquely forward direction but then resume their former course at the lower of the two keels.[2] Since this curious change in direction can be found at only one place of one specimen it is attributed to some lesion of the shell rather than considered a specific character. In the outer zone of the base the growth striae still maintain their obliquely backward direction, then change gradually to a more radial one in which they continue to the border of the umbilical niche. In crossing the revolving keels the growth striae produce beads, thus giving the keels a decidedly granulated aspect better visible in the two smallest specimens (A.M.N.H. Nos. 26543 and 26543/1; fig. 83) than in the largest (A.M.N.H. No. 26543/2:2, figs. 84, 85) in which the surface of the keels is worn. The fine granulation can also be observed on the keels of the base, although the growth striation is there otherwise less distinct than on the other parts of the shell. Up to 60 growth striae can be counted around the body whorl.

EARLIEST ONTOGENETIC STAGES: As seen in the largest shell present, the apex is flat. The two first whorls are smooth and rounded in profile, but in the second differentiation between an apical face and a lateral one, with a rounded edge between, becomes apparent. Both transverse and revolving ornamentation set in on the first half of the third volution.

REMARKS: Since at the time of publication of Münster's work a species named *Turbo cinctus* by Donovan in 1799 existed, Münster's specific name is a homonym which, according to Article 36 of the Rules, can never be used again, even though the generic name has since been changed. Therefore the name *subcinctus*, as proposed by d'Orbigny (*loc. cit.* in synon.), must be used for the present species.

Cox (*loc. cit.* in synon.), who seems to have overlooked Körner's earlier record of this species from Peru, admits the agreement of his *H. cimana* from La Cima, Peru, with *Turbo cinctus* Münster in size, shape, and whorl ornament but does not consider them conspecific because be ascribes an open umbilicus to the latter species, while calling the former imperforate. However, a careful scrutiny of the previous literature on Münster's species refutes Cox' assumption that "all published descriptions of it . . . repeat the information that it has a definite umbilicus." It is true that Münster's description is inconclusive and that his protograph is too poor for any inferences in this respect. Klip-

[1] Kittl and Körner (*loc. cit.* in synon.) count two apical revolving keels and three lateral ones.

[2] A slight decrease in obliqueness of the growth lamellae seems to be observable in the same zone of the smallest shell but one (A.M.N.H. No. 26543/1), but here their direction remains obliquely backward throughout the surface of the whorl.

stein's (1843, p. 155) description of his "*Monodonta*" *cincta*, mentioning a "small, strongly deepened umbilicus," is inconsistent with his drawing (*ibid*,. pl. 14, fig. 33), which clearly shows only an umbilical niche. Since this form is, however, only doubtfully included by Kittl (1891, p. 239) in the synonymy of the present species, Klipstein's data cannot be considered relevant. Laube's (*loc. cit.* in synon.) description, commended by Kittl, mentions a "narrow and deep umbilicus which is open," but his excellent apertural view (pl. 31, fig. 13) shows just the same aspect of an umbilical niche as Kittl's figures, my own specimens, those from the Nevado de Acrotambo, the umbilicus of which is, according to Körner's description, "almost concealed ['verdeckt'] by the reflexed inner lip," and Cox' specimens. Häberle's illustrations on which Cox bases his belief in the presence of a "definite umbilicus" in *Trochus cinctus* are deceptive. If there were such a feature, Häberle would hardly have spoken of a "vermutlich offenen Nabel" in the description (1908, p. 320) of the very form to which the specimen illustrated in his plate 2, figure 14, belongs. Furthermore Kittl, although mentioning (1891, p. 240) the occurrence of "narrowly but distinctly umbilicated" juveniles, calls in his generic heading on "*Collonia*" *Turbo cinctus* Münster and *T. reflexus* Münster "zwei ungenabelte Formen." Thus the only conclusion that can be safely drawn from the literature on *H. subcinctum* is that there is, especially in the young, sometimes a narrow umbilicus but as a rule only an umbilical niche. This would be quite in line with Wenz' (1938, p. 340) generic diagnosis of *Homalopoma, sensu lato* ("ungenabelt oder eng genabelt"), and with his subgeneric one of *Boutillieria* ("meist mit engem Nabelritz").

Decisive, however, for the question here discussed was the examination of three topotypes of "*Collonia cincta*" from St. Cassian in the Yale collection, all of which perfectly agree in the characters under discussion, as in others, with the Peruvian shells here dealt with. Since the latter, in turn, agree equally well with Cox' as shown in his figures 21 and 22, I cannot but include his *H. cimana* in the synonymy of the present species.

These topotypes from the Yale collection, compared with those of *Worthenia triton* d'Orbigny (see Kittl, 1891, pp. 197, 198, pl. 3, figs. 17, 18), served also to confirm the resemblance and the differences between both forms. In *W. triton* the whorl profile remains angular throughout development, without ever becoming so gibbous as in *H. (B.) subcinctum*, and the straight columella makes for a rather polygonal outline of the aperture, whereas it is almost circular in the present species. Moreover, the arrangement of the revolving keels is quite different in the latter and it lacks, in particular, the characteristic twin keels situated on the shoulder of *Worthenia triton*, interpreted as slit band keel by Kittl. Finally, the growth striae of *W. triton* are sharper, somewhat steeper, and less closely set than those of the present species and reversed on the lower of the shoulder twin keels. Kittl's description unfortunately gives no indication as to the course of the growth striae in *Turbo cinctus*, but in Laube's (*loc. cit.* in synon.) drawing that described above is recognizable. In Häberle's figures 13b, 14a, and 15, however, the growth striae can be seen to run obliquely forward instead, and his description (p. 320) mentions "sinuous growth striae whose strongest, forward concave sinuosity is situated on the maximum convexity of the whorl." Should both drawings and description in this point not be due to observational errors, Häberle's identification would have to be seriously questioned. Should his forms, on the other hand, really belong to the present species, his creation of two varieties, *sixcarinata* and *tricarinata*, based on minor differences in the revolving ornamentation only, for the forms from the Latemar and the Viezzena, respectively, would seem the more superfluous since both Laube and Kittl report in their descriptions intercalation of additional revolving keels in the course of growth. Referring to the same authors' observations, Körner (*loc. cit.* in synon.) also questions Häberle's varieties.

Kittl (1891, p. 240) called attention to the resemblance of the present species, especially in its early stages, to some pleurotomariids. As far as the genus *Worthenia* (or rather the Triassic forms to which this generic name is usually applied) are concerned, that species which the present one resembles most, *W.*

triton, is compared above, and no more comparison with those doubtfully referred in this report to *Worthenia* is needed. However, the spiral whorls of a new species assigned above to another pleurotomariid genus, *Pareuryalox perornata*, are deceptively similar to *H.* (*B*). *subcinctum;* the differences between them are pointed out above (p. 25). Finally a certain resemblance in shell shape and even more in ornamentation with *Guidonia bifasciata* (above, p. 74) should be noted. From it the present form differs not only in its generic characters, but also by lacking the comparatively wide umbilical opening of that species, in its whorl profile, which is less angular and more rounded, and by the markedly higher number of revolving keels.

The only congeneric form in the present material, *Homalopoma* (*Boutillieria*), new species, is compared below with this species.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26543	1
48	26543/1	1
No. 49[1]	26543/2	3
26	26543/3	1
Total (including fragments)		6

Homalopoma (Boutillieria), new species

Plate 6, figure 82

DIMENSIONS: This species, represented only by a single fragment of a body whorl, has an aperture about twice as high (*ca.* 6 mm.) as that of the largest shell of *H.* (*B.*) *subcinctum*. It may therefore be estimated to have attained, when complete, a total height of at least 10 mm., but rather more, since its shape must have been more slender than that of *H.* (*B.*) *subcinctum*. This inference is based on the fact that the aperture is only slightly higher than wide in the latter form, but almost twice as high as wide in the present fragment. Precise measurements cannot be made.

DESCRIPTION: Aperture high, oval; columella almost straight, with the inner lip narrowly reflexed over it; there is an extremely narrow umbilical niche but no open umbilicus.

[1] As distinct from lot 49 (see p. 4).

Whorl profile and revolving ornamentation closely resemble those of *H.* (*B.*) *subcinctum*, but differ as follows: The apical band is more nearly horizontal, narrow, and slightly concave. According to the higher whorl profile, the subsutural and the four lateral keels are more widely spaced, with the widest interval between the subsutural and the first lateral ones. The second of the lateral keels marks the point of greatest width of the whorl profile. They are all strong and prominent, chiefly the first. The revolving keels of the base, of which there are five, are much weaker than the lateral ones. The outermost is separated by a comparatively wide, gently concave band from the lowermost lateral keel. They gradually decrease in strength towards the center.

Only on the apical band can fine growth striae be recognized, which follow the same course as in *H.* (*B.*) *subcinctum*.

REMARKS: The differences of this form from the preceding species are pointed out in the section of dimensions and in the above description.

OCCURRENCE: A single fragment in lot 86 (A.M.N.H. No. 27129).

PSEUDOMELANIIDAE

OONIA GEMMELLARO

This name, proposed by Gemmellaro in 1878 but recognized by Cossmann (1909, p. 86) merely as that of a section of *Pseudomelania, sensu stricto*, is here used as a generic one, following Wenz' (1938, p. 375) example.

?Oonia ?subtortilis (Münster)

Plate 6, figures 90–92

?Melania subtortilis MÜNSTER, 1841, p. 95, pl. 9, fig. 29.

?Euchrysalis alberti Klipstein; LAUBE, 1868, p. 72, pl. 25, fig. 9.

?Pseudomelania (*Oonia*) *subtortilis* Mstr. sp.; KITTL, 1894, p. 178, *cum synon.*, pl. 6, figs. 5, 6.

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27196:1	*ca.* 2.8 mm.	*ca.* 53	*ca.* 30	32°[2]

These measurements are based on the penultimate whorl; most of the last one is

[2] If measured from antepenultimate whorl up, π amounts to 62°.

missing. As preserved, specimen number 1 is about 3.0 mm., and specimen number 2 is about 2.5 mm., high. When complete, the latter must have equaled, if not exceeded, the former in size.

DESCRIPTION: Conch, consisting of five and one-half volutions (including the embryonic ones), slender on the whole and characterized by the fact that the whorls increase markedly faster in height than in width. Thus the last three are slender and make for a fusoid appearance of the shell, whereas the earlier volutions form an obtuse cone (compare the two values for π in the table of dimensions). Except for part of its uppermost zone, the body whorl is broken off in both shells. In the larger one, however, the corkscrew-shaped columella is preserved beyond the point it would be if the penultimate volution were the last. This accident of preservation causes, as in similar cases, the illusion of the presence of a long canal, if the penultimate whorl is viewed from the side of what appears to be the aperture (fig. 91). In true apertural view (fig. 90), however, this illusion is somewhat corrected. The profile of the earliest post-embryonic whorls shows a sloping apical face and an almost vertical lateral one, which are connected by a broadly rounded shoulder; that of the later volutions is moderately convex. The sutures are shallowly engraved. The aperture is oblique and narrowly elliptical, with a rather acute angulation at its upper end and a narrow, not so short notch at the lower one. The inner lip is thickened and seems to be accompanied in its upper part by an extremely fine groove. There is a faint indication of an extremely fine revolving striation on the last preserved whorl of specimen number 1. In this shell the growth striae, though also fine, are better recognizable, on both that volution and the antepenultimate one; on the latter they are almost straight and perpendicular, but their course becomes slightly inverse-sigmoidal on the following whorl (fig. 93).

EARLIEST ONTOGENETIC STAGES: The obtuse nucleus is slightly inclined towards the axis of the conch (fig. 90).

REMARKS: The peculiar combination of an obtusely conical upper part of the spire with an almost cylindrical main part of the conch, consisting of slender and high volutions, seems to justify tentative identification of this very rare form from Peru with Münster's St. Cassian species with which it otherwise also agrees fairly well.

As pointed out by Kittl (*loc. cit.* in synon.), the latter's reference to Gemmellaro's genus cannot be considered absolutely certain.

It shares the pupoid shell shape to a certain extent with *?Glyptochrysalis*, juvenile form ex aff. *G. anthophylloidis* (Klipstein), which is compared below (p. 153). On the other hand, this peculiarity of the shell shape dispenses with comparisons with any other forms in the material under study.

OCCURRENCE: Two specimens in lot 26 (A.M.N.H. No. 27196).

RAMINA WENZ

Wenz (1938, p. 370) proposed this generic name to replace J. Böhm's (1895, p. 294) preoccupied one, *Rama*.

Rama was intended to accommodate some Triassic species from St. Cassian and one from the Marmolata which Kittl had referred to the genus *Macrochilina* Bayle,[1] namely, *M. sandbergeri* (Laube). *M. sublineata* (Münster), *M. brevispira* Kittl, *M. inaequistriata* (Münster), and *M. orbignyi* (Laube) from St. Cassian[2] and *M. ptychitica* from the Marmolata.[3]

Although Böhm discussed the last species at length, he did not formally designate it

[1] This name had been proposed as a replacement for Phillips' preoccupied *Macrocheilus* and was accepted as such by Cossmann (1909, p. 100), whereas Wenz (1938, p. 369) considers it a synonym of *Soleniscus* Meek and Worthen (1860, p. 467), *sensu stricto*. Cossmann (1909, p. 119), on the other hand, treats *Soleniscus* as a genus distinct from *Macrochilina*, even referring the latter to the Pseudomelaniidae but the former, though doubtfully, to the Subulitidae. Since the following species is here, though with reservations, referred to *Ramina* Wenz, the delicate question as to whether to follow Cossmann or Wenz need not be discussed further.

[2] Of these, Böhm mentions in his discussion (1895, pp. 295–296) all but *M. orbignyi*. Since he speaks quite generally of a "separation of the Triassic species from *Macrochilina*," it may be assumed that he meant to include that species also in his new genus *Rama*.

[3] Later Kittl (1899, p. 183) recorded two more forms of *Macrochilina* from that locality, namely, *M.* cf. *sandbergeri* and *M.* (?) *turrita* Kittl, but he referred only *M. ptychitica*, within that genus, to *Rama* Böhm which he accepted merely as a subgenus of the former, and that only with reservations.

the type species of *Rama;* only Cossmann did so in 1909 (p. 119).

With Wenz' dealing with this genus, however, confusion set in. In revising his species *M. ptychitica* in 1899 Kittl (p. 184) had explicitly excluded from it the specimen figured in figure 30 of his plate 6 of 1895, for which he (1899, p. 180) established instead a new species, *Euchrysalis laevis*, of which that specimen became the holotype by monotypy. Although Cossmann (1909, pp. 103, 104) took notice of that elimination and reproduced accordingly the other of Kittl's original figures (29) to illustrate a typical representative of the genus *Rama*, these passages in both Kittl's and Cossmann's papers escaped Wenz' attention. He figured instead the specimen that Kittl had expressly excluded as typical of *R. ptychitica*. What is even worse, he obviously based his generic diagnosis on the specimen that is the holotype of a different species, *Euchrysalis laevis* Kittl, belonging even to another genus, which is only doubtfully referred by Wenz to the same family.[1]

How then does Wenz' fundamental error affect the validity of his genus *Ramina?* Had he, in proposing this name, intended to establish a new genus, his error would, in my opinion, be bound to invalidate that genus. Since, however, Wenz meant merely to substitute a new name for Böhm's preoccupied one, his error does not affect the validity of the genus proposed by Böhm under the name *Rama*, which must be changed to *Ramina*, but Wenz' diagnosis, based on a specimen alien to this genus, must be disregarded altogether, as also his figure of that specimen. Rather the genus *Ramina* is to be interpreted merely on the strength of J. Böhm's diagnosis and discussion of 1895 and, in addition, of Cossmann's comments of 1909, based on the specimen which Kittl (1899) considered solely characteristic of the type species, *R. ptychitica*.

This error might have contributed to Wenz' decision to place the genus *Ramina* within the family Subulitidae, to which the shell incorrectly considered by him as characteristic of the type species of this genus, but made by Kittl the type of a species of *Euchrysalis*, may well belong.[2] It is true that Wenz (1938, p. 369) refers *Macrochilina*, a genus from which *Rama* was split off by Böhm and which he considers a synonym of *Soleniscus, sensu stricto*, to the Subulitidae,[3] but Cossmann (1909, pp. 81, 100, 103) refers both *Macrochilina* and *Rama* (the latter as merely a subgenus of the former) to the Pseudomelaniidae. As to the family affinities of *Ramina*, Cossmann's example but not Wenz' is here followed in referring the present genus to the Pseudomelaniidae rather than to the Subulitidae.

Even though conceived as explained above, *Ramina* still is not a very well-defined genus. Cossmann's skepticism with regard to its diagnostic characters[4] seems to be well founded. Despite that skepticism, however, he accepts *Rama* (now *Ramina*) provisionally as a taxonomic unit on the strength of its differences in both shell shape and ornamentation from the typical *Macrochilina*, though pointing out the necessity for future revision. It is with a similar attitude that the generic name *Ramina* is used in the present report to accommodate, with all reservations already and still to be made, the following species, which cannot be referred to any other genus represented in the material under study.

However, even so understood, this generic reference can be but a doubtful one. For our species differs markedly from the genotype, *R. ptychitica*, as well as from most of the other species referred by J. Böhm to his genus *Rama*, as enumerated above, in shell profile; it is decidedly gradate and

[1] Kittl (1899, pp. 180, 184) himself fell, in the very same subject, victim to an error not less annoying though less fatal than Wenz'. In designating in the synonymies of both *E. laevis* and *R. ptychitica* the specimens he considered typical of the one species and the other, he interchanged the numbers of the two text figures in which Böhm (1895, p. 295, figs. 88, 89) had reproduced these specimens. However, if for nothing else, that Kittl named his new species of 1899 *Euchrysalis laevis* (the smooth one) leaves no doubt but that he meant to base it on the original of his figure 30 of 1895. Thus that of his figure 29 of that year, reproduced in Böhm's text figure 89 (*not* 88), must be considered the holotype of *Ramina ptychitica*.

[2] Cossmann (1909, pp. 41, 68), however, refers *Euchrysalis* to the Coelostylinidae.

[3] See above, p. 108, footnote 1.

[4] "Il faut avouer que ce sont là des bases bien fragiles pour la constitution d'un nouveau Sous-Genre" (Cossmann, 1909, p. 104).

characterized by pronounced though rounded shoulders which separate the distinct apical bands of the slender whorls from their nearly cylindrical lateral faces. In *R. ptychitica*, on the other hand, as well as in *Macrochilina sandbergeri*, *M. brevispira*, *M. sublineata*, *M. inaequistriata* (for these four species, see Kittl, 1894, pl. 7, figs. 31–44), and *M.* (?) *turrita* (Kittl, 1899, p. 183, pl. 15, fig. 28), the spire is conical, there is hardly any ramp to be seen, and the sutures are only shallowly engraved. Only *M. orbignyi* (Laube, 1868, p. 3, pl. 21, fig. 1, *pro parte;* Kittl, 1894, p. 212, pl. 11, figs. 22, 23) shows a shell shape which, with its deeper sutures, its somewhat gradate spire, and at least indications of a shoulder and an apical whorl face, somewhat approaches that of the Peruvian form. This holds true in particular for the smaller of the two shells figured by Kittl, which must according to this author be considered Laube's type.[1] Now it may be thought that Cossmann was aware of these differences between *M. orbignyi* and other Triassic species referred by Kittl to *Macrochilina* (e.g., *M. inaequistriata*) and therefore left the former species with *Macrochilina* (1909, p. 102) but transferred the latter to *Rama* (*ibid.*, p. 104). However, he also treated (*ibid.*, p. 102) *M. sandbergeri*, *M. sublineata*, and *M. brevispirata* in the same way as *M. orbignyi*, although these three species seem to resemble *R. ptychitica* much more closely than does *M. orbignyi*. Be that as it may, both *M. orbignyi* and the Peruvian species here described are believed to be better referable to *Ramina*, despite the differences separating them from its type species, *R. ptychitica*, than to *Macrochilina* (if this name is to be maintained at all and not to be considered, as it is by Wenz, as a synonym of *Soleniscus, sensu stricto*), of which the type species is Devonian in age (whereas that of *Soleniscus* is Pennsylvanian). For in both Paleozoic genera aperture and umbilical region are quite different. Still, *?R. andina* can only doubtfully and provisionally be referred to this genus. Closer study of more abundant material may justify the future establishment of a separate subgenus, if not genus, for forms like *R. orbignyi* and *?R. andina*.

[1] Laube's own description and drawing, however, are, according to Kittl, based on a combination of characters of that type and of a specimen belonging to *Pseudomelania münsteri* and can therefore not be relied upon.

?Ramina andina, new species

Plate 6, figures 78–81, 86–89, 93,96–98

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27679/1	*ca.* 1.23 mm.	*ca.* 54½	*ca.* 18	*ca.* 70°
27679:1	*ca.* 1.68	*ca.* 50	*ca.* 15	61°
27679:2	*ca.* 1.79	*ca.* 50	*ca.* 19	60°
27679:3	*ca.* 1.82	*ca.* 46	*ca.* 20	57°
27679:10	*ca.* 2.07	*ca.* 48½	*ca.* 16	56°
27679:4	*ca.* 2.13	*ca.* 50	*ca.* 18½	57°
27679:5	*ca.* 2.24	*ca.* 45	*ca.* 16[2]	61°
27679:6	*ca.* 2.24	*ca.* 47½	*ca.* 20	54°
27679:11	*ca.* 2.24	*ca.* 47½	*ca.* 17½	56°
27679:7	*ca.* 2.30	*ca.* 49	*ca.* 17	55°
27679:8	*ca.* 2.52	*ca.* 44½	*ca.* 15½	58½°
27679:9	*ca.* 2.58	*ca.* 41½	*ca.* 15	52°
27679:12	*ca.* 2.58	*ca.* 43½	*ca.* 17½	53°
27679:13	*ca.* 2.63	*ca.* 44	*ca.* 19	60°
27679:14	*ca.* 2.69	*ca.* 48	*ca.* 20	59°
27679:15	*ca.* 2.69	*ca.* 39½	*ca.* 16½	48°
27679:16	*ca.* 2.74	*ca.* 51	*ca.* 19½	57°
27679:17	*ca.* 2.91	*ca.* 46	*ca.* 19	60°
27679:18 (syntype A)	*ca.* 2.91	*ca.* 42½	*ca.* 21	53½°
27679:19 (syntype B)	*ca.* 2.99	*ca.* 44½	*ca.* 16½	53°
27679:20	*ca.* 3.07	*ca.* 48½	*ca.* 16	62°
27679:21	*ca.* 3.07	*ca.* 52½	*ca.* 16	65°
27679:22	*ca.* 3.49	*ca.* 45	*ca.* 25	46°
27679:23	*ca.* 3.73	*ca.* 42	*ca.* 15½	62°
27679:24	*ca.* 3.9	*ca.* 43½	*ca.* 19	*ca.* 50°
27679:25	*ca.* 3.9	*ca.* 47	*ca.* 19	56°
27679:26	*ca.* 3.9	*ca.* 49	17	60°

The first specimen in the table is extremely small and separated by a comparatively wide gap in size from the second. Thus the inference that can be drawn from the measurements of the first are not too reliable. Lower in the table an extremely stout shell and a slender and extremely high-spired one (A.M.N.H. Nos. 27679:21 and 27679:22; figs. 78 and 88, 89, respectively) are listed. If all three specimens are eliminated from consideration, these inferences can be drawn: On an average, W and π are somewhat smaller, and h is somewhat greater, in the specimens measuring up to 2.52 mm. in total height than in those measuring from 2.58 mm. up, the medium height for all specimens measured being between these two values (2.56½ mm.). However, this fact is not expressed in any steady trend. Rather, the

[2] Reduced because of curvature of spire.

same values for W, h, and π are encountered at very different sizes, especially since the ranges of variations (after elimination of the three extreme cases) are not so wide, viz., from $39\frac{1}{2}$[1] to $52\frac{1}{2}$ for W, from 15 to 21 for h, and from 48 degrees to 62 degrees for π. Concerning h, in particular, allowance must be made for the fact that the spires are broken in most of the individuals of this species, that the values for h therefore had to be more or less roughly estimated and are thus not quite reliable. It is also worth noting that specimen A.M.N.H. No. 27679:21, surpassed in the values for W and π only by the smallest shell present (A.M.N.H. No. 27679/1), and specimen A.M.N.H. No. 27679:22, with the maximum of h and the minimum of π differ so little in size that they occupy neighboring places in the table.

SELECTION OF TYPES: The medium-sized shell A.M.N.H. No. 27679:18, which is among the best preserved, is designated syntype A. In addition, the less complete shell A.M.N.H. No. 27679:19 is selected as syntype B for showing the distinctive characters of this species on and near the columellar border best.

DESCRIPTION: Not more than one and a half embryonic volutions and four postembryonic ones can be counted even in the largest specimens present.

Shell shape altogether slender, although the body whorl is large and convex to such an extent that both the upper shoulder and the transition to the base merge into one homogeneous arc. The spiral whorls, on the other hand, exhibit a distinct, though well-rounded shoulder; the rather narrow ramp above it slopes more in the later volutions than in the earlier ones; simultaneously the lateral whorl faces beneath the shoulder, which are almost cylindrical at an early stage, become more distinctly though still only very gently convex. With their lateral facies running almost straight, these spiral whorls appear more slender. Indeed their height attains (e.g., in syntype A; figs. 79–81), up to three-fourths of their width. The sutures are markedly oblique, the gradient amounting (e.g., in both syntypes) to about 20 degrees.

[1] If the unusually slender specimen A.M.N.H. No. 27679:15 is also left out of account, from $41\frac{1}{2}$.

The aperture is lenticular in shape and not so wide. It is bounded by the arc of the outer lip on one side and by the thickened and reflexed inner one on the other. At both upper and lower ends of the aperture there are rather acute angulations. The inner lip runs nearly perpendicularly in its lower two-thirds, then turns obliquely upward to join the ceiling of the aperture. There is no open umbilicus nor even an umbilical niche, but beyond the inner lip there extends a crescent-shaped, not so narrow but very shallow depression, bounded at its far side by a blunt edge which spirals steeply upward; both depression and edge are best seen in syntype B (fig. 87). In its lowermost part only can this edge be seen in syntype A (fig. 80) to project as a rather sharp keel and to be accompanied outside by a shallow groove which at first sight might be mistaken for an umbilical niche. Except for the fact that there the lowermost part of the columellar border turns slightly to the left, Kittl's illustrations (1894, pl. 11, figs. 22, 23) of *?R. orbignyi*, one of which (fig. 22) depicts Laube's type of this species (as restricted by Kittl), show exactly the picture described above,[2] but Kittl, believing he dealt with a member of the genus *Macrochilina*, prefers to speak of "two steep folds," meaning columellar folds. The terms used above are believed to be more appropriate. As may be added here, it is this configuration of the columellar border and of the adjacent portion of the shell which suggests that *?R. orbignyi* and the present species are subgenerically, if not generically, different from the other members of the genus *Ramina* (cf. above).

The surfaces being mostly worn in this species, whatever ornamentation exists can be observed only occasionally. An extremely fine revolving striation, reminiscent of that seen in Kittl's illustrations of *?R. orbignyi*, can just be recognized in paratypes A.M.N.H. Nos. 27679:6, 27679:23, 27679:26, and 27679:27: in no. 23 (fig. 97) best on the base, in no. 27 (fig. 93) on the spiral volutions as well as on the body whorl. The course of the growth striae is indicated in paratype

[2] A similar one can be seen in Laube (1868, pl. 21, fig. 1), but this illustration is, according to Kittl, combined from two not even congeneric shells and therefore not dependable (cf. above, p. 110, footnote 1).

A.M.N.H. No. 27679:26 (fig. 98), where they run obliquely backward from the suture, turn forward on the shoulder, and then describe a shallow, forward concave arc on the lateral face of the body whorl.

Earliest ontogenetic stages can be observed only occasionally, since most of the shells examined have the apices broken off. Where observable, as in paratypes A.M.N.H. Nos. 27679:11 and 27679:22, the embryonic whorls can clearly be seen to be alloiostrophic (figs. 96, 89).

REMARKS: The generic affinities of this species are discussed at length under the genus *Ramina*, with the conclusion that *?R. andina* can only doubtfully and provisionally be attached to this genus, since certain of its characters are not present in most of the species of *Ramina*, or in those of *Macrochilina* for that matter. It is also stated that the only one among those species with which the present one shares to a certain extent these peculiarities is *?R. orbignyi* (Laube). As pointed out above, both species have in common the crescent-shaped shallow depression between the reflexed inner lip and the circumumbilical edge, the somewhat turreted shell profile, with more or less distinct shoulders and apical ramps, and the fine revolving striation. Also the sutural gradient is about the same in both forms. However, *?R. andina* differs from Laube's species by the more pronouncedly gradate shell profile, and in particular the more slender, almost cylindrical spiral volutions.

This species has the oblique sutures in common with *Spirostylus peruvianus* (p. 154) from which it is, however, readily distinguished by its much larger body whorl. In general shell shape it somewhat resembles *Coelostylina cylindrata* (p. 132) from which it differs most markedly by the steeper gradient of the sutures, larger body whorl, and greater slenderness and height of the spiral whorls of which there are, accordingly, fewer present at the same size.

The almost cylindrical shape of the spiral whorls accounts for a certain resemblance between this species and certain higher spired forms of *Cylindrobullina* [e.g., *C. (C.) avenoides;* see below, p. 261, and pl. 17, figs. 35, 36, 39–42, 46, 49–51, 58, 59], but the latter can readily be distinguished from *?R. andina* by their cylindrical, not convex, body whorls and by their apertures which are broadly rounded anteriorly, whereas they are lenticular in *?R. andina*. Another acteonid which somewhat resembles the latter in general shell shape, *Consobrinella elegantula*, is compared in detail below (p. 282).

Finally, for the sake of completeness, the similarity in whorl profile between both this species and *?R. orbignyi* and *Siphonophyla desori* (Klipstein MS) Kittl (1894, p. 235, pl. 11, figs. 1, 2) should be mentioned. *S. desori* is the type species of Kittl's genus, treated by Wenz (1938, p. 392) merely as a subgenus of *Coelostylina*. That species is, however, readily distinguished from the present one by its less high but inflated body whorl, by the shape of its aperture, and mostly by the presence of a rather wide umbilicus.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	27679	72
76	27679/1	1 (juvenile)
	Total (including fragments)	73

LOXONEMATIDAE

SUBFAMILY LOXONEMATINAE

LOXONEMA PHILLIPS

SUBGENUS POLYGYRINA KOKEN

Only a few shells, all very small, are with more or less certainty referred to this subgenus, the distinctive characters of which are believed to be the slender, somewhat subulate shell shape, the strongly convex, sometimes slightly angular profile of the whorls, which are comparatively low and numerous (hence the subgeneric name), and mostly the peculiar nucleus (Kittl, 1894, pl. 4, fig. 36).

Two forms can be distinguished in the present material, but they are too scantily represented and too poorly preserved to be given new specific names.

Loxonema (Polygyrina) sp. indet. 1

Plate 7, figure 6

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26571:1	1.79 mm.	50	31½	25°
26571:2	*ca.* 1.85	*ca.* 51½	*ca.* 30½	24°

DESCRIPTION: Shell, consisting in specimen A.M.N.H. No. 26571:1 of four and one-half volutions, slender, subulate. Whorl profile decidedly convex and rounded, sutures rather deep. The nucleus is obtuse, almost dome-shaped. The subulate shell shape is, even more than by these nuclear characters, caused by the fact that in both measured specimens the first post-nuclear whorl is almost as wide as, and even a little higher than, the second, which is the penultimate of this shell as preserved (fig. 6). In this apertural view of specimen A.M.N.H. No. 26571:1 not only the nucleus but most of the spire is inclined towards the axis of the conch. The base is rather short and slightly concave, the columella massive, and the aperture seems to have been obliquely rhombic, with angulations at both upper and lower ends. There is no umbilical niche.

Except for traces of growth striae, which seem to be sinuous, no ornamentation is observable.

REMARKS: Reference of this form to the subgenus *Polygyrina* is chiefly based on the nuclear and post-nuclear characters and on the strongly convex whorl profile. From the type species *L. (P.) lommeli* (Münster, 1841, p. 122, pl. 13, fig. 43; Kittl, 1894, p. 157, *cum synon.*, pl. 4, figs. 35–39) it differs mainly by its comparatively large body whorl.

For comparison with *Loxonema (Polygyrina)* sp. indet. 2, see the discussion of that form.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26571	2
91	26571/1	1
45	26571/2	1
86	26571/3	1
Total (including fragments)		5

The above description is primarily based on the two specimens in lot 26. All the others strongly resemble them in shell shape but are not well enough preserved to be referred with certainty to the same species. Among them, the single specimen in lot 91, which consists of at least seven volutions, is almost twice as large as the specimens in lot 26.

Loxonema (Polygyrina) sp. indet. 2

Plate 7, figure 7

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26572	*ca.* 2.69 mm.	44	41½	22½°

DESCRIPTION: This form has the peculiar, inverted-saucer-shaped nucleus in common with *L. (P.)* sp. indet. 1, but its first post-nuclear whorl is only about half as high as the second and even lower than the nucleus. Also the increase in width from the first to the second about corresponds to the general increase of the conch. Furthermore, the shell is slenderer on the whole, and especially the later of the five whorls present are less convex which causes the sutures to appear accordingly less deep. In this form, too, the nucleus is slightly inclined towards the axis of the conch. Base and aperture are too incomplete to be safely described. No ornamentation is recognizable on the worn surface.

REMARKS: This shell resembles in its nuclear and early post-nuclear characters, particularly in the lowness of the first post-nuclear volution, the type species *L. (P.) lommeli* even better than *L. (P.)* sp. indet. 1, but it is readily distinguished by its less convex whorls and cannot be considered conspecific with either.

Were it not for the nucleus, which is quite different from the nuclei observed in *Anoptychia*, it would have been referred to that subgenus of *Zygopleura* which it closely resembles in shell shape.

OCCURRENCE: A single small shell in lot 26 (A.M.N.H. No. 26572).

SUBFAMILY ZYGOPLEURINAE

All but a few of the forms which represent this subfamily in the Peruvian Triassic belong to the genus *Zygopleura, sensu lato*, explicitly discussed under the following heading. Of other genera of the subfamily only *Tyrsoecus* is represented.

ZYGOPLEURA KOKEN, SENSU LATO

This genus is here understood in the circumscription given it by Wenz (1938, pp. 383–385). Whereas neither *Zyglopleura, sensu stricto*, nor *Hypsopleura* is represented in our fauna, three other subgenera of *Zygopleura*,

sensu lato, namely, *Katosira*, *Kittliconcha*, and chiefly *Anoptychia*, are quite common. Two others, *Allostrophia* and *Allocosmia*, are represented by only one specimen each, the latter only doubtfully. These five subgenera contribute about 940 individuals to the present assemblage, thus making *Zygopleura*, *sensu lato*, one of the common genera, particularly in lots 78 and 48. Still it ranks only sixth in abundance, viz., after *Promathilda*, *Neritaria*, *Omphaloptycha*, *Cylindrobullina*, and *Guidonia*.

The comparatively large number of individuals referred to the first three of the subgenera enumerated above would have made it desirable to treat them as full-fledged genera; however, after careful consideration differences between some of their members appeared not sufficient for them to be granted generic rank.

Subgenus KATOSIRA Koken

This name was proposed, as a generic one, by Koken (1892a, p. 31; 1892b, p. 205). Kittl (1894, p. 162) redefined it, still considering *Katosira* an independent genus. Cossmann (1909, p. 27), however, relegated it to the rank of a section of *Zygopleura*, *sensu stricto*, simultaneously designating *Chemnitzia periniana* d'Orbigny (1850, p. 36, pl. 243, figs. 1, 2) from the Liassic of France as the type species. Wenz (1938, p. 384) treats it as a subgenus of *Zygopleura*, *sensu lato*, and the same procedure is followed in the present report.

Abundant as gastropods with conspicuous transverse costation are in the Peruvian material, only very few belong to this subgenus, and almost all occur in poor lots with only rare gastropods, whereas it is not represented at all in the lots particularly rich in gastropods such as 48, 78, or 86. Three species can be distinguished, of which only one can be closely compared with a St. Cassian species; the two others have been left unnamed.

Finally, an extremely poorly preserved incomplete shell in lot 40 which shows a faint indication of a transverse costation reminiscent of that of this subgenus is, though doubtfully and tentatively, referred to it. Even including the last, a total of only nine specimens is reached. This makes *Katosira* (after *Allostrophia* and *Allocosmia*, which are represented by a single specimen each) the third rarest among the subgenera of *Zygopleura* dealt with in the present report.

Zygopleura (Katosira) sp. indet. 1

Plate 7, figures 1–5

Dimensions

A.M.N.H. Nos.	H	W	h	π
26573:1	*ca.* 4.6 mm.	*ca.* 37	*ca.* 52½	21½°
26573:2	*ca.* 4.7	*ca.* 36	*ca.* 51½	23°

The third specimen present (A.M.N.H. No. 26573/1), of only about half the size of those above, is too incomplete to be measured, except for its pleural angle which amounts to 26 degrees.

Description: Shell subulate, consisting in the two measured specimens of seven or eight whorls which seem to increase faster in height than in width. Spiral whorls only very gently convex in profile, separated by shallow though distinctly engraved sutures. Base rather short, slightly concave, thus making the body whorl appear somewhat bulging, as compared to the spiral whorls. Peripheral shoulder well rounded. Aperture not complete in any of the specimens present; it seems to have been obliquely oval, with an upper (posterior) angulation and an indication of an anterior notch. The inner lip is reflexed over what seems to be a false umbilical niche.

The transverse ornamentation can be recognized only on unworn parts of the surfaces. The nuclear and early post-nuclear volutions seem to be smooth. Only on the four last whorls of the two larger shells can the costation safely be observed, but earlier in the small specimen A.M.N.H. No. 26573/1, the tip of which is broken off; here all the whorls present are costate. There are from 10 to 12 ribs per whorl which seem to increase with growth in strength but not in number. They are less wide than the intercostals and run steeply obliquely forward; only on the latest whorls present can they be seen to assume a slightly inverted-sigmoidal shape. As best seen in the small shell A.M.N.H. No. 26573/1 (figs. 4, 5), the ribs of later volutions tend to continue in the direction of those of the preceding ones. In the body whorl of this specimen, the ornamentation of which is preserved best, the

upper ends of the ribs project quite sharply from the suture, a feature that is somewhat reminiscent of the genus *Rhabdocolpus* (see pp. 233 ff.). Otherwise the character of the ornamentation is that of a *Katosira*, not of a *Rhabdocolpus*. Anyway, this specimen is only doubtfully referred to the present species. In this as well as in the other specimens the ribs seem to end at the periphery without continuing into the base. No spiral keels are recognizable on the latter, but an extremely fine revolving striation is noticeable where preservation permits, best on the transverse ribs on which it produces a fine denticulation.

EARLIEST ONTOGENETIC STAGES: Besides being smooth the nucleus under sufficient magnification can be recognized in specimen A.M.N.H. No. 26573:1 to be comparatively obtuse.

REMARKS: Of the St. Cassian forms referred to *Katosira* by Kittl, *K. seelandica* Kittl (1894, p. 162, pl. 4, figs. 33, 34) and *K. kokeni* Kittl (1894, p. 163, pl. 8, fig. 14) differ from the present form by having more convex whorls, as does *K. ?cassiana* Kittl (1894, p. 164, pl. 8, fig. 13) which is, however, only doubtfully referred to the genus by Kittl. *K. tyrolensis* Kittl (1894, p. 163, pl. 8, fig. 11) which otherwise closely resembles the type species, *K. periniana*, in shell shape and costation, differs from it as well as from the present species in that the ribs do not end abruptly at the periphery but continue into the base. Thus it seems doubtful if *tyrolensis* really belongs to this subgenus. *K.* (?) *lateplicata* (Klipstein) is only tentatively referred to *Katosira* by Kittl (1894, p. 162, pl. 4, figs. 33, 34) who emphasizes the presence of two lateral edges; it would seem rather to belong to the genus *Paracerithium* (see below, pp. 224–232). Kittl's illustrations prove how widely it differs from the typical species of the present subgenus.

For comparisons with *Z.* (*K.*) cf. *beneckei* and *Z.* (*K.*) *beneckei*, see the discussion of *Z.* (*K.*) cf. *beneckei* Kittl below.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
31	26573	2
57	26573/1	1 (incomplete)
	Total	3

Zygopleura (Katosira) sp. indet. 2

Plate 7, figures 8–11

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26574	*ca.* 3.24 mm.	*ca.* 49	*ca.* 46½	*ca.* 31°

Only slightly wider pleural angles, of 32 degrees and 35 degrees, respectively, have been measured in the two broken spires A.M.N.H. Nos. 26574/1 and 26574/2, which attain only about half the height of the shell measured above; in the latter also π measures about 35 degrees at the corresponding stage.

DESCRIPTION: This form must be dealt with apart from the preceding one since it is less slender and pointed in shell shape; it might be called slender-conical rather than subulate. Six or seven volutions can be counted in the largest shell present; the earlier volutions show a cylindrical rather than conical profile, as is the case in other Zygopleurinae (see the following descriptions of forms of the subgenera *Kittliconcha* and *Anoptychia*). This specimen, however, is badly worn; the whorl profile can better be studied in the small incomplete shells A.M.N.H. Nos. 26574/1 (fig. 8) and 26574/2 (fig. 9). It is gently convex and attains its maximum width somewhat above the lower suture. The sutures are shallowly engraved. The aperture seems to be similar in shape to that of the preceding species, but it is too poorly preserved for more detailed description. Base rather short and apparently slightly concave.

In the two better-preserved, smaller shells costation sets in on the fourth volution; it consists of about 11 ribs per whorl which are straight or nearly straight and run steeply obliquely forward. Unfortunately, their course cannot be studied on the worn surface of the body whorl of the largest specimen. There is an extremely fine revolving striation, observed as an equally fine denticulation of the transverse ribs, in the small shell A.M.N.H. No. 26574/2.

EARLIEST ONTOGENETIC STAGES: In both smaller specimens (A.M.N.H. Nos. 26574/1 and 26574/2) the nucleus is obtuse and slightly inclined towards the axis of the conch.

REMARKS: For comparison with *Z.* (*K.*) cf. *beneckei*, see that form.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
29	26574	1
33	26574/1	1
26	26574/2	1
	Total	3

Zygopleura (Katosira) cf. beneckei Kittl

Plate 7, figure 12

Cf. *Katosira Beneckei* KITTL, 1894, p. 163, pl. 8, fig. 12.

A.M.N.H. No.	DIMENSIONS H	W	h	π
26575	11.8 mm.	47	43	*ca.* 30°

DESCRIPTION: The incomplete shell measured above is turreted in shape and consists of 10 volutions (including the nuclear ones), but there must have been at least one more. The whorls are moderately convex in profile, with the maximum width at about the lowermost fourth of the height, and are separated by rather shallow sutures. The periphery is well rounded, the base short and obtusely conical. The aperture is almond-shaped, with a pronounced anterior canal. The columella is corkscrew-shaped and seems to be solid.

Transverse ornamentation is first recognizable on the fifth whorl and remains fairly constant from there on. Throughout the further development it consists of closely set, blunt folds which are from two to three times wider than the intervals between them and gently forward concave on the spiral whorls; only on the body whorl their inverse-sigmoidal course is just indicated. Twenty-one can be counted there. They do not continue into the base. On the small portion that is preserved of the base four inconspicuous revolving keels are recognizable. Above the periphery there is a fine revolving striation. The striae, about 15 of which can be counted from suture to suture, are decidedly undulating and lend a wrinkled aspect to the surface, particularly to the transverse folds which thus appear somewhat imbricate (cf. Kittl, 1894, pl. 8, fig. 12, *K. beneckei*).

EARLIEST ONTOGENETIC STAGES: The nucleus, though not too well preserved, can be recognized to be obtuse and slightly inclined towards the axis of the conch.

REMARKS: In shell shape and character of ornamentation, particularly in the wavy character of the revolving ornamentation, this form closely resembles *Katosira beneckei* Kittl from which it differs mainly in being less slender and pointed, the pleural angle of Kittl's type measuring only 16 degrees as compared to about 30 degrees in the present form. Also the ribs run a little obliquely forward in the St. Cassian species and on all volutions but the last are less concave.

From both preceding species of this subgenus, *Z.* (*K.*) cf. *beneckei* differs in being of larger size, having broader and blunter transverse ribs and more convex whorl profile, and from *Z.* (*K.*) sp. indet. 1, in addition, by a wider pleural angle.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
34	26575	1
15	26575/1	1
26	26575/2	1
	Total	3

The above description is based on the single shell from lot 34. The specimen from lot 15 is a poor fragment consisting of two volutions and with a pleural angle of 27 degrees; that from lot 26 is a shell fragment. Both exhibit the same ornamentational characters as the shell from lot 34.

SUBGENUS KITTLICONCHA BONARELLI

When proposing this subgenus of *Zygopleura*, Bonarelli (1927, p. 60) based it on the specimen illustrated by Kittl (1894, pl. 8, fig. 5) under the name *Loxonema walmstedti* Klipstein but renamed *Z.* (*K.*) *cassiana* by him. To this one specimen from St. Cassian[1] he added another from Carbajal, Argentina, under the specific name *Z.* (*K.*) *doelloi*.

Bonarelli's and Wenz' (1938, p. 385) conception of *Kittliconcha* as a subgenus of *Zygopleura* is followed here. From two other

[1] I found what I believe to be another specimen of *Z.* (*K.*) *cassiana* among the topotypes of *Z. hybrida* (Münster) from St. Cassian in the Yale collection.

subgenera of that genus, *Katosira* and *Anoptychia*, *Kittliconcha* differs essentially by the peculiarity of its ornamentation, keenly recognized by Bonarelli. From *Katosira* it differs by its strongly forward concave costation, which appears only comparatively late and attenuates and becomes intermittent or even sporadic on the body whorl, and by its much finer and fainter revolving ornamentation, perceptible only under favorable conditions of preservation. From *Anoptychia* it differs by the late appearance of ribs, whereas in the latter subgenus costation, if at all present, is restricted to early volutions and comparatively stiff and not so sinuous as in *Kittliconcha*.

The two following species of Bonarelli's subgenus can be distinguished within the present material. In addition, some 90 specimens in lots 78 and 48, mostly small juveniles or incomplete, do not permit recognition of specific characters and have therefore been labeled merely *Zygopleura* (*Kittliconcha*) sp. indet. (A.M.N.H. Nos. 26558, 26558/1). The same designation, though preceded by a question mark, has been given to a poorly preserved, incomplete shell from lot 86 (A.M.N.H. No. 27696) which, when complete, may have attained a height of almost 5 mm. and which seems to exhibit the distinctive characters of this subgenus. Within it, it resembles *Z.* (*K.*) *dissimilis* rather than *Z.* (*K.*) *peruviana*, but it differs by its greater width, lower spire, and wider pleural angle from the former species.

With a total of somewhat more than 400 individuals, this subgenus cannot be considered a rare one, but it ranks only second in abundance among the subgenera of *Zygopleura*, *sensu lato*, within the Peruvian material.

Zygopleura (Kittliconcha) peruviana, new species

Plate 7, figures 13–25

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26556/1:1	0.95 mm.	73½	23½	44°
26556/1:2	1.12	70	27½	48°
26556/1:4	1.23	64	25	46°
26556/1:13	1.40	68	32	46½°
26556/1:3	1.46	61½	27	41°
26556/1:9	1.57	?	32	*ca.* 49°
26556/1:7	*ca.* 1.74	*ca.* 58	*ca.* 29	45°
26556/1:5	1.79	56	31	42°
26556/1:14	1.79	56½	23½	46°
26556/1:8	1.79	62½	28	49°
26556:1	1.79	61	33	44°
26556/1:15	1.85	57½	33½	42°
26556/1:16	*ca.* 1.85	*ca.* 57½	*ca.* 36½	35°
26556/1:10	1.96	63	30	50°
26556/1:12	1.96	57	34½	37°
26556:2	2.02	58½	32	38°
26556/1:11	2.07	51½	32½	33°
26556/1:17	2.18	53½	34½	35°
26556:3	2.3	51	36½	37°
26556/1:18	2.46	57	34	31°
26556:9	3.32	47½	40	33°
26556:10	3.72	49	39	34°
26556:14	*ca.* 5.5	*ca.* 44½	*ca.* 39	30°
26556:15	6.36	44½	44½	29°
26556:17	7.08	42½	40½	26°
26556:18 (holotype)	7.8	42½	43	26°

The table shows drastically how W and π decrease with growth, while h increases. Thus W, more than three times the amount of h in the smallest shell measured, eventually equals it (No. 26556:15) or is, in the largest specimen measured (holotype), even slightly smaller. These growth trends may be considered a natural consequence of a loxonematid shell shape. As in other forms the dimensions of several shells of the same height are quite intentionally listed in the table to show the interaction of the various ratios. Thus greater thickness of the conch makes for a more obtuse pleural angle, but this effect may be diminished by greater height of the spire, as can be seen in one example.

SELECTION OF TYPE: Since the largest specimen present (A.M.N.H. No. 26556:18) well illustrates most of the important characters of this species, it is herewith designated the holotype.

DESCRIPTION: Shell small, consisting of up to eight volutions; in general of a loxonematid shape but with increasingly convex whorl profile, comparatively deep sutures, and large body whorl. The base is inverted-conical and only gently convex; its boundary with the lateral face of the body whorl is not marked by any edge. In apertural view its left outline slopes at an angle of about 45 degrees. The aperture is obliquely oval, with a marked angulation at its upper (posterior) end, but without anterior notch. The outer

lip is thin, the inner one thickened almost to form a callosity which more or less covers the shallow umbilical niche, more so in specimens A.M.N.H. Nos. 26556:15 and 26556:17 than in the holotype where that niche is clearly visible (figs. 19, 20). The columella is corkscrew-shaped and apparently solid.

Most characteristic of this species is its ornamentation which considerably varies, however, from individual to individual. The outstanding sculptural element is transverse ribs which appear rather suddenly, as illustrated best by the small juvenile A.M.N.H. No. 26556/1:2; only a few ribs are just perceptible in apertural view (fig. 15), whereas the second half of its body whorl, as seen in the opposite view (fig. 14), shows clearly six transverse ribs which are only very gently forward concave or even straight at this early stage (H = 1.12 mm.). There is some variation as to the stage at which this transverse costation appears, but its seemingly late appearance may often be due to less favorable preservation of the earlier spiral whorls, as in the holotype where they still appear smooth at a stage at which costation is already fully developed in shells with well-preserved surface. Thus in specimen A.M.N.H. No. 26556:20 (figs. 13, 25) the transverse ribs appear in the early part of the penultimate whorl; 10 can here be counted in that volution, and 12 in the body whorl. There they become increasingly forward concave; they are rather widely spaced. As a rule, they do not continue into the base; only here and there is a faint indication of such a continuation recognizable, rendering a sigmoidal aspect to the ribs concerned. Costation appears at about the same stage in some other individuals, for example, in A.M.N.H. No. 26556:22, which is otherwise very incomplete but shows well the sculptural development of three consecutive volutions (fig. 23). In the largest specimen present, the holotype, the ribs appear later than in many smaller shells of this species, namely, on the antepenultimate volution. There are still 12 decidedly forward concave, rather widely spaced, transverse costae per volution. In the body whorl they can be seen gradually to vanish on the base, but some remain sufficiently distinct to permit recognition of their inverse-sigmoidal course, emphasized by Bonarelli (1927, p. 60) when establishing the subgenus *Kittliconcha*. On the last part of the body whorl the costation degenerates; the ribs become thin, weak, and, after an unusually wide intercostal, the last become crowded. A similar development is also observable in specimen A.M.N.H. No. 26556:24, where the weakness and irregularity of the costation on the last whorl contrast even more strikingly with the sharp and regular ribbing of the last but one (fig. 24). This degeneration of the sculpture on the body whorl is undoubtedly a subgeneric character of *Kittliconcha*, also well observable in the genotype *K. cassiana* (Kittl, 1894, pl. 8, fig. 5). The phenomenon, noted by that author (1894, p. 150), that a single rib stands out almost like a varix,[1] is also observable in a few specimens of both this and the following species.

Only where preservation permits, for example, in the holotype (fig. 20), can fine growth striae be seen to run parallel to the ribs. Their lower parts, running across the base towards the umbilical niche, are recognizable even where the ribs do not yet continue on the base, as in specimen A.M.N.H. No. 26556:20. In the holotype some growth striae can be seen on the ribs as well as between them. This observation seems not to confirm Wenz' assumption in his subgeneric diagnosis of *Kittliconcha* (1938, p. 385) that the transverse ribs of this genus originate merely by amalgamation of growth striae.

For the sake of completeness it should here be noted that a few shells of which the surface is worn, although they are more readily referable to this than to the following species, appear smooth even at a large size (A.M.N.H. No. 26556:14; fig. 21).

In addition to the transverse sculpture an extremely fine, faint, revolving ornamentation can be observed in some shells, best where it produces tiny beads on the ribs, as in specimens A.M.N.H. Nos. 26556:1, 26556:20, and in the holotype, but occasionally also where no ribs are present (A.M.N.H. Nos. 26556:16 and 26556:17).

EARLIEST ONTOGENETIC STAGES: The nucleus, observable in several individuals (A.M.N.H. Nos. 26556:1, 26556:2, 26556:9,

[1] "Eine der [Rippen] sehr mächtig als Ausbauchung entwickelt."

26556:17, 26556/2:1) is obtuse, slightly inclined towards the axis of the conch and gradate, with whorls that are rectangular rather than convex in profile and smooth, as are the early post-nuclear ones.

To be distinguished from the slight inclination of the nucleus is a curvature of the spire found in a few shells, for example, A.M.N.H. No. 26556:23 (fig. 22). Such curvature of the spire, although an abnormality, seems to occur often in Zygopleurinae, to judge by some of Kittl's topotypes of St. Cassian species in the Yale collections.

REMARKS: This form cannot well be referred to either of the previously known species of this rare subgenus, *K. cassiana* from Tyrol or *K. doelloi* from Argentina. Both grow much larger than the present species, which also differs from *K. cassiana* by the later appearance of its costation and in maturity by its more acute pleural angle, and from *K. doelloi* by its more convex whorls and wider pleural angle.

The only other *Kittliconcha* occurring in the Peruvian fanua, *K. dissimilis*, is compared below.

Another Peruvian form of the genus *Zygopleura, sensu lato, Z. (Anoptychia) tambosolensis*, may also be said to come fairly close to the present species. In lots 78 and 48, where both forms are rather common, the juveniles are sometimes not easy to distinguish. Detailed comparison follows in the discussion of *Z. (Anoptychia) tambosolensis*.

From the species referred above to the subgenus *Katosira* this species can be distinguished by the following differences: Its body whorl grows larger. Its costation is not so uniform throughout the conch, but appears only comparatively late and tends to degenerate on the body whorl; also it does not end so abruptly at the boundary between the lateral face of the body whorl and the base, and the forward concavity of the ribs is more pronounced. From *Z. (K.) cf. beneckei*, which it somewhat resembles in shell shape, in particular, *K. peruviana* differs by the restriction of its costation to certain growth stages, whereas there it persists throughout the whorls, and by its lesser density (12 ribs per whorl, as a rule, as compared to 20 to 24 in the former species). Also the ribs are here rather sharp and much narrower than the intercostals, whereas in *Z. (K.) cf. beneckei* they are flat and much broader and crossed by revolving striae which are more distinct than those of the present species and somewhat wavy.

There are still other genera, belonging even to other families, from which *Z. (K.) peruviana* cannot always readily be distinguished, especially in the young. One is *Protofusus;* for comparison reference is made to the discussion of *P. gracilis* (p. 216).

Finally, juveniles of both *Kittliconcha* and *Protofusus* surprisingly resemble in shell shape some species of *Omphaloptycha*, namely, *O. jaworskii* and *O. jenksi*. Also in their measurements they come fairly close (compare tables of dimensions of the present species and of *O. jaworskii*, pp. 137, 138). As long as the transverse costation has not appeared, or if it is not preserved, small juveniles of *Z. (K.) peruviana* can be distinguished from equally small ones of *Omphaloptycha* only by their less pronounced umbilical niche and their slightly less gibbous body whorl.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	26556	45
48	26556/1	110
86	26556/2	1 (doubtful)
		156

If a proportionate part of the specimens of this subgenus that were left undetermined as to species be added to the above sum a total of about 200 individuals can be assumed for the present species.

It is worth noting that full-grown shells were found only in lot 78, whereas all those from lot 48 are small.

Zygopleura (Kittliconcha) dissimilis, new species

Plate 7, figures 26–35

A.M.N.H. Nos.	DIMENSIONS H	W	h	π
26557/1:1	1.18 mm.	71½	24	49°
26557/1:2	1.23	68	25	45°
26557/1:3	1.23	70½	27½	46°
26557/1:4	1.46	61½	27	44°
26557/1:5	1.46	65½	23	52°
26557:1	1.58	63	29	48°
26557/1:10	*ca.* 1.68	*ca.* 63½	*ca.* 30	49°

A.M.N.H. Nos.	H	W	h	π
26557:2	1.70	68½	34	52°
26557/1:11	1.79	56½	31½	40°
26557/1:12	*ca.* 1.79	*ca.* 65½	*ca.* 33	50°
26557:3	1.90	63	30½	42°
26557/1:6	1.90	54½	32½	38°
26557:4	1.95	72	28	52°
26557:5	1.99	64½	33½	*ca.* 45°
26557/1:7	2.02	58½	33½	43°
26557/1:8	2.10	56	29½	40°
26557/1:13	2.18	64	25½	52°
26557/1:9	2.24	60	32½	40°
26557:6	2.30	56	36½	41°
26557:7	2.49	53	38½	40°
26557:9	2.66	51½	33	38½°
26557:11	2.80	55	40	38°
26557:13	2.90	54½	41½	37°
26557:14	3.15	51½	37	38°
26557:15	3.32	52½	37½	35°
26557:17	3.65	52	37½	37°
26557:18	3.72	51½	35½	36°
26557:19	4.20	51½	38½	35°
26557:20	4.23	53	37½	39°
26557:21	4.23	54	41	38°
26557:22 (holotype)	5.76	46	37½	36°
26557:23	*ca.* 5.9	*ca.* 49	*ca.* 42	36°

In this species, too, h increases and W and π decrease with growth. It is, however, noticeable that the pleural angle does not decrease so far as it does in *K. peruviana.* Up to the largest sizes present it remains above the mark of 35 degrees, which it touches only twice, first at a height of the shell of 3⅓ mm., whereas in the preceding species pleural angles of 30 degrees and considerably below have been measured in shells exceeding 5 mm. in height. The observations made in dealing with *Z. (K.) peruvinaa* on the loxonematid trend in shell growth and on the mutual interrelations of W, h, and π apply to the present species as well.

SELECTION OF TYPES: One of the largest specimens present (A.M.N.H. No. 26557:22), which shows the ornamentation of the body whorl best, has therefore been designated holotype.

DESCRIPTION: Since *Z. (K.) dissimilis* closely resembles *Z. (K.) peruviana* except for certain specific differences, it can best be described by stressing those differences. As seen from the tables of dimensions, the sizes of both species are of the same order of magnitude, but within the material available *Z. (K.) dissimilis* does not quite reach the size attained by the holotype of *Z. (K.) peruviana.* In the form under discussion, too, up to eight volutions can be counted in the largest individuals present. In shell profile, however, it differs from the preceding species in having less convex whorls and shallower sutures. That lends a more unbroken aspect to the profile and, combined with the fact that the pleural angles are less acute in maturity, makes for a less slender and more conical appearance of the conch above the base. The latter is somewhat lower than in *Z. (K.) peruviana;* in apertural view it slopes at an angle of only about 35 degrees as compared to 45 degrees in the former. Thus the periphery of the conch is more distinct, but in this species, too, it is not marked by any edge but is well rounded. The aperture, unfortunately not complete in any of the larger shells, seems in general to have agreed with that of *Z. (K.) peruviana.* The thickening of the inner lip is more pronounced in the present species. In many specimens, for example, in the holotype, it forms a callosity (fig. 31) which covers most of the umbilical niche so that only its outer margin remains visible (fig. 29).

In this species, too, a transverse costation is the outstanding sculptural feature, but it appears somewhat later in the ontogeny and is, throughout it, weaker and somewhat denser than in *Z. (K). peruviana.* Thus it is found at the earliest on the body whorls of specimens A.M.N.H. Nos. 26557/1:7 and 26557/1:8 (figs. 26, 27), both about 2 mm. high, but in the preceding species on those of shells only slightly exceeding 1 mm. in height. However, costation appears at an unusually early stage in the individuals just mentioned. In the broken spire A.M.N.H. No. 26557:29 only a faint indication of transverse folds can be recognized at the same stage, but ribs deserving this name appear only on the next whorl, which is the antepenultimate preserved one (fig. 32). Costation also appears at about the same stage in paratype A.M.N.H. No. 26557:30 (fig. 28). In both these shells the ribs show the same course as they do at the same ontogenetic stage in *Z. (K.) peruviana,* but they are a little more closely set, there being from six to seven of them per half whorl; even eight per half whorl can be counted in the small but stout shell A.M.N.H. No. 26557/1:12. In

the last and best-preserved volution of paratype A.M.N.H. No. 26557:29 the costation has become more distinct but is still considerably less coarse and denser (seven ribs per half whorl) than it is in the preceding species at the same stage. In the holotype ribs appear much later than in the paratypes just discussed. There are only a few blunt folds on the penultimate whorl, but 17 or 18 not so prominent ribs can be counted on the body whorl. They follow the same inverse-sigmoidal course as in *Z.* (*K.*) *peruviana* (figs. 29, 30). In most of the other shells which attain the same or a similar size as the holotype the body whorl appears smooth, except for outstanding single ribs which occur in this species as well as in the preceding one (paratypes A.M.N.H. Nos. 26557:25 and 26557:28; figs. 33, 34). These cases seem to indicate the same degeneration of the costation on the body whorl.

Growth striae, which follow the same course as the ribs, and an extremely fine revolving striation are recognizable in the present species, best in paratypes A.M.N.H. Nos. 26557:26–26557:28. Of these, the last, which also shows an outstanding single rib, is illustrated in figure 28.

EARLIEST ONTOGENETIC STAGES: The nucleus can be studied in paratypes A.M.N.H. Nos. 26557:5, 26557:8, 26557:12, 26557:20, 26557:26, 26557:27, and 26557/1:8. It shows the characters reported above for *K. peruviana*. As examples the nuclei of paratypes A.M.N.H. No. 26557:27 and 26557/1:8 are illustrated in figures 35 and 26, respectively. Curved spires are also occasionally (A.M.N.H. No. 26557:31) found.

REMARKS: *Zygopleura* (*K.*) *dissimilis* differs from species of the subgenus *Anoptychia* (see pp. 124, 126, 127), especially *Z.* (*A.*) *ninacacana*, hardly more than it does from *Z.* (*K.*) *peruviana*.

The less pronounced costation of *Z.* (*K.*) *dissimilis* makes it even easier to distinguish from comparable *Katosira* species than *Z.* (*K.*) *peruviana*. Thus *Z.* (*K.*) cf. *beneckei*, although similar in shell shape, can readily be distinguished by its uniform costation which persists through development.

Protofusus delicatulus is compared below.

For the distinction of juveniles of *Kittliconcha* and some forms of *Omphaloptycha*, especially *O. jaworskii* and *O. jenksi*, see the respective remarks above. Since costation appears later in *Z.* (*K.*) *dissimilis* than in *Z.* (*K.*) *peruviana*, juveniles of *dissimilis* are even more difficult to disinguish from young *Omphaloptychae* than are those of *peruviana*.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	NO. OF SPECIMENS
78	26557	137
48	26557/1	22
		159

If a proportionate part of the individuals left specifically undetermined is added, the total number of specimens that belong to this species can be estimated at a little more than 200.

All the individuals found in lot 48 are small.

SUBGENUS **ALLOSTROPHIA** KITTL

Kittl (1894, p. 158) proposed this name as a generic one for *Melania perversa* Münster (1841, p. 96, pl. 9, fig. 41; Kittl, 1894, p. 159, *cum synon.*, pl. 6, figs. 37, 38), but Cossmann (1909, pp. 28, 29) relegated *Allostrophia* to a mere section of *Zygopleura*, *sensu stricto*, since its only distinctive feature is sinistral coiling, a fact of which Kittl (*ibid.*, p. 159) was well aware. Wenz (1938, p. 385) considers it, as here, a subgenus of *Zygopleura*. It is represented in the Triassic of Peru by the following specimen only.

Zygopleura (Allostrophia) sp. indet.

Plate 7, figure 36

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26563	*ca.* 8 mm.	*ca.* 27½	*ca.* 47½	*ca.* 15°

DESCRIPTION: The single shell here dealt with projects as a longitudinal section from a little slab of limestone, from which it unfortunately cannot be extracted chemically. It is slender-subulate in shape and exhibits sinistral coiling, a pointed apex, about seven rather high, gently convex volutions, and moderately deep, steeply oblique sutures. The last part of the body whorl seems to be broken and thus permits no statement

as to the shape of the aperture, but it can be assumed to have resembled that seen in Kittl's figure 37 of Münster's type of *Melania perversa*.

No part of the surface of the shell is preserved, but the cast seems to show on the anteriormost part of the penultimate whorl two rather strong, gently forward concave, transverse ribs.

REMARKS: What little is observed in this specimen seems to justify its reference to the subgenus *Allostrophia* and the characters would not even exclude its conspecificity with the type and only species, *Z.* (*A.*) *perversa*, but it is altogether much too poorly preserved for specific determination.

OCCURRENCE: A single specimen in lot 19, of which it is the only fossil (A.M.N.H. No. 26563).

SUBGENUS **ANOPTYCHIA** (KOKEN) KITTL

This name was proposed as a generic one by Koken (1892a, p. 32, footnote) for a group with transverse folds on the "uppermost volutions, excl. nucleus," which he considered to be close to his genus *Undularia*. Ever since its creation the history of this genus has been one of confusion. It started when Koken (*loc. cit.*) named "*Chemnitzia*[1] *supraplecta* Msr., *turritellaris*, *multitorquata* u.a. [and others]" as species belonging to his newly proposed genus. However, in his monograph of the Hallstatt gastropods (1897, p. 99) he corrected that enumeration, stating that it should have read *Turritella*, not "*Chemnitzia* [actually *Melania*] *supraplecta*" and that the two other species (*turritellaris*, *multitorquata*) had been included merely owing to a "lapse of memory." This later statement by Koken leaves not a single species to be selected as type of his genus and since his diagnosis is not sufficiently distinctive makes it undoubtedly a *nomen nudum*.

Meanwhile Kittl (1894, p. 152) had redefined Koken's genus, which he considered a subgenus of *Loxonema*, taking over the two species *Melania supraplecta* and *M. multitorquata* referred to it by Koken in 1892, but transferring *M. turritellaris* to *Coelostylina* (*ibid.*, p. 185, pl. 5, fig. 19). In addition to the two first species he also included *Melania canalifera* Münster and *Turritella carinata* Münster (with *T. supraplecta* Münster as a synonym) and, though doubtfully, two new species (*A. subnuda* and *A. janus*) in *Anoptychia*. Since Koken's enumeration of 1892 was declared by himself altogether erroneous, *Anoptychia* must be considered to have been established as a genus, or subgenus, only by Kittl in 1894, not by Koken in 1892, and in the circumscription given to it by Kittl.

Cossmann (1909, p. 30), unaware of Koken's (1897) recantation, quite incorrectly censored Kittl for not having respected Koken's "selection of type" and for having moved *A. canalifera* into the foreground. He formally designated "*Tur. supraplecta* Münst." as type species of *Anoptychia*. However, from his words "Diagnose refaite d'après la figure de l'espèce génotype (in Kittl, 1894, *loc. cit.* pl. VIII, fig. 6) reproduite [fig. 12]" and from this text figure it follows beyond doubt that Cossmann, falling victim to the same confusion as Koken 17 years earlier,[2] meant to establish *Melania supraplecta* Münster (1841, p. 96, pl. 9, fig. 40), but not *Turritella supraplecta* Münster (*ibid.*, p. 118, pl. 13, fig. 13) as the type species of *Anoptychia*.[3] Erroneous as Cossmann's premises were, his designation of *Melania supraplecta* Münster, misnamed by him "*Turritella supraplecta* Münster," as type species of *Anoptychia* is certainly valid. Unfortunately, however, he chose for its illustration (1909, fig. 12) Kittl's figure of a specimen which

[1] This generic name was applied to the species concerned by Laube (1864, p. 408; 1868, pp. 53, 55), but Münster had referred them to *Melania*.

[2] Cf. Kittl (1894, p. 156; 1899, p. 155, footnote 1).

[3] *Turritella supraplecta* had furthermore no nomenclatural standing in 1909, for it was both a synonym of *A. carinata* (Kittl, 1894, p. 156) and a homonym of *Melania supraplecta*, since both of Münster's species had been included by Kittl (1894) in *Anoptychia* and since the latter species takes precedence in Münster's original paper.

Furthermore, Koken (1892a, p. 32) included *Turritella carinata* Münster "u.a. triassische Arten [and other Triassic species]" in his genus *Undularia*. Among these other species *Turritella supraplecta* Münster, proved by Kittl to be a synonym of *carinata*, must certainly be included. This fact was, however, ignored by Koken in 1897 when he corrected his earlier enumeration to the effect that he originally meant to name the very same species in the first place among those representative of his genus *Anoptychia*.

that author (1894, p. 155, pl. 8, fig. 6) has explicitly stated deviated in various respects from the typical form. It should therefore be emphasized that Münster's original, refigured by Kittl (1894, pl. 4, fig. 54), must be considered the holotype of *Melania supraplecta*.

It is regrettable indeed that Wenz (1938, p. 385, fig. 924), despite Kittl's warnings, was misled into the belief that Cossmann really had meant to designate *Turritella supraplecta* Münster as type species of *Anoptychia*. Wenz listed it as such, although adding "=*carinata* (Münster) [*Turritella*]," and even figured one of the specimens of *carinata* illustrated by Kittl, although the latter species may well be considered the least typical of all those referred to *Anoptychia* by Kittl. With regard to the authority enjoyed by Wenz' handbook it may not be out of place here to repeat that *Melania supraplecta* Münster, not *Turritella supraplecta* Münster, is the type species of *Anoptychia*.

Although proposed as an independent genus by Koken, *Anoptychia* was treated as a subgenus of *Loxonema* by Kittl and of *Zygopleura, sensu lato*, by Cossmann and Wenz (*loc. cit.*), whose example is followed in the present report.

This subgenus, with two quite abundant species, is common in lot 78 but rare in lot 48. These two lots also include about 75 poorly preserved shells which may belong to one or the other of these species and have therefore been labeled merely *Z.* (*A.*) sp. indet. (A.M.N.H. Nos. 26562, 26562/1). A third comparatively rare species occurs in lots 86 and 48 only, and a very poorly preserved small shell in lot 87 is tentatively also referred to it. A fourth much larger species, ?*Z.* (*A*). sp. indet. 1, represented by an incomplete shell and some fragments in lots 71, 69, and perhaps 33, is only doubtfully referred to this subgenus. A small fragment of a body whorl from lot 26, under the designation ?*Z.* (*A.*) sp. indet. 2 (A.M.N.H. No. 26565), is not explicitly dealt with in the following descriptions of species.

With a total of about 530 individuals, *Anoptychia* is the most common subgenus of *Zygopleura, sensu lato*, in the Peruvian Triassic.

Zygopleura (Anoptychia) tambosolensis, new species

Plate 7, figures 37–43, 53, 54

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26559:1	2.72 mm.	55½	34	34°
26559:2	2.90	50	43	31½°
26559:3	2.99	50	41½	28°
26559/2	3.24	42½	44	23°
26559:4	3.40	46	41½	23°
26559:5	4.03	50½	39	28°
26559:6	4.08	48½	47	29°
26559:7	4.13	49	41	29½°
26559:8	4.20	43	43	23°
26559:9	4.32	45½	34½	28°
26559:10	4.32	44½	39	22°
26559:11	4.68	46	41	30°
26559:12	*ca.* 4.8	?45	*ca.* 45	27°
26559:13	4.92	46	41½	27°
26559:14	5.04	45	40½	20°
26559:15	6.06	33½	39½	22°
26559:16 (syntype A)	6.48	40½	42½	22°
26559:17	9.48	35½	47	24°
26559:18[1] (syntype B)	*ca.* 13.8	*ca.* 36	*ca.* 42½	21°

As with other Zygopleurinae in the present material, this species shows the trends of W and π to decrease, and of h to increase, with growth, although the last trend is much less steady than in the two species of the subgenus *Kittliconcha* just dealt with. Comparison of the tables of dimensions with the one above shows at a first glance that the present species, in its later growth stages at least, is markedly more slender and that it has, at the same sizes, quite regularly more acute pleural angles.

SELECTION OF TYPES: One of the best specimens present (A.M.N.H. No. 26559:16) is designated syntype A, and the largest shell (A.M.N.H. No. 26559:18), though incomplete, is designated syntype B.

DESCRIPTION: Shell consisting of up to eight volutions; shell shape slender-conical, becoming slightly subulate in maturity. Whorls gently convex, with the maximum convexity somewhat above the lower suture. The sutures are shallow and only moderately oblique. No subsutural ledge ("Nahtfacette") is observable. In syntype A (H = *ca.* 6.5 mm.)

[1] Incomplete.

the penultimate whorl is almost twice as wide as high, whereas in syntype B (H = *ca.* 14 mm.) this ratio has decreased to 1.57. The base is comparatively short and only slightly concave. The lateral face of the body whorl changes without any edge into the base, the boundary zone being well rounded (figs. 40, 41, 53). The aperture is unfortunately not complete in any specimen examined; it seems to have been obliquely elliptical, with angulations at both ends. The inner lip is thickened and somewhat reflexed; an umbilical niche is indistinctly recognizable in some shells (syntype A and A.M.N.H. No. 26559:17; figs. 41 and 37, respectively) but not in syntype B (fig. 54). The columella is corkscrew-shaped and apparently solid.

For all practical purposes, the shells of this species appear smooth. Only occasionally, as in syntype A and specimen A.M.N.H. No. 26559:19, can a transverse costation be recognized, which is restricted to one of the earlier volutions, the sixth in syntype A and the fifth in specimen number 19. This costation consists of gently forward concave, rather blunt ribs, five of which can be counted per half whorl in the latter specimen (fig. 42). Other shells, such as syntype B or A.M.N.H. No. 26559:20, show indistinct folds on the body whorls which are obviously bundles of growth striae, as seen from their inversely sigmoidal course, as it is quite common in the Loxonematidae (figs. 53 and 38, respectively). Otherwise growth striae can be observed only occasionally (specimen A.M.N.H. No. 26559:7), but not a few shells, for example, A.M.N.H. No. 26559:21, seem to carry a faint, extremely fine revolving striation (fig. 39).

EARLIEST ONTOGENETIC STAGES: The nucleus, well observable in specimen A.M.N.H. No. 26559:22, is comparatively pointed and distinctly gradate, with its second whorl markedly projecting beyond the first, and cylindrical rather than conical, with flat, not convex whorl profiles. The nuclear whorls are smooth.

REMARKS: This form cannot be referred to any of the species of this subgenus from the Triassic of the southern Alps of Europe. It differs from *Z.* (*A.*) *canalifera* (Münster) (see Kittl, 1894, p. 152, *cum synon.*, pl. 4, figs. 41–45) by its more convex whorl profile and more acute pleural angle, from *Z.* (*A.*) *multitorquata* (Münster) (see Kittl, 1894, p. 154, *cum synon.*, pl. 4, figs. 51–53) chiefly by its higher whorls, and from *Z.* (*A.*) *supraplecta* (Münster) (see Kittl, 1894, p. 155, *cum synon.*, pl. 4, figs. 54, 55, ?pl. 8, fig. 6) mainly in its gently convex whorl profile which lacks a laterobasal edge.

The other species of *Anoptychia* dealt with in the present report, *Z.* (*A.*) *tilarniocensis* and *Z.* (*A.*) *ninacacana*, are compared below.

As indicated above, this species, especially in its early stages, so closely resembles *Z.* (*Kittliconcha*) *peruviana* as to make distinction, particularly of juveniles, sometimes not easy. Adults of *Z.* (*A.*) *tambosolensis* can, however, readily be distinguished from those of *Z.* (*K.*) *peruviana* by their more slender shell shape which tends to become subulate, less convex and somewhat higher spiral whorls, smaller body whorl, more acute pleural angle, and by certain characters of the ornamentation. If there is any costation at all recognizable in the species under discussion, it is restricted to one of the earlier volutions, whereas in *Z.* (*K.*) *peruviana* it persists through several, including the body whorl, although it tends to degenerate there. Also the ribs in *Z.* (*A.*) *tambosolensis*, where present, are less prominent, less sharp, and less forward concave than in that species. From *Z.* (*K.*) *dissimilis* the present species differs furthermore by its somewhat more convex whorl profile.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	26559	*ca.* 270
48	26559/1	2 (doubtful)
31	26559/2	1
		ca. 273

If a proportionate part of the individuals of this subgenus in lots 78 and 48 which could not be determined as to species is added, the total specimens belonging to this species can be estimated at about 320.

As seen from the above tabulation, this species is almost exclusively restricted to lot 78. Its trivial name was taken from the village of Tambo del Sol, near which this lot was collected. Many of the individuals in this lot are juveniles.

The single small shell from lot 31 is somewhat more slender than shells of the same size from lot 78.

Zygopleura (Anoptychia) tilarniocensis, new species

Plate 7, figures 44–50, 55, 56

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26560:1	2.16 mm.	?53	36	35°
26560:2	3.07	51½	35	32°
26560:3	3.32	47½	40	26°
26560/1:1	3.57	39½	37	29°
26560:4	3.82	45½	43½	30°
26560:5	4.44	46	40½	30°
26560:6	4.50	40	40	30½°
26560:7	4.56	44½	42	25°
26560:9	4.68	43½	42½	29°
26560:11	4.92	39	44	22°
26560:12	5.28	44	40	31°
26560:13	5.40	40	42	24°
26560:14	5.76	44	44	28½°
26560:15	*ca.* 7.68	*ca.* 40	*ca.* 47	21½°
26560:16	8.16	35½	45½	22°
26560/1:2 (holotype)	15.50	32½	49	23°

The trends inferred from the above measurements are about the same as for *Z.* (*A.*) *tambosolensis*, except that the decrease in W is more drastic. It can be observed in this species more clearly than in *Z.* (*A.*) *tambosolensis* how, from a total height of about 4 mm. on, the increase of the shell in absolute width becomes slower than the general growth.

SELECTION OF TYPE: The largest specimen present (A.M.N.H. No. 26560/1:2), which shows the mature shell shape well, is designated holotype.

DESCRIPTION: Since this species is closely related to the preceding one, from which it is separated by specific differences only, emphasis on these differences can suffice for the present description. The largest shell present (holotype) seems to comprise nine volutions. The shell shape is slender-conical and, owing to the peculiarity of its growth, somewhat more clearly subulate than in *Z.* (*A.*) *tambosolensis*. Also the whorls are somewhat higher, the ratio of width to height (from suture to suture) decreasing to 1.48 in the holotype, and less convex in profile, with their maximum width immediately above the lower suture. This makes the sutures appear even shallower than in the preceding species and lends a decidedly conical, almost unbroken aspect to the shell profile. The base is a little higher, gently concave, and separated from the lateral face of the body whorl by a clearly recognizable, though well-rounded peripheral shoulder. No apical ledge is present in this species either. None of the specimens exhibits a complete aperture. To judge by the holotype (fig. 46) the aperture seems to have had a similar shape as assumed above for *Z.* (*A.*) *tambosolensis*, but the lower (anterior) angulation assumes a beak-like appearance ("bec" Cossmann) which, owing to conditions of preservation, even simulates an anterior canal.[1] This impression is further reënforced by the fact that the corkscrew-shaped columella swings to the left to support one more volution which is not preserved. The corkscrew shape of the columella is best visible in specimen A.M.N.H. No. 26560:17 (fig. 55); as seen here, it is not perforated. There is a distinct umbilical niche, well observable in the holotype (fig. 46). In some individuals (e.g., A.M.N.H. No. 26560:10), however, the umbilical niche is almost entirely covered by the callosity formed by the reflexed outer lip. Such specimens closely resemble in their umbilical aspect the holotype of *Z.* (*Kittliconcha*) *dissimilis* (compare fig. 48 with fig. 31).

Like the preceding species, the present one appears smooth at first sight; only here and there can ornamentation be observed. The same transverse costation as occasionally observed in *Z.* (*A.*) *tambosolensis* is found on the early whorls of some individuals (A.M.N.H. Nos. 26560:18, 26560:19; see fig. 56). A somewhat denser and stiffer costation is indistinctly seen at a lower site, namely, on the seventh volution, in the otherwise poorly preserved and crushed shell A.M.N.H. No. 26560:20 the conspecificity of which is not absolutely certain. The growth striation is that common in the genus and does not differ from that occasionally observed in the preceding species. Single

[1] A similar deception (later cleared up by Kittl, 1894, p. 153) seems to have suggested to Münster the trivial name *canalifera* for one of the St. Cassian *Anoptychia* species.

growth striae are recognizable in specimen A.M.N.H. No. 26560:13 (fig. 50), and bundles of them on the body whorl of A.M.N.H. No. 26560:10 (figs. 47, 48). Finally, there is a fine revolving striation in the present species. It is faintly observable in the shells A.M.N.H. Nos. 26560:7 and 26560:20 on the sides and in A.M.N.H No. 26560:21 on the base, but quite distinctly between and on the ribs, on which it produces minute beads, of paratype A.M.N.H. No. 26560:19 (fig. 56).

Some irregular, rather broad, blunt revolving ridges are quite clearly visible on the base of the holotype (fig. 44).

The earliest ontogenetic stages, best observable in specimens A.M.N.H. Nos. 26560:13 (fig. 50) and 26560:14, agree with those of *Z.* (*A.*) *tambosolensis.*

REMARKS: This species resembles *Z.* (*A.*) *canalifera* (Münster) from St. Cassian in shell shape, particularly in having a pronounced, though rounded peripheral shoulder, but its whorls tend to increase less fast in width than in height and it has at the same size a more acute pleural angle and always a prounounced umbilical niche. On the contrary, Münster's species is called "ungenabelt" (non-umbilicate) by Kittl. *Z.* (*A.*) *supraplecta* (Münster) from St. Cassian also has a similar shell profile but even flatter whorls and lacks an umbilical niche. *Z.* (*A.*) *multitorquata* (Münster) from the same fauna is readily distinguishable by its lower, more convex whorls.

For comparison of *tilarniocensis* with *Z.* (*A.*) *ninacacana* and *Z.* (*A.*) sp. indet. 1, see those species.

As *Z.* (*A.*) *tambosolensis* resembles *Z.* (*Kittliconcha*) *peruviana*, so the present species resembles *Z.* (*K.*) *dissimilis* with which it has the almost flat whorl profile in common. Distinction, especially of juveniles, is not always easy. The same differences that can be depended on for distinguishing *Z.* (*A.*) *tambosolensis* from *Z.* (*K.*) *peruviana* serve also to distinguish *Z.* (*A.*) *tilarniocensis* from *Z.* (*K.*) *dissimilis*. The shell is more slender, the body whorl smaller, and the transverse costation, where present and recognizable, restricted to one of the earlier whorls, less dense and even less pronounced than in *Z.* (*K.*) *dissimilis.*

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	26560	*ca.* 150
48	26560/1	13
		ca. 163

Addition of a proportionate part of the *Anoptychia* specimens from lots 78 and 48 left undetermined as to species increases the probable total number of individuals of this species to about 190.

Although this species is much more abundantly represented in lot 78 than in lot 48, its holotype was selected from the latter. It was named after the town of Tilarnioc from the vicinity of which lot 48 was collected.

Zygopleura (Anoptychia) ninacacana, new species

Plate 7, figures 51, 52, 57–61, 65–70

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26561:7	1.79 mm.	70½	31	44°
26561/1:1	1.96	63	28½	37°
26561/1:2	2.35	58	31	33°
26561:9	*ca.* 2.46	*ca.* 62½	*ca.* 34	52°
26561:1	2.69	57	33½	36°
26561:8	2.91	57	38½	34°
26561:2	3.98	52	33½	35°
26561:3 (holotype)	9.60	43½	37½	34°

This species, too, shows a certain increase in h and a pronounced decrease in W, but π stops decreasing at an early stage. Specimen A.M.N.H. No. 26561:9 deviates quite markedly by greater width and by an unusually wide pleural angle.

SELECTION OF TYPE: The largest specimen present (A.M.N.H. No. 26561:3), which is almost complete, is designated holotype.

DESCRIPTION: The shell, consisting of up to seven whorls, is conical in shape. The whorls attain their maximum width immediately above the lower suture. The ratio of width to height (from suture to suture) amounts to 1.86 in the last whorl of the holotype. A narrow, but distinct, sloping subsutural ledge ("Nahtfacette") appears in the post-nuclear stage, as a rule earlier in the juveniles from lot 48 (A.M.N.H. Nos. 26561/1:1, 26561/1:2) than in those from lot 86 (A.M.N.H. Nos.

26561:7, 26561:1, as clearly seen by comparing figures 57 and 58 with figures 67 and 68. In paratype A.M.N.H. No. 26561:9, however, this subsutural ledge is well developed at a size somewhat smaller than that of paratype A.M.N.H. No. 26561:1. This ledge makes the sutures appear rather deep. They are also remarkable for being comparatively steeply oblique, the "Nahtanstieg" (Häberle, = gradient of the suture) reaching almost 15 degrees in maturity. Except for the subsutural ledge and a slight supersutural reëntrant, the whorl profile is almost flat. The base is comparatively high, slightly concave, and separated from the lateral face of the body whorl by a rounded peripheral shoulder which is quite pronounced even in the smallest shell present (A.M.N.H. No. 26561:7). In the six juveniles measured the aperture is subcircular, though with an upper (posterior) angulation. In none of the adults present is the aperture completely preserved. From an incomplete shell (A.M.N.H. No. 26561:4), which repeats in every respect the characters of the holotype, it can be inferred to have been obliquely rhombic, with angulations at both ends, an only slightly convex outer lip, and a markedly concave inner one; the latter is thickened and a little reflexed (fig. 66). In the apertural view of the holotype (fig. 52) the lower end of the aperture is seen to form a beak, as in the holotype of *Z.* (*A.*) *tilarniocensis;* here, too, this beak simulates an anterior canal.

The three smallest shells present (A.M.N.H. Nos. 26561:7, 26561:1, 26561/1:2), have pronounced umbilical niches (figs. 59, 58, 68), which seem to persist longer in the shells from lot 48 than in those from lot 86, for in specimens A.M.N.H. Nos. 26561:9, 26561:1, and 26561:8, although not so much larger than A.M.N.H. No. 26561/1:2 (see dimensions), there is only a rudimentary umbilical niche (compare figs. 68 and 70 with fig. 58). In larger individuals it has disappeared entirely (figs. 52 and 66). In two broken shells (A.M.N.H. Nos. 26561:5, 26561:6) the columella can be recognized to be corkscrew-shaped and apparently not perforated, but in the smallest shell (A.M.N.H. No. 26561:7) the umbilical niche can be seen in basal view (fig. 60) to continue into a narrow umbilicus. Except for a faint indication of blunt transverse folds on the penultimate whorl of paratype A.M.N.H. No. 26561:8 (fig. 69), all the shells examined appear to be smooth and show no growth striae.

The nucleus, well observable in some of the juveniles (A.M.N.H. No. 26561:8) and in the holotype, is gradate and also smooth (figs. 70, 61).

REMARKS: From *Z.* (*A.*) *tambosolensis* and *tilarniocensis*, *Z.* (*A.*) *ninacacana* can be readily distinguished by its markedly wider pleural angle, by the presence of a subsutural ledge, and by the absence in maturity of an umbilical niche.

From *Z.* (*A.*) *supraplecta* (Münster) from St. Cassian which it somewhat resembles in shell shape, *Z.* (*A.*) *ninacacana* differs by having a more obtuse pleural angle, more oblique sutures, and higher base and aperture; from *Z.* (*A.*) *canalifera* (Münster) of the same fauna by its higher and flatter whorls; and from both of Münster's species by the presence of a subsutural ledge and the absence of any transverse ornamentation even in the early volutions.

Its smoothness and the subsutural ledge serve to distinguish this species from *Z.* (*Kittliconcha*) *dissimilis* which it resembles in shell shape.

Going beyond the limits of the genus *Zygopleura*, a certain similarity in shell shape between the juveniles of this species and those of some *Omphaloptycha* species must be noted; it is further increased by the fact that the former exhibit pronounced umbilical niches, as mentioned in the description.

Most striking, however, is the resemblance between the holotype of this species and *Endiataenia terquemi* Cossmann (1906, p. 23, pl. 5, figs. 31, 32, pl. 6, figs. 6, 6 bis), from the Liassic of France, the type and so far only species of *Endiataenia* Cossmann. This resemblance is, however, not believed to go far enough to warrant congenerity, for *E. terquemi* lacks the subsutural ledge and has a much more pronounced peripheral edge and a clear umbilical niche even in maturity. As suggested by Cossmann (*loc. cit.*), Wenz (1938, p. 394) placed this rare genus tentatively in the Coelostylinidae. Thus the similarity in the young and in mature shell shape suggest that of the Zygopleurinae dealt with in

the present report this species closely approaches the Coelostylinidae, as does the following one.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26561	15
48	26561/1	2 (juveniles)
87	26561/2	1 (doubtful)
	Total	18

The trivial name was taken from the village of Ninacacana in the vicinity of which lot 86 was collected.

?Zygopleura (Anoptychia) sp. indet. 1

Plate 7, figures 64, 71

A.M.N.H. No.	H	W	h	π
26564:1	41.3 mm.[1]	*ca.* 41[2]	*ca.* 52[2]	*ca.* 25°[2]

When complete, this specimen must have been at least 45 mm. high.

DESCRIPTION: Shell slender, conical; in the largest individual present, measured above, eight volutions can be counted, but there must have been at least 10. In the antepenultimate volution the ratio of width to height is 27/11. The whorl profile is moderately convex, with the maximum width somewhat above the lower suture. The sutures are clearly engraved and moderately steeply oblique.

The aperture is not preserved in any of the shells present, but the inner lip, which is somewhat thickened and reflexed, is recognizable in an otherwise very poorly preserved cast of a body whorl (A.M.N.H. No. 26564/2) which is tentatively referred to this species. In a transverse slice from a young shell (A.M.N.H. No. 26564:2) the columella appears to be perforated. As seen indistinctly in the largest shell but quite clearly in a fragment from lot 69 attaining a width of about 11 mm. (A.M.N.H. No. 26564/1:2), there is a pronounced peripheral shoulder, and the base is truncate and flatly conical. The umbilical region, however, is not visible in any specimen.

Except for a few indistinct growth folds, which are perceptible on the antepenultimate volution of specimen A.M.N.H. No. 26564:1, the only ornamentation found in this species is a revolving one on the base of the fragment mentioned above. It consists of broad, flat lirae, separated by much narrower, shallow furrows. Seven or eight such lirae can be recognized, which in general increase in breadth and strength towards the center of the base, but their total number seems to have been at least 10.

Since the apex is not preserved in any of the few shells available, the early ontogenetic stages could not be studied.

REMARKS: Since the aperture could not be examined, this form is only doubtfully referred to the subgenus *Anoptychia* of *Zygopleura*. In general shell shape it considerably resembles some species of the subgenus *Allocosmia*, for example *Z.* (*Allocosmia*) *insignis* (Koken, 1897, p. 98, pl. 15, figs. 1, 10, pl. 17, figs. 1, 3, 9), but Koken's species, especially in its later stages, has more convex and better-rounded whorls, lacking the pronounced peripheral shoulder observed in the present species. There is also considerable resemblance to *Coelostylina irritata* Kittl (1895, p. 159, pl. 5, figs. 15–19), later referred by the same author (1899, p. 130, pl. 14, figs. 10, 11) to the genus *Omphaloptycha*,[3] especially with the specimen illustrated in Kittl's figure 17, but all these forms from the Marmolata and from Esino also have a larger, more rounded body whorl than the present one can have had.

Although this form thus somehow approaches *Allocosmia* and even some Coelostylinidae, the revolving ornamentation of the base, as found sometimes in *Anoptychia* but, as far as I could ascertain, not in *Allocosmia* or *Coelostylina*, suggests its reference to *Anoptychia* rather than to *Allocosmia*.

From all three of the *Anoptychia* species described above from lots 78, 48, and 86 the present form deviates in being much larger. *Z.* (*A.*) *tilarniocensis* comes closest in whorl profile but is markedly more slender and assumes at a much earlier stage a more

[1] As preserved.

[2] Measured from penultimate whorl up.

[3] As the genera *Coelostylina* and *Omphaloptycha* are understood in the present report, *irritata* would have to be referred to the former rather than to the latter genus. However, some of Kittl's Marmolata specimens may belong to *Allocosmia*.

acute pleural angle. Also the revolving ornamentation of its base is not so pronounced and regular as in the present species.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
71	26564	2
69	26564/1	3
33	26564/2	1 (doubtful)
		—
Total (including fragments)		5

SUBGENUS **ALLOCOSMIA** COSSMANN
(=**HETEROCOSMIA**
KOKEN, NON EHRENBERG)

?Zygopleura (Allocosmia) sp. indet.

DESCRIPTION (INCLUDING DIMENSIONS): A single incomplete cast, with only some relics of the test preserved, consists of three volutions. As preserved, it measures about 50 mm. in height and attains a width of 26 mm.; the pleural angle is about 15 degrees. The whorl profile is strongly convex and rounded; the sutures must have been quite deep and are rather steeply oblique. Neither nucleus nor aperture can be studied. As preserved, this cast shows a rather wide umbilical opening, but, taking the thickness of the test as indicated by the width of the gap between two consecutive volutions into account, this opening might well have been left behind by a massive columella. No ornamentation of any kind can reliably be observed on this specimen.

REMARKS: The characters in the description and the size would refer this specimen to the subgenus *Allocosmia* of *Anoptychia*, but its preservation permits no more than a tentative determination, certainly not a specific one. However, in shell profile it is reminiscent of the type species *Z. (A.) grandis* (Hörnes) (see Koken, 1897, p. 99, *cum synon.*, pl. 15, figs. 4, 9, 12, 16, 17, pl. 16, fig. 3) and of the closely related *Z. (A.) insignis* (Koken, 1897, p. 99, pl. 15, figs. 1, 10, pl. 17, figs. 1, 3, 9).

OCCURRENCE: A single incomplete cast in lot 38 (A.M.N.H. No. 26566).

TYRSOECUS KITTL

SUBGENUS **TYRSOECUS**, SENSU STRICTO

Kittl proposed this generic name in 1892 (p. 54) for a group of St. Cassian forms previously referred to *Turritella*, but recognized by him to be Loxonematidae instead. However, Koken (1892a, p. 31) proposed, apparently later in the same year, the generic name *Coronaria* for *C. coronata*, which comes under *Tyrsoecus* as conceived by Kittl. In 1894 (p. 165) Kittl obligingly granted precedence to Koken's name which had been proposed by the latter first (1892a) as an independent genus, then (1892b, p. 204) as merely a section of *Zygopleura*.

Cossmann, after having replaced in 1895 (1895b, p. 62) Koken's preoccupied name by *Stephanocosmia*, maintained in 1909 (p. 34) the latter as an independent genus, with two subgenera, *Stephanocosmia, sensu stricto*, and *Goniospira*,[1] and included *Tyrsoecus* as a section in the former subgenus.

It is, however, believed that Kittl (1894) could not properly forsake the priority of his clearly defined name of 1892 (*Tyrsoecus*) and that therefore Wenz (1938, pp. 387, 388) was correct in using it as the generic name, relegating both *Stephanocosmia* Cossmann (= *Coronaria* Koken) and *Goniospira* Cossmann (= *Goniogyra* Kittl) to subgenera of *Tyrsoecus, sensu lato*. Thus *Turritella compressa* Münster (1841, p. 120, pl. 13, fig. 22) becomes the type species of *Tyrsoecus*, not only *sensu stricto* but *sensu lato*. *Coronaria coronata* Koken remains the type species of *Stephanocosmia*. Both Cossmann and Wenz otherwise agree that the two subgenera differ by the presence of a revolving ornamentation in *Tyrsoecus, sensu stricto*.

In the Peruvian material *Tyrsoecus, sensu stricto*, is represented in lot 37 by several specimens belonging to two different species. In addition, an extremely poor fragment from lot 16A (A.M.N.H. No. 26557) is doubtfully referred to this subgenus.

Tyrsoecus (Tyrsoecus) andinus Bonarelli

Plate 7, figures 74–78

Tyrsoecus andinus n. f.; BONARELLI, 1921, p. 71, pl. 10, fig. 17.

Tyrsoecus moniliformis n. f.; BONARELLI, 1921, p. 71, pl. 10, fig. 18.

Tyrsoecus perarmatus n. f.; BONARELLI, 1921, p. 71, pl. 10, fig. 19.

[1] Cossmann, 1895, replacing *Goniogyra* Kittl, 1894 (p. 167) which also is a homonym.

Tyrsoecus andinus n. f.; COSSMANN, 1925a, p. 202, *cum synon.*

Tyrsoecus andinus Bonar.; BONARELLI, 1927, p. 80, pl. 3, fig. 6.

Tyrsoecus moniliformis Bonar.; BONARELLI, 1927, p. 80, pl. 3, fig. 7.

Tyrsoecus perarmatus Bonar.; BONARELLI, 1927, p. 81, pl. 3, fig. 8.

?Stephanocosmia tyrsoecina Bonar.; BONARELLI, 1927, p. 79, pl. 3, fig. 5.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26568:1	*ca.* 12.0 mm.	*ca.* 44	*ca.* 50	17°[1]
26568:2	*ca.* 12.0[2]	?	?	17°
26568:3	*ca.* 20.0[3]	?	?	18°

DESCRIPTION: Shell turreted; in the two larger specimens present (nos. 3, 4), both of which are incomplete, six or seven volutions are preserved, but there must have been at least three more. Whorl profile sharply angular, with the upper band sloping less steeply than the lower one. While the peripheral shoulder marks about half the height in the earlier spiral whorls it moves downward, to about the lower third, in the course of growth. The sutures are rather deep and only slightly oblique. Base rather short, slightly concave, and separated by a distinct edge[4] from the lower lateral band of the body whorl. The aperture is not complete in any shell present, but in the smallest (no. 1) it can be seen to have been subcircular in shape (fig. 76).

The transverse ornamentation consists of rather indistinct ribs which run almost perpendicularly across the upper band of the whorl but turn slightly forward on the lower, thus forming a very obtuse angle on the peripheral shoulder, where they culminate in prominent nodes. These nodes are transversely elongated but tend to become bullate on the body whorl. If preservation is poor, these nodes are the only sculptural elements that can be recognized. About 20 transverse ribs or nodes can be counted per whorl.

The revolving ornamentation is recognizable only in the two smaller specimens present (nos. 1, 2), best in number 1 (figs. 75, 76). There are three revolving keels on the lower band of the whorls, one immediately below the peripheral shoulder, one immediately above the suture, or the lower edge of the body whorl, respectively; the third keel, between them, is weaker and thread-like. Particularly on the earlier whorls, these keels can be recognized to be beaded, apparently owing to the crossing of the transverse ribs or growth striae, which are otherwise not perceptible. No revolving ornamentation can be seen on the upper band of the whorls.

The earliest ontogenetic stages cannot be studied in any specimen present.

REMARKS: Bonarelli's species *Tyrsoecus andinus* is here taken in the circumscription given it by Cossmann, viz., including Bonarelli's two other species listed in the synonymy. Bonarelli maintained, in his 1927 paper, their independence, writing that he would state his reasons in a later paper; this later paper I have not been able to find. Cossmann's procedure seems to be correct, especially since both *T. moniliformis* and *T. perarmatus* are represented by only a single specimen each, and both are rather poor. The fragment illustrated by Bonarelli (1921, pl. 10, fig. 13) under the erroneous designation *Stephanocosmia frequens* and refigured by him (1927, pl. 3, fig. 5) as *S. tyrsoecina* may also be conspecific with *T. andinus*, as assumed by Cossmann. In any case there can be no doubt as to the conspecificity of this Peruvian form with the typical *T. andinus*, as seen by comparing the illustration of the type (1927, pl. 3, fig. 6) with our figures 74, 77, and 78. The tubercles are slightly more closely set in the Peruvian shells, but the same is true for "*T. perarmatus*," included in *T. andinus* in the present report as well as by Cossmann. That no revolving ornamentation is observable in the Argentinian specimens may be owing to the worn condition of their surfaces, reported by Cossmann; this is also true for the two larger shells from Peru.

Among the species from St. Cassian, *T. subcompressus* (Kittl, 1894, p. 166, pl. 4, figs. 31, 32) most resembles the present species, in having three distinct, though almost thread-like, revolving keels on the lower whorl face and in other characters, but the peripheral shoulder is less pronounced and its transverse ornamentation less dense.

[1] If measured from penultimate whorl up, 23°.

[2] Height of fragment.

[3] As preserved.

[4] Called "sublaterale Kante" by Kittl (1894, p. 165) in his discussion of the genus "*Coronaria*."

The only congeneric species within the Peruvian material, *T.* (*T.*) *obtusus*, is compared below.

OCCURRENCE: Very rare (four specimens) in lot 37 (A.M.N.H. No. 26568).

Tyrsoecus (Tyrsoecus) obtusus, new species

Plate 7, figures 72, 73, 81–83

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26569:1	*ca.* 6.0 mm.[1]	?[2]	?	33°
26569:2 (syntype A)	7.6[1]	?[3]	?	31°
26569:3 (syntype B)	21.7[1]	?[4]	?	37°

SELECTION OF TYPES: Specimen A.M.N.H. No. 26569:2 shows the juvenile shell shape and the details of ornamentation best and is therefore designated syntype A. The mature shell shape and sculpture are best illustrated by the largest specimen, A.M.N.H. No. 26569:3, which is therefore designated syntype B, although it is deformed.

DESCRIPTION: This species is undoubtedly congeneric and closely related to *T.* (*T.*) *andinus* but differs quite markedly by its considerably wider pleural angle, stouter shell shape, the fact that the peripheral shoulders project farther, and by the resulting deeper sutures. There are furthermore minor differences in ornamentation.

In syntype A the aperture is subcircular (fig. 73). In this figure, the appearance of a furrow accompanying the lower part of the inner margin and simulating an umbilical niche is caused by the fact that the inner lip is broken off.

In one place of the penultimate whorl and in the anteriormost part of the last whorl of syntype A sharp, somewhat lamellar growth striae are recognizable which run backward above, and forward below, the peripheral shoulder, thus forming a rather sharp angulation on the shoulder (fig. 81). This suggests that the indistinct folds following the same course and culminating on the periphery in blunt nodes, seen elsewhere on this shell, are nothing but bundles of growth striae. The same type of transverse ornamentation is found on the three last whorls of syntype B (fig. 83) and of the fragment number 4 (fig. 82). The folds and tubercles are somewhat more closely set than in specimens of the preceding species of the same size, there being at least 22 per volution.

The revolving ornamentation is well preserved only in syntype A. Here there are, as in *T.* (*T.*) *andinus*, three keels, the middle one of which is somewhat weaker than the other two, but the uppermost is not, as in the preceding species, situated immediately below the peripheral shoulder but slightly above the middle of the lower band of the whorl, and the three keels thus stand closer together. Here their beaded appearance can clearly be seen to be caused by the crossing of growth lamellae. The upper whorl faces carry no revolving ornamentation.

As the apex is not preserved in any of the specimens, the early ontogeny cannot be studied.

REMARKS: *Tyrsoecus* (*T.*) *obtusus* seems to resemble the type species of *Tyrsoecus*, *T. compressus* (Münster, 1841, p. 120, pl. 13, fig. 22[5]; Kittl, 1894, p. 166, *cum synon.*, pl. 4, fig. 30) more closely than *T. subcompressus*, compared above with *T. andinus*, since Münster's species has a somewhat wider pleural angle than Kittl's. However, *T.* (*T.*) *obtusus* is readily distinguished from the type species by its stouter shell shape and much more angular whorl profile.

A certain resemblance in shell shape with *Promathilda* (*Teretrina*) sp. indet. is discussed on page 207.

OCCURRENCE: Occurs, as does *T.* (*T.*) *andinus*, in lot 37 only; four specimens (A.M.N.H. No. 26569).

COELOSTYLINIDAE

Represented by the eight genera *Coelostylina*, *Omphaloptycha*, *Gigantogonia*, *Undularia*, *Pustulifer*, *Toxoconcha*, *Protorcula*, and *Glyptochrysalis*, this family may well be considered one of the most diversified and important in the assemblage under study. However, as to total of individuals its genera vary over a wide range. Among them, only *Omphaloptycha*, with about 1800 specimens,

[1] As preserved.
[2] Width *ca.* 5 mm.
[3] Width 5.64 mm.
[4] Width *ca.* 11 mm.

[5] A very poor illustration which does not give a correct idea of this species, as refigured by Kittl.

is abundant. At a very wide distance, *Coelostylina* and *Pustulifer* follow, with about 25 and 15 individuals, respectively. All the others are represented by only a few specimens (*Toxoconcha*) or by a single incomplete individual each (*Gigantogonia*, *Undularia*, *Protorcula*).

COELOSTYLINA Kittl

Kittl (1894, p. 179), when creating this generic name, was well aware of the fact that von Ammon had "presque timidement"[1] proposed, a year earlier (1893, p. 199), the genus *Omphaloptycha* for some forms which Kittl first thought he could include in his new genus. Later (1899, p. 107) he acknowledged the priority of von Ammon's name for certain species but maintained *Coelostylina* as the generic name for others.[2]

Ever since the almost simultaneous creation of these two genera, there has been the utmost confusion in literature as to their delimitation and hierarchic relation. As pointed out cautiously by Kittl (1899, p. 107), but more decidedly by Cossmann (1909, p. 46), J. Böhm (1895, pp. 272 ff.) seems to have contributed most to this confusion. Koken's share in it, however, should not be overlooked. In his paper on gastropods of the Muschelkalk of southern Germany (1898, pp. 34, 35) he gave very concise diagnoses of both *Omphaloptycha* von Ammon and *Coelostylina* Kittl which would excellently serve the purpose of distinguishing these genera from each other, were it not for the fact that he gave no indication as to which species he considered typical of either. It seems that only Cossmann (1909, pp. 42, 45)[3] designated *C. conica* (Münster) and *O. nota* von Ammon, respectively, as genotypes, thus selecting the species obviously best qualified. If applied to these genotypes, Koken's distinction is doomed to failure. Thus the body whorl is markedly higher than the spire in *O. nota*, whereas the opposite ratio would be required by Koken's generic diagnosis.

Furthermore, all three possible solutions as to the hierarchic interrelations of *Omphaloptycha* and *Coelostylina* can be found in literature. Whereas Cossmann (1909, pp. 40, 47) treats *Omphaloptycha* as a subgenus of *Coelostylina*, giving his reasons for so doing despite the fact that the former name antedates the latter, and Kutassy (1937, p. 68) does likewise, Jaworski (1923, p. 147) and, following him, Körner (1937, p. 211) consider *Coelostylina* a subgenus of *Omphaloptycha*. Zittel (1924, pp. 470, 471), Diener (1926, pp. 148, 181), and Wenz (1938, pp. 391, 392) treat both as independent genera.

In the present paper, Wenz' example is followed as to the hierarchic interrelation, and the genera are distinguished from each other according to Cossmann's (*loc. cit.*) diagnoses taken over by Wenz (*loc. cit.*), in places even verbatim. Accordingly only forms with a comparatively high spire are referred to *Coelostylina* in the present report, whereas all those with lower spires and rather large, more or less gibbous body whorls are dealt with under *Omphaloptycha*. Still it is felt that the distinction between these two genera is in some respects rather artificial and arbitrary.

Thus conceived, the genus *Coelostylina* is rather poorly represented in the present assemblage, namely, by five forms, only two of which have been deemed worthy of new specific names. These five forms together total only 24 specimens. Thus this genus is immensely outnumbered by *Omphaloptycha*, with about 1800 individuals.

Coelostylina cylindrata, new species

Plate 7, figures 79, 80, 88–91, 99, 100

A.M.N.H. Nos.	Dimensions H	W	h	π
27678/2:1	*ca.* 1.40 mm.	*ca.* 46	*ca.* 22	*ca.* 48°
27678:5	*ca.* 2.18[4]	*ca.* 43½	*ca.* 20½[4]	46½°
27678:1	*ca.* 2.24	*ca.* 45½	*ca.* 18½	55°
27678:2	*ca.* 2.30	*ca.* 46½	*ca.* 19½	53°
27678:3	*ca.* 3.07	*ca.* 46	*ca.* 27	44°
27678:4 (syntype A)	*ca.* 3.49	*ca.* 45	*ca.* 31	44°
27678/1 (syntype B)	*ca.* 4.55[1]	*ca.* 47½	*ca.* 34	41°

The first measured specimen is too small to yield strictly reliable measurements, and

[1] Quoted after Cossmann (1909, p. 46).

[2] Many, if not most, of the 33 species that Kittl (1899) described from the Esino and Marmolata limestones under the generic name *Omphaloptycha* [and which seem largely to have contributed to Wenz' (1938, p. 393) impression that "very many species" of *Omphaloptycha* exist] appear on the strength of Cossmann's and Wenz' generic diagnoses to be referable to *Coelostylina* rather than to *Omphaloptycha*.

[3] Koken's distinction of the two genera apparently was not known to Cossmann when he dealt with this problem.

[4] Estimated.

the second is particularly slender and accordingly shows a more acute pleural angle. Disregarding these two, it may be inferred from the table that the spire markedly increases in height with growth and that simultaneously the pleural angle becomes more acute.[1] The width varies within such a narrow range that any inference regarding growth trends from the slight increase from the top of the table to the bottom would be rash, particularly if the extraordinarily slender paratype A.M.N.H. No. 27678:5 here again be disregarded.

SELECTION OF TYPES: Specimen A.M.N.H. No. 27678:4 is designated syntype A, but since its embryonic whorls are not so well preserved, specimen A.M.N.H. No. 27678/1, in which they can be studied, is, in addition, designated syntype B.

DESCRIPTION: The largest shell present (syntype B) consists of six and one-half volutions, including the embryonic ones. Shell slender, with high, steeply conical spire and conical, gently concave base. Spiral whorls nearly twice as wide as high and almost cylindrical in profile (as indicated in the specific name). Precisely speaking, this character applies to the lateral whorl faces only, for there is a narrow, moderately sloping ramp above the well-rounded shoulder. Owing to its gradual transition into the base, the body whorl appears to be more convex than the spiral whorls, but the part above the base is nearly cylindrical also. Here, too, the narrow, sloping apical band, separated by a more or less rounded shoulder from the lateral whorl face, is present. The shape of the aperture can best be characterized as ear-like. The outer lip first indicates the narrow ramp, then forms a gentle arc of which the cord runs obliquely downward to the left. Thus the aperture tapers considerably towards its lower end where there is an indication of an anterior notch, best seen in paratype A.M.N.H. No. 27678:3 (fig. 90), although even there it is not entirely preserved. From there the columellar border rises at first nearly perpendicularly. Here the inner lip is seen to be a little thickened, slightly reflexed, and accompanied by a hardly perceptible umbilical niche (fig. 89). Then the inner lip rises at an angle of about 45 degrees or less towards the angulation marking the ceiling of the aperture.

No other ornamentation than growth striation is present, as seen in paratype A.M.N.H. No. 27678:3 and better still in paratype A.M.N.H. No. 27678/2:2. The growth striae seem to run in a backward direction over the narrow apical band; in the second individual they describe an extremely shallow, forward convex arc on the lateral face of the penultimate whorl (fig. 91).

EARLIEST ONTOGENETIC STAGES: In both paratype A.M.N.H. No. 27678:3 and syntype B the embryonic whorls can clearly be seen to be inclined towards the axis of the shell (figs. 88, 90, 99, 100).

REMARKS: In shell shape this small form certainly resembles the type species of this genus, *C. conica* (Münster), particularly the holotype, refigured in Kittl (1894, pl. 5, fig. 1), and the specimen depicted in Kittl's figure 4.[2] It cannot be considered conspecific with *conica*, for it is not only much smaller but also thinner[3] and has a more clearly cylindrical whorl profile. The latter distinguishes the present species from all the others of *Coelostylina* as well, be they Triassic [including the many species of the Esino and Marmolata limestones, many of which were described by Kittl (1899) under the generic name *Omphaloptycha*] or Liassic. Among the latter, both *C. elatior* Cossmann (1902, p. 188, pl. 4, fig. 5) and "*Phasianella*" *liasina* Terquem (1854, p. 267, pl. 16, fig. 4; see also Cossmann, 1909, p. 44) from the Hettangian of the Vendée and of Hettange, respectively, are quite similar in shell shape but show more convex whorl profiles than *C. cylindrata* and grow considerably larger. Other forms referred to the genus *Coelostylina* in the present report are compared in the discussions of those species below.

[1] The farther-projecting shoulder of the body whorl of syntype A accounts for the fact that its pleural angle is the same as in paratype A.M.N.H. No. 27678:3, although the former specimen has a higher spire and is slightly thinner.

[2] The topotypes of Münster's species from St. Cassian in the Yale collection, however, although identified by Kittl himself, show a quite different, more conical, and less gradate shell profile.

[3] In Münster's type, W, as measured on Kittl's figure, is 53, as compared with 47½ in our syntype B, although the former is more than three times as large as the latter and the shells of this genus, as of many others, tend as a rule to become more slender with growth.

The characteristic profiles of the shell and, chiefly, of the slender, nearly cylindrical body whorl, the inclination of the nucleus, and the much smaller size distinguish this species also from *Omphaloptycha jenksi*, which does not differ so much in dimensions, except in W.

These profiles of the shell and of its several volutions sometimes cause a deceptive similarity between this species and certain small forms of the genus *Cylindrobullina* with which it is associated in lots 26 and 48, particularly *Cylindrobullina* (*C.*) *avenoides* (p. 261, pl. 17, figs. 35, 36, 39–42, 46, 49–51, 58, 59) and the specimens with high spire of *C.* (*?C.*) *tenuicostata* (p. 268, pl. 18, figs. 3–8). They are, however, readily distinguished from the present species by the lower spires and larger body whorls, wider apical bands, different shape of the apertures, which are broadly rounded at the lower ends and the margins of which run more nearly parallel, more pronounced alloiostrophy of the initial volutions, and the peculiar ornamentations, namely, a revolving striation in *C.* (*C.*) *avenoides* and a fine transverse costation in *C.* (*?C.*) *tenuicostata*. In shell shape and dimensions this species somewhat resembles another acteonid, *Consobrinella elegantula*, but the angular whorl profile of the latter, especially its wide, sloping apical bands, pronounced alloiostrophy, and characteristic costation make distinction easy.

? Ramina andina is compared above (p. 112) with this species.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	27678	8
33	27678/1	1
48	27678/2	2
	Total	11

Coelostylina sp. indet. 1

Plate 7, figures 84, 85

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26570	*ca.* 2.8 mm.	*ca.* 50	*ca.* 38	*ca.* 32°

DESCRIPTION: The five whorls that are preserved are quite convex, without any angularity, and attain maximum width somewhat below half the height. They are separated by rather deep, moderately oblique sutures. Base and aperture are too incomplete to venture any description; the upper end of an umbilical niche can just be perceived. Growth striae, where recognizable on the spiral whorls, seem to run obliquely backward in a shallow forward concave arc. There are also faint traces of what might have been anastomosing color markings.

The nucleus is not fully preserved; it seems to have been flattened and slightly inclined towards the axis of the conch.

REMARKS: This shell differs from the type species, *C. conica* (Münster, 1841, p. 94, pl. 9, figs. 21, 32; Kittl, 1894, p. 181, pl. 5, figs. 1–7), and particularly from its type as refigured by Kittl, by the far greater convexity of its whorl profile which makes the sutures appear somewhat deeper. By the same character, it is even more different from *C. cylindrata* which deviates in the opposite direction from the type species. It has the convexity of the whorls in common with the following species, *C. inexspectata*, but it is markedly more slender and has a smaller body whorl and lower pleural angle.

Within the present material, it considerably resembles *Polygyrina* in the convexity of its whorls, but its nucleus does not show the characteristics of that subgenus. On the other hand, it differs by the very convexity of its whorl profile from some juveniles of *Kittliconcha* and *Anoptychia* which it resembles in general shell shape.

OCCURRENCE: A single incomplete juvenile in lot 26 (A.M.N.H. No. 26570).

Coelostylina inexspectata, new species

Plate 7, figures 86, 87, 93–98

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26548:1	2.27 mm.	*ca.* 64	36	*ca.* 45°
26548:2 (syntype A)	3.5	69	38	44°
26548/1:1	3.57	63	32½	41°
26548:3 (syntype B)	4.2	63	41½	42°
26548/1:2	*ca.* 4.56	*ca.* 56½	*ca.* 42	36°
26548/1:3 (syntype C)	*ca.* 4.0[1]	?	?	42°
26548/1:4	*ca.* 4.9[2]	?	?	40°

[1] As preserved; base broken off.
[2] As preserved.

From the table it would seem that W and π slightly decrease, whereas h somewhat increases, with growth. Specimen A.M.N.H. No. 26548/1:2 deviates from the norm in being more slender and having accordingly a more acute pleural angle.

DESIGNATION OF TYPES: Since no individual present exhibits all diagnostic characters of this species equally well, three syntypes were selected, of which A shows the aperture and the umbilical niche best, B the mature shell shape, and C the nucleus and the growth striation.

DESCRIPTION: Shell small, slender-turbiniform, consisting of up to seven volutions which are separated by deeply channeled sutures and which become more and more convex with growth; accordingly, the body whorl appears to be particularly gibbous. The maximum convexity is reached at about the lower third of the distance between the sutures. There is no edge separating the lateral whorl face from the base which is strongly rounded. The aperture (figs. 93–95, 98) is subcircular, with only a faint indication of angularity at the upper (posterior) end. The inner lip is reflexed over a rather wide umbilical niche which accompanies it all along its length. The columella is perforated and slightly corkscrew-shaped (fig. 93).

Several casts, in which the shell substance is destroyed in the umbilical region (e.g., syntype B and paratype A.M.N.H. No. 26548/1:2), show there a comparatively wide, circular opening, thus simulating a trochid-like aspect of base and umbilicus (figs. 95, 98).

The latter specimen seems to exhibit a subsutural keel on its last two volutions, whereas a supersutural one might be believed to be present in syntype A. Closer examination reveals, however, that both aspects are deceptive and caused merely by remainders of the test preserved in the sutures, but not above and beneath.

The growth striae, best observable in syntype C (fig. 96), run first backward, then form a wide forward concave sinus and immediately above the lower suture turn back again, thus forming an inverted S. On the base they converge in a decidedly backward direction towards the umbilicus. In addition, the earlier volutions of syntype C clearly show some revolving ornamentation, and a faint revolving striation is just recognizable, except on the body whorl, in syntype B and, despite corrosion of the surfaces, in specimens A.M.N.H. Nos. 26548/1:2 and 26548/2.

EARLIEST ONTOGENETIC STAGES: In several individuals, best in syntype C (fig. 96), the nucleus can be seen to be somewhat truncate and the first nuclear volution to be slightly inclined towards the axis of the conch.

REMARKS: Within the genus *Coelostylina* this species clearly belongs to Kittl's (1894, p. 181) group of *C. conica* Münster (Kittl, 1894, p. 181, *cum synon.*, pl. 5, figs. 1–7), from which the present form differs mainly by smaller size, more convex whorls, lower body whorl, and presence of a faint revolving ornamentation. It has the latter character as well as the increased convexity of the body whorl in common with *C. inconstans* Kittl (1895, p. 157, pl. 6, fig. 9; 1899, p. 142) and *C. ovula* (Kittl) (1895, p. 165[1]; 1899, p. 141, pl. 15, fig. 4). The former comes rather close to *C. inexspectata* also in shell shape; still, it is readily distinguished by its more slender shape, lower pleural angle (26° in Kittl's illustration), higher spire, less convex whorl profile, and by having a "fine umbilical slit" only. In his original description of *C. inconstans* Kittl expresses the opinion that the revolving ornamentation "points to *Rhabdoconcha*." "*Rhabdoconcha*" *triadica* Kittl (1894, p. 161, pl. 8, figs. 9, 10) from St. Cassian is indeed rather similar in shell shape to the present form, from which it differs mainly by its flatter whorls, lower pleural angle (29° in Kittl's fig. 9), and the straight columella. In my opinion, the St. Cassian form is no *Rhabdoconcha*. Its open umbilicus (or umbilical niche, for that matter) excludes its reference to that subgenus of *Pseudomelania* which, according to its generic diagnosis,[2] lacks an umbilicus. Since the same holds true for the Zygopleurinae, the similarity in shell profile between the specimens of *Anoptychia canalifera* (Münster) illustrated in Kittl (1894, pl. 4., fig. 41–43) and the present form

[1] As *Pseudomelania* (*Oonia*).

[2] See Wenz, 1938, p. 372; by giving the range of *Rhabdoconcha* as "Middle Triassic to Upper Jurassic," Wenz (*ibid.*, p. 373) seems tacitly to include in Gemmellaro's genus the species referred to it by Kittl, but Cossmann (1909, p. 89) obviously does not.

is merely noted in passing as a superficial one.

Within the Peruvian material *C. cylindrata* differs so essentially in shell shape and whorl profile that no detailed comparison is needed. *C.* cf. *medea* and *C.* sp. indet. 2 are compared below. No detailed comparison seems necessary with the various *Omphaloptycha* species dealt with under the following generic heading, all of which are readily distinguished from the present form by their more gradate shell profile and their larger body whorl.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
71	26548	4
86	26548/1	3
91	26548/2	1 (juvenile)
	Total	8

Coelostylina cf. **medea** Kittl

Plate 7, figures 62, 63

Cf. *Coelostylina medea* KITTL, 1895, p. 184, *cum synon.*, pl. 5, fig. 10.

A.M.N.H. Nos.	DIMENSIONS H	W	h	π
26549/1	*ca.* 2.57 mm.	*ca.* 58	*ca.* 26	49°
26549	*ca.* 2.9	*ca.* 59	*ca.* 25	41°

DESCRIPTION: Shell small, conical. Whorls only very gently convex, with the maximum convexity slightly above the lower suture, and separated by extremely shallow sutures. This makes for the almost continuous, nearly pupoid shell profile which in addition to the comparatively large body whorl is most characteristic of this form. A rounded edge separates the lateral face of the body whorl from the base which is obtusely conical and well rounded. The aperture is too poorly preserved for description, but the inner lip can be seen to be reflexed over the broad umbilical niche. In basal view the latter can be seen to continue into the perforation of the columella (fig. 62).

No other ornamentation than fine growth striae, which seem to be only little sinuous, has been observed, and those only indistinctly.

The earliest ontogenetic stages could not be studied.

REMARKS: Since both shells are incomplete on upper and lower ends, this form was not named. Scanty as the material is, the specimens are recognized as resembling *C. medea* Kittl, a rare St. Cassian species, more closely than any other *Coelostylina*. Kittl's species, of which shells more than three times as large are known, shows merely a somewhat higher spire and a lower pleural angle.

For a comparison with *C. inexspectata* and *Coelostylina* sp. indet. 2, see the discussions of those two species.

Among the *Omphaloptycha* species of the present assemblage some young shells of *O. jenksi* show about the same dimensions, but besides being mostly more slender they differ by the decidedly gradate shell profile, much deeper sutures, and the indication of an anterior notch in the aperture. *?O. cacuana* also comes in dimensions fairly close to the present form, but it can readily be distinguished by its ventricose body whorl, shorter spire, and less shallow sutures.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26549	1[1]
26	26549/1	1
	Total	2

Coelostylina sp. indet. 2

Plate 7, figure 92

DESCRIPTION (INCLUDING DIMENSIONS): Of two poor fragments from lot 37 only the larger one (no. 1), which as preserved is 11.5 mm. high and about 7 mm. wide and has a pleural angle of 47 degrees, lends itself to description, but the smaller one (no. 2), even more incomplete, can be assumed to be conspecific.

Shell profile convexo-concave; whorls gently convex, attaining maximum convexity at the lowermost fourth of the height; sutures shallowly engraved. The body whorl seems to have been somewhat higher than the spire and is moderately gibbous. Base rounded, conical. The aperture seems to have been rhombic in outline and to have had a thickened, if not reversed, inner lip. There is an indication of a narrow umbilical niche.

[1] It is not absolutely certain that this specimen is from lot 86, but there is every reason to assume it.

The shell seems to have carried no ornament other than growth striae; to judge by the few indistinct growth folds recognizable, the course of the growth striae seems to have been the one common in this genus.

Since the apex is preserved in neither specimen, the earliest ontogeny could not be studied.

REMARKS: There is hardly any doubt but that this form is a *Coelostylina*, but it is too scantily represented and the specimens available are too poorly preserved for specific identification.

It is not so dissimilar from the type species, *C. conica* (Münster) (Kittl, 1894, p. 181, *cum synon.*, pl. 5, figs. 1–7), but it has a lower spire, a less gradate shell profile, and more shallow sutures.

From *C. inexspectata* it differs by its larger body whorl, less convex whorls, and shallower sutures, from *C.* cf. *medea* by its lower spire and more distinct sutures, and from both by its considerably greater size and convexo-concave shell profile.

OCCURRENCE: This form was found only in lot 37 where it is represented by two fragments (A.M.N.H. No. 26550).

OMPHALOPTYCHA von Ammon

For the history of this genus and of its ever vacillating distinction from and hierarchic relation to *Coelostylina* Kittl, and for the diagnoses of both genera adopted in the present report, see the genus *Coelostylina* above.

To the genus *Omphaloptycha* as there conceived four species are referred without reservation. One of these, previously known from the Triassic of Peru but here renamed *O. jaworskii*, may well be considered one of the index fossils of this assemblage. Two more species, *O. jenksi* and *O. speciosa*, are new, as seems to be a fourth, so scantily represented that it was left unnamed. In addition to the specimens definitely referred to these four species, a total of about 585, there are in lots 48, 69, 70, 78, and 86 more than 1100 poorly preserved or incomplete shells and fragments which seem to belong to one or the other of them but were left specifically undetermined.

A fifth species, *?O. cacuana*, which is (with about 90 specimens) quite common in lot 91 and is perhaps present in lots 35 and 87 also but occurs nowhere else, is only tentatively assigned to *Omphaloptycha*.

Including these more than 90 specimens, this genus boasts a total of about 1800 individuals within the present material and is thus outnumbered only by the genera *Promathilda* and *Neritaria*.

Omphaloptycha jaworskii, new name

Plate 8, figures 1–28, 31

?Phasianella Münsteri Wissmann; MÜNSTER, 1841, p. 118, pl. 13, fig. 7.

?Phasianella Münsteri Wissmann; LAUBE, 1870, p. 18, pl. 31, fig. 5.

?Pseudomelania Münsteri Wissmann sp.; KITTL, 1894, p. 176, pl. 6, figs. 7–9.

?Pseudomelania cf. *Münsteri* Wissmann; BROILI, 1907, p. 115, pl. 10, fig. 39.

Omphaloptychia Rhenana Kok.; JAWORSKI, 1920, p. 382.

Omphaloptycha (*Coelostylina*) *rhenana* Kok.; JAWORSKI, 1923, p. 147, pl. 5, fig. 19.

Omphaloptycha rhenana Kok.; STEINMANN, 1929, p. 64, fig. 59a (p. 59).

Omphaloptycha (*Coelostylina*) *rhenana* Koken; KÖRNER, 1937, p. 211, pl. 14, fig. 3.

DIMENSIONS[1]

A.M.N.H. Nos.	H	W	h	π
26522/1:13*	*ca.* 1.01 mm.	*ca.* 66½	*ca.* 28	54°
26522/5:3*	*ca.* 1.12	*ca.* 75	*ca.* 25	50°
26522/5:4*	*ca.* 1.12	*ca.* 72½	*ca.* 25	54°
26522/1:14*	*ca.* 1.15	73	27	56°
26522/1:15*	1.26	69	27	54°
26522/1:16	1.34	64½	21	59°
26522/1:17*	1.37	69½	24½	51°
26522/1:18*	1.85	63½	27½	57°
26522/1:1	1.68	70	23½	64°
26522/1:2	*ca.* 2.02	66½	?19½	63°
26522/1:4	2.24	72½	25	61°
26522/1:3	2.52	69	26½	61°
26522:33	2.6	69½	25	63°
26522/1:5	2.63	72½	23½	64°
27622/1:6	2.8	70	26	62°
26522/1:7*	*ca.* 3.32	62½	*ca.* 27½	49°
26522:35	3.49	69	26	61°
26522/1:8*	*ca.* 3.5	66½	*ca.* 26	54°
26522/1:9*	3.57	67½	28	56°
26522:59†	3.6	73½	23½	70°
26522:34	3.65	68½	27½	66°
26522/1:10	3.73	69	24½	65°
26522:36	*ca.* 3.8	*ca.* 67½	*ca.* 24½	63°
26522:37	*ca.* 3.8	*ca.* 67½	*ca.* 26	63°
26522:60†	3.98	73	23	71°
26522:38	*ca.* 4.15	*ca.* 64	*ca.* 24	62°
26522:40	4.15	68	24	64°

[1] For explanation of symbols, see text.

A.M.N.H. Nos.	H	W	h	π
26522:39	4.23	68½	23½	64½°
26522:30	4.3	55½[1]	21	63°
26522:61†	4.32	71	22	63½°
26522:41	4.44	73	27	62°
26522:42	4.44	73	24	65°
26522:31	4.56	57½	24	59°
26522:62†	4.56	70½	21½	70°
26522:45	*ca.* 4.68	70½	*ca.* 20½	63°
26522:44	4.68	74	23	64°
26522:63†	4.8	68½	23½	70°
26522:46	*ca.* 4.92	71	25	63°
26522:49	4.92	71	27	67°
26522:43**	5.04	62	28½	60½°
26522:50**	5.16	67½	23½	56°
26522:47	5.22	67	25½	60°
26522:48	5.4	69	22	66½°
26522:53	5.4	71	22	66°
26522:51	5.52	65	26	59°
26522:56*	5.76	68½	26	53°
26522:52	5.88	66½	20½	60°
26522:54	5.88	71½	26½	57°
26522:55	6.0	70	23	67°
26522/5:1†	6.2	75	25	73°
26522/5:2	6.36	68	24½	57½°
26522:68*	6.72	60½	28½	56½°
26522:1**	7.1	66	25½	55°
26522:57**	7.2	66½	25	55°
26522:58	*ca.* 7.2	71½	*ca.* 23½	65°
26522:2	7.5	65	24	58°
26522:64†	8.4	71½	20	73°
26522:65†	9.4	74½	20½	76°
26522:27	*ca.* 9.9	68	29½	49°
26522:5 (holotype)	10.4	68	26	62°
26522:66†	11.0	71	25	70°
26522:26*	11.6	70	31	54°
26522:8	*ca.* 12.1	*ca.* 69½	*ca.* 25½	57°
26522/3:1*	*ca.* 12.2	67	30½	51°
26522:10	*ca.* 13.1	68½	*ca.* 25½	58°
26522/2:4*	*ca.* 13.3	67½	31½	52°
26522/2:5*	*ca.* 13.8	*ca.* 59½	29	50°
26522:15	*ca.* 14.5	*ca.* 65	*ca.* 24	60°
26522:16	*ca.* 14.5	*ca.* 67	*ca.* 26	63°
26522:14	*ca.* 15.2	65	*ca.* 25	63°
26522/2:6†	15.3	77½	19½	72°
26522/3:2*	16.0	67	32½	53°
26522:21	16.6	69	24	63°
26522:28*	*ca.* 17.0	*ca.* 63	26½	54°
26522:29*	*ca.* 17.2	60½	30	52°
26522:32	*ca.* 18.3	*ca.* 68	*ca.* 23½	60°

No larger specimens than those included in the table are sufficiently complete to yield precise ratios. However, there are present in our material individuals attaining about twice the size of the largest shell measured above. One of these (A.M.N.H. No. 26522/1: 11) must have reached about 35 mm. in height when complete.

[1] Crushed.

Within the sample measured, some individuals, which are marked by a single asterisk in the table of dimensions, deviate from the majority of measured specimens by having a more acute pleural angle and as a rule a somewhat higher spire, and are also slightly more slender. In all these respects they are transitional to *O. jenksi*. This is especially true of A.M.N.H. Nos. 26522/2:4 and 26522/2:5 which differ in dimensions from *O. jenksi* only by being less slender, but even these two individuals can readily be distinguished from that species by their more gibbous body whorls. As examples of this group of individuals, see figures 15–18. Several other shells, marked by two asterisks in the table of dimensions, are considered intermediate between the first group and the typical form.

A third group of shells, marked by a dagger in the table of dimensions, deviates from the typical form in quite the opposite way, that is, by greater width and by having, as a rule, a wider apical angle. Both these characters cause the body whorls to appear somewhat more ventricose than in the typical form. Most of these individuals are also distinguished by comparatively low spires. This group is best exemplified by specimens A.M.N.H. Nos. 26522:61, 26522:66, 26522/2:6, and 26522/5:1 and is illustrated in figures 9, 13, 14, 19, 26, and 27. In all these respects this last group is transitional to *O. speciosa*, but it never reaches the high apical angles of that species. *O. speciosa* can furthermore be readily distinguished from these transitional shells by its characteristic shell shape. For the particular differences between *O. jaworskii* and *speciosa*, see the discussion of the latter below.

Since all these groups intergrade, it has not been considered advisable to separate them taxonomically.

If the extremes be disregarded, the widest ranges of variation in both h and π are found in shells measuring between 4 and 6.5 mm. in height. The small and medium-sized shells are somewhat thicker, no width exceeding 70 occurring in individuals higher than 7.2 mm. Otherwise no general rules as to the influence of growth on dimensions are evident from the table which, at any rate, follows the development of this species only

to about half the size reached within the present material.

DESCRIPTION: Shell turbiniform, consisting of from six to eight whorls according to size. The spire occupies from about two-tenths to about three-tenths of the total height. Sutures channeled; immediately below them runs a narrow, more or less horizontal apical band which is separated by a rounded shoulder from the lateral whorl face. In the spiral whorls the latter is conical and gently convex, reaching maximum convexity at about the lower third of its height, whereas the maximum width is attained at or immediately above the suture. The body whorl is moderately ventricose in typical specimens (A.M.N.H. Nos. 26522:1, 26522:2, 26522:5, holotype, and 26522:14; figs. 1, 10, 3–8), more so in shells transitional to *O. speciosa* and less so in those transitional to *O. jenksi*, but always markedly more so than in *O. jenksi* and markedly less so than in *O. speciosa*. The base is rounded, the aperture oval, with its longer axis running obliquely towards the axis of the shell. It is somewhat angular at its upper (posterior) end and shows an indication of a shallow, wide notch at the lower (anterior) one (seen in the illustrations of the other specimens listed above much better than in the illustration of the holotype). Both lips are neatly convex; the outer one is sharp, the inner one somewhat thickened and clearly reflexed, except in its uppermost portion, leaving, however, a narrow umbilical niche open. As seen in many broken shells, the columella is hollow.

Specimen A.M.N.H. No. 26522:69 is here mentioned and illustrated (fig. 21) for showing an extraordinarily steep gradient of the suture which is believed to be caused by some distortion of the shell.

No sculpture other than growth striation is observable in any of the shells examined. Growth striae can be observed only occasionally, best in the comparatively large specimen A.M.N.H. No. 26522:32 (fig. 23). They run slightly sigmoidally all over the body whorl, forming a reversed S, with a shallow forward concavity in its upper half and an equally shallow forward convexity in the lower one. It is worth noting that they run distinctly, though only slightly, forward in the latter part of their course. Where observable, the growth striae are altogether indistinct, rather broad and fold-like, and tend to unite in irregular bundles. In one shell (A.M.N.H. No. 26522:16; fig. 11) the last two or three bundles of growth striae even simulate transverse ribs.

In many specimens color markings are preserved, best of all and most frequently in those from lot 86 (A.M.N.H. No. 26522), in which their reddish brown color stands out clearly from the light shell surface, but also in some from lots 48 and 71 (A.M.N.H. Nos. 26522/1 and 26522/2, respectively). Their pattern is highly variable, but always different from, and independent of, that of the growth striae, as can be clearly seen, for example, in the largest specimen present (A.M.N.H. No. 26522/1:11; fig. 22).

No color markings show on nuclei, but they are well developed at a comparatively early growth stage (specimen A.M.N.H. No. 26522:52, the total height of which is less than 6 mm.).

On the body whorls of larger shells, from 11 to 18 color markings can be counted.

As a rule (e.g., A.M.N.H. No. 26522:25; fig. 31) they run decidedly forward on the narrow apical band, turn more or less sharply backward on the shoulder, then run in a wide, rather deep, forward concave arc across the body whorl; on the base, they turn back again and run in a more or less radial direction towards the umbilical niche. In specimen A.M.N.H. No. 26522:24 (fig. 20), which is somewhat smaller than the one just referred to, they zigzag throughout the body whorl, inserting in the afore-mentioned forward concave arc prongs which become increasingly sharper towards the aperture. The pattern just described can, however, by no means claim general validity. Rather the design of the color markings is subject to sudden, not to say whimsical, changes. In specimen A.M.N.H. No. 26522:6 (fig. 25), for example, of about the same size as the holotype, the arc assumes the shape of a very long, pointed prong in the last portion of the penultimate whorl and in the first half of the body whorl, but this sharp prong disappears rather abruptly; in the anterior half of the body whorl the color markings run in a gently forward concave arc across the side. Similar sudden changes can be observed

in several other shells (e.g., A.M.N.H. Nos. 26522/2:6 and 26522/1:12). In the former the color markings become almost straight, slightly sigmoidal, or even forward convex in the anterior part of the body whorl, then they turn first forward, then backward again to run towards the umbilical niche (fig. 26). In the latter specimen they run, after forming a short forward concave arc, very obliquely forward in the later part of the penultimate whorl and in the beginning of the body whorl. Then they assume quite suddenly a course similar to the one described in No. 26522/2:6, but zigzagging in six prongs (fig. 28). The small incomplete shell A.M.N.H. No. 26522:67 is distinguished by unusual density of color markings, some of which run nearly vertically across the body whorl. On the other hand, there are unusually few (only five or six per whorl) in the even smaller shell A.M.N.H. No. 26522:47 (fig. 2). This character seems otherwise to be distinctive of *O. jenksi*. The fact that most of the color is accumulated in the points of the prongs of zigzagging markings and preserved there, even though the rest has faded, seems to account for the spotted appearance of some shells, or parts thereof (e.g., the body whorl of A.M.N.H. No. 26522:32; fig. 24).

The examples quoted suffice to prove that no definite rule can be set as to the pattern of color markings, as it can for that of growth striae, and that, at least in the present genus, they cannot be depended on for specific distinctions. Markings of different genera, however, seem to be sufficiently characteristic to permit distinction even of small shell fragments on the strength of the color patterns only, as repeatedly experienced in the present material when those of *Omphaloptycha* were compared with those of *Neritaria hologyroides* (see p. 169). The course of the color markings is also helpful in the distinction of certain species of *Trachynerita* from large shells of *Omphaloptycha* (cf. p. 177).

The earliest ontogenetic stages could be studied in a considerable number of individuals. Where the nucleus is perfectly preserved, the apex seems to be fairly pointed, at least as long as examined macroscopically. There is no planospiral stage, nor in any of these specimens can the nuclear volutions be seen to be obliquely inclined towards the axis of the shell.[1] The latter character is considered diagnostic of *Coelostylina, sensu stricto*, by Cossmann (1909, p. 42) and Wenz (1938, pp. 391/2). Its absence in this and the following species thus further supports their reference to *Omphaloptycha* rather than to *Coelostylina*.

REMARKS: This species is undoubtedly the same as the one reported from Peru by Jaworski, Steinmann, and Körner (*loc. cit.*, in synon.) under the specific name *rhenana* Koken. Measurements of the shell figured by Jaworski (and Steinmann) resulted in the following values: W, 64½; h, 30½; π, 46°.[2] It is true that none of the 76 shells of our measured sample shows such a low pleural angle, its minimum, reached in only two individuals of the group considered transitional to *O. jenksi*, being 49 degrees. On the other hand, a pleural angle of 46 degrees would come well within the range found in the latter species. However, the distinctly ventricose body whorl of the specimen figured by Jaworski excludes its reference to *O. jenksi*. It is believed that, despite its unusually low pleural angle, it can well be included in that group within *O. jaworskii* that is transitional to *O. jenksi*. Since it is thus not typical of the most common form of this species, its holotype was chosen from the present material.

Jaworski, in his search for a known species to which to refer his four Peruvian specimens, seems to have been satisfied to find in "*Coelostylina*" *rhenana* Koken (1898, p., 38, pl. 6, figs. 1, 2) a form of about the same shell shape and dimensions. Those of Koken's figure 2 (W, 62; h, 26½; π, 58°) would indeed fit well in the table of dimensions given for the present species, considering the natural size of Koken's specimen of which the height amounts to only 5.6 mm. The faunule of the upper Muschelkalk of Marlenheim, Alsace, is termed a microfauna by Koken (1898, p. 4) and it seems to be indeed a dwarf fauna,

[1] Nor could Körner (1937, p. 211) observe such an inclination in either of his two small fragments, but in his erroneous belief that this form is a *Coelostylina*, he misses this supposed generic character with some regret.

[2] Jaworski (1923, p. 147) gives a "Gehäusewinkel" of about 60°; measurement of the apical angle in his figure yielded 58°.

whereas the abundance of small, even tiny, shells in the material here studied creates in our opinion only the appearance of a dwarf fauna, for much larger specimens of the same species occur, although they are much less common (cf. p. 299). Thus it would seem odd to refer the Peruvian population under discussion, amounting to many hundreds of examined individuals and yielding a good index fossil for its horizon in that region, to a dwarf form from a faunule found about a third of the earth's circumference away.[1]

As long as there were no specific differences to be found between the Alsatian and the Peruvian forms the Rules would not permit assigning a new name to the Peruvian. There are, however, such differences. Jaworski alluded to one in the shape of the aperture, but poor preservation of his sample prevented him from further investigating it. As a matter of fact, both lips are about equally rounded in the present species, whereas in Koken's the inner lip is almost straight in its lower part. Also the gradient of the suture is somewhat steeper in *O. jaworskii* than in *O. rhenana*, and Koken's figure 1 shows a light inclination of the initial whorls towards the axis of the shell, never observed in the Peruvian form. Thus we feel justified in renaming the latter in honor of its first describer.

As noted by Jaworski (1923, p. 149), *Pseudomelania münsteri* (Wissmann) agrees very well in shell shape with the present form. The dimensions of Münster's type of Wissmann's species, as taken from Kittl (1894, pl. 6, fig. 9) rather than from Münster (pl. 13, fig. 7, believed to be less dependable), are: H, 8 mm.; W, 64; h, 25; π, 58°. They thus come perfectly within the range found in the dimensions for the typical *O. jaworskii*, as do those of the much larger shell illustrated in Kittl's figure 7 (H, 13.8 mm.; W, 63; h, 25; π, 64°).[2] Neither Münster, Laube, nor Kittl himself states in his description explicitly that the columella of Wissmann's species is solid, but this character must be inferred from Kittl's (1894, p. 173) decision "to use the generic name *Pseudomelania* only for forms with closed umbilicus and solid columella." As far as the former character is concerned, Kittl seems not to have been faithful to his own decision in the case of *P. münsteri*, for he mentions in its description its "gefurchte Nebelgegend" (furrowed umbilical region), which means obviously the umbilical niche clearly seen in his figures 7 and 9.[3]

The solid columella of *P. münsteri* thus seems to be the only obstacle to assuming its conspecificity with the Peruvian form here dealt with. In the discussion of the latter Jaworski alludes to the fact that such an authority on gastropods as Koken (1897, p. 86) questioned the value of a solid or perforated columella as a generic character. Personally, I would not be too surprised should it be shown in the future that this character is not necessarily constant even within the species, or should future reëxamination of the type lot of *P. münsteri* prove that its columella is not solid. In both these cases *P. münsteri* would have to be referred to the genus *Omphaloptycha*, and *O. jaworskii* would become merely a synonym of *O. münsteri*. Therefore Wissmann's species has been included with question marks in our synonymy above.[4]

Both Jaworski and Körner (*loc. cit.* in synon.) emphasize the close resemblance between the Peruvian form and *Coelostylina cochlea* (Münster) (Kittl, 1894, pl. 183, *cum synon.*, pl. 5, fig. 8). The latter seems to differ from the former merely in its higher spire

[1] Such considerations may, though perhaps subconsciously, have motivated the somewhat apologetic tone of Körner's (1937, p. 211) attempt to justify Jaworski's earlier identification of the Peruvian form. Jaworski (1923, p. 148) considered the form from Misol, a locality about equally distant from Alsace as from Peru, which he had previously (1915, p. 127, pl. 45, figs. 9–10) described and figured as "*?Coelostylina* ? nov. spec." also merely a variety of *C. rhenana* Koken. An *Omphaloptycha* aff. *O. rhenana* Koken has recently been recorded by Bauza-Rullán (1946, p. 398) from Mallorca (Balearic Islands).

[2] The specimen shown in Laube (1870, pl. 31, fig. 5) is more slender (W, 58½) and has a lower pleural angle (π, 55°).

[3] This character was overlooked by Jaworski (1923, p. 149), who erroneously believed that there is no "Nabelritze" (umbilical niche) in *P. münsteri*.

[4] Reference of Wissmann's species to the genus *Omphaloptycha* would make *O. münsteri* Böhm (1895, p. 275, pl. 14, fig. 18, text fig. 61) a junior homonym, which would have to be renamed according to Article 35, second paragraph, of the Rules, assuming that Böhm's species is really an *Omphaloptycha*. In my opinion, it is not.

and considerably wider umbilical niche. On the strength of Kittl's diagnosis of his "Group of *Coelostylina conica* Mstr. sp." (1894, p. 181), the initial whorls must be assumed to be inclined towards the axis of the shell in *C. cochlea*, which thus may be a true *Coelostylina*. The same holds true for Jaworski's "*?Coelostylina* ?nov. spec." from Misol (1915, p. 127, pl. 45, figs. 9–10; cf. p. 141, footnote 1), stated to be "very similar" to the Peruvian form by Jaworski (1923, p. 148).

For comparisons of this species with *Omphaloptycha jenksi*, *O. speciosa*, *O.*, new species, *?O. cacuana*, and *Heterospira simulatrix*, see the discussions of those several species.

The differences between this species and *O. lissoni* Cox were pointed out in the original description of the latter (1949, p. 43). Cox' remark on a difference in the color markings, however, should be referred to my statement above on the limited value of color markings for specific distinction. Thus they are mostly linear in the present species also, although in some shells they assume the spotted pattern seen in Jaworski's specimen from Junin and in A.M.N.H. No. 26522:32, mentioned above (fig. 24). For discussion of the rather delicate problem of whether the differences established by Cox make *O. lissoni* conspecific with my *O. speciosa* or not, see page 145.

For the remarkable resemblance in shell shape between small juveniles of this and the following species and those of *Kittliconcha peruviana*, see page 119.

OCCURRENCE: Extremely common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26522	*ca.* 365
48	26522/1	55
71	26522/2	11
70	26522/3	6
69	26522/4	1
78	26522/5	10
26	26522/6	1
		ca. 449

In addition, about three-fourths of the more than 1100 specimens of *Omphaloptycha* which are left specifically undetermined are believed to belong to this species. Including them, I estimate the total number of individuals within the material examined at about 1300. Thus it is one of the index fossils of the present assemblage.

Omphaloptycha jenksi, new species

Plate 8, figures 29, 32–34, 38, 39, 42

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26523/4:1	5.4 mm.	55½	35½	45°
26523/4:2	6.0	54	30	*ca.* 45°
26523:2 (syntype A)	*ca.* 7.56	*ca.* 60½	*ca.* 27	47°
26523/3:1	*ca.* 10.0	*ca.* 54	*ca.* 31	50°
26523:4 (syntype B)	*ca.* 13.3	*ca.* 60½	25½	46°
26523:3	14.3	51½	30½	32½°[1]
26523/3:2	*ca.* 14.4	*ca.* 62	*ca.* 35	49°

No entire shell exceeds about 15 mm. in actual height, but some incomplete ones (e.g., A.M.N.H. No. 26523/1:2 the body whorl of which has been broken off) may when complete have reached nearly 25 mm. in height.

If specimen No. 26523:3 which deviates far from the mean in both width and pleural angle is left out of account, the range of variation within the sample measured is rather narrow. Except for a certain increase of the pleural angle with growth, no general trends can be deduced from the dimensions.

SELECTION OF TYPES: Since certain characters believed to be distinctive of this species are recognizable at a later stage only, a perfectly preserved small shell (A.M.N.H. No. 26523:2; figs. 38, 39) and a larger one (A.M.N.H. No. 26523:4; figs. 34, 42) have been designated syntypes A and B, respectively.

DESCRIPTION: Shell turbiniform, comparatively slender, consisting of from five to seven whorls. The spire occupies from a fourth to a little more than a third of the total height. The pleural angle as a rule does not exceed 50 degrees. Sutures moderately channeled and accompanied by an extremely narrow, hardly perceptible apical band of the following whorl. Beneath the rounded shoulder connecting the apical band with the lateral face the spiral whorls are only little convex, with the maximum convexity at about half their height. Body whorl even less ventricose than in slender specimens of *O. jaworskii*.

[1] Measured on body whorl; if on penultimate one, π amounts to 41°.

The difference in this respect from the more gibbous specimens of that species, not to speak of *O. speciosa*, is even more marked. The aperture occupies in small shells (syntype A) a little more, in larger ones (syntype B) a little less, and in specimen A.M.N.H. No. 26523:3 (figs. 32, 33) markedly less, than two-thirds of the height of the body whorl. This comparatively low site of the upper end of the aperture and the lesser degree to which the body whorl embraces the preceding one are, next to the lesser convexity of the lateral whorl faces, distinctive of the shell shape of this species as compared to its closest relatives. Base and aperture closely resemble those of *O. jaworskii*. The umbilical niche becomes, as a rule, closed at a later growth stage. The columella could not be examined internally in any of the shells present.

No shell shows distinct growth striae. Faint traces of them, recognizable only here and there (e.g., on the spiral whorls of syntype A), seem to indicate a course similar to that described in *O. jaworskii*.

Color markings are also observable in some shells of this species. They resemble in their general pattern and in variability those of *O. jaworskii*, but they are more widely spaced, with only from six to 10 per whorl, and less sinuous. As seen best in specimen A.M.N.H. No. 26523/1:2 (fig. 29), they run as a rule slightly sigmoidally or almost straight across the lateral whorl face, but they seem to turn sharply forward below the peripheral shoulder and then back again towards the center. This assumed course can, however, nowhere be closely followed, since only isolated color spots, most of them stretched in the assumed direction of the markings, show in the lower part of the last volution. Some seem to represent the tips of zigzag prongs. The same pattern is also observed in specimen No. 26523/1:3, which deviates, however, from the typical shells of *O. jenksi* by its comparatively wide pleural angle of 63 degrees and is therefore only doubtfully referred to this species.

REMARKS: *Omphaloptycha jenksi* differs from *O. jaworskii* by its somewhat more slender shape, somewhat higher spire, lower pleural angle, and most characteristically the lesser convexity of its whorls, the higher site of the maximum convexity of the spiral whorls, the lesser degree to which the body whorl embraces the preceding one, and by the lesser relative height of the aperture. It seems, however, that all these differences in shell shape become recognizable only in the course of development but are not yet perceptible in the earliest growth stages. Thus shells less than 2 or 3 mm. high which actually may belong to the present species are indistinguishable from equally small ones of *O. jaworskii*. As far as their dimensions come within the range observed in that species, they have been included there. Furthermore, the color markings are less sinuous and more widely spaced in this species than in most of the shells of *O. jaworskii*.

Omphaloptycha speciosa, *Omphaloptycha*, new species, and *?O. cacuana* are compared below with the present species. The resemblance in proportions of *O. jenksi* to *Coelostylina* cf. *medea* is mentioned above (p. 136).

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	26523	8
48	26523/1	4 (?3)
86	26523/2	1 (doubtful)
71	26523/3	2
70	26523/4	5
		20

If a proportion of the specifically undetermined *Omphaloptycha* shells belong to this species, the total number of specimens in the present material is not likely to exceed 40.

Thus this species is rather rare as compared with *O. jaworskii*. This may, to a certain extent, be only apparent, as no very small juveniles can be referred to *O. jenksi*, since they seem to be indistinguishable from those of *O. jaworskii*.

Omphaloptycha speciosa, new species

Plate 8, figures 30, 35–37, 40, 41, 45–50, 53, 54, 59, 62, 65

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26524/1:6	*ca.* 1.46 mm.	*ca.* 77	*ca.* 23	84°
26524/1:7	*ca.* 2.07	*ca.* 75½	*ca.* 24½	77°
26524/1:8	2.35	76	24	82°
26524/1:9	2.52	75½	20	90°
26524/1:10	2.58	76	21½	86°

A.M.N.H. Nos.	H	W	h	π
26524:12	*ca.* 3.35	84	23½	79°
26524:3	3.84	63[1]	22	*ca.* 80°[1]
26524/1:3	4.1	75½	22	90°
26524:4	*ca.* 4.9	*ca.* 78	*ca.* 22	91°
26524:6	5.4	78	22	84°
26524:5	5.5	76	22	88°
26524/1:2	6.2	82½	24½	90°
26524:4	*ca.* 6.4	*ca.* 69	*ca.* 20½	85°
26524:7	*ca.* 6.9	*ca.* 83½	*ca.* 21	92°
26524/1:5	*ca.* 7.0	*ca.* 64½	*ca.* 17	102°
26524:1	*ca.* 7.8	*ca.* 81	*ca.* 18	95°
26524:8	9.0	72	20	81°
26524:10	11.8	80	21½	91°
26524/1:1 (holotype)	12.0	74	20	90°
26524:11	16.6	74	22	83°

Unfortunately, the largest shells belonging to this species, all from lot 86, are broken and do not lend themselves to precise measurements. However, their pleural angles could be measured and were found to vary from 85 degrees to 98 degrees. The latter angle was measured in specimen A.M.N.H. No. 26524:13 (figs. 59, 65), which when complete must have reached or exceeded 25 mm. in height.

The range of variation in both width and pleural angle seems to be rather wide in this species, less so that in height of spire.

DESCRIPTION: Shell turbiniform, inflated, consisting of from five to seven whorls. The spire never quite reaches a fourth of the shell in height, but the bulge of the body whorl, by producing a reëntering angle between both, makes it appear rather pointed. The flat apical band and the shoulder of the whorls are much more pronounced than in *O. jaworskii*, particularly in the body whorl where they show clearly in the shape of the aperture. Sutures more deeply channeled than in the two preceding species. Spiral whorls moderately convex, with the maximum convexity at about half their height and the maximum width at the suture. Body whorl gibbous, thus causing the pleural angle considerably to exceed that found in closely related species and the base to appear slightly concave around the umbilical niche which is clearly recognizable and always open, in some shells (e.g., A.M.N.H. No. 26524/1:2; figs. 36, 37) to such an extent that it might be called an open umbilicus just as well. Aperture similar in shape to that of *O. jaworskii*, except for the angle formed by the shoulder at its upper end. Inner lip projecting markedly near the wide and shallow anterior notch and clearly reflexed over the umbilical niche. Columella hollow.

Growth striae, where visible (A.M.N.H. No. 26524:11, fig. 62; No. 26524:13, figs. 59, 65; No. 26524:14), follow the same course as those of *O. jaworskii* and tend, as do those in that species, to unite in irregular bundles.

Color markings are preserved in many shells of *O. speciosa*, better in those from lot 86 than in those from lot 48. Among the latter the holotype (figs. 53, 54) shows about 15 per whorl. They are equally spaced and form a forward concave arc on the upper two-thirds of the body whorl and a forward convex one on the base, running on the whole decidedly forward without zigzagging. Their basic pattern is about the same in the large broken shells from lot 86, but there is much zigzagging, and they are much more closely set, there being, on the body whorl of specimen A.M.N.H. No. 26524:13 (figs. 59, 65), as many as 23. In the larger shells the color markings can be seen to run forward on the apical band and to turn backward on the shoulder, forming a hook.

Two specimens from lot 86 (A.M.N.H. Nos. 26524:16, 26524:17), otherwise too incomplete for precise identification, can be referred to this genus and within it, though doubtfully, to the present species merely on the strength of the color markings. In the less incomplete of these fragments (A.M.N.H. No. 26524:16; fig. 30) the density and intense zigzagging on the upper part of the body whorl are about the same as in the large broken shells just mentioned, but at about half the height of the body whorl they turn sharply forward to form a regularly revolving pattern around the umbilical niche, a feature not found in any other shell of this genus examined for its color markings.

Another abnormality, not found in any other specimen of this genus, is five faint revolving edges, more or less equally distributed over the upper two-thirds of the body whorl of specimen A.M.N.H. No. 26524:11 (fig. 62).

[1] Crushed.

EARLIEST ONTOGENETIC STAGES: Even where the nucleus is perfectly preserved, no inclination of the initial whorls towards the axis of the shell is observable.

REMARKS: First and foremost, this species should be compared with *O. jaworskii*. It can readily be distinguished by its more gibbous body whorl, shorter spire, more pronounced apical band and shoulder and more deeply channeled sutures, wider pleural angle, and more projecting inner lip. The most conspicuous difference in shell profile is tested best by drawing a tangent connecting the body and penultimate whorls. When produced towards the apex, this tangent will be more or less continuous along the spiral volutions, as it will in *O. jaworskii*, but it will cut off part of the apical portion of the spire. A less reliable difference is the greater density of the color pattern in *O. speciosa*. The general appearance of the only specimen on which Cox (1949, p. 42, pl. 2, fig. 11) established his *O. lissoni* and the differences by which he distinguishes it from Jaworski's *O. "rhenana"* strongly suggest conspecificity of *O. lissoni* with the species here discussed. However, Cox' insistence on the absence of a visible umbilicus excludes identification, since in *O. speciosa* the umbilical niche is always open and clearly recognizable. It would seem that only careful reëxamination of Cox' holotype can decide this problem. Should it prove to be conspecific with my hypodigm, his name would take precedence over mine. In the meantime, the name *O. speciosa* is maintained in this report for the present species.

Since *O. jaworskii* occupies in most characters an intermediate position between *O. jenksi* and *O. speciosa*, its differences from the former are added to those pointed out above to give the full width of the contrast between the present species and *O. jenksi*, these two species representing the extremes of *Omphaloptycha* within the fauna under examination.

Omphaloptycha speciosa is compared with *Omphaloptycha*, new species, below. A similarity in shell shape of *speciosa* with *Trachynerita porrecta* and the differences serving to distinguish them are dealt with in the discussion of *Trachynerita porrecta* (p. 177).

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26524	96
48	26524/1	28
91	26524/2	1
		125

If it be assumed that a proportionate percentage of those shells of the genus *Omphaloptycha* that could not be determined specifically is also referable to this species, the total number of its individuals present would rise to nearly 350.

Furthermore, two incomplete small shells from lot 26 which only by their lower, obtuse spires somewhat deviate from the typical form of this species have been labeled *Omphaloptycha* cf. *speciosa* (A.M.N.H. No. 26544).

Omphaloptycha, new species

Plate 8, figures 55, 56

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26525:1	5.5 mm.	54½	27	50°

DESCRIPTION: This species is mainly based on a little shell from lot 86 which deviates from all the other *Omphaloptycha* species present by its peculiar, slender, and somewhat pear-like shape. The spire is unusually high, owing to the fact that it consists, despite the smallness of this shell, of more than five whorls which are, as such, higher than in other forms of this genus. The ratio of height to width of the penultimate whorl is about three-fifths in this individual, but only a little more than one-third in the holotype of *O. jaworskii*. The spiral whorls are only little convex, reminiscent in this respect of those of *O. jenksi*. Strangely enough, they show extremely narrow flat apical bands more distinctly than does the body whorl. The latter is quite gibbous, despite the general slenderness of the shell. It reaches its maximum width a little above the middle of the height, as compared to the upper third in the holotype of *O. jaworskii*. The aperture is narrower than in the latter species, but otherwise similar. The umbilical niche is distinct.

Traces of growth striation are observable in the penultimate whorl; they seem to follow the course usual in this genus.

On this whorl and on the body whorl pale

color markings are recognizable. They form a forward concave arc on the former and over most of the height of the latter and are not so closely set, there being about 16 per volution.

No obliqueness of the embryonic whorls can be observed in this shell either, although its nucleus is completely preserved.

Two even smaller specimens, one incomplete, are believed to be conspecific with the one just described (no. 1).

REMARKS: Of the other species of this genus dealt with in this report *O. jenksi* comes closest to the present one by its slenderness, comparative height of the spire, low degree of convexity of the whorls, and low pleural angle, but this species can readily be distinguished by its gibbous body whorl.

It has the last character in common with *O. speciosa* which is, however, much more inflated and has a considerably shorter spire and much wider pleural angle. *O. jaworskii* has, in the mean, also a wider pleural angle and is furthermore stouter than *O.*, new species.

Thus this form must be considered specifically different from all three of the preceding species, but the scanty material present does not justify assigning it a specific name.

Juveniles of *Heterospira simulatrix* are compared below (p. 181).

OCCURRENCE: Very rare; occurs in lot 86 only (three specimens) (A.M.N.H. No. 26525).

?Omphaloptycha cacuana,[1] new species

Plate 8, figures 43, 44, 51, 52, 57

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26545:1	1.16 mm.	*ca.* 68	25	*ca.* 55°
26545:2 (syntype B)	3.0	*ca.* 67	18	*ca.* 65°
26545:3	3.24	67	25	62°
26545:4	*ca.* 4.15	*ca.* 68	*ca.* 22	*ca.* 55°
26545:5	*ca.* 4.8	*ca.* 67½	*ca.* 17½	55°
25645:6	*ca.* 4.9	*ca.* 63½	*ca.* 19½	60°
26545:7	*ca.* 5.5	58½	28	*ca.* 52°
26545:8 (syntype A)	8.76	62½	20½	51°

In this species both W and π seem to tend to decrease with growth, but no definite trend can be recognized in h. Specimen number 7 markedly deviates from the mean by being more slender and by its higher spire, but these deviations are believed to come within the range of intraspecific variation.

DESIGNATION OF TYPES: Since the nucleus of the largest specimen present (no. 8) is not well preserved, both it and the much smaller specimen number 2, of which the nucleus can be studied, have been selected as syntypes A and B, respectively.

DESCRIPTION: Shell pear shaped, consisting of up to six whorls which become increasingly gibbous with growth and are separated from one another by only shallowly engraved sutures. The nucleus is bubble shaped; the first one and a half to two embryonic volutions are obliquely inclined towards the axis of the conch. Both these characters account for the slanted, torch-like aspect of the apex in well-preserved shells (e.g., syntype B; figs. 51, 52). The earlier whorls appear gradate in some specimens (e.g., nos. 9, 10, 11), but this may be due, at least in part, to corrosion. Base conical; aperture rather wide, ear shaped, with its axis standing at an angle of about 30 degrees towards the axis of the conch, angular at its upper end. The lower margin seems to be entire, without indication of a notch. Outer lip sharp and thin, inner one sinuous, reflexed, as seen in specimen number 6 (fig. 57), and thickened (syntype A; fig. 44). On its outer side it is accompanied by a hardly perceptible umbilical niche which, however, becomes closed in maturity. In a single specimen (no. 12) the columella is seen to be hollow.

The shell is smooth, except for growth striae, which can be observed best in syntype A (figs. 43, 44). Here they form a hardly perceptible, shallow, forward hook immediately below the suture, then run straight and slightly backward over the face of the body whorl. Upon reaching the base, this backward trend becomes more pronounced, and they converge towards the center of the base. A faint revolving striation is recognizable on a part of the base of the same specimen (syntype A).

REMARKS: Whereas the large, gibbous body whorl, the low spire, and the comparatively high pleural angle clearly refer this species to *Omphaloptycha* and not *Coelostylina*, if Cossmann's conception of these genera is followed, as it is here, the obliquely inclined

[1] Named after Cerro Cacuan, near which the fossils of lot 91 were found.

nucleus constitutes a character mentioned in Cossmann's and Wenz' diagnoses of *Coelostylina, sensu stricto*, but apparently hitherto not recorded for *Omphaloptycha*. Thus the present species may represent a genus (or subgenus) intermediate between both, and its reference to *Omphaloptycha* can be only tentative.

Actually *?O. cacuana* can be readily distinguished from all the preceding species of *Omphaloptycha* by its oblique nucleus, pear-like shell shape, and shallow sutures. Even where there is a certain agreement in dimensions, as, for example, between specimen number 7 of the present species and syntype A of *O. jenksi*, other characters warrant easy distinction, the latter specimen exhibiting a more slender spire, more and lower spiral whorls, and deeper sutures than the former. The present species is compared above (p. 136) with *Coelostylina* cf. *medea*.

On the other hand, it resembles *O. pachygaster* Kittl (1895, p. 164, text figs. 7, 8; 1899, p. 127, pl. 14, figs. 8, 9) from the Marmolata and Esino limestones in shell shape, shallowness of the sutures, and growth striation. This is particularly true for the stouter form with lower spire from Esino, figured in Kittl's 1899 paper, which might represent a species different from the Marmolata form figured by him in 1894. The latter rather widely differs from ours by its much higher spire, less ventricose body whorl, and much greater size, whereas only the last difference seems to exclude conspecificity between the present species and the Esino form.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. NOS.	NO. OF SPECIMENS
91	26545	90
87	26545/1	1 (doubtful)
35	26545/2	1 (doubtful)
	Total	92

This species is the only gastropod common in, and the index fossil of, lot 91 which otherwise includes only a few isolated individuals of species occurring also in other lots.

GIGANTOGONIA COSSMANN

This name was established by Cossmann (1909, p. 50) as a subgenus of *Coelostylina* "sur le même rang qu'*Omphaloptycha*." Wenz (1938, p. 393) raised it to generic rank, as he did with *Omphaloptycha*, a course followed in this report.

?Gigantogonia sp.

Plate 9, figure 32

DESCRIPTION (INCLUDING DIMENSIONS): This fragment is an incomplete whorl of a large shell. It is obviously a late volution but not the body whorl, since parts of the ceiling of a following whorl are attached. If it were, the height of the shell would have been about 100 mm.; since it is not, the size must have been considerably greater. As preserved, the present fragment measures about 60 mm. in height and 46 mm. in width. The pleural angle can be estimated as between 30 degrees and 35 degrees.

The shapes of both spire and base must have been conical and comparatively slender, the sutures shallow. Decisive for the tentative reference of this fragment to *Gigantogonia* were, in addition to the size, the aspect of the aperture (fig. 32), which is rhomboidal, with a slightly oblique axis, angular upper and lower ends, and reflexed inner lip, and the gentle sinuosity of the columella, which is hollow.

The test is markedly (up to 7 mm.) thick and, as often happens in the course of acid preparation, here and there split up into its various layers. What little is preserved of the outer surface is much too corroded to permit any observation of ornamentation.

REMARKS: The close resemblance in the aspect of the aperture between the present fragment and the large Esino specimen of the type species, *G. aldrovandii* (Stoppani; Kittl, 1899, p. 136, *cum synon.*, text figs. 66–69, pl. 16, figs. 1–4, pl. 17, figs. 1–4),[1] illustrated in figure 1 of Kittl's plate 17, seems to justify at least tentative reference of the former to Cossmann's genus. Since the whorl preserved in the Peruvian fragment seems to correspond in both shape and size with the penultimate whorl of the shell from the Val de'Mulini, both specimens can be assumed to have been about the same size when complete. However, the former's poor preservation

[1] Recently recorded by Bešić (1948, pp. 65, 70, pl. 4, fig. 3) from the Pivska Planina of Montenegro.

does not warrant an attempt at specific determination.

OCCURRENCE: A single fragment in lot 40 (A.M.N.H. No. 26547).

UNDULARIA KOKEN

Pustulifer, *Toxoconcha*, and *Protorcula* are dealt with below as independent genera.

Undularia cf. **disputata** Kittl

Plate 9, figure 2

Cf. *Undularia scalata* Schloth. sp.; KITTL, 1895, p. 153, pl. 5, figs. 8–10.

Cf. *Toxonema scalatum* Schloth. sp.; BÖHM, 1895, p. 270, text figs. 57, 58, pl. 12, fig. 6, pl. 15, fig. 20.

Cf. *Undularia disputata* KITTL, 1899, p. 157.

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26551	10.9 mm.[1]	*ca.* 54	*ca.* 41	45°

DESCRIPTION: The larger and better fragment present consists of eight and a half volutions; the largest of these is unfortunately incomplete and may or may not have been the body whorl. The spire is slender-conical and decidedly pointed. Most characteristic of this shell, however, are the deeply channeled sutures which form a narrow, slightly concave ledge at the top of the whorls. The lateral whorl faces are gently convex and attain their maximum width just above the lower suture. The spiral whorls are about twice as wide as high. There is no distinct edge separating the base from the lateral face of the body whorl. What can be seen of the aperture agrees well with the generic characters, particularly the pronounced upper angle which corresponds to the apical ledge of the whorl. The columella seems to have been perforated.

Growth striae can be recognized here and there, best where they unite into fold-like bundles. They form a forward concave sinus on the lateral whorl faces and turn backward on the base.

EARLIEST ONTOGENETIC STAGES: The nuclear volutions seem to be slightly obliquely inclined towards the main axis of the spire.

REMARKS: The present fragment closely resembles *U. disputata* from the Marmolata. However, it cannot fully be identified with Kittl's species because its whorls remain convex until a comparatively late stage, at which they turn concave in the latter (see Kittl, 1895, fig. 8), and because there is no peripheral edge separating the base from the lateral face of the body whorl.

The shell profile is so characteristic and unique within the present assemblage that no further comparisons are needed.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26551	1
76	26551/1	1 (fragment)
	Total	2

The above description is based on the specimen in lot 26.

PUSTULIFER COSSMANN

(=**PUSTULARIA** KOKEN, NON SWAINSON)

The differences between this genus and *Undularia* seem to be wider than admitted by Cossmann (1909, p. 65). The former comprises heavily sculptured forms, the latter essentially smooth ones. *Pustulifer* is therefore here considered an independent genus, as it was (under its first, but preoccupied, name *Pustularia*) by Koken (1892b, p. 203) and by Kittl (1894, p. 231), especially since its reference to the family Coelostylinidae seems not absolutely certain.[2]

Pustulifer peruvianus, new species

Plate 9, figures 20–24

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26552 (holotype)	*ca.* 51 mm.	*ca.* 42	*ca.* 51	*ca.* 22°
26552/2:1	*ca.* 100[3]	*ca.* 34½	*ca.* 71½	*ca.* 26°

Inasmuch as inferences can be drawn from the comparison of only two specimens, W seems to decrease, but h and π seem to in-

[1] As preserved.

[2] Kittl (*loc. cit.*) included it with *Promathilda* in the Cerithiidae. The latter genus is, however, placed by Wenz (1939, p. 660) in another family of the Cerithiacea, the Mathildidae.

[3] As preserved; including the apex, which is broken off, this shell may have measured about 110 mm. in height.

crease, with growth. For the pleural angle this inference seems to be supported by the fragment A.M.N.H. No. 26552/3:1 of a much larger specimen, in which the pleural angle attains 28 degrees. On the other hand, this angle appears to amount to only about 20 degrees in specimen A.M.N.H. No. 26552/3:2, the lower end of which approximately corresponds in size to the upper end of specimen 1 of the same lot. This appearance is, however, exaggerated by the fact that the natural cross section of this conch shown on the rock surface runs obliquely rather than along the median plane, thus making the shell appear more slender and more pointed than it really is.

Both paratypes A.M.N.H. Nos. 26552/2:1 and 26552/3:2 are far from complete at their lower ends, as is the fragment A.M.N.H. No. 26552/3:1, which corresponds in dimensions to the lower part of A.M.N.H. No. 26552/2:1. Thus this species may easily have reached a total height of 120 mm., if not more. It seems to be exceeded, within the present assemblage, in size only by the *Gigantogonia* species, a poor fragment of which is described above (p. 147; pl. 9, fig. 32).

DESIGNATION OF TYPE: the better of only two shells with aperture preserved, A.M.N.H. No. 26552, is herewith designated holotype.

DESCRIPTION: Shell turritelliform, consisting of up to 15 or more volutions which are separated from one another by only shallowly engraved sutures. The profile of the earlier whorls is more or less flat; that of the later ones appears concave in the upper two-thirds of the whorl height, owing to the prominence of the nodes in the lowermost one. The base, separated by an indistinct, rounded edge from the lateral face of the body whorl, is rather low. The aperture is obliquely elliptical, with an angular upper (posterior) end and a well-rounded lower (anterior) one. Inner lip thickened and apparently accompanied by an indistinct umbilical niche. Columella solid,[1] corkscrew shaped.

The ornamentation of the earlier whorls consists of heavy transverse ribs, six of which can be counted per half whorl and which run somewhat obliquely forward from the upper suture to the lower. At this stage they increase downward in prominence; this feature becomes more and more pronounced with growth. In maturity, the ornament seems to be restricted to one row of from 10 to 12 heavy nodes per whorl immediately above the suture, which are but slightly elongated in the direction of the original ribs and increase in width downward, thus assuming the shape of a drop of water. This row of heavy tubercles is diagnostic of even badly corroded shells of this species. In specimen A.M.N.H. No. 26552/2:2 these tubercles seem to be crossed by two or three revolving striae. Growth striation could not be observed in any specimen, nor could the nuclear characters, since nowhere is there a complete apex.

REMARKS: From the type species of this genus, *P. alpinus* (Eichwald) (see Koken, 1892b, p. 203; pl. 15; Kittl, 1894, p. 231, *cum synon.*, pl. 12, fig. 1), the present form differs by its somewhat more slender shape and narrower pleural angle, shallower sutures, and chiefly by having in maturity[2] only a supersutural but no subsutural row of tubercles. Thus the whorl profile never becomes so deeply concave as in *P. alpinus*. Also the tubercles of the latter are more bullate, whereas those of the present form even in maturity are a little expanded in the transverse sense. *P. wengensis* Kittl (1894, p. 232, pl. 12, figs. 2–6) deviates even farther from the Peruvian form, as seen from its differences from the type species, enumerated by Kittl. On the other hand, "*Chemnitzia* sp. ind. (cfr. *Ch. Rosthorni* Hörn.)," described from Gorno (Lombardy) by Parona (1889, p. 69, pl. 3, fig. 2) and referred by Koken (*loc. cit.*) to this genus, comes fairly close to the present species, particularly in sculptural characters, since it, too, has only one row of tubercles at the lower ends of the later whorls. It differs only in its even more acute pleural angle; that the sutures of Parona's specimen appear to be deeply channeled may be due merely to the fact that it is a cast.

For comparisons, see *Pustulifer* sp. indet. below.

[1] Cossmann (1909, p. 65) insists that the columella is perforated, and Wenz (1938, p. 395) repeats this statement in his diagnosis.

[2] According to Kittl's (*loc. cit.*) description, *P. alpinus* also has transverse folds in adolescence.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	NO. OF SPECIMENS
40	26552	1
37	26552/1	3
3	26552/2	5
21	26552/3	2
97	26552/4	1 (fragment)
	Total	12

Unfortunately many of the specimens listed above are incomplete or poorly preserved or both; the majority occur in lots that proved not susceptible to acid preparation.

Pustulifer sp. indet.

Plate 9, figures 1, 4, 5, 10

DESCRIPTION (INCLUDING DIMENSIONS): As there is no complete shell present, no orthodox measurements are feasible. Of the two specimens on which this description is based, one (no. 1), measuring as preserved about 22 mm. in height and about 13 mm. in width, consists of the body whorl and a little more than one spiral volution. The other (no. 2) consists mainly of a slice broken out of the median region of a somewhat larger shell. It measures as preserved 32 mm. in height and about 20 mm. in width and comprises four volutions, only the uppermost of which is preserved as a half whorl. This fragment approximately agrees in size with the holotype of *P. peruvianus*. The pleural angle amounts to 24 degrees in the first specimen and to 26 degrees in the second. Thus it seems to be somewhat wider than in the preceding species if the respective sizes are taken into account.

In shell shape this form agrees on the whole with *P. peruvianus*. It is true that specimen number 1 shows in basal view a comparatively wide umbilical opening, but this aspect is deceptive and due merely to the fact that the outer layer of the test is destroyed. Specimen number 2, of the conspecificity of which there can be no reasonable doubt, shows clearly that the corkscrew-shaped columella is solid (fig. 1; see p. 149, footnote 1).

This species differs from *P. peruvianus* mainly in its ornamentation. As far as the smaller shell is preserved, it shows less prominent transverse ribs, which are a little more oblique than on the earlier whorls of *P. peruvianus* and of which here also six can be counted per half whorl. They tend to form inconspicuous nodes at both upper and lower ends. The same holds true for the earlier volutions of specimen number 2; on the last two whorls, however, these nodes have merged into one rather prominent node, situated a little above the middle of the whorl face (fig. 10). Whereas the earlier volutions are more or less flat in profile, this development of the sculpture lends a decidedly convex profile to the last two, which makes for a striking difference from the more or less concave mature volutions of *P. peruvianus*.

The earliest ontogenetic stages could not be examined.

REMARKS: Reference of this form to the genus *Pustulifer* seems fairly safe, but it cannot be united with any previously known species. On the other hand, the scanty material available does not warrant creation of a new one.

The presence of one tubercle at about half the height of the mature volutions and their convex rather than concave profile, thus produced, distinguish this form readily from the type species, *P. alpinus*, even if differences in size are omitted.

OCCURRENCE: Found in lot 76 only. In addition to the two specimens dealt with above, a third, broken beyond repair, is doubtfully referred to this species; the total number of specimens, including the last, is three (A.M.N.H. No. 26553).

TOXOCONCHA KITTL

Established as a subgenus of *Undularia* by Kittl (1899, p. 161) and treated as such by Cossmann (1909, p. 65), *Toxoconcha* was raised to generic rank by Wenz (1938, p. 395). In the present report also it is considered an independent genus. It is represented in the Peruvian assemblage by a single species.

Toxoconcha gracilis, new species

Plate 9, figures 6–9

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26554:1 (syntype A)	*ca.* 22 mm.	*ca.* 37½	*ca.* 48½	22°
26554/1 (syntype B)	*ca.* 23	*ca.* 35½	50	23°

The second of the specimens measured above is broken at the base; when complete, it must have reached a height of at least 30 mm.

SELECTION OF TYPES: Since specimen A.M.N.H. No. 26554:1 shows the aperture and ornamentation best, but has its apex broken off, whereas the spire is nearly complete in specimen A.M.N.H. No. 26554/1, both were selected as syntypes, A and B, respectively.

DESCRIPTION: Shell turritellid, slender, consisting of up to 10 whorls which are separated by shallowly engraved sutures and of which the slightly concave lateral face is bordered by a distinct torus above and a hardly perceptible one below. Here and there a minute ledge[1] can be seen to slope gently from the suture to the upper torus, better in the earlier whorls than in the later ones. The lateral face of the body whorl becomes flat anteriorly and is separated by a distinct though rounded edge (corresponding to the lower torus) from the rather low base which is conical and gently rounded. The aperture (unfortunately not complete in any shell present) is rounded-rhombical, with its upper (posterior) end forming an acute angle. Its inner lip is somewhat thickened and broadly reversed so as to close the umbilicus. (The opening seen in fig. 8 is obviously due to a break.) However, in both syntypes the columella can clearly be seen to be hollow.

The ornamentation consists mainly of coarse growth lamellae which sometimes assume the shape of blunt, broad folds. About 30 can be counted around the body whorl of syntype A. Here and there the single fine growth striae which unite to form these folds are recognizable. Their course is inverse S-shaped, as is characteristic of this genus, with the apex of the forward concave part of the curve somewhat below the middle of the lateral whorl face (fig. 6; see also Kittl, 1899, p. 162). On the base, the growth lamellae converge in gentle forward convex arcs towards the columella (fig. 8). In addition to the growth striation, a fine revolving striation can be recognized here and there in both syntypes, best on the later volutions and immediately below the upper torus. A somewhat less fine spiral striation is observable on the anteriormost part of the base of syntype A.

Although the apex of syntype B seems to be complete, it is so corroded that it permits no reliable observations on the nucleus.

REMARKS: This graceful shell belongs undoubtedly to the genus *Toxoconcha* and resembles some of the diversified forms included by Kittl (1899, p. 163, text figs. 93–98, pl. 12, figs. 15–24) in the type species *T. brocchii* (Stoppani),[2] best so its typical form (Kittl, fig. 17), but it differs by its concave, not convex, whorl profile, less distinct subsutural ledges, and a more acute pleural angle. *T. uniformis* (Stoppani) (Kittl, 1899, p. 168, text fig. 90, pl. 12, fig. 28) and *T. ontragnana* (Kittl, 1899, p. 170, pl. 12, figs. 29, 30), the former with a flat whorl profile, the latter with a slightly concave one, resemble the Peruvian form even more closely, but, besides being much larger, they do not show so distinct an upper torus as *T. gracilis*, nor its characteristic coarse growth lamellae; also, their bases are somewhat higher. Creation of a new species might thus appear justified.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26554	2
56	26554/1	1
67	26554/2	1 (doubtful)
	Total	4

PROTORCULA KITTL

Kittl (1894, p. 169) first established this name as a subgenus of *Undularia* Koken, and it was so used by Cossmann (1909, pp. 41, 67). Later Kittl (1899, p. 184) raised *Protorcula* to the rank of an independent genus, and it is treated as such by Wenz (1938, p. 396) and in the present study.

Cossmann (1909, p. 67) assumes that the columella is perforated in *Protorcula*, but this is inconsistent with Kittl's original diagnosis ("Spindel . . . solid") and his emphasis on the same character in distinguishing

[1] See Kittl's (1899, p. 162) subgeneric diagnosis: "Eine Nahtfacette ist mehr oder weniger deutlich entwickelt."

[2] Recently recorded also by Bešić (1948, pp. 67, 70, pl. 4, fig. 4) from the Pivska Planina of Montenegro.

Protorcula from *Undularia* (1899, p. 184), Cossmann (1912, p. 108) was wrong also when he showed astonishment that Kittl should not have been struck by the close relationship between his subgenus and some Triassic *Turritellae*, for it escaped him that Kittl himself in establishing *Protorcula* (1894, p. 169) had proposed inclusion of his "*Turritella*" *fasciata* (1892, p. 55, pl. 9, figs. 12–14) and "*T.*" *abbatis* (1892, p. 56, pl. 9, fig. 15).[1]

Protorcula, new species

Plate 8, figures 63, 64

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26520	2.8 mm.	50	71	19°

DESCRIPTION: Shell turritellid in shape, consisting of four whorls and a half, in addition to the incomplete nucleus. Whorls slightly concave in profile, separated from one another by shallowly engraved sutures. Columella solid, almost straight; aperture depressed-rhomboidal in outline, with narrowed, circular lumen and thickened peristome.

The revolving ornamentation consists mainly of twin keels immediately above the suture; the upper projects a little farther than the lower. Immediately below the suture there is no proper keel, but merely a swelling of the whorl, accentuated by blunt nodes formed by the upper ends of the growth striae. The latter can well be studied on the two last whorls present. Immediately below the suture they form a short, backward concave loop; then they run in a very shallow, forward concave arc slightly forward over the face of the whorl. Thus they assume a somewhat sigmoidal aspect. There seem to be from 25 to 30 per whorl. They produce a row of blunt nodes immediately below the suture and hardly perceptible beads in crossing the revolving twin keels. In addition to the latter, there seem to be a few fine revolving striae on the middle part of the whorl surface.

Nucleus obtuse, rounded.

REMARKS: In both shell shape and ornamentation this form comes fairly close to the genotype (Cossmann, 1909, p. 67), *P. subpunctata* (Münster) (1841, p. 118, pl. 13, fig. 10; see also Kittl, 1894, p. 169, *cum synon.*, pl. 7, figs. 50–54, 56), but differs from it as well as from the many other species referred to this genus (see the enumerations in Cossmann, 1909, pp. 67, 68, supplemented by Cossmann, 1912, p. 108, and Diener, 1926, pp. 189–191)[2] by the twin keels immediately above the suture, a character not found, as far as I could ascertain, in any other species of *Protorcula*. On the other hand, the only shell present is much too poor to deserve a new specific name.

Within the fauna here dealt with, *Kittlistylus alter*, new species, somewhat resembles the present form in shell shape; for comparisons, see under that species.

OCCURRENCE: A single small, incomplete specimen in lot 26 (A.M.N.H. No. 26520).

GLYPTOCHRYSALIS KOKEN

This genus, created by Koken (1896, p. 115) for two Hallstatt species (see Koken, 1897, pp. 90–91, pl. 21, figs. 13–14), is here discussed merely for the presence in the material examined of two juveniles somewhat resembling "*Melania*" *anthophylloides* Klipstein,[3] a species doubtfully referred by Kittl (1894, p. 233, pl. 10, figs. 33, 34) to Gemmellaro's Liassic genus *Tomocheilus*,[4] but tentatively assigned by both Koken (1896, p. 116; 1897, p. 90) and Cossmann (1909, p. 59) to *Glyptochrysalis*. However, Koken himself points out certain differences between his typical forms and Klipstein's. Although relegated to the rank of a subgenus of *Spirochrysalis* Kittl by Cossmann (1909, p. 51) and Wenz (1938, p. 397), *Glyptochrysalis* is here treated as an independent genus, without further discussion, considering the extreme scantiness of the material at hand.

[1] "*Turritella*" *paedopsis* Kittl (1892, p. 55, pl. 6, fig. 1), mentioned by Cossmann (*loc. cit.*) in this connection, has decidedly convex whorls and does not fit in *Protorcula* which by diagnosis has "flat or concave whorls" (as accepted also by Cossmann, 1909, p. 67).

[2] *P. decorata* Kutassy (1937, p. 70, pl. 2, figs. 71–73) may now be added.

[3] 1843 (p. 185, pl. 12, fig. 6); Laube (1868, p. 63, pl. 24, fig. 16, *Loxonema*).

[4] Renamed, as a quasi-homonym, *Teliochilus* by Cossmann (1906, p. 43).

?Glyptochrysalis juvenile form ex aff.
G. anthophylloidis (Klipstein)

Plate 8, figures 58, 60, 61

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26519/1	*ca.* 1.23 mm.	*ca.* 63½	*ca.* 27½	34°/60° (47°)
26519	1.34	64½	29	18°/66° (42°)

Owing to the chrysaliform shell shape very different values for π are obtained depending on whether this angle is measured from the last or from the penultimate whorl up. Above, the former values are given first, the latter second, and the mean values, which are not so different between the two measured specimens, are added in parentheses. Agreement in W and h is even better.

DESCRIPTION: Both shells present are extremely small. Specimen A.M.N.H. No. 26519/1, of which the apical portion is better preserved, can be recognized to consist of from four and a half to five volutions, including the embryonic ones. The shell shape is characterized by the contrast between the obtusely conical apical part of the conch and the almost cylindrical lower one, the last volution being not so much wider than the penultimate. The latter is about two and a half times as wide as high. The post-embryonic whorls are quite convex and separated from one another by rather deep sutures. Base convex, with a narrow, funnel-shaped central depression, but there seems to be no open umbilicus. Aperture rounded-rectangular, with a somewhat thickened peristome that shows a faint indication of a short and wide anterior notch (fig. 59).

The specimen from lot 26 (A.M.N.H. No. 26519; fig. 58) shows on its last two whorls a quite heavy transverse costation. There are about 25 ribs per whorl which run perpendicularly across the lateral whorl faces, describing a shallow, forward convex arc. An extremely delicate denticulation of these ribs indicates the presence of a fine revolving striation. The specimen from lot 48 (A.M.N.H. No. 26519/1; fig. 55) exhibits about six even heavier, almost tubercle-like transverse folds on the posterior half of the body whorl, whereas the rest of the surface is covered by fine growth striae which run in a shallow, forward concave arc obliquely forward across the lateral whorl faces. These fine growth striae can be recognized here and there to be beaded, owing to the crossing of the even finer revolving striation. No ornamentation is visible on the base of either specimen.

EARLIEST ONTOGENETIC STAGES: The nucleus of specimen A.M.N.H. No. 26519/1 is clearly inclined towards the main axis of the shell (fig. 58).

REMARKS: The above description proves a certain relationship of this form to Klipstein's St. Cassian species, but it differs by its more convex whorls.

The only form in the Peruvian material which by its similarly chrysaliform shell shape somewhat resembles the present one is *?Oonia ?subtortilis* (Münster) which can, however, readily be distinguished by its more slender shell shape, in particular, higher, less convex body whorl and narrower aperture, and lack of a costation.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	26519	1
48	26519/1	1
	Total	2

Both these specimens are extremely small juveniles.

SPIROSTYLIDAE[1]

SPIROSTYLUS KITTL

This genus, established by Kittl in 1894 (p. 197), was assigned a type species only in 1909 (p. 73) by Cossmann, namely, *Melania subcolumnaris* Münster (1841, p. 95, pl. 9, fig. 31). Based on this genotype, it seems a well-defined genus, but it is doubtful if all the species from St. Cassian and from the Marmolata and Esino limestones referred to it by Kittl and especially by J. Böhm[2] belong to it. *Spirostylus elegans* Bonarelli (1921, p. 71, pl. 10, figs. 23–26; 1927, p. 98, pl. 5, fig. 1) from Tres Cruces, Argentina,

[1] Cossmann (1909, p. 72) incorrectly named the family Spirostylinidae instead of Spirostylidae, although he based it on the genus *Spirostylus* Kittl. Wenz (1938, p. 398) uses the correct version.

[2] Böhm's *S. radiciformis* was shown by Kittl (1899, p. 100) to be a synonym of *Trypanostylus triadicus* (Kittl).

certainly does not, as already stated by Cossmann (1925, p. 205). Not only the quite conspicuous revolving ornamentation mentioned by Cossmann in this connection, but especially the sharp shoulder keel, recognizable only in Bonarelli's 1927 figure, clearly exclude it from this genus. On the other hand, the two forms referred to this genus in the present report share the distinctive characters of the type species.

Cossmann's (1909, pp. 73, 74) splitting of the present genus into two subgenera, namely, *Spirostylus, sensu stricto*, and *Heligmostylus*, the former with the genotype, the latter with *Melania columnaris* Münster (1841, p. 95, pl. 9, fig. 26) as type species, although accepted by Wenz (1938, p. 398), is quite unwarranted. The differences between Münster's two species which were selected as subgenotypes by Cossmann are differences of degree rather than of kind, and they seem to be closely related despite those differences, more closely than some of the other species referred to this genus are to its type species, *S. subcolumnaris*. Creation of the subgenus *Heligmostylus* seems the more superfluous since it rests to this day solely on the type species, of which altogether 30 individuals have been recorded by Kittl (1894, p. 199; 1895, p. 172; 1899, p. 102).[1]

Spirostylus peruvianus, new species

Plate 9, figures 11–17

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27680:1	*ca.* 1.68 mm.	*ca.* 51½	*ca.* 23½	44°
27680:2 (syntype A)	*ca.* 2.46	*ca.* 45½	*ca.* 27½	41°
27680:3 (syntype B)	*ca.* 2.58	*ca.* 42½	?	40°
27680:4	*ca.* 3.39[2]	*ca.* 39	?	39°

[1] It is true that Bonarelli (1921, p. 71, pl. 10, figs. 27–29) referred still another form, *H.* cf. *columnaris* (Münster) from Tres Cruces, to *Heligmostylus*, and maintained this generic reference in 1927 (p. 100, pl. 5, fig. 2), although Cossmann had (1925, p. 204) transferred this form to *Spirostylus, sensu stricto*, renaming it *S. bonarellii*. Comparison of Bonarelli's (1927) figure 2 with Kittl's (1894, pl. 7) figures 1–10 and, in particular the former's close resemblance to Kittl's figure 6 of a *S. subcolumnaris* seem to corroborate Cossmann's decision.

[2] Computed.

None of the above specimens is complete; in numbers 1 and 2 the lower part of the body whorl is missing, in number 3 the upper part of the spire, and in number 4 both. Thus all the figures of the table are estimates, based on comparison with specimens in which the missing parts are preserved. Specimen number 5, a spire without body whorl, must, when complete, have been of about the same size as number 4; the same pleural angle of 39 degrees as in the latter could be measured.

With all caution imposed by the somewhat synthetic way in which the above measurements were obtained, and despite the smallness of the sample the inference is inescapable that W and π decrease, and h tends to increase, with growth.

SELECTION OF TYPES: The two medium-sized specimens numbers 2 and 3 which, though incomplete, supplement each other to such an extent as to give an idea of a complete shell are designated syntypes A and B, respectively.

DESCRIPTION: Five volutions and a half, including the embryonic ones, can be counted in syntype A; more do not seem to be present in paratype number 5 which grows about one and one-third times as large.

Shell slender, with the spiral whorls only gently, but the body whorl more markedly, convex. Spiral whorls slender and high, the height attaining almost three-quarters of the width. There is a narrow subsutural ledge ("rampe," "Nahtfacette") which, however, almost disappears in the body whorl, the profile of which appears evenly rounded from the suture down. The subsutural ledge contributes to the appearance of rather deeply engraved sutures. Their obliqueness constitutes one of the most distinctive characters of this species as well as of the genotype, *S. subcolumnaris*. Altogether seven measurements of their gradient in both syntypes and in paratype number 5 yielded results from 21 degrees to 24 degrees, that is, only slightly less than in *S. subcolumnaris* where this angle, as measured in Kittl (1894, pl. 7, figs. 5, 6), amounts to about 25° degrees but much less than in *S. columnaris*, where it goes up to 30 degrees and beyond. To judge by our syntype A, this gradient tends somewhat to increase with growth.

The aperture, nearly entirely preserved

only in syntype B, is lenticular in outline, with its longitudinal axis running obliquely to the lower left. Its outer margin is gently convex, the inner one only slightly sinuous. Along its lower half the inner lip is somewhat bent up, but not properly reflexed, and accompanied at its left by a narrow but comparatively deep umbilical slit (fig. 15). At its upper end the aperture forms a more or less acute angulation; the lower one, preserved not even in syntype B, seems to have been rounded as in *S. subcolumnaris*. The columella of syntype A can be seen in cross section; it is not perforated.

The only ornamentation that can occasionally be observed in this species (e.g., in paratypes 1 and 4 and in syntype B) consists of fine growth striae which can be seen to run in a gently (not inversely) sigmoidal and in general vertical course across the penultimate whorl (figs. 14, 16).

EARLIEST ONTOGENETIC STAGES: Where the embryonic volutions are preserved, as in syntype A and in paratype number 6, their alloiostrophy is recognizable (figs. 12, 13).

REMARKS: Creation of a new species for a sample consisting of six specimens only, all of which are more or less incomplete, may be questioned. It is, however, believed to be justifiable by the fact that all relevant diagnostic characters are well observable in this sample. Also a named species gives better proof of the occurrence of this rare genus in the late Triassic of Peru than a "sp. indet." The possibility that all the specimens here dealt with are merely juveniles must, it is true, be kept in mind, but even if they were, this would not invalidate the present species.

It exhibits the characteristic features of the genus *Spirostylus* well, even better apparently than some of the species from the southern Alps referred to this genus. It differs, however, from the genotype, *S. subcolumnaris*, and even more from *S. columnaris*, by its considerably wider pleural angle[1] and the somewhat milder gradient of the sutures. The first difference also distinguishes it from *S. bonarellii* (see above under the genus *Spirostylus*). *S. elegans* Bonarelli is not even congeneric, as is pointed out above.

Among species of other genera, *?Ramina andina*, which also occurs in the material under study, is compared above (p. 112). *Siphonophyla desori* Kittl (1894, p. 235, pl. 11, figs. 1, 2) has similarly oblique sutures and resembles *S. peruvianus* in shell shape even more closely than it does *?Ramina andina*, but it can readily be distinguished from the present species by its inflated body whorl and its rather wide open umbilicus.

OCCURRENCE: Rare (six specimens) in lot 48 (A.M.N.H. No. 27680).

Spirostylus sp. indet.

Plate 9, figures 18, 19

DESCRIPTION (INCLUDING DIMENSIONS): A single fragment, consisting of the body whorl and about half of the penultimate one (with a worn part of the antepenultimate attached) of a shell of which the total height is estimated at about 3½ mm., exhibits the distinctive characters of *Spirostylus* but is dealt with separately, since it is obviously not conspecific with *S. peruvianus*.

The following differences distinguish it from that form: The base is somewhat truncate and decidedly concave, the height of the penultimate whorl attains only two-thirds of its width (as compared to almost three-fourths in *S. peruvianus*), and there is a distinct revolving ornamentation, consisting of rather deeply engraved striae which are separated by bands about three times their width. About 10 such striae, or bands, respectively, can be counted on 1 mm.

Faint indications of growth striae which seem to follow about the same course as those in *S. peruvianus* are recognizable at the anterior end of the penultimate whorl.

The outline of the aperture shows at its upper end the rather acute angulation which is common in this genus, but this angle is filled with a secondary deposit of shell substance, later silicified like the rest of the shell, which makes the inner lumen of the aperture appear elliptical rather than lenticular.

REMARKS: The revolving ornamentation described above occurs, according to Kittl's (1894, p. 197) diagnosis, only exceptionally

[1] Even if measured as near the apex as possible in Kittl's (1894, pl. 7) drawings of the two species, π amounts to only 14 degrees to 16 degrees, and only in his var. *brevior* of *S. subcolumnaris* does it rise to 26 degrees, whereas it ranges between 39 degrees and 44 degrees in the present species.

in this genus. That author records and figures it for *S. beneckei* (*ibid.*, pl. 6, fig. 62), where it seems to be restricted to the base, and *S. contractus* (*ibid.*, pl. 8, fig. 29), both species admitted by Cossmann (1909, p. 74) to this genus.[1]

The remarks in the discussion of *S. peruvianus*, comparing it with species of the genera *Ramina* and *Siphonophyla*, hold true for the present form.

OCCURRENCE: A single incomplete shell in lot 26 (A.M.N.H. No. 27681).

EUTHYSTYLUS COSSMANN

A single fragment from lot 26 is referred to this genus, established by Kittl (1894, p. 199) under the name *Orthostylus* but, since this name was preoccupied, renamed *Euthystylus* by Cossmann (1895, p. 6; cf. Cossmann 1909, p. 75; Wenz, 1938, p. 399).

Euthystylus sp. indet.

Plate 9, figure 3

DIMENSIONS: No proper dimensions can be given for this fragment, consisting of four whorls of a shell that must have had many more. As preserved, it is 2.76 mm. high and 1.3 mm. wide; the pleural angle amounts to 19 degrees.

DESCRIPTION: Shell shape steeply conical; height of whorls about six-tenths of the width. Whorls very gently convex, with their greatest width somewhat above the sutures which are shallowly engraved and only little oblique. Base and aperture not preserved; columella solid.

Preservation permitting, a fine and dense growth striation is observable; the striae are straight or nearly so; on the earlier volutions present they run very steeply backward from the upper suture to the lower, but they seem to become almost vertical on the later whorls.

REMARKS: Shell shape, particularly the low degree of obliqueness of the sutures, and character of growth striation seem to refer this fragment, within the family Spirostylidae, to *Euthystylus* rather than *Spirostylus*. However, it cannot well be assigned to any known species of the former genus. From both the type species, *E. fuchsi* (Klipstein) (1843, p. 174, pl. 11, fig. 11; Kittl, 1894, p. 200, pl. 7, figs. 17–21), and *E. angustus* (Münster) (1841, p. 95, pl. 9, fig. 30; Kittl, 1894, p. 200, pl. 7, fig. 22; 1899, p. 104) it differs by a considerably higher pleural angle, from *E. fuchsi*, moreover, by its lower whorls, and from *E. angustus* by lacking the fine revolving ornamentation of the latter species. Nor can it safely be referred to any of the other previously described species of *Euthystylus;* on the other hand, creation of a new species for this poor fragment is out of the question.

Within the present assemblage, only *Kittlistylus flexuosus* (p. 244) somewhat resembles it in shell shape, but the form here dealt with is readily distinguished by its less acute pleural angle, gently convex whorl profile, and the absence of a subsutural torus and of any ornamentation other than growth striae.

OCCURRENCE: A single fragment in lot 26 (A.M.N.H. No. 26546).

[1] A more pronounced revolving ornamentation is found in "*S.*" *elegans* Bonarelli which, as discussed above, cannot be considered a *Spirostylus*.

NERITOPSIDAE

This family, here conceived in the circumscription given it by Wenz (1938, pp. 402–413), is distinguished from the following one, the Neritidae, by the fact that no resorption of the inner walls of the whorls occurs.

Of the two subfamilies of this family the Neritopsinae are well represented in our material by a characteristic St. Cassian species of the type genus *Neritopsis*, whereas only a single specimen of doubtful generic affinities is, under the designation *?Marmolatella* sp., referred to the Naticopsinae.

SUBFAMILY NATICOPSINAE

The genera comprised under this heading were assigned to two families, the Naticopsidae and the Hologyridae, by Kittl (1899, pp. 31–55), but united in one family, the Naticopsidae, by Cossmann (1925, pp. 65–83). In the present report this group is granted only subfamily rank, as it was by Wenz (1938, pp. 402–410).

MARMOLATELLA KITTL

This name was proposed by Kittl (1895, p. 142) in his Marmolata paper for an in-

tended subgenus of *Naticopsis*, comprising "*Ostrea*" *stomatia* Stoppani (see Kittl, 1895, p. 144, pl. 4, fig. 9; 1899, p. 47, *cum synon.*, pl. 10, figs. 1–4) and closely related species. In 1899 (p. 45) Kittl raised *Marmolatella* to generic rank. It was recognized as an independent genus by Wenz (1938, p. 406), whereas Cossmann (1925), p. 74) preferred to treat it as a subgenus of *Naticopsis*. The latter author designated Stoppani's above-mentioned species as the genotype.

The subdivision of *Marmolatella* by Cossmann into *Marmolatella, sensu stricto*, *Planospirina*, and *Fedaiella*, and by Wenz into *Marmolatella, sensu stricto*, and *Planospirina* is rather irrelevant for this report since the assignment of the following single specimen even to *Marmolatella, sensu lato*, can only be most tentative.

?Marmolatella sp.

The single cast, which projects only in part from the rock and cannot safely be freed by mechanical or chemical preparation, measures about 45 mm. in width, whereas its height may be estimated at about 35 mm. and its pleural angle at about 165 degrees. Despite this comparatively large size it seems to consist of only two or two and a half volutions. The surface is badly corroded, and neither base nor aperture is exposed. Thus only the shell shape and the fact that there seems to occur no resorption of inner walls can be utilized in an attempt at identification.

The extremely rapid increase of the whorls, especially in width, the flattened top of the conch, the well-rounded upper part of the body whorl, the deepened suture, the almost sunk spire, and the smallness of the nucleus are all characters strongly reminiscent of the type species of *Marmolatella, M. stomatia*, as illustrated in Kittl (1899, pl. 10), and thus support the reference of this specimen to the same genus.

OCCURRENCE: A single specimen in lot 2 (A.M.N.H. No. 27195).

SUBFAMILY NERITOPSINAE

The group of genera here dealt with was granted, as the Neritopsidae, family rank by both Kittl (1899, pp. 25–31) and Cossmann (1925, pp. 83–96), but Wenz (1938, pp. 410–413) relegates them to a subfamily which he unites with the Naticopsinae in the family Neritopsidae, as conceived by him. Wenz' example is here followed.

NERITOPSIS GRATELOUP

Although Wenz (1938, p. 413) lists the Middle Triassic with a question mark within the stratigraphic range of this genus, Laube's (1868, p. 17) reference of some of Münster's St. Cassian species to this genus is here followed, as it was by Kittl (1892, p. 37), Koken 1892a, p. 27; 1892b, p. 193), and Böhm (1895, p. 245). One of Münster's species is represented in the Cerro de Pasco collections.

Neritopsis decussata (Münster)

Plate 9, figures 25, 26, 28–31, 34, 35

Naticella decussata MÜNSTER, 1841, p. 102, pl. 10, figs. 21, 22.

Neritopsis decussata Münster sp.; LAUBE, 1870, p. 17, pl. 31, fig. 4.

Neritopsis decussata Münster; KITTL, 1892, *cum synon.*, p. 41, *pro parte*, pl. 5, figs. 17–21.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26507:3	3.24 mm.	*ca.* 92½[1]	4½	130°
26507:2	5.04	88	5	141°
26507:4	5.29	104½	4½	122°
26507:5	7.75	108	3	127°
26507:1	8.86	94½	7½	121°
26507:6	*ca.* 11.19	96½	*ca.* 2[2]	127°

The table seems to show a certain trend of the pleural angle towards decreasing with growth, but it must be kept in mind that the width of the angle depends not only on the shell shape but the degree of prominence and corrosion, respectively, of the shoulder tubercles, farther-projecting tubercles making for a wider pleural angle. The width of the shell seems first to increase, then to decrease again, whereas the figures for h are inconclusive, especially since the figure for the largest measured specimen does not indicate the full height of the spire.

DESCRIPTION: Shell obliquely subspherical, mostly somewhat higher than large, consisting of never more than two and a half volutions. The apical face of the body whorl is

[1] Estimated.

[2] Apex corroded.

flattened or even slightly concave and separated from its lateral part by a distinct edge which is marked by the first of the principal revolving keels and further accentuated by its tubercles. Between the lateral and basal parts of that whorl, however, there is no such distinct boundary; the former passes quite gradually into the latter.

Aperture subcircular, both outer and inner lip thickened. The latter is quite widely reflexed over the columella, from which it remains, except in its uppermost part, separated by a distinct umbilical niche. A slit-like notch running from the lower right to the upper left separates the upper ends of the lips. In the best among the larger specimens (no. 1) a slight indication of a shallow notch can be seen at the lower end of the aperture (cf. Zittel, 1885, p. 203; Kittl, 1892, p. 37).

The ornamentation is dominated by strong transverse ribs, 13 of which can be counted on the body whorl of specimen number 1. They start immediately below the suture as blunt folds, then run, rapidly increasing in both prominence and sharpness, steeply obliquely backward all over the body whorl. They are slightly forward convex or almost straight. They are crossed by distinct revolving keels, of which there are 14 on the body whorl of the afore-mentioned specimen, if faint indications of spiral ornamentation discernible on the apical part are not counted. Five of these keels stand out among the others by greater strength: one on the shoulder, one about halfway between shoulder and periphery, one marking the periphery, one at a short distance below it, and the lowermost one. The second of these main keels is by far the strongest; next in strength is the one marking the shoulder. However, even the strongest of these keels is still inferior in strength to the transverse ribs. From one to two minor keels are intercalated between two main keels. In crossing the radial ribs these keels produce tubercles, the strength of which depends in general on that of the keels. However, the tubercles of the shoulder keel project farthest and are the sharpest, though they are never developed as spines to the same extent as in the typical form of *N. armata* (see Kittl, 1892, pl. 5, fig. 4). These tubercles are quite regularly arranged, as they are, in our opinion, in Kittl's (1892, pl. 5) figure 21 also, notwithstanding his remarks to the contrary in his characterization of the sculpture of *Neritopsis decussata* var. *nodulosa* to which he refers the specimen in that figure. Growth striae running parallel to the transverse ribs are discernible in only the best preserved shells (e.g., number 2).

EARLIEST ONTOGENETIC STAGES: Most of the adult shells are encrusted in their apical parts, but in the excellently preserved juvenile number 2 (figs. 25, 30) the first one and a half volutions, including the protoconch, can be seen to be smooth and rounded. In the later half of the second whorl there appear first two edges indicating the shoulder and the site of the second main keel, then the three upper main keels, with indications of thread-like minor keels between them, and, immediately afterward, the first transverse ribs which are comparatively strong from the outset.

REMARKS: The Peruvian specimens come closest to Laube's (see synonymy) drawing and to Kittl's figure 17 of the same specimen. From the var. *nodulosa*, as shown in Kittl's figure 21, our shells differ only in having the transverse ribs more closely set. In Münster's drawing (pl. 10, fig. 20) of his *Naticella nodulosa*, however, they disappear entirely, perhaps owing to inaccuracy of the drawing. Such inaccuracy is suggested by the fact that both Laube and Kittl united Münster's species with his *N. decussata* (Kittl as a variety) and by Kittl's (1892, p. 41) description of the ornamentation of *N. nodulosa*.

Koken's (1892b, p. 193, pl. 12, figs. 7, 8) "*N. decussata*" with its very few and heavy transverse ribs and primary spiral keels, and no secondary keels intercalated between the latter, does not seem conspecific with the true *N. decussata*.

From *N. plicata* (Münster, 1841, p. 101, pl. 10, fig. 16),[1] relegated by Kittl (1892, p. 39, p.. 5, figs. 7–9) to the rank of a variety of *N. armata* (Münster), the present species differs by its slightly denser costation and somewhat lower spire. If it were not for Kittl's authority, who considers them specifically different, it might be doubted if such minor differences warrant specific separation.

D'Orbigny (1850–1855, p. 227, pl. 301,

[1] Closely related to *N. plicata* is *N. compressula* Gümbel (see von Ammon, 1893, p. 174, text fig. 12).

figs. 8–10) would have this species survive into Middle Jurassic times, but his form, though certainly closely related, differs from the true *N. decussata* by the about equal strength of revolving keels and transverse ribs, whereas the latter clearly dominate in our species, and by the dissolution of the sculpture into a checkered system of tubercles. Another species figured by d'Orbigny (*op. cit.*, pl. 300, figs. 1–4), *N. hebertana* d'Orbigny from the Middle Liassic, seems to resemble the St. Cassian species more closely in the character of ornamentation, but its sculpture is even heavier and it is considerably wider than high.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26507	15
26	26507/1	1 (fragment)
87	26507/2	1 (juvenile, doubtful)
	Total	17

NERITIDAE

SUBFAMILY NERITINAE

Much as the authors who dealt with the taxonomy of this and related groups differ in their opinions, Kittl (1899, pp. 55 ff.),[1] Cossmann (1925, pp. 177 ff.), and Wenz (1938, pp. 413 ff.) agree fairly well as to the circumscription to be given to this family. Kittl deviates from the other two authors merely in naming it Protoneritidae rather than Neritidae, but his name is the less justifiable since Kittl himself uses in the same paper (*loc. cit.*) Koken's name *Neritaria* but not his own name *Protonerita*[2] for the genus serving as "chef de fil" for this family.

The main distinctive character of this family is the resorption of the inner walls in the course of growth. It would seem that the shell substance thus regained goes into the callosity of the inner lip.

In the material under study this family is represented by three genera, *Neritaria*, *Trachynerita*, and *Oncochilus*, all of which belong to the subfamily Neritinae (see Wenz, 1938, p. 413). Solely owing to the abundance of the genus *Neritaria*, with a total of more than 2800 individuals, this family is within the present material outnumbered in specimens only by the Mathildidae.

NERITARIA KOKEN

(=PROTONERITA KITTL AND COSSMANN)

This genus was originally proposed by Koken (1892a, p. 26) and based on *N. similis*, a species which he described and illustrated only somewhat later (1892b, p. 192, pl. 12, figs. 1–6, 9).[3]

On the other hand, Kittl (1895, p. 127) established the genus *Protonerita*, with his *P. calcitica* (*ibid.*, p. 129, pl. 2, figs. 18–22) as its type species, for 10 forms from the Marmolata. In doing so, he was fully aware of their close relation to Koken's genus *Neritaria*, but since he missed most of the characters listed by Koken as diagnostic of his genus, chiefly the presence of a sharp tooth on the inner lip, in his forms, he refrained from including them in *Neritaria*. This procedure was rather sharply criticized by Koken in the same year (1895, p. 450).

J. Böhm (1895, p. 235) expressed the opinion that *Neritaria* and *Protonerita* Kittl are the same genus.

In his Esino paper, Kittl (1899, pp. 55 ff.) conducted a careful review of all the species from the southern Alps which come into consideration and arrived at the result that a tooth may or may not be present on the inner lip in all of them. Since thus this character could no longer be considered diagnostic of *Neritaria* Koken as distinct from *Protonerita* Kittl, he "provisionally" treated both names as synonymous, accepting Koken's older name for the genus.

Cossmann (1925, p. 182) agreed with Kittl's belief that both names are synonymous but used Kittl's younger name *Protonerita*, because Koken's older name *Neritaria* was in his opinion preoccupied by *Neritarius* Duméril, 1806.[4] Cossmann's opinion cannot

[1] In 1892 (pp. 35 ff.) and 1894 (p. 255), however, Kittl had included also the genus *Neritopsis*, referred above to the Neritopsidae, in the Neritidae.

[2] For the vicissitudes in the use of these two conflicting names, see the discussion under the genus *Neritaria*.

[3] Wenz (1938, p. 413) considers *N. similis*, apparently correctly, a junior synonym of *N. plicatilis* (Klipstein; see Kittl, 1892, p. 88, *cum synon.*, pl. 7, figs. 34–36).

[4] Although Cossmann's decision was based on a purely nomenclatural reason, he lists not Koken's type species, *N. similis* [=*N. plicatilis* (Klipstein)], but Kittl's *T. calcitica*, as the genotype.

be maintained, since the Recommendations following Article 36 of the Rules explicitly state that generic names differing from older ones only in termination (example: *Picus-Pica*), "when once introduced, . . . are not to be rejected on this account." Therefore the name *Neritaria* Koken is here used for the present genus, as it is by Wenz (1938, p. 413). Accordingly *N. similis* Koken [=*N. plicatilis* (Klipstein)] must be considered the type species.[1]

The 2800 individuals representing this genus came chiefly from lot 86. One species only, *N. distincta*, is represented in lots 70 and 71 by equally good but much fewer specimens.

As might be expected, this total shows a wide range of variation in shell shape and other characters, among which the color markings assume in this genus a more important part than in others. The characteristic shells selected as types for the several species are clearly different from one another, but there is considerable intergradation between the species thus distinguished. The group consisting of *N. obliqua*, *N. dicosmoides*, and *N. hologyroides* might be considered as one large, polytypic species. It is, however, believed that nothing would be gained by such lumping, since within that large species the several forms here assigned specific rank would have to be distinguished, and separately described and illustrated, as "forms" or "varieties." *N. ninacacana* shows considerable resemblance to *N. hologyroides*, but has also much in common with *N. distincta*, which is clearly distinct from the group just mentioned; *N. ninacacana* is thus transitional between that group and *N. distincta*.

It seems worth pointing out that in the present group, in contradistinction from, for example, the genus *Omphaloptycha* (see above), a definite pattern of color markings seems as a rule to be characteristic of every one of the five species distinguished below. There is considerable intergradation in this respect also. On one hand, many shells show a color pattern transitional between those found, in general, distinctive of two different species; on the other, specimens exhibiting the shell shape of one species not rarely show the color pattern usually found in another. Thus a decision had to be made whether to rely for the distinction of species on shell shape and related characters or on the pattern of the color markings. Since the latter proved to be more subject to random variation than the former characters, preference has been given for taxonomic purposes to shell shape and related characters.[2]

In addition to the five named species mentioned above and a single shell closely resembling *N. distincta* but much more slender than that species, which is therefore separated under the designation *N.* aff. *distinctae*, more than 400 shells and fragments in lots 16, 48, 53, 70, 71, and 86 (chiefly in the last lot) undoubtedly also belong to the present genus but are too poorly preserved or too incomplete to be definitely referred to any one of the five species (A.M.N.H. Nos. 27186/1, 27186/2, 27186/3, 27186/4, 27186/5, 27186).

Among these specifically indeterminable specimens a worn shell fragment from lot 48 (A.M.N.H. No. 27186/2:1) is especially mentioned for exhibiting on the preserved part of the base fine growth striae and equally fine revolving striae which cross the former at more or less right angles. This feature was erroneously (see Kittl, 1899, p. 35) considered by Canavari (1890) a distinctive character of his subgenus *Dicosmos* (raised to generic rank by Kittl, 1899, p. 34, and Wenz, 1938, p. 407).

Furthermore, three juveniles in lot 3, attaining in their greatest dimension roughly from 2 to 3 mm., seem also to belong to this

[1] Here it might be added in passing that the boundary between this genus and *Neridomus* Morris and Lycett ("corrected" to *Neritodomus* by Fischer and following him by Cossmann, 1925, p. 187) is not a very clear one, as admitted by Cossmann himself (*op. cit.*, p. 188). As a matter of fact, the first three of the following species resemble to a certain extent Terquem's (1854, pp. 261–263, pl. 15, figs. 10–12) three "*Neritina*" species from the Lower Liassic of Hettange (*N. cannabis*, *N. hettangiensis*, and *N. arenacea*), which Cossmann (*op. cit.*, p. 189) was inclined to refer to *Neridomus*, but none of the former can be considered conspecific with any of the latter.

[2] In this procedure Kittl's example has been followed. He did not hesitate to refer a specimen with the general color pattern of our *N. dicosmoides* and another with that of our *N. hologyroides* to the same species, *Oncochilus globulosus* (Laube); see Kittl (1892, pl. 6, figs. 20, 21).

genus, for in the largest (A.M.N.H. No. 27194:1) the suture becomes obsolete on the cast about half a volution hehind the anterior end, which seems to indicate resorption of the inner walls of the whorls. These three juveniles are, however, only tentatively determined as ?*Neritaria* sp.

Two fragments (A.M.N.H. No. 27185) of comparatively large shells are, even more doubtfully, referred to this genus on account of the degree of curvature. They are remarkable for a network of bifurcating and anastomosing, rather heavy ridges on their surfaces which are believed to be subcortical.

Neritaria obliqua, new species

Plate 9, figures 27, 36–38, 40–42, 45, 46, 49–52

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27179:1	1.85 mm.	85	3	*ca.* 100°
27179:2	2.07	86½	*ca.* 3	107°
27179:7	*ca.* 2.07	*ca.* 89	*ca.* 5½	107°
27179:6	2.18	87	3½	108°
27179:8	*ca.* 2.35	*ca.* 90½	*ca.* 3	110°
27179:9	*ca.* 2.52	*ca.* 86½	*ca.* 5	108°
27179:21	2.58	91½	*ca.* 4½	106°
27179:13	2.63	83	*ca.* 5	*ca.* 100°
27179:25	*ca.* 2.63	*ca.* 89½	*ca.* 5½	105°
27179:29	2.66	90½	*ca.* 2	98°
27179:16	*ca.* 2.69	*ca.* 84½	*ca.* 6	*ca.* 105°
27179:22	*ca.* 2.69	*ca.* 91½	*ca.* 4	104°
27179:23	*ca.* 2.8	*ca.* 94	*ca.* 5	108°
27179:24	*ca.* 2.8	*ca.* 86	*ca.* 4	108°
27179:20	*ca.* 2.9	*ca.* 89	*ca.* 9	95°
27179:31	2.99	91½	5½	112°
27179:26	3.07	81	6½	90°
27179:27	3.07	84	3	*ca.* 100°
27179:34	3.07	89½	5½	108°
27179:30	3.15	84	4	96°
27179:39	3.32	87½	5	108°
27179:40	3.32	90	5	102°
27179:47	*ca.* 3.32	*ca.* 95	*ca.* 4	106°
27179:37	3.40	83	5	111°
27179:43	3.40	95	?2½	111°
27179:55	3.40	92½	6½	105°
27179:45	3.49	88	3½	110°
27179:49	*ca.* 3.49	*ca.* 88	*ca.* 5	*ca.* 95°
27179:44	3.57	81½	7	96°
27179:41	3.57	90½	4½	100°
27179:35	3.65	91	4½	99°
27179:54	*ca.* 3.65	*ca.* 87½	*ca.* 3½	86°
27179:42	*ca.* 3.73	*ca.* 89	*ca.* 3½	116°
27179:56	3.73	82	6½	84°
27179:57	*ca,* 3.73	*ca.* 85½	*ca.* 3½	91°
27179:32	*ca.* 3.73	*ca.* 93½	*ca.* 4½	100°
27179:91	*ca.* 3.82	*ca.* 91½	*ca.* 4½	111°
27179:58	*ca.* 3.90	*ca.* 93½	*ca.* 4	102°
27179:92	*ca.* 3.90	*ca.* 91½	*ca.* 3	105°
27179:46	*ca.* 3.98	*ca.* 79	*ca.* 5½	82°
27179:67	3.98	83½	4	85°
27179:59	*ca.* 4.07	*ca.* 87½	*ca.* 4	103°
27179:63	4.07	*ca.* 80½	6	76°
27179:68	*ca.* 4.15	*ca.* 82	*ca.* 4	100°
27179:75	*ca.* 4.18	*ca.* 85½	*ca.* 6	86°
27179:77	4.18	94	6	106°
27179:69	*ca.* 4.23	*ca.* 85½	*ca.* 4	89°
27179:70	*ca.* 4.23	*ca.* 80½	*ca.* 6	99°
27179:71	4.23	84½	5	91°
27179:72	*ca.* 4.32	*ca.* 80	*ca.* 5	81°
27179:73	4.43	89	5½	94°
27179:74	4.67	79	6½	91°
27179:78	*ca.* 4.80	*ca.* 84½	*ca.* 5	93°
27179:79	*ca.* 4.92	85	5½	85°
27179:82	5.04	80	7½	74°
27179:85	*ca.* 5.35	*ca.* 81½	*ca.* 3½	90°
27179:84	5.53	80	6½	79°
27179:87	5.78	89½	5	88°
27179:89	6.64	85	7½	85°
27179:88	6.76	82	5½	82°
27179:90 (syntype A)	7.13	83	7	90°

The pleural angles tend to be comparatively wide in the smaller specimens measured, but much less so in the largest ones. The minimum of 74 degrees occurs in number 82 at a height of about 5 mm.; the maximum of 116 degrees, however, is found not in one of the smallest shells measured, but in a medium-sized one (no. 42, H = *ca.* 3.73 mm.). Both the maximum (95) and the minimum (79) values for W have been measured in medium-sized specimens (nos. 47 and 43, and 46, respectively), whereas the extremes for h (*ca.* 2 in no. 29 and *ca.* 9 in no. 20) are both found between the sizes of 2½ and 3 mm. It should, however, be pointed out that the measurements of the height of the spire are not too dependable in this group, since the spire is so short that even a moderate degree of corrosion influences the results quite markedly. If maxima and minima are left out of account, about the same values for both W and h appear rather indiscriminately at widely different growth stages. Thus, no definite growth trends can be deduced from the above table.

SELECTION OF TYPES: The largest measured specimen (no. 90) is selected as syn-

type A. Since the color markings characteristic of this species are hardly recognizable on it, the incomplete shell number 93, which shows them best, is designated syntype B.

DESCRIPTION: The shell consists of a comparatively large body whorl and of a short spire which, even in the largest measured specimen (syntype A), comprises not more than two and a half whorls, including the nuclear ones. The maximum width of the body whorl is situated at about the lower third of its height. Upward from this zone of the maximum width the shell shape is obliquely conical rather than globular. Most characteristic of the shell profile of this species is the fact that, on the left side of an opposite view (figs. 36, 40, 45), a nearly straight line rises at an angle of about 45 degrees from that point of greatest width almost continuously all the way to the apex. In this profile the body whorl appears slightly convex in syntype A (fig. 45) but almost straight in paratype number 85 (fig. 40). The profile is interrupted by the sutures; of these that separating the body whorl from the penultimate one is slightly channeled. The apex is slightly flattened and owing to the obliqueness of the shell profile appears somewhat eccentric. The base is rather short and obtuse. The aperture (figs. 37, 41, 46) is pear-shaped. It exhibits a rather acute angulation above but is only gently rounded below. Its outer margin is moderately convex, the inner one slightly inverted-sigmoidal. The outer lip (not preserved in syntype A, and complete in hardly any of the almost thousand specimens present) must have been thin and rather sharp. The inner lip forms a rather heavy callosity which is thickest and somewhat swollen near the ceiling and gradually tapers towards the bottom of the aperture.

In addition to syntype A paratype number 85 is illustrated in apertural view (fig. 41) to show this callosity. In this species it does not develop distinct teeth, as it does in some of the following ones. However, in some shells (e.g., paratype no. 94; fig. 38) the above-mentioned swelling in its upper part assumes the shape of a little knob, comparable to those observed and illustrated by Kittl (1892, p. 7, figs. 31, 32) in *N. mandelslohi* and by Böhm (1895, p. 234, text fig. 20a) in *N. comensis*. Where completely preserved, the callosity entirely covers the umbilical region. In some of the larger shells (e.g., syntype A; fig. 46), the lower margin of the aperture can be seen to continue as a blunt edge up along its left side, gradually disappearing upward and accompanying the outer margin of the callosity, from which it remains separated by a distinct though narrow furrow. This furrow can be recognized in both syntype A and paratype number 85 (figs. 46, 41). However, this circumumbilical edge is never so distinct as the circumumbilical keel encountered in some of the following species (e.g., *N. hologyroides*).

The generic and family character of the resorption of the inner walls is observable in many specimens to a varying extent. Paratype number 95 is illustrated from inside as an example of complete resorption, except for the body whorl (fig. 42).

The shell surface carries no sculpture other than fine growth striae. In the body whorls of some specimens (e.g., syntype A; fig. 45), they can be seen to run obliquely backward in a nearly straight line all the way from the suture to the circumumbilical edge. At both ends of this line the obliqueness appears to increase somewhat, that is, their course is steeper on the main body of the body whorl than it is immediately below the suture and on the base.

As in most species of this group, color markings are quite frequently preserved. As a rule, they form a meshwork of fine, anastomosing, and sometimes zigzagging, dark brown lines, with occasionally a larger blank polygon between.[1] This pattern is found mostly on the body whorl, not on the spire. It is best exemplified by syntype B (fig. 51). In paratype number 96 (fig. 27) this meshwork is confined to a subsutural band and another, markedly wider one which covers somewhat more than the lower half of the body whorl, including the base. Between those two colored bands, a zone occupying the greater part of the upper half of the body whorl remains blank.

In a similar but somewhat different way the meshwork of color patterns is restricted to three bands, one on the top, one in the

[1] A similar pattern of color markings is exhibited by *Hologyra uhligi* (Klipstein; Kittl, 1892, p. 83, pl. 7, fig. 26; 1899, p. 49) from St. Cassian.

middle, and the third near the bottom of the body whorl, in paratype number 92 (fig. 52), with two light bands between which in this specimen are crossed here and there by single dark lines connecting the meshworks above and below. These deviating patterns of color markings are here especially mentioned and illustrated because they are transitional in the distribution though not in the details of the markings to the pattern characteristic of *N. dicosmoides*. The meshwork pattern typical of the present species is also occasionally found, in its pure form or combined with patterns peculiar to other species, in *N. hologyroides*. It should be added that wherever color markings have been studied in the present species, their course proved to be independent from the course of the growth striae.

Observations on the earliest ontogenetic stages are scanty, since the apices are always more or less corroded. Paratype number 8 is shown in figures 36 and 37 as an example of a comparatively well-preserved juvenile.

REMARKS: The characteristic shell shape, which has suggested the specific name, serves best the purpose of distinction of this species from the species of the same genus with which it is associated in the assemblage under study.

The shape of the shell also distinguishes this species from the similarly small and also rather slender *N. collegialis* von Ammon (1893, p. 192, fig. 23) from the "Grenzdolomit" of the Monte Nota near Lake Garda and more so from the two other species in that assemblage, *N. flavimaculata* von Ammon and *N. obtusangula* von Ammon (*ibid.*, p. 194, figs. 24, 25).[1]

Of earlier species from the Triassic of the southern Alps, *N. mandelslohi* (Klipstein; see Kittl, 1892, p. 88, *cum synon.*, pl. 7, figs. 31–33; 1899, p. 61) perhaps most closely resembles *N. obliqua*, but it shows greater width of the shell, a lower spire, a less eccentric apex, an even heavier callosity of the inner lip, and a different pattern of the color markings (see Laube, 1868, pl. 21, fig. 10b, and Kittl, 1892, pl. 7, fig. 32). *N. neritina* (Münster; see Kittl, 1892, p. 86, *cum synon.*, pl. 7, figs. 28–30; 1899, p. 60, *cum synon.*) may resemble *N. obliqua* even more in apertural view but differs from it mostly by the strong lateral compression of the conch perpendicularly to its greatest diameter.[2]

OCCURRENCE: Extremely common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27179	957
26	27179/1	1[3]
		958

Addition of a proportionate number of the more than 400 specimens of this genus left specifically undetermined would increase the total number of individuals of this species to well over 1000.

Neritaria dicosmoides, new species

Plate 9, figures 33, 39, 43, 44, 47, 48, 53, 54; plate 10, figures 1–7, 9, 29, 32

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27180:2	1.40 mm.	100	?4	119°
27180:4	*ca.* 1.46	*ca.* 96	*ca.* 4	124°
27180:3	1.62	89½	3½	118°
27180:8	*ca.* 1.79	*ca.* 100	*ca.* 1½	?126°
27180:6	1.85	98½	4	135°
27180:7	1.85	94	4½	118°
27180:10	*ca.* 2.02	*ca.* 97½	*ca.* 3	*ca.* 130°
27180:15	*ca.* 2.07	*ca.* 100	*ca.* 3½	134°
27180:12	*ca.* 2.16	*ca.* 97½	*ca.* 4	120°
27180:14	*ca.* 2.24	*ca.* 97½	*ca.* 5	127°
27180:21	*ca.* 2.35	*ca.* 100	*ca.* 3	134°
27180:23	*ca.* 2.35	*ca.* 95	*ca.* 3	118½°
27180:17	2.38	96½	4½	132°
27180:18	*ca.* 2.46	*ca.* 100	*ca.* 4½	126°
27180:24	*ca.* 2.52	*ca.* 93½	*ca.* 2	127°
27180:27	2.58	98	4½	125°
27180:20	2.69	93½	4	125°
27180:26	*ca.* 2.69	*ca.* 98	*ca.* 2	137°
27180:102	2.80	96	4	125°
27180:111	*ca.* 2.86	*ca.* 104	*ca.* 4	136°
27180:31	*ca.* 2.91	*ca.* 92½	*ca.* 4	120°
27180:38	2.91	100	3	125°
27180:37	*ca.* 3.02	*ca.* 89	*ca.* 3	136°
27180:35	*ca.* 3.08	*ca.* 91	*ca.* 4	110°
27180:46	*ca.* 3.15	*ca.* 105½	*ca.* 5	129°
27180:39	*ca.* 3.19	*ca.* 93	*ca.* 3½	133°
27180:53	3.24	96	*ca.* 2½	125°
27180:107	*ca.* 3.24	*ca.* 95	*ca.* 2½	136°
27180:54	3.24	107½	*ca.* 2½	136°

[1] A visit to the Palaeontologische Staatssammlung of Munich in June, 1951, gave me the opportunity to examine the types of these three species of von Ammon.

[2] Kittl (*loc. cit.*): "etwa dreimal so breit als dick." For the meaning of the dimension called "thickness," see under *N. dicosmoides* below.

[3] Extremely small and poorly preserved.

A.M.N.H. Nos.	H	W	h	π
27180:57	3.32	100	5	133°
27180:58	3.32	104	2½	138°
27180:48	3.40	100	*ca.* 2½	125°
27180:112	*ca.* 3.40	*ca.* 105	*ca.* 2½	132°
27180:49	3.49	99	5	121°
27180:56	3.73	100	3	138°
27180/1	3.73	100	2	145°
27180:59	3.82	91½	3½	122°
27180:63	*ca.* 3.82	*ca.* 104½	*ca.* 2	138°
27180:65	*ca.* 3.90	*ca.* 100	*ca.* 4½	128°
27180:69	*ca.* 3.90	100	2	136°
27180:75	*ca.* 4.30	*ca.* 109	*ca.* 4½	140°
27180:109	4.43	97	3½	131°
27180:73	*ca.* 4.43	*ca.* 103	*ca.* 3	127°
27180:79	4.43	105½	*ca.* 1½	148°
27180:76[1]	*ca.* 4.55	*ca.* 102½	*ca.* 3	134°
27180:83[2]	4.55	108	*ca.* 3	*ca.* 142°
27180:71	4.67	100	2½	130°
27180:72	*ca.* 4.67	*ca.* 94½	*ca.* 2½	121°
27180:106	*ca.* 4.67	*ca.* 95	*ca.* 4	131°
27180:78	*ca.* 4.92	*ca.* 100	*ca.* 3½	137°
27180:84	4.92	105	*ca.* 2½	131°
27180:86	4.92	95	3½	126°
27180/3:1	*ca.* 4.92	*ca.* 92½	*ca.* 2½	146°
27180:87	*ca.* 5.04	*ca.* 105	*ca.* 3	129°
27180:82	5.17	97½	3	*ca.* 135°
27180:90[3]	5.29	114	0	?142°
27180:93[4]	5.29	100	*ca.* 2½	*ca.* 130°
27180:91	5.41	102½	2½	136°
27180:88	5.53	100	2	139°
27180:95	*ca.* 5.78	*ca.* 100	*ca.* 2	133°
27180:97[5]	6.03	98	*ca.* 3	118°
27180:98 (holotype)	6.03	96	2½	118°
27180:99	6.03	106	3½	124°
27180:96	6.15	94	2	128°
27180:105	6.15	100	2	137°
27180:100	*ca.* 6.52	*ca.* 100	*ca.* 2½	141°
27180:110	6.64	94½	3½	140°
27180:101	*ca.* 6.76	*ca.* 109	*ca.* 4½	134°
27180/2:1	*ca.* 7.63	*ca.* 100	*ca.* 2	134°
27180/2:2	*ca.* 11.07	*ca.* 96½	*ca.* 4½	*ca.* 143°

The dimensions of this species show definite growth trends even less than do those of *Neritaria obliqua*. Maxima and minima for W (114–89), h (5–0), and π (148°–110°) occur (with the exception of one of the two maxima for h, A.M.N.H. No. 27180:14) in the middle of the table rather than at or near the top and bottom. What is said above (p. 161) about the measurement of the spire also applies here. In the present species it is even more complicated by the fact that the spire is usually somewhat sunk, so that measurement from the upper margin of the body whorl up does not necessarily yield its full height. This accounts for the zero value for h in specimen A.M.N.H. No 27180:90, where the spire is so deeply sunk that, short as it is, it does not overtop the upper margin of the body whorl.

In some particularly wide shells (e.g., A.M.N.H. Nos. 27180:76, 27180:83, 27180:90, 27180:93, and 27180:97) the rapid increase of the body whorl in width causes the base to assume an elliptical rather than circular shape. In order to measure the degree of this ellipticity, a diameter has been drawn across the base at a right angle to the largest diameter, as expressed by W, and the length of the former (Th)[6] has been compared with W in footnotes added to the measurements of the five specimens enumerated above. One (A.M.N.H. No. 27180:76) is shown in apical view (pl. 10, fig. 9) to illustrate the high degree of ellipticity occasionally encountered in this species.

SELECTION OF TYPE: One of the larger shells from lot 86, A.M.N.H. No. 27180:98, which exhibits well the characteristic features of this species, including its peculiar pattern of color markings, is designated holotype.

DESCRIPTION: Including the nucleus and the body whorl, not more than three or perhaps three and one-half volutions can be counted even in the largest available shells of this species. The shell shape is more decidedly globular than in any of the congeneric species, there being no indication whatever of a shoulder. The ellipticity caused by rapid increase of the body whorl in width is dealt with in the discussion of the dimensions. The spire is extremely low and to a varying degree sunk into the body whorl. Accordingly the last suture appears to be deeply channeled, whereas the earlier ones are only shallowly engraved. The nucleus is flattened; the apex, where clearly observable, as in paratype A.M.N.H. No. 27180:119, is only slightly eccentric. The short and rounded base is in no way separated from the upper part of the body whorl and fits perfectly into the spherical shell shape.

[1] Th = 71% of W.
[2] Th = 70% of W.
[3] Th = 77½% of W.
[4] Th = 74½% of W.
[5] Th = 75% of W.

[6] For thickness, following Kittl's (1892, p. 86) example, who calls the conch of *N. neritina* "about three times as wide as thick."

The aperture resembles in outline that of *N. obliqua*, but the angulation at its upper end is markedly less acute in *N. dicosmoides*, especially so in juveniles (e.g., paratype A.M.N.H. No. 27180:14; pl. 10, fig. 5), in which the ceiling of the aperture appears to be nearly horizontal. The inner lip can be recognized to be reflexed in its lowermost part in some shells, as in the holotype and in the much smaller paratype A.M.N.H. No. 27180:108 (pl. 9, fig. 48; pl. 10, fig. 3). The callosity formed by its upper part is less heavy and somewhat less expanded than in *N. obliqua*. Quite frequently it does not fully cover the umbilical region, so that an umbilical niche is left open. The latter is shallow and not so large in the holotype (pl. 9, fig. 48), but quite deep and conspicuous in some other specimens (e.g., in paratypes A.M.N.H. Nos. 27180:90 and 27180:110; pl. 10, fig. 29). It cannot be decided whether the cavities shown in these illustrations were never overgrown by the callosity or are to be interpreted as "resorption pits," as repeatedly reported by Kittl in dealing with this genus and related ones. In two comparatively small shells (A.M.N.H. Nos. 27180:6 and 27180:24; pl. 10, figs. 6, 7), indications of twin teeth reminiscent of, but much less pronounced than, those found in the genus *Oncochilus* (p. 178), can be observed on the inner edge of the callosity. This feature, although encountered only sporadically in the present species and in the three following ones, raises the question (discussed below) whether the generic separation of *Oncochilus* from *Neritaria* can be justified. A circumumbilical edge, continuing the bottom margin of the aperture upward along its left side, is well recognizable in some shells (e.g., paratypes A.M.N.H. Nos. 27180:49 and 27180:84; pl. 10, figs. 1, 2). Where present, it is developed more like the one found in the *N. obliqua*, as distinct from the more conspicuous circumumbilical keel quite common in *N. hologyroides*.

In this species also resorption of the inner walls can be observed to a varying extent in many broken shells. The interior of paratype A.M.N.H. No. 27180:144 gives a good example of complete resorption.

Surface ornamentation consists of growth striae and color markings. Both these elements of ornamentation are in the present species closely interconnected, at least in the most characteristic shells.

The course of the growth striae can best be followed in the holotype (pl. 9, figs. 47, 48, 53, 54). They turn decidedly backward from the suture, then follow a more steeply oblique backward course over the main body of the last volution, to turn again more distinctly backward on the base, where they converge towards the umbilical niche. Their course is thus essentially the same as in *N. obliqua*.

The color pattern characteristic of this species, preserved in several hundred shells, consists of three dark brown revolving bands on the body whorl, about equally distant from one another (pl. 9, figs. 33, 39, 43, 44, 47, 48). The uppermost in the holotype is situated somewhat below the suture, separated from it by a blank band of about the same width. In paratype A.M.N.H. No. 27180:115 (pl. 9, fig. 33), however, it reaches all the way up to the suture. The second and the third bands in the holotype,[1] are situated above and beneath the zone of the maximum width of the conch at about the same distance from it in either direction. Both site and width of these color bands vary within the species. As a rule, the middle one tends to be a little wider than the two others. In most of the best preserved shells, among them the holotype (pl. 9, figs. 47, 48, 53, 54), these bands are not solid but finely hatched by dark brown lines running in the general direction of the growth striae. This calls for the explanation that the pigment accumulated and was preserved best in the fine grooves between the striae. The density of the hatching varies. Thus in paratype A.M.N.H. No. 27180:115 (pl. 9, fig. 33) the individual dark lines are less closely set than in the holotype, perhaps due to the fact that here the growth striae united in bundles, thus making for wider intervals between the grooves separating them. It may be mentioned that in this shell some of those individual lines assume a somewhat wavy aspect, apparently not in accordance with the course of the growth striae. In the shell fragment A.M.N.H. No. 27180:116 (pl. 9, fig. 39), on the other hand, those individual lines are

[1] The lowermost color band can well be seen only in apertural view (pl. 9, fig. 48), but not in the anterior part of the body whorl (pl. 9, fig. 47) where it is worn off.

thicker and even more closely set than in the holotype and show a tendency to merge. This is a condition transitional to that found in paratype A.M.N.H. No. 27180:117 (pl. 9, fig. 43) where they have merged beyond recognition so as to form solid color bands. An extreme case is represented by another shell fragment (A.M.N.H. No. 27180:118; pl. 9, fig. 44), in which not only are these color bands completely solid, but the blank bands are sunk as extremely shallow furrows between them This would not seem to permit any other interpretation than that the pigment, where concentrated, acts as a protective cover against weathering. This conclusion is the more surprising since in *Trachynerita tambosolensis* (described below, p. 176) the color markings weather out, leaving empty grooves between the uncolored portions of the shell. As will be seen in the description of *N. hologyroides*, the color pattern believed to be characteristic of *N. dicosmoides* occurs in *N. hologyroides* also, either in its pure form or combined with that peculiar to the latter species or with the meshwork pattern of *N. obliqua*. The three-banded color pattern of this species is found quite frequently throughout the Neritidae, for example, in the specimen of *Oncochilus globulosus* (Laube) figured by Kittl (1892, pl. 6, fig. 20) or in the Pliocene species *Theodoxus* (*Calvertia*) *lorkoviti* (Brusina), figured by Wenz (1938, p. 424, fig. 1036).

Where the outer shell surface has been worn down, pitted subcortical surfaces are encountered in the present species more frequently than in others of the same genus (paratypes A.M.N.H. Nos. 27180:58, 27180:88, and 27180:93 and best of all in the largest measured shell, A.M.N.H. No. 17180/2:2; pl. 10, fig. 32).

REMARKS: From *N. obliqua* the present species can readily be distinguished by its plainly globular shell shape and the less heavy callosity of its inner lip. The shell shape serves also to distinguish it from the three following species as well as from those from the Monte Nota quoted in the discussion of *N. obliqua*. In all of the latter the spire clearly projects over the body whorl, whereas it is more or less sunk into it and the shell profile is nearly uninterrupted in *N. dicosmoides*.

The shell shape of this species is, on the other hand, strongly reminiscent of that found in, and considered by Kittl (1899, p. 35) characteristic of, Canavari's genus *Dicosmos* (for references, see p. 160), in which, however, the inner walls are not resorbed and which is, therefore, referred to the Neritopsidae, subfamily Naticopsinae, but not to the Neritidae. This similarity has suggested the specific name.

OCCURRENCE: Very common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27180	674
15	27180/1	1
48	27180/2	6
70	27180/3	4
71	27180/4	1 (doubtful)
78	27180/5	1
87	27180/6	3
		690

If a proportionate part of the specimens of this genus left specifically undetermined is added to those above, there is total of about 800 individuals.

Neritaria hologyroides, new species

Plate 10, figures 8, 10–28, 30, 33, 35

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27181:1	*ca.* 1.12 mm.	*ca.* 105	*ca.* 5	?123°
27181:2	1.23	100	4½	119°
27181:3	1.34	96	5½	121°
27181:5	*ca.* 1.46	*ca.* 92½	*ca.* 5	118°
27181:4	*ca.* 1.57	*ca.* 93	*ca.* 7	113°
27181:7	*ca.* 1.57	*ca.* 96½	*ca.* 4½	120°
27181:9	1.68	100	5	120°
27181:8	*ca.* 1.74	*ca.* 97	*ca.* 6	123°
27181:93	1.79	87½	5½	109°
27181/3:1	*ca.* 1.85	*ca.* 100	*ca.* 5	126°
27181:11	1.96	94½	7	116°
27181/2:1	1.96	94½	5½	110°
27181:94	*ca.* 2.02	*ca.* 91½	*ca.* 5½	108°
27181:14	*ca.* 2.07	*ca.* 92	*ca.* 5½	113°
27181:17	*ca.* 2.13	*ca.* 95	*ca.* 4	121°
27181:18	*ca.* 2.13	*ca.* 92	*ca.* 5½	115½°
27181:86	*ca.* 2.16	*ca.* 96	*ca.* 3½	123°
27181:15	2.18	88½	7½	112°
27181:22	*ca.* 2.18	*ca.* 92	*ca.* 4	118°
27181:28	*ca.* 2.27	*ca.* 99	*ca.* 7½	103°
27181:20	*ca.* 2.35	*ca.* 100	*ca.* 5½	118½°
27181:24	*ca.* 2.35	*ca.* 88	*ca.* 5	108°
27181:29	*ca.* 2.35	*ca.* 94	*ca.* 5	109°
27181:87	*ca.* 2.41	*ca.* 96½	*ca.* 4½	123°
27181:30	*ca.* 2.46	*ca.* 91	*ca.* 5½	116°

A.M.N.H. Nos.	H	W	h	π
27181:96	2.46	88½	4½	112°
27181:63	2.52	95½	3½	120°
27181:32	2.58	95½	6½	110°
27181:64	*ca.* 2.58	*ca.* 89	*ca.* 5½	112°
27181:26	*ca.* 2.63	*ca.* 91½	*ca.* 5½	121°
27181:67	2.69	96	4	121°
27181:33	*ca.* 2.74	*ca.* 100	*ca.* 6	116°
27181:65	2.74	92	5½	111°
27181:88	*ca.* 2.74	*ca.* 94	*ca.* 4	120°
27181:92	2.80	92	6	115°
27181:38	*ca.* 2.86	*ca.* 100	*ca.* 5	113°
27181:37	*ca.* 3.02	*ca.* 92½	*ca.* 7½	110°
27181:89	*ca.* 3.11	*ca.* 93½	*ca.* 4	112°
27181:43	*ca.* 3.15	*ca.* 102½	*ca.* 5½	121°
27181:74	*ca.* 3.15	*ca.* 92	*ca.* 5½	115°
27181:44	*ca.* 3.24	*ca.* 97½	*ca.* 5	115°
27181:41	*ca.* 3.32	*ca.* 90	*ca.* 5	108°
27181:42	3.40	95	5	118°
27181/1:1	*ca.* 3.40	*ca.* 89	*ca.* 3½	*ca.* 126°
27181:75	*ca.* 3.82	*ca.* 80½	*ca.* 6½	103°
27181:97	*ca.* 3.82	*ca.* 85	*ca.* 3	124°
27181:77	3.82	92½	4½	107°
27181:46	*ca.* 4.03	*ca.* 93½	*ca.* 6	106°
27181:91	4.07	90	5	108°
27181:70	*ca.* 4.15	*ca.* 86	*ca.* 6	105°
27181:49	*ca.* 4.15	*ca.* 86	*ca.* 6	110°
27181:50	*ca.* 4.15	*ca.* 90	*ca.* 4	115°
27181:47	*ca.* 4.23	*ca.* 84	*ca.* 4	110°
27181:78	4.23	100	4	118°
27181:95	4.24	95½	4	121°
27181:60	4.43	89	5½	113°
27181:51	4.55	89	5½	116°
27181:52	*ca.* 4.67	*ca.* 95	*ca.* 5½	122°
27181:53	*ca.* 4.80	*ca.* 90	*ca.* 6½	109°
27181:80	*ca.* 5.17	*ca.* 85½	*ca.* 5	112°
27181:79	5.29	89½	3	122°
27181:54	5.29	93	4½	126°
27181:81	5.66	87	4½	119°
27181:82	*ca.* 5.66	*ca.* 82½	*ca.* 4½	112°
27181:57	6.15	90	6	120°
27181:56	*ca.* 6.40	*ca.* 92½	*ca.* 6½	112½°
27181:55	*ca.* 7.13	*ca.* 86	*ca.* 5	120°
27181:58	*ca.* 7.38	*ca.* 95	*ca.* 6	121°
27181:84	*ca.* 7.87	*ca.* 87½	*ca.* 3	121°
27181:59 (holotype)	*ca.* 8.73	*ca.* 97	*ca.* 7	127°

The table seems to be not much more conclusive as to general growth trends than that of *N. dicosmoides*. From the fact that widths of 100 or more do not occur beyond the size of 4.23 mm. a certain tendency of the shells to become somewhat more slender with growth may be deduced. Otherwise, however, even the fact that three out of the six maxima and minima are encountered at or near the top and bottom of the table is of no avail, if weighed against the occurrence of the same values for W, h, and π at very different sizes.

SELECTION OF TYPE: The largest measured specimen (A.M.N.H. No. 27181:59) shows well the specific characters, including the pattern of color markings peculiar to this species, and is therefore designated its holotype.

DESCRIPTION: The conch consists of a globular, evenly rounded body whorl and a distinct, flatly conical spire. Thus the shell shape is not quite so sturdy as in the preceding species. A characteristic shell profile is seen in the natural cross section of paratype A.M.N.H. No. 27181:82 (fig. 14). In some specimens (holotype) the spire appears to be slightly sunk into the body whorl, from which it is separated by a deeply channeled suture. The earlier sutures, however, are markedly shallower. Even in the holotype, which is the largest shell measured, there are not more than two and one-half spiral volutions, including the nuclear ones. The aperture is broadly pear-shaped, with an angulation (less obtuse than in *N. dicosmoides*) above and an evenly arched margin beneath. The latter continues as a rather sharp circumumbilical keel about halfway up the left margin of the callosity of the inner lip. Within this keel, the callosity is deeply excavated, most so in paratypes A.M.N.H Nos. 27181:38 and 27181:55 (fig. 20), but it is flat or gently convex in its upper part, which is separated from the colored part of the body whorl by an almost straight line rising at an angle of about 45 degrees from the upper end of the circumumbilical keel to the upper end of the aperture and marked by a more or less distinct groove (holotype and paratype A.M.N.H. No. 27181:55; figs. 18, 20). In the small paratype A.M.N.H. No. 27181/2:1 (fig. 11) this groove is even more pronounced and the callosity heavier than in the full-grown individuals just discussed. This small specimen which, owing to the above characters, is somewhat reminiscent of *N. obliqua* but exhibits the characteristic shell shape of *N. hologyroides* is also distinguished by having the lowermost part of the inner lip slightly reflexed. Only exceptionally the callosity of the inner lip develops just above its excavated lower part a tooth-like swelling, as in paratype A.M.N.H. No. 27181:51 (fig. 30), or even a distinct tooth, as in the considerably smaller paratype

A.M.N.H. No. 27181:15 (fig. 12), or it shows an indication of twin teeth (paratypes A.M.N.H. Nos. 27181:5, 27181/1:1; fig. 8), as also found in *N. dicosmoides*. A deep umbilical niche, which might well be a resorption pit (see above), is observable only in paratype A.M.N.H. No. 27181:60 (fig. 25).

Resorption of inner walls, sometimes of the earliest whorls only, sometimes of all but the last, can be recognized in this species. Paratypes A.M.N.H. Nos. 27181:97 and 27181:98 are illustrated (figs. 10, 33) as examples of resorption of all inner walls except the wall separating the anteriormost part of the body whorl from the rest of the interior.

A fine growth striation can be recognized only exceptionally (e.g., in the holotype; fig. 17), where the striae can be seen to run steeply obliquely backward across the body whorl.

It is important to note that the color markings, as found in the pattern dominant in this species and represented best by the holotype and by paratypes A.M.N.H. Nos. 27181:49, 27181:55, and 27181:56 (figs. 17, 18, 21, 22, 26, 19, 20, 23), follow a course entirely independent of that of the growth striae. They run, occasionally slightly zigzagging, from the suture decidedly backward, form a rather brusque hook in the zone of maximum width of the conch, and then run in a gently forward direction across the base. Twelve such color markings can be counted on the body whorl of the holotype. In paratype A.M.N.H. No. 27181:56 they are less closely set, whereas they are much more so in paratype A.M.N.H. No. 27181:55, along the suture of which 21 can be counted. They occasionally bifurcate at some distance from the suture. The density is even higher (25–30 markings on the body whorl) in paratype A.M.N.H. No. 27181/1:1.

In addition to this color pattern, which is believed to be peculiar to the present species, *N. hologyroides* borrows, as it were, that of related species or even combines the patterns in a whimsical way. Thus a few shells (A.M.N.H. Nos. 27181:63, 27181:64, 27181:67, 27181:70) feature the color pattern peculiar to *N. obliqua;* paratype A.M.N.H. No. 27181:67 is illustrated (fig. 28) as an example. A greater number of shells, among them A.M.N.H. Nos. 27181:43, 27181:75, 27181:78, 27181:79, 27181:80, 27181:82, 27181:84, 27181:89, 27181:92, exhibit the pattern of *N. dicosmoides* in its pure form; paratypes A.M.N.H. Nos. 27181:80 and 27181:82 are shown, as examples, in figures 35 and 13, respectively. Had I not decided to base the taxonomy of this group on the shell shape rather than on the color pattern, these specimens might be referred to *N. dicosmoides* as a separate, high-spired variety. Not a few shells, among them paratypes A.M.N.H. Nos. 27181:65, 27181:86–27181:89, 27181:91, and 27181:99, carry three color bands, filled with the meshwork found in *N. obliqua* and separated by two blank bands, thus combining the *obliqua* and *dicosmoides* patterns (paratype A.M.N.H. No. 27181:91; fig. 24). Still others (paratype A.M.N.H. No. 27181:96 and shell fragment A.M.N.H. No. 27181:100; figs. 27 and 16) show the pattern characteristic of the present species on the two bands between three more densely hatched ones, thus combining the *dicosmoides* and *hologyroides* patterns. Finally, an arabesque pattern, somewhat intermediate between that of *N. obliqua* and the typical one of *N. hologyroides*, is found in a single small shell (A.M.N.H. No. 27181:101).

Pitted subcortical surfaces, as recorded above for *N. dicosmoides* are also occasionally encountered in *N. hologyroides*.

The earliest ontogenetic stages are well observable only in paratype A.M.N.H. No. 27181:93 (fig. 15), where the nucleus can be seen to be slightly eccentric and perhaps also a little alloiostrophic.

REMARKS: The shell shape and in particular the presence of a distinct circumumbilical keel produce a certain resemblance of this species to the genus *Hologyra* Koken (1892b, p. 193; see also Koken 1892a, p. 26, and Kittl, 1899, p. 49),[1] which is indicated in the specific name. The resorption of its inner walls excludes, however, reference of this species to *Hologyra* or to the subfamily Naticopsinae. In particular, it resembles Kutassy's (1937, p. 47, pl. 1, figs. 84–86) *Dicosmos applanatus* and his var. *pachygaster* (*ibid.*, p. 48, pl. 1, figs. 87, 88) of *Dicosmos declivis* Kittl (1895,

[1] Whereas Cossmann (1925, pp. 77, 79) considers *Hologyra* a subgenus of *Naticopsis* in which he includes *Dicosmos* Canavari as a section, Wenz (1938, p. 407) treats *Hologyra* as a subgenus of *Dicosmos*.

p. 140, pl. 4, figs. 10–14; 1899, p. 36, *cum synon.*). Both of Kutassy's forms might just as well, if not better, be referred to *Hologyra*, as was the typical *D. declivis* in Kittl's original description. However, they might be Neritidae. At least no indication as to whether the inner walls are resorbed or not can be found in Kutassy's descriptions or illustrations.

From *N. obliqua* and *N. dicosmoides*, *N. hologyroides* differs in its shell shape, from *N. dicosmoides* in particular by its less depressed spire which makes for a less spherical and somewhat more slender appearance. It is true that a peculiar color pattern is dominant in *N. hologyroides*, but it cannot be relied on for distinguishing this species from *N. dicosmoides*, since the color pattern of *N. dicosmoides* also occurs on shells that must be referred to *N. hologyroides* because of their shape. *N. hologyroides* is compared with *N. ninacacana* and *N. distincta* in the discussions of those species.

The characteristic shell shape and in particular the large body whorl readily distinguish this species from all three of von Ammon's *Neritaria* species from the Monte Nota.

Whereas there is no difficulty in distinguishing complete shells of the genus *Omphaloptycha*, even of *O. speciosa* which has the most obese body whorls and the lowest spires, from those of the present species and closely related ones, body whorl fragments are less easy to separate. Color markings, where present, are helpful, for even those of *N. hologyroides*, which come closest to those found in *Omphaloptycha*, are as a rule more closely set and turn decidedly backward in the upper part of the body whorl and only gently forward in the lower part, whereas in *Omphaloptycha* they run back only for a short distance from the suture and then turn decidedly forward for the rest of the course.

OCCURRENCE: Common.

LOT	A.M.N.H. NOS.	NO. OF SPECIMENS
86	27181	415
48	27181/1	2
70	27181/2	3
71	27181/3	2
78	27181/4	2 (doubtful)
87	27181/5	3 (doubtful)
		427

Including a proportionate part of the specifically undetermined specimens of this genus, the total number of individuals belonging to this species is estimated at about 500.

Neritaria ninacacana,[1] new species

Plate 10, figures 31, 34, 38–42, 44–47, 49–55, 57

DIMENSIONS

A.M.N.H. Nos.	W	H	h	π
27182:1	1.12 mm.	100	*ca.* 5	?138°
27182:3	1.26	93½	*ca.* 3	128°
27182:5	1.37	100	*ca.* 2½	128°
27182:2	1.40	96	*ca.* 4	124°
27182:12[2]	1.51	107½	3½	*ca.* 138°
27182:8	1.57	89½	7	119°
27182:10	*ca.* 1.57	*ca.* 82	*ca.* 7	116°
27182:13	1.62	100	*ca.* 3½	140°
27182:11	*ca.* 1.68	*ca.* 90	*ca.* 3½	130°
27182:14	*ca.* 1.68	*ca.* 86½	*ca.* 4½	140°
27182:15 (syntype A)	1.79	103	4	138°
27182:19	1.79	100	4	134°
27182:20	*ca.* 1.96	*ca.* 97	*ca.* 3	135°
27182:21	2.02	97	4	131°
27182:24[3]	2.04	100	2½	128°
27182:23[4]	*ca.* 2.07	*ca.* 105½	*ca.* 3½	134°
27182:22	2.07	94½	4½	136°
27182:26	2.30	102½	3	131°
27182:42	2.46	91	4½	127°
27182:25	2.52	100	4½	127°
27182:27	2.52	93½	3	135°
27182:31	*ca.* 2.63	*ca.* 104	*ca.* 3	?148°
27182:32	*ca.* 2.74	*ca.* 102	*ca.* 3	142°
27182:44	*ca.* 2.74	*ca.* 94	*ca.* 6	125°
27182:33	*ca.* 2.80	*ca.* 96	*ca.* 4	128°
27182:35	*ca.* 2.86	*ca.* 100	*ca.* 2	131°
27182:36	*ca.* 3.15	*ca.* 97½	*ca.* 3	134°
27182:37	3.24	95	2½	136°
27182:38	4.43	97	4	132°
27182/1:1	*ca.* 9.2	*ca.* 90	?	?
27182:39	*ca.* 10.9	*ca.* 89	*ca.* 3½	*ca.* 135°
27182:40	*ca.* 11.5	*ca.* 93	*ca.* 5½	133°
28182:41[5] (syntype B)	*ca.* 17.4	*ca.* 111½	*ca.* 5	132°

No safe inferences as to general growth trends can be drawn from the above table. It can be said that greater widths and wider pleural angles occur more commonly among the large shells than among the small ones, but the spires, which should then be inversely shortest in the large shells and are indeed rather short between heights of about 3 and

[1] Named after the Peruvian town Ninacaca, in the vicinity of which lot 86 was collected.
[2] Th = 73% of W.
[3] Transitional to *N. hologyroides*.
[4] Th = 74½% of W.
[5] Th = 80% of W.

11 mm., are comparatively quite high again in the two largest specimens measured. In general the observation that the same values for W, h, and π are encountered at very different growth stages applies to this species as well as to the preceding ones.

For the meaning of Th, see the discussion of the dimensions under the heading *N. dicosmoides* above.

SELECTION OF TYPES: Since the appearance of this species changes markedly in the course of its ontogeny, one of the best juveniles (A.M.N.H. No. 27182:15) and the excellently preserved largest shell present (A.M.N.H. No. 27182:41) have been chosen as syntypes A and B, respectively.

DESCRIPTION: Although syntype B is by far the largest *Neritaria* shell in the present assemblage, reaching almost one and a half times the size of the largest specimen of *N. distincta* (A.M.N.H. No. 27183/1:5), it consists of not more than four volutions, including the nuclear ones. Accordingly, there are only from three to three and a half in smaller and medium-sized shells of this species.

In general shell shape it resembles at first sight *N. hologyroides*, but closer examination reveals the following clearly distinctive characters: The body whorl is, as a rule, somewhat wider, the spire, on an average, somewhat lower, and, accordingly, the pleural angle somewhat greater than in *N. hologyroides*. There is a distinct though rounded shoulder which makes for a somewhat flattened top from which the comparatively small spire arises. The suture which separates it from the body whorl is, at later and latest growth stages, deeply channeled[1] and accompanied on the outside by an indistinct torus formed by the uppermost part of the body whorl. It should, however, be noted that the shoulder characteristic of this species becomes less pronounced with growth, as seen by comparing the profiles of syntype A, paratype A.M.N.H. No. 27182:38, and syntype B (figs. 49, 53, and 39). Furthermore, the base is comparatively high and slightly concave. In apertural view this causes the left outline of the shell profile to run in an almost straight line at an angle of about 45 degrees from the point of greatest width to the lower end of the inner lip and brings the middle of the lower margin of the aperture to a position considerably to the right of the apex, whereas it is found to lie on the same perpendicular line, or nearly so, in the preceding species. The aperture is essentially of the same shape as in the congeneric species hitherto dealt with, except that the presence of a shoulder is manifest in an almost horizontal ceiling and accordingly in an upper angulation of nearly 90 degrees, especially in the young (figs. 50, 42, 55, 40). The inner lip, at least in medium-sized and large shells such as paratype A.M.N.H. No. 27182:38 and syntype B (figs. 55, 40), is clearly reflexed between the lower end and the point where it joins the center of the base. In syntype B the rim of this reflexed part of the inner lip is somewhat reënforced and accompanied outside by a not too clearly defined, rather wide furrow which tapers to a narrow groove towards the center of the base. From there the reflexed part continues as the callosity, present throughout this genus, up to the ceiling of the aperture. In the young (syntype A; figs. 50, 52) and in medium-sized shells (paratype no. 38) this callosity is slightly swollen and accompanied on the outside by a shallow to moderately deep umbilical niche (or resorption pit?). In the latest stage, however, as seen in syntype B (fig. 40), this callosity has become a flat expanse of which the outer margin is sinuous, not straight, as in *N. hologyroides*. Throughout this species no circumumbilical keels are present. A faint indication of twin teeth, as occasionally encountered in *N. dicosmoides* and *N. hologyroides*, can just be recognized on the inner lip of syntype A only (fig. 50). Whereas in those species the bottom of the aperture is evenly rounded and continues without any sharp boundary into the inner lip, precisely speaking into the circumumbilical ridge or keel bordering it on its outer side, in *N. ninacacana* the reflection of the inner lip produces throughout development a distinct, sometimes (paratype no. 38; fig. 55) even sharp corner at its lower end which clearly separates it from the bottom of the aperture.

Resorption of inner walls can be recognized in a few broken specimens, best in the frag-

[1] In paratype number 45 this also applies to the penultimate suture.

ment A.M.N.H. No. 27182:45 of a shell reaching almost the size of syntype B; here the inner walls of all volutions but the last can be seen to have been resorbed. None of these specimens would photograph well, so resorption is not illustrated in this species.

A fine growth striation is well preserved in some larger shells, best in the aforementioned fragment number 45 and in syntype B (figs. 41, 38–40, 46, 47). The growth striae run from the suture decidedly (though not "tangentially," see Kittl, 1899, *passim*, especially p. 45) backward across the apical portion of the whorl, then change on the shoulder to a more steeply backward direction and form a hardly perceptible backward concavity on the sides of the body whorl. On the base they turn again more decidedly backward, radially converging towards its center. On the whole, they look almost straight in side view.

Color markings, wherever present in this species (syntype B and paratypes A.M.N.H. Nos. 27182:33, 27182:37, 27182:39, 27182:42, 27182:45, and 27182:46), are of the general pattern encountered in *N. dicosmoides*, although with some modifications. In smaller shells, such as paratypes number 42 (fig. 34) and number 33, the individual lines which in their entirety constitute each of the three revolving color bands are generally rather widely spaced and separated by interspaces of about three times their own width. They are more closely set in somewhat larger shells (paratype no. 37) and become so dense in large ones (paratypes nos. 39 and 45 and syntype B) that the bands appear solid to the naked eye and can be recognized only under the microscope (fragment A.M.N.H. No. 27182:45; fig. 41), to consist of extremely fine, brown, transverse lines which fill the intervals between the growth striae. The same condition prevails in paratype number 46 (fig. 31), even though it is hardly larger than number 37. In this species there is considerable variation in width of the color bands. They are narrowest in paratype number 45 (fig. 41), where the blank belt between the upper and the middle band is eight times as wide as the upper band and four times as wide as the middle band, and widest in syntype B (fig. 38), where the upper and the middle band have become so wide that they almost merge, with an extremely narrow blank band just recognizable between them, and thus cover virtually all the upper half of the body whorl. The lowermost band is almost as wide as the middle one but clearly separated from it by a blank belt which is just a little narrower than the lowermost band and constitutes the only readily recognizable element of the color pattern of this specimen.

The earliest ontogenetic stages can well be studied in paratypes A.M.N.H. Nos. 27182:33 and 27182:45 and, best of all, in syntype B, where the nucleus is button shaped, slightly flattened, and smooth (figs. 44, 41, 57).

REMARKS: The peculiarities of this species, particularly in shell shape and aperture, distinguishing it from the congeneric species described in the preceding sections and especially from *N. hologyroides*, which it most closely resembles in general appearance, are given in the description. Comparison with *N. distincta* is made in the discussion of that species.

Of congeneric species from other paleogeographical provinces *N. obtusangula* von Ammon (1893, p. 194, fig. 25) has the rounded shoulder in common with *N. ninacacana* but the shell shape of the latter is flatter on top, reaches its maximum width nearer that shoulder, and tapers more decidedly downward. *N. subincisa* (Kittl, 1895, p. 131, pl. 2, figs. 26–28; 1899, p. 68, *cum synon.*, text figs. 14, 15, pl. 2, fig. 13, pl. 3, figs. 23, 24, pl. 4, fig. 24)[1] considerably resembles *N. ninacacana* in shell shape, but the two forms cannot well be considered conspecific, since Kittl's species exhibits a less wide body whorl, a lower spire,[2] a heavier callosity, and at least in some specimens a circumumbilical keel, and seems furthermore to lack the shoulder and the apical band characteristic of *N. ninacacana*. These characters and the deepened sutures that go with it are, however, present in *N. incisa* (Kittl, 1895, p. 131, pl. 2, figs. 30, 31; 1899, p. 68,

[1] Recently recorded also by Bešić (1948, pp. 67, 70, pl. 4, fig. 1) from the Saranci region of Montenegro.

[2] In this character, however, the "low form" depicted in Kittl (1899, pl. 2, fig. 13) comes fairly close to the largest specimen present (syntype B) of *N. ninacacana*.

cum synon., pl. 2, figs. 11, 12), which is, on the other hand, readily distinguished from the present species by its much higher spire and altogether more slender shell shape.

Finally, there is a striking similarity in shell shape between our syntype B and the two larger of three specimens of *Fedaiella meriani* (Hoernes, 1856, p. 26, pl. 2, fig. 6) figured by Kittl (1899, p. 43, pl. 9, figs. 4–6). Congenerity is, however, out of the question since Hoernes' species belongs to the Naticopsinae in which inner walls are not resorbed. The same holds true for *Dicosmos maculosus* (Klipstein, 1843, p. 193, pl. 13, fig. 1 = *Naticopsis neritacea* Kittl, 1892, p. 73, *cum synon.*, pl. 6, figs. 29–32, pl. 7, fig. 1; 1894, p. 252; 1899, p. 35, *non* Münster), some of the specimens of which (e.g., the one shown in Kittl, 1892, pl. 6, fig. 29a) similarly resemble our syntype B in shell shape.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27182	240
71	27182/1	2
		242

If a proportionate part of the specimens left specifically undetermined be added, the total number of individuals rises to about 285.

Neritaria distincta, new species

Plate 10, figures 43, 48, 56, 58–67; plate 11, figures 1–6, 9

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27183:1	*ca.* 1.46 mm.	*ca.* 96	*ca.* 7½	119°
27183/2:1	*ca.* 1.90	*ca.* 91	*ca.* 6	*ca.* 116°
27183:2	*ca.* 1.96	*ca.* 97	*ca.* 8½	*ca.* 119°
27183:4	2.07	89	8	105°
27183:5	*ca.* 2.35	*ca.* 85½	*ca.* 9½	?95°
27183:6	*ca.* 2.41	*ca.* 90½	*ca.* 7	101°
27183:8	*ca.* 2.52	*ca.* 98	*ca.* 8	107°
27183:10	*ca.* 2.8	*ca.* 90	*ca.* 9½	105°
27183:25	*ca.* 3.07	*ca.* 94½	*ca.* 6	104½°
27183:13	*ca.* 3.16	*ca.* 88½	*ca.* 9½	108°
27183/2:2	*ca.* 3.32	*ca.* 85	*ca.* 6	112°
27183:15	*ca.* 3.73	*ca.* 96½	*ca.* 6½	120°
27183:14	3.90	98	8½	115°
27183:16	*ca.* 4.07	*ca.* 90	*ca.* 8	114°
27183:17	4.15	92	9	106°
27183/2:4	4.40	94½	9½	?
27183:18	*ca.* 4.43	*ca.* 97	?6	112°
27183/2:5	4.55	92	9	102°
27183/2:3	4.56	89	7½	120°
27183:19[1]	*ca.* 4.92	*ca.* 105	*ca.* 10	125°
27183/1:6	*ca.* 4.92	*ca.* 95	*ca.* 7½	105°
27183:26	5.17	88	7	102°
27183:20	*ca.* 5.41	*ca.* 91	*ca.* 9	108°
27183:21 (syntype A)	5.53	91	9	98°
27183:22	6.15	90	7½	112°
27183:24[1]	6.52	107½	7½	118°
27183:23	*ca.* 6.89	*ca.* 89½	*ca.* 9	*ca.* 98°
27183/1:2	*ca.* 8.24	*ca.* 86½	*ca.* 7	111°
27183/1:3	*ca.* 9.59	*ca.* 85	*ca.* 7½	123°
27183/2:6 (syntype B)	*ca.* 10.33	*ca.* 91½	*ca.* 9½	111½°
27183/2:7	*ca.* 10.58	*ca.* 90½	*ca.* 7	121½°
27183/1:4	*ca.* 10.95	*ca.* 87½	*ca.* 8	120½°
27183/2:8	*ca.* 11.2	*ca.* 93½	*ca.* 7	121½°
27183/1:5[2]	*ca.* 12.42	*ca.* 100	*ca.* 7½	124°

The only inference that can be drawn from the table is that pleural angles are in general wider at sizes above 8 mm. than at those below 7 mm.; angles of 110 degrees or less do not occur among the larger-sized shells. If the crushed specimens A.M.N.H. Nos. 27183:19 and 27183:24 are left out of consideration, as they must be, then both the maximum width (100) and the widest pleural angle (124°) are found in the largest shell measured. This seems not to indicate that W increases with growth, for widths of 97 or 98 are repeatedly encountered at considerably earlier stages. Altogether the table is inconclusive as to general growth trends; this agrees well with the observation that the general shell shape of this species remains rather constant throughout development.

For the ratio Th/W, see the discussion of the measurements under the heading *N. dicosmoides* above.

SELECTION OF TYPES: A comparatively large shell from lot 71 (A.M.N.H. No. 17183/2:6) has the best preserved surface but its aperture is unfortunately incomplete, so a much smaller complete specimen from lot 86 (A.M.N.H. No. 27183:21) is designated syntype A. The one from lot 71 is syntype B.

DESCRIPTION: About four volutions can be counted in the largest shell present (A.M.N.H. No. 27183/1:5) and three and

[1] Crushed.

[2] Th = 71½% of W.

one-half in syntype A which reaches less than half the size of the former. The shell shape of this species is characterized by a gibbous body whorl, a distinct though rounded shoulder, a gently sloping, slightly concave apical band, and chiefly by its comparatively high spire. The last suture or in the largest shells the last two are shallowly engraved.

The aperture is widely rounded at the bottom but narrows markedly towards the ceiling. The outer margin is semicircular, with a slight truncation at the top which corresponds to the apical whorl face (noticeable particularly well in syntype B; pl. 11, fig. 4). The inner one is strongly oblique and slightly sinuous. The lowermost point of the bottom of the aperture lies not so far to the right of the apex as in *N. ninacacana*, and still a little to the left of the upper end of the aperture. The bottom margin continues mostly as a thin but quite sharp circumumbilical keel which is accentuated where the callosity of the inner lip is in its lower part excavated next to it, as in paratypes A.M.N.H. Nos. 27183:14 (pl. 11, fig. 5) and 27183/2:5 and in syntype A (pl. 10, fig. 63). This callosity is comparatively heavy and wide. Its outer margin is clearly sinuous as in the preceding species and even at late growth stages does not tend to become straight, as it does in *N. hologyroides*. Above the end of the aforementioned keel this margin as a rule is marked by a narrow groove, which in some shells, for example, in paratypes A.M.N.H. Nos. 27183:22 and 27183:23 (pl. 10, figs. 64, 65) and 27183/1:6, somewhat widens and deepens, thus assuming the appearance of an umbilical niche. As in the preceding congeneric species, there is the possibility that these umbilical niches are merely resorption pits. Occasionally, as in paratype A.M.N.H. No. 27183:14 (pl. 11, fig. 5), there is a slight swelling at about the middle of the callosity. In the small paratype A.M.N.H. No. 27183:6 it shows in its upper half a faint indication of twin teeth, as observed in some other species of this genus, but in the body whorl fragment A.M.N.H. No. 27183:28 such twin teeth are quite clearly recognizable (pl. 10, fig. 67).

The body whorls of syntype A and of paratype A.M.N.H. No. 27183:23 are partly filled with matrix. Some distance behind the apertural margin this filling ends in a surface which seems too definitely shaped to be purely incidental. As can be clearly recognized in syntype A, it consists of matrix but not of shell substance. Thus it cannot be an operculum, but it may be the mold of the reverse face of an operculum that was lost. Shape and ornamentation of that surface, as observable in paratype A.M.N.H. No. 27183:23 (pl. 10, fig. 65), seem to support such an assumption. At about the lower third of the height of the aperture and about the inner fourth of its width, it forms a peak which might correspond to the nuclear region of the operculum. From that peak two ridges radiate, one obliquely downward, one obliquely upward. Combined, these ridges approximately duplicate the outline of the inner lip. The fan-shaped field extending between these two ridges and the outer lip shows a faint concentric ornamentation. Thus the surface somewhat resembles the operculum of *Hologyra zitteli* (Kittl, 1892, p. 76, pl. 7, fig. 5; 1899, pp. 32, 33) except for being raised where that operculum is deepened.[1] Should it be the mold of an operculum, it would be the only indication of that structure among the many thousands of gastropods in the present assemblage.

The interior of conchs, wherever examined, shows to a varying extent resorption of the inner walls. Paratype A.M.N.H. No. 27183:34 is illustrated (pl. 10, fig. 48) as an example of the resorption of all inner walls but that of the anterior half of the body whorl, and the smaller paratype A.M.N.H. No. 27183:35 as an example of complete resorption (pl. 10, fig. 58).

A fine growth striation can be recognized in the present species more frequently and in better preservation than in any of the preceding ones, best in syntype B (pl. 11, figs. 2–4) and in paratypes A.M.N.H. Nos. 27183:28 (pl. 10, fig. 66), 27183:33, and 27183/2:5. In paratypes A.M.N.H. Nos. 27183/2:3 (pl. 10, fig. 43) and 27183:24 the growth striae unite in bundles, thus forming comparatively coarse folds. The course of the growth striae is the same as described in *N. ninacacana*. In the anteriormost part of

[1] It is less similar to that figured by Koken (1889, p. 472, fig. 26) under the designation "*Naticopsis Deshayesi* Mü. sp."

the largest paratype A.M.N.H. No. 27183/1:5 they can clearly be seen to start from the suture not in a "tangential" direction (p. 171), but at a steep, nearly right angle (pl. 11, fig. 12).

Color markings of this species, where present, show a wide variation in pattern. However, the three revolving bands prevailing in *N. dicosmoides* and *N. ninacacana* seem also to constitute the dominant pattern in this species. The color bands vary in width both within the same shell, as seen in the crushed paratype A.M.N.H. No. 27183:31 (pl. 10, fig. 60), and within the species. Mostly they are rather narrow, as in paratypes A.M.N.H. Nos. 27183:32 (also crushed, pl. 10, fig. 56), 27183/1:5 (pl. 11, fig. 1) and 27183/2:3, and can be recognized under the microscope to consist of fine individual lines of pigment filling the intervals between the growth striae, but occasionally, as in the shell fragment A.M.N.H. No. 27183/1:7 (pl. 11, fig. 6), they are solid and quite broad. A single shell (A.M.N.H. No. 27183:25) exhibits the combination of the *obliqua* and *dicosmoides* color patterns repeatedly encountered in *N. hologyroides*, another (paratype A.M.N.H. No. 27183:26, pl. 10, fig. 59) the pure *hologyroides* pattern. The same pattern but unusually widely spaced is found in the incomplete body whorl A.M.N.H. No. 27183:30, whereas another incomplete, but otherwise excellently preserved body whorl (A.M.N.H. No. 27183:28) and the less incomplete, but also less well-preserved paratype A.M.N.H. No. 27183:29 exhibit the "arabesque" variant of that pattern hitherto encountered only in a single small shell of *N. hologyroides*. This variant is illustrated by paratype number 28 which deserves special mention also for excellently showing the independence of color markings of this pattern from the course of the growth striae (pl. 10, fig. 66).

The earliest ontogenetric stages can best be studied in syntype A, which shows a flatly conical, neither eccentric nor alloiostrophic nucleus (pl. 10, fig. 61).

REMARKS: The peculiarities of the shell shape of this species, i.e., the distinct shoulder, the gently rising and slightly concave apical whorl face, and chiefly the comparatively high spire, serve readily to distinguish it from all the other species of this genus with which it is associated in the assemblage under study as well as from those from the Monte Nota. Among them *N. collegialis* von Ammon is not so dissimilar in shell shape but lacks a distinct shoulder. These distinctive characters have been indicated in the trivial name. To a lesser degree the characters of the aperture are also helpful in distinguishing it from congeneric forms.

Among the congeneric forms, *N. incisa* (Kittl, 1895, p. 131, pl. 2, figs. 30, 31; Böhm, 1895, p. 235, pl. 11, fig. 7, ? pl. 15, fig. 13; Kittl, 1899, p. 68, pl. 2, figs. 11, 12) from the Marmolata and Esino seems to resemble *N. distincta* most closely in shell shape and growth striation, but differs in the horizontal depression around the suture, considered diagnostic of *N. incisa* by its author, and narrower aperture. Thus the Peruvian form cannot be referred to Kittl's species.

Neritaria distincta is compared with *N.* aff. *distinctae* in the discussion of that form.

Among forms referred to other genera, *Oncochilus peruvianus*, represented by a single specimen only in our material, resembles fairly closely some individuals of *N. distincta* (syntype A); for comparison reference is made to the remarks on that species.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27183	50
70	27183/1	17
71	27183/2	10
		77

If a proportionate part of the specifically undetermined shells and fragments be added, the total number of individuals of this species rises to only about 90. Thus it is by far the least common *Neritaria* species in the late Triassic of Peru.

Neritaria aff. **distinctae** Haas

Plate 10, figures 36, 37

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27184	2.95 mm.	67	11½	93°

DESCRIPTION AND REMARKS: Whereas in several other specimens of *N. distincta* deviations in shell shape and dimensions may be due to crushing, the single shell here dealt with, although not considerably deformed, differs from the typical *N. distincta* by its much more slender body whorl, an even higher spire, and a less wide pleural angle. In all other characters it agrees well with *N. distincta* and is therefore believed to be closely related to it, although the differences in dimensions seem to preclude conspecificity.

OCCURRENCE: A single specimen in lot 86 (A.M.N.H. No. 27184).

TRACHYNERITA KITTL

This genus was established by Kittl in his Marmolata paper (1895, pp. 120, 133) and accepted by Böhm in his paper on the same fauna (1895, p. 239), as it was by Cossmann (1915, p. 185) and Wenz (1938, p. 415). Cossmann designated *T. fornoënsis* Kittl (1895, p. 134, pl. 3, figs. 9–12) as the genotype, but since this species was declared by its author (1899, p. 72) to be a junior synonym of *Turbo quadratus* Stoppani, the latter must be considered the type species. It seems that no holotype has hitherto been selected for *T. quadrata* (Stoppani). Therefore the large specimen depicted by Kittl (1895, pl. 3, fig. 12; reproduced by Böhm, 1895, text fig. 25, and by Wenz, 1938, fig. 1007) is here designated its holotype.

In establishing this genus, Kittl included both smooth and nodose forms, reporting a gradual transition from the former to the latter. Within the Peruvian material under examination smooth and sculptured forms are also referred to this genus. The former (if a shell fragment found in lot 26 is not included) are restricted to lot 78 and are conspicuous by attaining the greatest sizes among all the gastropods collected from the light limestones of the Pucará group. Although only four individuals are present there, it was necessary to refer them to two new species, namely, *T. tambosolensis* and *T. porrecta*. The shell fragment A.M.N.H. No. 27191 may belong to one or the other and is therefore designated merely *Trachynerita* sp.[1] The nodose form present in three lots representing a different facies can be identified with *T. evoluta* Jaworski, but its reference to this genus remains doubtful for reasons pointed out in the discussion of that species.

[1] It has been listed with *T. tambosolensis* in table 1.

Trachynerita tambosolensis,[2] new species

Plate 11, figures 18, 19, 24

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27189:2[3]	*ca.* 21 mm.	?	*ca.* 20	?
27189:2 (holotype)	*ca.* 42 (est.)	*ca.* 97½	*ca.* 19	110°

DESCRIPTION: The holotype, consisting of four or four and one-half volutions, unfortunately lacks most of its base, but the upper part of the body whorl and the spire are preserved well enough to permit recognition not only of its close affinity to *T. quadrata* but also of the differences which necessitate specific separation.

The whorl profile is characterized by a pronounced though rounded shoulder; the apical band above it is rather wide (about one-sixth of W), practically horizontal, and slightly concave. The pronounced shoulder and the horizontal apical bands produce a distinctly staircase-like shell profile. The body whorl attains its maximum width at about the upper third of its height; above that zone the lateral whorl faces diverge only a little in profile so as to make the upper part of that whorl appear subcylindrical; the base, on the other hand, seems to have been strongly convex. The spire is obtusely conical. The width of the apical band affects the outline of the aperture by providing it with a rather wide ceiling which forms an angle of a little more than 120 degrees with the upper part of the outer lip. The rest of the aperture is too incompletely preserved to be properly described, at least in the holotype. However, in the penultimate volution of the paratype, which sticks in the cavity of the body whorl of the holotype, the inner lip can be seen to be reflexed and accompanied on the outside by a well-developed umbilical niche. Thus the statement in Kittl's (1895, p. 133) generic diagnosis to the effect that

[2] Named after the village Tambo del Sol in the vicinity of which lot 78 was collected.

[3] Enclosed in body whorl of holotype.

the callosity of the inner lip "entirely covers the umbilical region" does not seem to apply at this early stage. Nor can this callosity in the present species be called thick, as it is by Kittl (1895, p. 134) in the description of *T. fornoënsis;* rather it is thin in both holotype and paratype, but this may be due to wear.

The inner walls of the earlier volutions seem to have been resorbed in the paratype.

Where fully preserved, the test can be seen to be thick and to consist, as usual, of three layers, the middle one often missing or replaced by druses of small crystals. The growth striae, which sometimes irregularly unite in bundles, can be studied on the anteriormost part of the body whorl of the holotype. They run from the suture only slightly backward across the apical band on which they are only very gently concave. Then they cross the shoulder without any deflection and run in a straight or slightly sigmoidal line steeply obliquely backward across the lateral face of the body whorl. Their course is thus the same as the one observable in Kittl's (1895, pl. 3, fig. 12), drawing of the holotype of *T. fornoënsis.* On the penultimate and body whorls of the holotype color markings have left rather deeply eroded furrows; there must have been about 30 on the body whorl. They run obliquely backward across the apical band, form a wide open, forward concave sinus on the shoulder, where they turn forward, and then zigzag in a generally perpendicular direction down the lateral face of the body whorl. Thus in contradistinction from what has been observed in some shells of *Neritaria dicosmoides*, here the pigment rather than protecting the shell substance accelerated its erosion.

In neither of the two specimens present can the earliest ontogenetic stages be observed. The nucleus, although corroded in both, is seen to have been well centered and obtuse.

REMARKS: This species shares the diagnostic characters of the genus with the type species, *T. quadrata*, but it is clearly distinct owing to its higher spire, steeper lateral whorl faces, and less wide pleural angle. Measurements of Kittl's figure of the holotype of *T. quadrata* (= *T. fornoënsis* Kittl) yielded the following values: W, 100; h, 8; π, 125°. Furthermore, the present species carries (or carried) very conspicuous color markings which according to Kittl (1895, p. 135) do not occur in *T. quadrata. T. lipoldi* Hörnes (1856, p. 24, pl. 1, fig. 5), believed by Kittl (*loc. cit.*) to be possibly identical with *T. quadrata*, seems to deviate even farther from the present species by its wide and ventricose body whorl (W, 112½).

Trachynerita dichroos (Benecke, 1868, p. 43, pl. 3, fig. 4) from the Muschelkalk of Recoaro (northern Italy) also has color markings which are, however, quite different from those of *T. tambosolensis*. It also differs in shell shape and heavy umbilical callosity.

For a comparison with *T. porrecta*, see that species.

OCCURRENCE: Represented in lot 78 by only two specimens, the smaller of which is enclosed in the larger (A.M.N.H. No. 27189).

Trachynerita porrecta, new species
Plate 11, figures 27, 28, 31

DIMENSIONS OF HOLOTYPE

A.M.N.H. No.	H	W	h	π
27190	*ca.* 44 mm. (est.)	*ca.* 82½	*ca.* 18	96°

DESCRIPTION: Six volutions, including the nuclear ones, can be counted in the only specimen present (holotype). Shell profile decidedly staircase-like; body whorl large but not so wide as in congeneric species, spire comparatively high. Shoulder pronounced but rounded; apical band horizontal or even a little sloping towards the suture, slightly concave, and only moderately wide; lateral face of spiral whorls steep, nearly perpendicular, and gently convex. The maximum width of the penultimate whorl is reached considerably above the last suture. Only in this volution are base and aperture preserved; the former is comparatively high and continues the curvature of the whorl profile down from the zone of maximum width. The aperture must have been rather wide and has a horizontal ceiling which is markedly less wide than in the preceding species, a strongly oblique, slightly sinuous inner margin and an evenly rounded bottom.

The callosity of the inner lip, if present,

is not clearly defined, and there is no indication of an umbilical niche.

The inner walls of the last and penultimate volutions are not resorbed; the interior of the spire cannot be seen.

Faint indications of growth striae and folds can be recognized on the last whorl but one. They run steeply back from the shoulder across the lateral face, but in a sigmoidal, first forward, then backward course across the base. Furrows left by leached-out color markings can be recognized only on the apical bands and in the uppermost parts of the lateral faces of the body whorl and of the anteriormost part of the penultimate whorl. Their course, as far as preserved, is the same as in the preceding species; they run back on the apical band and turn decidedly forward on the shoulder. There they have left the deepest impressions; immediately below it they start zigzagging.

The nucleus is somewhat obtuse and cap shaped.

REMARKS: Although only a single, incomplete specimen is available, it is so characteristic that it is believed to be qualified to serve as the holotype of a new species. This species differs from *T. tambosolensis*, with which it is associated in the same lot, by its slender shell shape and high spire; in these characters, which suggested the specific name, it deviates even farther from the type species, *T. quadrata*.

In shell shape there is also a certain resemblance to *Omphaloptycha speciosa* (p. 143, pl. 8, figs. 30, 35–37, 40, 41, 45–50, 53, 54, 59, 62, 65). In that species, however, the shoulder is never so pronounced as it is in *T. porrecta*, the apical band is markedly narrower and never concave, and the color markings run obliquely forward, not backward as in the present species. There is also a difference in the course of the growth striae, which is radial and straight or slightly forward concave in *Omphaloptycha*, but straight and steeply backward in *T. porrecta*. Furthermore, the two generically different forms can readily be distinguished by the shape of the aperture and the presence of a distinct umbilical niche in *O. speciosa*.

Finally a certain resemblance in general shell shape between this species and certain forms of the genus *Cylindrobullina, sensu lato* (p. 256), should be mentioned. Even without the vast difference in size, the more pronounced shoulder and cylindrical shell profile of *Cylindrobullina* make distinction easy.

OCCURRENCE: A single specimen in lot 78 (A.M.N.H. No. 27190).

?Trachynerita evoluta Jaworski

Plate 11, figures 10, 17, 20, 26, 29

Trachynerita evoluta, n. sp., JAWORSKI, 1923, p. 142, pl. 5, fig. 16.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27193/1:1	*ca.* 21.5 mm.	*ca.* 74½	*ca.* 22½	67°
27193:1	*ca.* 41.5	*ca.* 70	*ca.* 23	*ca.* 70°
27193/2:1	*ca.* 45.2	*ca.* 75	*ca.* 24½	*ca.* 67°
27193/2:2	*ca.* 52 (est.)	*ca.* 80	*ca.* 19½	?80°

With the only exception of A.M.N.H. No. 27193:1 the above specimens have been measured in natural sections only. Therefore no reliable inferences as to growth trends can be deduced from the table.

DESCRIPTION: The shell consists of from five to six volutions, including the nuclear ones. Its shape is biconical, with a large body whorl and a comparatively slender, conical spire. The presence of a narrow subsutural ledge ("rampe" Cossmann, "Nahtfacette" Kittl), which later changes to a true apical band, makes the sutures more conspicuous and produces a staircase-like shell profile (A.M.N.H. No. 27193/1:1; fig. 10). The spiral whorls are shaped like the frustum of a cone, with the lateral faces rising at an angle of about 60 degrees. The base is comparatively high and is separated from the rest of the body whorl by the lower of two revolving rows of tubercles. The aperture is incomplete in specimen A.M.N.H. No. 27193:1 (fig. 20) and can be studied better in the largest specimen A.M.N.H. No. 27193/2:2 (fig. 26), if allowance is made for the fact that the face along which it weathers out is receding backward if the shell is oriented correctly. It is pear-shaped and shows a rather acute angulation at the top, an almost semicircular, thin outer lip, an evenly rounded bottom and an inverted-sigmoidal inner margin. The thickness of the shell increases markedly from the outer

lip to the inner one which forms a wide and apparently quite heavy callosity. This callosity attains its greatest width at about its lower third, thus resembling that seen in Kittl's (1899, pl. 2) figure 7 of *T. depressa*. It seems to have a similar shape in specimen A.M.N.H. No. 27193:1, but here the surface is too corroded to draw the boundary between this callosity and the adjacent shell surface with any certainty. There is no umbilical niche; the cavity seen at the extreme left end of the callosity in the largest specimen (fig. 26) may be a resorption pit.

The sculpture, observable only on the last two volutions of specimen A.M.N.H. No. 27193:1, consists of eight or nine heavy but rather low folds per half whorl, which run steeply obliquely backward across the lateral whorl faces. On the penultimate volution they swell at both ends; on the last, these swellings turn gradually into heavy tubercles; the upper ones are still elongated in the direction of the folds, whereas the lower ones change into bullate nodes. Between the upper and lower tubercles the folds become obsolete on the body whorl, as already observed by Jaworski. These two rows of tubercles affect the whorl profile inasmuch as it becomes slightly concave between them, as seen not only in the specimen here described but also in A.M.N.H. No. 27193/1:1 (fig. 10).

No growth striae nor color markings can be recognized on the worn surfaces.

None of the shells present shows an indication of resorption of inner walls, nor is the nucleus preserved well enough in any to permit any observation on the earliest ontogenetic stages, except that ornamentation sets in only much later.

REMARKS: There can be no doubt as to the identity of the present form with Jaworski's species from the "*Myophoria* limestone of Uliachin." There is indeed a certain similarity in the character of the sculpture and in the shape of the aperture and particularly of the callosity to both *T. depressa* (Hörnes, 1856, p. 24, pl. 1, fig. 3; Kittl, 1899, p. 73, *cum synon.*, pl. 2, figs. 4–8) and *T. wanneri* (Krumbeck, 1913, p. 78, pl. 6, figs. 1, 2), but this similarity was somewhat overestimated by Jaworski; the shell shape is altogether more slender and the spire is decidedly higher in the Peruvian species.

Despite the similarity with undoubted *Trachynerita* species[1] the reference of *evoluta* to *Trachynerita* remains doubtful, since no resorption of the inner walls seems to occur. On the other hand, the specimens now available for examination (not to speak of Jaworski's single fragment, exhibiting neither base nor aperture) are not well enough preserved for any other generic reference to be suggested. The present form is therefore here provisionally and with a question mark left with *Trachynerita*.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
40	27193	2
2	27193/1	3
3	27193/2	3
34	27193/3	1[2] (doubtful)
Total		8

The specimens of lots 2 and 3 could not be etched out and are visible only on the surfaces of the rock.

ONCOCHILUS PETHÖ

This genus, recognized with some doubt by Kittl (1892, p. 35), was relegated to the rank of a subgenus of *Nerita* by Zittel (1885, p. 200), of *Neridomus*[3] Morris and Lycett by Cossmann (1925, p. 193), and of *Neritoma*[4] Morris by Wenz (1938, p. 416). Here, however, it is treated as an independent genus not only for convenience but because observations on the material under study suggest that it may be as closely allied to *Neritaria* as to the three other genera mentioned.

The two rather prominent teeth on the callosity formed by the inner lip are considered a subgeneric character by both Cossmann and Wenz, but within the Peruvian fauna they have also been found to be indicated sporadically, though sometimes only faintly, in several species of *Neritaria* (*N. dicosmoides*, *N. hologyroides*, *N. ninacacana*, and *N. distincta*). Thus the question arises

[1] According to Kittl (1899, p. 74) the resorption of the inner walls of *T. depressa* was already well known to Stoppani.

[2] Several fragments, possibly from the same shell.

[3] "Emended" to "*Neritodomus*" by Fischer.

[4] "Emended" to "*Neritotoma*" by Fischer.

whether the degree of development of these two teeth is not a matter of quantity rather than of kind; in this case, even a high degree could not well serve as a diagnostic generic (or subgeneric) character. This revives the possibility, already considered by Kittl (*loc. cit.*), "that the genus might prove superfluous." Only with this reservation is it being used in the present report.

Cossmann's (1898, p. 149) proposal to replace the name *Oncochilus*, as preoccupied by *Oncochila* Stål, by *Sphaerochilus* is not accepted by Wenz, nor is it here, since it is not justified by the Rules, as interpreted by the Recommendations following Article 36. The case is the same as that of *Neritaria* versus *Neritarius*.

Oncochilus peruvianus, new species

Plate 11, figures 7, 8, 11

DIMENSIONS OF HOLOTYPE

A.M.N.H. No.	H	W	h	π
27187	3.86 mm.	8 3½	12½	78°

DESCRIPTION: The shell, consisting of three and one-half or four volutions, including the nuclear ones, is comparatively slender and characterized by a rounded shoulder and in the body whorl by a marked concavity of the sloping apical band. An extremely narrow subsutural ledge ("Nahtfacette") can be recognized in the anterior half of the body whorl only. The spire is comparatively high, the base well rounded.

The aperture tapers rather quickly upward, owing to the fact that the body whorl contracts in its upper part and to the strong development of the callosity of the inner lip. This callosity forms a crescent strongly projecting into the upper two-thirds of the aperture and carries the twin teeth considered diagnostic of this genus. They run across it in the revolving sense, starting from its outer margin and turning around the inner one into the apertural cavity within which they soon end. In the outer parts their crests are eroded away; only the holes thus produced indicate their shape. The upper angulation of the aperture is rather acute, and its lower margin is wide and evenly rounded. The latter continues from the left end upward, about halfway along the inner lip, as a not too sharp circumumbilical keel. Above that, the boundary between the callosity and the ordinary shell surface is marked by a slight groove. There is no indication of an umbilical niche or resorption pit, nor does the only shell present, which is complete, permit any observation as to resorption of inner walls.

Growth striae run in a straight or nearly straight line obliquely backward all the way from the suture across the body whorl; only on the base do they somewhat increase their backward obliquity. They seem less closely set than in *Neritaria distincta*. No color markings can be seen.

The nucleus, though somewhat corroded, can be recognized to be obtusely conical and well centered.

REMARKS: The single specimen is almost complete and quite well preserved and moreover is the only neritid in the present assemblage with well-developed twin teeth on the inner lip. These facts seem to justify the establishment of a new species based solely on it.

Were it not for the presence of these "*Oncochilus*" teeth, the present specimen might well have been dealt with by way of appendix to *Neritaria distincta*, which it closely resembles in shell shape and other characters, as seen best by comparing the illustrations of that species' syntype A (pl. 10, figs. 61–63) with those of the present specimen. However, the latter is much more slender and has a considerably higher spire and the pleural angle is accordingly much less wide than in the former. Also the growth striation is less dense. These differences might warrant specific separation regardless of the twin teeth, but it seems somewhat difficult to acquiesce in generic separation of two forms so closely resembling each other.

On the other hand, this species differs widely in shell shape from *O. globulosus* (Klipstein, 1843, p. 196, pl. 13, fig. 13; Laube, 1868, p. 44, pl. 21, fig. 11; Kittl, 1892, p. 35, *cum synon.*, pl. 6, figs. 19–21), a species quite common at St. Cassian, designated genotype by Cossmann (1925, p. 193). The latter, as indicated by its name, is globular in shape, has a much lower spire and wider pleural angle, and shows no indication of the concavity of the apical whorl face so characteristic of *O. peruvianus*. Furthermore,

the twin teeth are much heavier in the St. Cassian species, as clearly seen in some topotypes in the Yale collection which I had the opportunity to compare.

OCCURRENCE: A single specimen in lot 70 (A.M.N.H. No. 27187).

LACUNIDAE

HETEROSPIRA KOKEN

Cossmann (1915, p. 97) refers *Lacuna karreri* Kittl (1892, p. 97, pl. 8, fig. 32) "probably" to Koken's (1897, p. 84) genus *Heterospira*, although Kittl's species shows no trace of that gradate profile of the earlier whorls which both Cossmann and Wenz (1939, p. 510) consider in their diagnoses a distinctive character of Koken's genus.

However, in the following species, believed to be related to *Lacuna karreri*, this character is recognizable, though at an early stage only, and it is therefore without reservation referred to the genus *Heterospira*.

Within the Peruvian material this genus occurs in lot 71 only.

Heterospira simulatrix, new species

Plate 11, figures 13–16

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26527:5	2.74 mm.	63½	34½	60°
27527:1 (holotype)	7.7	65½	31	69°
26527:3	*ca.* 8.4	*ca.* 68½	*ca.* 30	58°
26527:4	*ca.* 14.2	*ca.* 72½	?34	57°

In the table W can be seen to increase, and h (if the doubtful measurement of the largest specimen is omitted) to decrease, with growth. The pleural angle also tends to decrease, but only after a certain size is reached; the fact that the spire is somewhat pointed makes for more acute pleural angles at earlier stages. Thus if measured one volution higher than in the table, π amounts to 52 degrees only in specimen number 5 and to 62 degrees in the holotype.

DESCRIPTION: Shell consisting of from seven to eight whorls, turbiniform, with rounded, rather low base. Spire comparatively high, consisting even in the smallest shell measured of five whorls, and decidedly conical. When sufficiently enlarged, the two earliest whorls of the holotype appear to be gradate, with a marked angular shoulder separating the lateral faces from the apical ones. In the next two whorls an almost horizontal, narrow apical band is still recognizable, but the shoulder becomes more and more rounded. Similar observations were made in specimen number 5 and in some otherwise poorly preserved fragments. The later spiral whorls are only gently convex and separated from each other by moderately impressed sutures. The body whorl is not so high and clearly ventricose. The contrast between this ventricose body whorl and the slender, somewhat pointed spire causes the shape of mature shells to appear slightly convexo-concave. The aperture is broad, with its longer axis running obliquely towards the lower end of the shell. Its shape is well rounded on the whole, but somewhat angular not only at the upper (posterior) end but also at the lower one where it tends to form a nearly right, though rounded, angle. There is no anterior notch, but the inner lip projects freely all the way from the lowermost point of the aperture to its upper end where it is only slightly reflexed, leaving a narrow umbilicus open.

The only ornamentation found in this species is its distinct and characteristic growth striation (figs. 13, 15, 16). It is markedly regular and dense, there being about 80 rather lamellar striae on the body whorl of the holotype. They run slightly back from the suture, forming on the upper two-thirds of the body whorl a very shallow forward concave arc. The spiral whorls exhibit the upper part only of this arc. The growth striae of the body whorl continue, after a hardly perceptible change in direction, in a shallow, forward convex arc, or almost straight, towards the umbilicus. On the whole they run slightly backward.

EARLIEST ONTOGENETIC STAGES: The upper part of the spire of the smallest measured specimen (no. 5) seems to be inclined towards the axis of the shell, but since this spire is broken this appearance may be due to damage suffered by this shell rather than to alloiostrophy.

REMARKS: The course of the growth striae closely resembles that of *H. karreri* (Kittl), as seen in that author's drawing and described by him and further discussed by Cossmann

(1915, p. 102). Taking the similarity in shell shape also into account, the two species may well be considered congeneric, but they are specifically different. The spire of *H. simulatrix* is higher and more pointed, its body whorl lower, and the base and the aperture are slightly truncate, as compared with *H. karreri*. Also there is no trace of the revolving striation, mentioned in Kittl's description though not recognizable in his figures. On the other hand, in neither can any indication be found of angularity of the nuclear whorls, as observed in *H. simulatrix*.

Adult individuals of the present species resemble in shell shape so closely those of about the same size of *Omphaloptycha jaworskii* that this species would have gone unnoticed among the hundreds of shells of the latter species had not its characteristic growth striation attracted the writer's attention. This fact is alluded to in the specific name. On closer examination, however, well-preserved specimens of the two forms are readily distinguished. The growth striation is much more pronounced, more regular, and denser in *H. simulatrix*, and the growth striae run, on the whole, a little backward, whereas they run slightly forward in *Omphaloptycha jaworskii*. Furthermore, the spiral whorls increase somewhat more slowly in the present species; therefore, there is always one more present at the same size. The spire is higher and more decidedly conical; its whorls are less convex and the sutures less impressed. The body whorl is rather more ventricose than in *O. jaworskii* but somewhat truncate at its base, as compared with that species. This makes for a broader aspect of the aperture which also lacks the anterior notch and tends to become a little angular at the lower end also. Juveniles (e.g., specimen number 5), owing to the slenderness of their spires, resemble closely *Omphaloptycha*, new species, from which they otherwise differ in the same way as adults do from *O. jaworskii*. Finally, no color markings are ever found in the present species.

OCCURRENCE: Not so rare in lot 71 where it is represented by about 45 specimens, including fragments (A.N.M.H. No. 26527).

PURPURINIDAE

This family is represented in our material by a few specimens only which belong to two different subgenera or genera. Before their description can be attempted, some nomenclatorial confusion concerning the Triassic members of this family needs clarification.

As stated by Kittl (1899, p. 78, footnote 1), the generic names *Angularia* (and *Tretospira*) and *Pseudoscalites* were proposed simultaneously, the two former by Koken (1892a, p. 32), the last by Kittl (1892, p. 66). In his Esino paper Kittl (1899, p. 78) treated *Pseudoscalites* and *Angularia* (and, doubtfully, *Tretospira*) as synonyms. Of the two former names he gave his own *Pseudoscalites* preference over Koken's *Angularia*. If confusion in applying these names is to be avoided, these facts must be kept in mind, whenever *Angularia* and *Pseudoscalites* are considered to be subgenerically different, as they are by Cossmann (1909, pp. 3–5) and Wenz (1938, p. 525). Now, *Actaeonina armata* Stoppani (Kittl, 1899, p. 79, *cum synon.*, text figs. 18–20, pl. 11, figs. 1–12) certainly differs widely from *P. elegantissimus* (Klipstein MS) Kittl (1892, p. 66, pl. 6, figs. 11, 12), the type species (by monotypy) of *Pseudoscalites*, whereas it is not so dissimilar from *Turbo pleurotomarius* Münster (Kittl, 1892, p. 63, *cum synon.*, pl. 6, figs. 3–5), correctly referred by Cossmann (1909, p. 4) to *Angularia*. To this genus (or subgenus), not *Pseudoscalites*, *Actaeonina armata* Stoppani should be referred. Cossmann's (1909, p. 5) reference to *Pseudoscalites* cannot be maintained.[1]

Jaworski (1923, p. 143, pl. 5, figs. 17, 18), when considering a form he described from Suta in northern Peru closely related to Stopanni's Esino species, fell victim to the same error as had Cossmann. Thus he named his Peruvian form "*Pseudoscalites*" *subarmatus*, although the correct name for the European genus to which he compared it is *Angularia*. This name therefore should also have been applied to the species from Suta. In my opinion, however, for the reasons given

[1] As in other cases, Wenz (1938, p. 526) seems to follow this error of Cossmann's. His inclusion of the Ladinian in the stratigraphic range of *Pseudoscalites* and his mention of "few species" seem to indicate that Wenz, too, incorrectly includes *armatus* in *Pseudoscalites* rather than in *Angularia*.

below, the latter is not only specifically but generically different from *Angularia armata*. A new generic name, *Andangularia*, is therefore proposed for Jaworski's species and for a few specimens in the present material that are closely related, if not conspecific.

Both *Andangularia* and *Pseudoscalites* are here granted generic rank, whereas both Cossmann and Wenz (*loc. cit.*) treat *Pseudoscalites* merely as a subgenus of *Angularia*.[1]

For completeness it should be mentioned that true members of the genus *Angularia* occur in the Americas. "*Brachycerithium*" *ferruglioi* Bonarelli (1927, p. 112, pl. 6, figs. 10–13) is a close relative of *A. armata* from the Esino limestones (compare Bonarelli's figs. 11 and 13 with Kittl's pl. 11) and undoubtedly belongs to *Angularia*, as does a very similar, if not conspecific, form which is so common in a hitherto unpublished, supposedly late Triassic fauna from near Lewiston, Idaho, that it may well be considered its index gastropod. I wish to add that neither these forms nor those here included in *Andangularia* could possibly be referred to *Gonioconcha* Bonarelli, which Cossmann (1925a, p. 205) states to be intermediate between *Angularia* and *Pseudoscalites* but which, according to Bonarelli's (1927, p. 100) generic diagnosis, has no transverse ornamentation.

A slight resemblance between some members of this family, especially of the genus *Angularia*, and the new acteonid genus *Consobrinella* is discussed under the latter genus.

ANDANGULARIA,[2] NEW GENUS

DIAGNOSIS: Resembling *Angularia*, but with higher, turreted spire and smaller body whorl and horizontal rather than sloping apical bands; aperture ending in a distinct canal; transverse ornamentation predominant over revolving one.

TYPE SPECIES: *Pseudoscalites subarmatus* Jaworski (1923, p. 143, pl. 5, figs. 17, 18).

DISCUSSION: The differences between this genus and *Angularia* Koken, as given in the above diagnosis, are believed to justify its separation from Koken's genus. By the dominance of transverse sculptural elements (revolving ones, if recognizable, are inconspicuous) it differs more from *Pseudoscalites* Kittl than from *Angularia*.

[1] The former author, precisely speaking, only as a "section" of the subgenus *Angularia, sensu stricto*.

[2] Combined from Andes and *Angularia*.

Andangularia aff. **Andangulariae subarmatae** (Jaworski)

Plate 11, figures 21–23, 25, 33–35

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27682	4.23 mm.	43	37½	38°
(From Suta)	*ca.* 6.27	*ca.* 45	*ca.* 41	42°
27682/1	*ca.* 8.12	*ca.* 41	*ca.* 47	36°

Comparison of the measurements of the two specimens from the Cerro de Pasco region shows the usual decrease of W and π, and increase of h, with growth. The specimen from Suta fits in fairly well as far as the height of the spire is concerned, but it is stouter and accordingly exhibits a wider pleural angle than even the smaller of the other two.

DESCRIPTION: Seven or eight volutions, including the embryonic, can be counted in specimen A.M.N.H. No. 27682, and two more in A.M.N.H. No. 27682/1. Spire turreted, spiral whorls amost cylindrical in shape, as is the body whorl above the peripheral shoulder, which is pronounced, though rounded, and separates its lateral face from the decidedly concave base. On the other hand, a sharp shoulder keel, further accentuated by the strong and prominent tubercles formed there by the transverse ribs, separates the vertical lateral whorl faces from horizontal apical bands which develop on only the sixth or seventh volution and are at first narrow but considerably increase in width in the two last volutions of the largest specimen (A.M.N.H. No. 27682/1). The outline of the aperture can well be seen in specimen A.M.N.H. No. 27682 (fig. 22), but since it is here partly filled with matrix, it can be better studied in the specimen from Suta (fig. 35). The aperture is roughly obliquely elliptical in shape and ends anteriorly in a rather long canal which points to the left. The outer lip reproduces the profile of the body whorl; the inner one is clearly reflexed in its lower half, but the fine groove thus produced between it and the columella can-

not be called an umbilical slit, as it is situated considerably below the umbilical region. To judge by its border, the columella seems to be corkscrew-shaped.

The ornamentation is dominated by strong transverse ribs which run across the lateral faces of both spiral and body whorls. On the latter, they end rather abruptly at the peripheral shoulder. In the largest shell present they appear on the fourth whorl. They are straight and their direction is perpendicular, later slightly backward oblique. Only two or three ribs on the anteriormost part of the penultimate whorl of specimen A.M.N.H. No. 27682/1 are less prominent than the others and form forward concave arcs. Ten such ribs are present on the last two volutions of specimens A.M.N.H. Nos. 27682 and 27682/1, 12 or 13 on those of the Suta specimen, but 15 on the fragment A.M.N.H. No. 27682/2 only doubtfully referred to this form. These ribs culminate in heavy tubercles marking the upper shoulders of the whorls and, becoming more and more prominent with growth. When fully developed, as in specimen A.M.N.H. No. 27682/1, they project outward and slightly upward (figs. 23, 25). No growth striae or folds are observable in the few specimens here under study, but revolving ornamentation is present. In the smallest measured shell (A.M.N.H. No. 27682) only a faint indication of such striae, separated by bands from three to four times their width, can be recognized on the body whorl, but in the Suta specimen, in addition, are two fine but quite distinct revolving keels immediately below the peripheral shoulder and three other faint ones around the lower end of the columella. Four or five revolving keels can be counted on the base of the penultimate whorl of specimen A.M.N.H. No. 27682/1. Furthermore, on the three last preserved volutions of this specimen as well a on the body whorl of that from Suta a second revolving keel can be seen immediately beneath the shoulder keel, from which it is separated by a narrow groove. This groove is at first visible only in the intercostals but on the ribs it is overgrown, as it were by the tubercles. In the latest stages observable in both afore-mentioned specimens, however, these grooves continue across the ribs, and in crossing the costae the lower keel produces minor tubercles of its own beneath those of the shoulder.

EARLIEST ONTOGENETIC STAGES: Of the few specimens here dealt with only the smallest (A.M.N.H. No. 27682) has the embryonic volutions preserved (figs. 21, 22). They are inclined towards the main axis of the conch and show the alloiostrophy which is much better observable in some specimens from Suta, referable without any doubt to *A. subarmata*.

REMARKS: This form, although undoubtedly closely related to the type species with which it is associated at Suta, clearly differs in several respects from Jaworski's specimens as well as from those in Kummel's collection which fully agree with Jaworski's. In the form here dealt with the costation is somewhat less dense and the ribs are more robust and persist even on the body whorl down to the peripheral shoulder in undiminished strength, whereas in the typical *A. subarmata* they diminish on the later whorls downward in strength until on the body whorl they are reduced to transversely elongated, somewhat hook-like tubercles clinging to the upper shoulder. Where they continue down the lateral whorl face, they assume the shape of indistinct growth folds and can no longer be termed true ribs. Revolving ornamentation, of which Jaworski (1923, p. 143) could observe only traces in a single specimen, is well recognizable in some of the examined specimens of the typical *A. subarmata* from Suta, especially on the base, and there are the same twin keels immediately below the peripheral shoulder and the same duplication of the upper shoulder keel and of its tubercles on the latest volutions as reported in the above description. Whether or not the differences in ornamentation warrant specific separation of the form here dealt with from the typical *A. subarmata* can be decided only after a thorough examination of the very numerous specimens of the present genus in Kummel's collection from Suta. It is hoped to carry out that examination in the not too distant future, but at the time of writing it cannot be started since only a part of the material has been chemically prepared. It has already yielded several hundred specimens referable to *Andangularia*. In the meantime the above taxonomic designation is

considered the best provisional solution. Should this form be specifically different, the new species should be based on, and its types selected from, the material from Suta, which is more than a hundred times richer than that from the Cerro de Pasco region, which consists of only two or three specimens, none complete.

It seems very doubtful that the small specimen believed by Cox (1949, p. 43, pl. 2, fig. 19) to be a juvenile of *A. subarmata*, but tentatively referred by him to the genus *Omphaloptycha*, has anything to do with Jaworski's species, and it seems not even to be an *Omphaloptycha*.

The similarity between the present genus and in particular its form here dealt with and the genus *Rhabdocolpus* (below, pp. 230 ff.) is striking indeed. Both genera have the general character of costation in common and especially the tubercles formed by the ribs on the upper shoulder and their abrupt ending at the lower one. The general shell shapes are not essentially different. There are the same horizontal and rather narrow apical bands, the apertures are not so dissimilar, and there are anterior notches or canals and reflexed inner lips in both genera. On the other hand, there are quite remarkable differences which make distinction easy. Costation is less dense in *Rhabdocolpus* and even in the latest ontogenetic stages does not withdraw to the upper part of the lateral whorl face. The ribs as such are higher and sharper than in *Andangularia*, and their upper tubercles not so heavy and broad. There are distinct, thread-like, revolving keels on the lateral whorl faces, where there is only a faint striation in *Andangularia*, but there are, on the other hand, no more revolving keels on the base beyond the twin keels on, and immediately below, the peripheral shoulder. The spire is higher, and the body whorl lower and more slender than in the present genus, and the anterior canal is longer and narrower. Thus it is believed that *Rhabdocolpus* and *Andangularia* can well be kept separate generically. It is hardly a mere coincidence that the two are nowhere associated in the Peruvian material under study, the former genus occurring in lots 26, 48, 86 (and scantily also in lots 57, 76, and 87) but the latter only in lots 24, 96, and possibly 34.

It is difficult to decide if the striking similarities between these two genera represent merely a case of convergence or if they indicate some phyletic relationship. Should the latter be the case, then *Rhabdocolpus* as the younger genus, hitherto believed to appear only in the Liassic, would have to be derived from *Andangularia*, previously recorded from the Upper Triassic only. As is shown below (pp. 304 ff.), there may be some reason to assign a somewhat older age to lots 24 and 96 than to lots 48 and 86, even within the present material. Such a derivation could, however, be only tentative. Should it be corroborated by future studies, it would certainly upset the taxonomy of the Procerithiidae, unless one could acquiesce in assuming a polyphyletic origin of that family.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
24	27682	1
96	27682/1	1
34	27682/2	1 (doubtful fragment)
Total		3

PSEUDOSCALITES KITTL

This genus, as restricted according to what has been said under the family Purpurinidae, is characterized by its sharp shoulder keel, the concavity of both apical and lateral whorl faces above and beneath it, and the predominance of the revolving over the transverse ornamentation.

As restricted, it seems hitherto to be represented by only its type species, *P. elegantissimus*. Another species occurs in Peru.

Pseudoscalites, new species

Plate 11, figures 30, 32; plate 12, figures 5–7

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27683:1	*ca.* 2.24 mm.	*ca.* 65	*ca.* 30	77°
27683:2	*ca.* 2.86[1]	*ca.* 61	*ca.* 35½	73°

Even this extremely small sample shows the usual decrease of W and π, and increase of h, with growth.

DESCRIPTION: The larger specimen (no.

[1] Measured at last apertural profile. Full height, as preserved, 3.98 mm.

2) consists of six or seven volutions, including the embryonic ones. Shell shape biconical, spire turreted. The whorl profile culminates in a strong, sharply projecting keel which in the spiral volutions is situated only slightly above the middle. The apical band slopes at an angle of 30 degrees or less towards this keel; it is gently concave. The lateral whorl face, which is also slightly concave beneath this keel, slopes steeply inward towards the suture. In the body whorl that part of the lateral face which is beneath the last suture first continues at about the same angle; then it changes, without any boundary, into the base which is inverted conical and gently concave. The columella is strongly twisted in corkscrew fashion. In specimen number 2 there is a deep, groove-like, umbilical niche, but in the smaller one there seems to be even an open umbilicus; this appearance might, however, be merely the only part of the aperture that shows, the rest of it being filled with matrix. The outer lip follows the triangular whorl profile; the inner one is sinuous and clearly reflexed over the umbilical niche. At its lower end the aperture narrows to a rather long canal which points obliquely downward to the left (pl. 11, fig. 32; pl. 12, fig. 6).

Below the strong middle keel there follow two minor revolving keels; the lower one, visible on the body whorl only, continues the line of the last suture; the upper is halfway between the lower one and the main keel. In addition, there is a fine revolving striation just recognizable on the apical band of the body whorl of specimen 2. Fine growth striae run obliquely backward on the apical band, obliquely forward on the lateral whorl face; in between, they make a rather sharp turn on the main keel on which minute beads are thus produced (pl. 12, fig. 6).

EARLIEST ONTOGENETIC STAGES: The embryonic volutions of the larger specimen (no. 2) appear to be alloiostrophic.

REMARKS: From the type species, *P. elegantissimus*, this one differs by its more slender shell shape, much smaller size, more twisted columella, longer and narrower canal, lack of transverse folds above and below the main keel, which instead carries only minute beads, and absence of a revolving ornamentation from the base. On the other hand, its two well-defined minor keels beneath the main keel cannot be recognized as such in Kittl's drawings of the type species.

There is a certain resemblance in the shape of shell and aperture between this form and *Promathilda* (*Teretrina*) *eucycloides* and this form and *Cylindrobullina* (*?Cylindrobullina*) aff. *pyrulaeformi;* for detailed comparisons, see the discussions of these other forms.

OCCURRENCE: Very rare (two specimens) in lot 26 (A.M.N.H. No. 27683).

MATHILDIDAE[1]

This family is by far the most abundant in the material under study, but it is represented by only one genus.

PROMATHILDA[2] ANDREAE, SENSU LATO

This genus is here conceived in the circumference given it by Koken (1889, pp. 458–460), Kittl (1894, p. 215), Cossmann (1912, pp. 3–8), and Wenz (1939, p. 660), which includes the more diversified Triassic forms in addition to the Jurassic ones originally intended by Andreae to be comprised in this genus. Accordingly the alloiostrophy of the nucelus and the course of the growth striae which form a wide, forward concave angle culminating on the upper lateral main keel are considered, along with others, distinctive characters of this genus. This course of the growth striae distinguishes it from the younger genus *Mathilda* in which the striae are straight (see Cossmann, 1912, p. 3).

The short and somewhat truncate base and comparatively small body whorl, as shown by *P. biserta* (Münster), designated by Cossmann (1912, p. 4) the type species, and other St. Cassian species [*P. bolina* (Münster)] should, however, not be considered generic

[1] Since Semper (1865) named the type genus of this family *Mathilda* (a spelling incorrectly censored and changed to *Mathildia* by Cossmann, 1912, p. 8, footnote 1), the correct spelling of the family name is Mathildidae as in Wenz (1939, p. 660), not Mathildiidae as in Cossmann (1912, p. 2).

[2] Andreae (1887, p. 23) tentatively, almost diffidently, proposed the name *Promathildia* for the Jurassic precursors of the younger genus *Mathilda* Semper, which he also then misspelled *Mathildia*. However, since he clearly intended to combine the preposition *pro* with Semper's generic name, *Promathildia* is merely an error in transliteration and should therefore be corrected to *Promathilda*, as it was by Zittel-Eastman (1896, p. 457; 1913, p. 537) and Wenz (1939, p. 660).

characters of *Promathilda, sensu lato.* In some Liassic species, e.g., *P. dunkeri* Terquem (see von Bistram, 1903, p. 64, pl. 5, figs. 3–8) and *P. terquemi* (*ibid.*, p. 68, pl. 5, figs. 9–11), and in some younger Jurassic ones, e.g., *P. binaria* (Hébert and Eudes-Deslongchamps, see Andreae, 1887, p. 23, pl. 1c, figs. 1–3),[1] the bases become quite high and the body whorls quite large. If the forms referred below to the subgenus *Clathrobaculus* are not considered, in these characters the Peruvian forms resemble in varying degrees those Jurassic species rather more closely than those from St. Cassian. This is one reason why the late Triassic gastropod fauna from Peru seems to be younger than it actually is. But in many of the St. Cassian forms (Kittl, pls. 9 and 10) the lowermost parts of the apertures are missing, thus deceptively creating the impression of even shorter bases and lower body whorls. On the other hand, in many of the Peruvian specimens only the columella of the missing last volution is preserved, thus causing the bases to seem higher, and the apparent body whorls (which are actually the penultimate whorls) to seem larger than they really are.

These characters, namely, the high bases and comparatively large body whorls, produce a remarkable similarity between some Peruvian *Promathilda* species [*P.* (*Teretrina*) *obtusa* and *P.* (*T.*) *eucycloides*] and some forms of the genus *Eucyclus*, best exemplified by *E. ornatus abbas* (Hudleston, 1892, p. 280, pl. 21, figs. 16–18, pl. 22, fig. 1). This similarity made Cox (1949, p. 38, pl. 2, fig. 16) mistake his single *Promathilda*[2] for a *Eucyclus*. However, the characters mentioned above among those distinctive of the present genus serve also to distinguish it from *Eucyclus*. In *Eucyclus* no alloiostrophy of the nucleus has been recorded,[3] as far as I could ascertain, whereas the nucleus is clearly alloiostrophic in the *Promathilda* species that resemble *Eucyclus* as well as in those that do not. Furthermore, the growth striae run in *Eucyclus* obliquely backward from the upper suture to the shoulder, then perpendicularly across the band bordered by the two lateral main keels, and then resume their obliquely backward course. This pattern can be seen in some of Koken's drawings of Upper Triassic *Eucyclus* species (1897, pl. 19, fig. 15b; pl. 20, figs. 2–4) better than in Hudleston's illustrations. The pattern is essentially different from that prevailing in the *Promathilda* species with large body whorl here under discussion as well as in other species of *Promathilda*.

Three groups can be distinguished among the manifold forms of this genus occurring in the Cerro de Pasco and Tilarnioc regions of central Peru. In the first the transverse ornamentation, consisting of single growth lamellae (*P. alia*) or bundles of growth striae (*P. subnodosoides*, *P.* cf. *perarmata*), becomes marked enough to produce distinct beads or even coarse nodes on the revolving keels, thus creating a lattice-like pattern. The species of this group, which most closely resemble the type species *P. biserta* (Münster), are here referred to Cossmann's (1912, p. 3) section *Promathilda, sensu stricto.* In the second group, far outnumbering the two others, the revolving keels decidedly dominate the ornamentation, with the transverse one restricted to fine growth striae or single growth lamellae which only occasionally produce small beads on the keels they cross. This group is referred to Cossmann's section *Teretrina.* Finally, a comparatively few specimens exhibit the characters distinctive of Cossmann's section *Clathrobaculus.* A species differing from all others by having more revolving keels and a gently convex whorl profile [*P.* (*?C.*) *gracillima*] is, though doubtfully, also referred to *Clathrobaculus.*

The differences between the first two groups can hardly be granted subgeneric rank, as some of the species of each group so closely resemble one another that the reference of individual specimens is sometimes quite difficult. Cossmann (1912, p. 6) himself was fully aware that the differences were slight, particularly between *Promathilda, sensu stricto*, and *Teretrina*, and justified the proposal of *Teretrina* by stating that it is more expedient to use a sectional name than the cicumlocution "Group of *P. bolina*," as

[1] The form that inspired Andreae to propose the generic name *Promathilda.*

[2] As compared to about 5800 dealt with here.

[3] Hudleston (1892, p. 280) says in his description of *E. ornatus abbas* merely that ". . . although the spire is pointed on the whole, yet the apex is obtuse." No indication of alloiostrophy is found in any of his excellent illustrations.

used by Kittl (1894, p. 216). He therefore granted only sectional, not subgeneric, rank to both those groups and to *Clathrobaculus*, which seems, however, better defined. Since no infrageneric units other than subgenera are used in the present report, all three of Cossmann's sectional names are here treated as if they were subgeneric, largely to facilitate the grouping of our immense material of *Promathildae*.

With regard to the slight differences and the many borderline cases between *Promathilda, sensu stricto*, and *Teretrina*, about 770 specimens in lots 86, 48, 53, 70, 71, 78, and 45 of which the preservation did not permit specific determination have been labeled merely "*Promathilda* (*s. l.*) ssp. indet." (A.M.N.H. Nos. 27169, 26169/1, 27169/2, 27169/3, 27169/4, 27169/5, 27169/6).

Including the specimens left specifically undetermined the total number of individuals examined is 5800. More than three-quarters are concentrated in lot 86; about one-eighth come from lot 48. None of the other eight lots in which this genus is represented has as many as 50 individuals. *Promathilda* is thus by far the most abundant genus in the fauna.

Subgenus **PROMATHILDA**, sensu stricto

Within *Promathilda, sensu lato*, the "ornamentation subgranuleuse" is, as by Cossmann (1912, p. 3), considered distinctive of this section.

The first of the three following forms (*P. subnodosoides*), closely resembling the St. Cassian species *P. subnodosa* (Münster), is certainly a very characteristic member of this group, as is the third, which is closely comparable to another St. Cassian species, *P. perarmata* (Münster). The second of these three species (*P. alia*) is somewhat transitional to the following section *Teretrina*, since its revolving keels are much more pronounced than the transverse ornamentation which consists merely of single growth lamellae. Since, however, in maturity the last-named form has well-developed beads on the two lateral main keels, the ornamentation may still be considered a "subgranulose" one, so this species is also here included.

With a total of about 275 individuals, this section is much less abundant than *Teretrina*, though considerably more so than *Clathrobaculus*.

Promathilda (Promathilda) subnodosoides, new species

Plate 12, figures 1–4, 8–16, 18–20, 22, 23, 37

Dimensions

A.M.N.H. Nos.	H	W	h	π
27155:1	1.91 mm.	53	44	42°
27155:49	1.96	48½	43	39°
27155:2	2.02	50	40	42°
27155:3	*ca.* 2.13	*ca.* 51½	*ca.* 44½	46°
27155:4	2.24	48	40	42½°
27155:5	*ca.* 2.41	*ca.* 49	*ca.* 46½	41½°
27155:6	2.46	*ca.* 48½	42	42°
27155:7	2.46	47½	38½	42°
27155:13	2.69	47	43½	35½°
27155:8	2.80	46	42	37½°
27155:9	2.80	46	40	43°
27155:14	2.86	48	47	35°
27155:16	2.86	44	43	36°
27155:17	2.86	49	47½	41°
27155:12	2.91	48	46	41°
27155:11	2.91	48	48	38½°
27155:15	2.91	49	44	46°
27155:18	*ca.* 3.15	*ca.* 47½	*ca.* 37	47½°
27155:19	*ca.* 3.15	*ca.* 50	*ca.* 47½	40°
27155:20	3.15	47½	42	38°
27155:21	3.21	44	46½	37°
27155:22 (syntype A)	3.40	46½	53½	40°
27155:24	3.40	47½	50	39°
27155:23	3.57	42	44	39°
27155:25	3.57	51	43	41½°
27155:27	3.73	46½	46½	37°
27155:29	3.73	50	44½	41°
27155:26	*ca.* 3.82	*ca.* 41½	*ca.* 50	37½°
27155:28	3.82	45½	48	41°
27155:32	*ca.* 3.90	*ca.* 51	*ca.* 42½	44°
27155:30	*ca.* 4.07	*ca.* 47	*ca.* 47	36½°
27155:33	4.07	45	41	38°
27155:31	*ca.* 4.15	*ca.* 45	*ca.* 44	35½°
27155:50	4.49	38½	55	34°
27155:34	*ca.* 4.67	*ca.* 44½	*ca.* 44½	35°
27155:35	*ca.* 5.41	*ca.* 45½	*ca.* 47½	33½°
27155:36	5.53	44½	51	34°
27155:37	5.66	43½	51	32°
27155:38	5.66	48	48	38½°
27155:39	5.78	40½	47	36°
27155:51	6.15	36	56	31°
27155:52 (syntype B)	6.76	40	52½	31°
27155:40	7.38	38½	55	29°
27155:41	7.63	42	51½	33°
27155:42	7.99	37	54	28°
27155:43	7.99	38½	55½	30½°
27155:44 (syntype C)	9.35	39½	51½	28°
27155:46	10.45	*ca.* 34½	56½	*ca.* 25°

In this species, as in the genus *Promathilda* in general, the growth trends prevail-

ing in most gastropod groups with turritellid shell shape are recognizable: W and π tend to decrease, and h tends to increase, with growth. In this species these trends are, however, again and again arrested until a late ontogenetic stage is reached. Thus W varies between $48\frac{1}{2}$ and 53 in the four smallest shells measured; then it continues gradually to decrease, but values as high as 50 and 51 are still found between the sizes of 3 and 4 mm. Only above a total height of 6 mm. does W, with a single exception (no. 41), definitely fall to or below 40, reaching the minimum of *ca.* $34\frac{1}{2}$ in the largest paratype measured. A similar development, although in the inverse sense, can be followed in the values for h, which go beyond 50 for the first time at a total height of 3.4 mm., then again at about $4\frac{1}{2}$ mm., but keep permanently above that mark only after a size of 6 mm. is surpassed; the maximum of $56\frac{1}{2}$ is attained in the aforementioned largest paratype. Similarly, pleural angles about as wide as in the smallest group measured (nos. 1–7) occur still at sizes between $3\frac{1}{2}$ mm. and 4 mm. (and an even wider one in no. 18, which is *ca.* 3.15 mm. high); only beyond the size of 4 mm. π falls definitely below 40 degrees, finally attaining a minimum of 25 degrees in the largest paratype. Particularly with regard to the values of h, π, or both, paratypes numbers 13, 14, 50, and 51 and syntype B can be considered examples of accelerated development, and paratype number 18 an example of retarded development.

SELECTION OF TYPES: A rather small shell with characteristic nucleus (no. 22), a medium-sized one representing the slender type within this species and with less coarse transverse ornamentation (no. 52), both excellently preserved, and one of the largest shells present, which shows the coarse mature ornamentation best (no. 44), are designated syntypes A, B, and C, respectively.

DESCRIPTION: Shell shape turritellid, becoming somewhat subulate in the latest stages present. Whorl profile decidedly angular, with the point of maximum width accentuated by the main keel which is at the middle of the whorl height or slightly below. The sloping apical band above this keel is distinctly concave. Sutures deeply channeled between the supersutural and subsutural keels of the whorls which they separate from each other. The base is rather short and slightly concave. Aperture suboval, with a posterior angulation and a shallow anterior notch which projects as a short beak. Inner lip reflexed over the straight columella, which runs vertically downward, and accompanied by a shallow umbilical niche.

The revolving ornamentation is dominated by the afore-mentioned middle keel which is by far the strongest. The subsutural one, which becomes distinct only at a comparatively late stage, is considerably weaker, and the supersutural keel is about intermediate in strength between middle and upper keels. The distance between these two is only somewhat greater than that between the middle keel and the supersutural one in syntype B, but nearly twice as great in syntype C. Only in the latest stages observable does a fourth keel show as a thin thread above the suture, but it is quite pronounced and nearly equals the third ("supersutural") in strength on the body whorl, where it is accompanied on the inside by a fifth keel which is only slightly weaker than the fourth. On the base of syntype C (fig. 12) there is one more, rather faint revolving ridge at about the inner third of the distance between that fifth keel and the center, whereas one and two more, the innermost of which narrowly encircles the umbilical niche, are just perceptible in paratypes 46 and 40 (fig. 18), respectively. Thus, if those two innermost be included, up to five revolving elements can be counted on the base beneath and inside the supersutural keel.

The transverse ornamentation consists of closely set growth striae or lamellae which form a wide, forward, open angle culminating on the middle keel. They begin to form bundles at an early stage and then produce first small beads, then more and more distinct nodes on the keels they cross, chiefly on the main keel. The first indication of such nodes on the middle keel is observable in paratype number 16, at a height of the shell of a little more than 2 mm., but on the body whorls of this specimen as well as of paratype number 17 the subsutural keels can also be recognized to be beaded (figs. 13, 16). Syntype A (figs. 9, 11) represents about the same ornamentational stage. It is worth noting that in some

shells (e.g., paratype number 38; fig. 4), the individual growth striae remain recognizable within the bundles. In some shells, best represented by syntype B (figs. 19, 20, 37), these growth lamellae and the bundles of them remain comparatively delicate and produce just beads and irregular minor nodes on the keels they cross. In others, such as syntype C or paratype number 31 (figs. 1–3, 23), however, these bundles gradually assume the aspect of coarse, sometimes quite prominent folds which lend a lattice pattern to the ornamentation and produce strong tubercles where crossing the keels, the strongest on the middle keel and somewhat less strong ones on the supersutural keel. However, these tubercles do not, as a rule, extend in the spiral sense beyond the width of the growth folds which produce them (paratype no. 31, syntype C, paratype no. 46; figs. 23, 1–3, 22). The fragment no. 45 is illustrated in figure 15 to show its particularly coarse and sharp, almost spine-like tubercles. The growth folds and correspondingly the tubercles are rather irregularly spaced. Sometimes they crowd together, sometimes stand at greater distances from each other; some split in two, thus forming twin folds. Thus counts of these folds and tubercles yield varying results. Seventeen or 18 can be counted on the body whorl of syntype B, but only 12 or 13 on that of paratype number 31, although it is larger, about as many on the penultimate volution of syntype C, and not more than 15 (including a twin fold) on its body whorl. The largest paratype (no. 46) shows about the same density of transverse ornamentation as syntype C. In other shells, such as syntype B, the growth folds are not pronounced enough to be properly counted.

EARLIEST ONTOGENETIC STAGES: The alloiostrophy of the nucleus, characteristic of this genus, is well observable in a considerable number of shells, best in syntypes A and B (figs. 9, 11, 37) and in paratypes numbers 43, 47, and 48. The nuclear volutions are rounded and smooth, but the first postnuclear volution shows an indication of the middle keel and assumes the angular profile of this species. Soon the supersutural keel appears, too, but only considerably later the subsutural one. First indications of growth striae are found on the second or third postnuclear whorl.

REMARKS: This species has many of its characteristic features in common with *P. subnodosa* (Münster) (Kittl, 1894, p. 224, *cum synon.*, pl. 8, figs. 36–45)[1] but it cannot be considered fully conspecific with the St. Cassian species. As seen form Kittl's discussion of that species and confirmed by the examination of 12 topotypes in the Yale collections, *P. subnodosa* is extremely variable. Among its various "form varieties," distinguished by Kittl (*loc. cit.*), his typical form, as represented by Münster's (1841, p. 124, pl. 13, fig. 51) holotype and by the specimen figured under the name *Cerithium bolinum* by Laube (1869, pl. 29, fig. 5) and refigured by Kittl (*ibid.*, fig. 41), clearly differs from the Peruvian species by its more convex whorls and accordingly more deeply indented shell profile, the lack of strong growth folds on the apical whorl faces, smaller number and more pronounced spiral elongation of its tubercles, and distinct outward curvature of its apertural canal. The last difference serves to distinguish from the Peruvian form even that figured by Laube (1869, pl. 29, fig. 10) as *Cerithium brandis*, but included in *P. subnodosa* by Kittl, which otherwise resembles it most closely. Further though less important differences might be mentioned: Kittl's typical shells (figs. 38–41) do not show such a distinct subsutural keel as the Peruvian ones; also, many of the examined topotypes of *P. subnodosa* show two keels between the middle keel and the suture even in the spiral whorls. Considering all these facts, the present form is here dealt with as an independent species, but its close relationship to Münster's species is alluded to in the name.

From other *Promathilda* species of the St. Cassian fauna, among them the type species *P. biserta* (Münster) (see Kittl, 1894, p. 220, pl. 9, figs. 18–23), *P. subnodosoides* can be distinguished in a similar way as the true *P. subnodosa*; for the respective differences, see Kittl (1894).

For further comparisons see pages 190 and 195.

The resemblance of *P. subnodosoides* to *Trypanocochlea*, new species, which is repre-

[1] A. *P.* cf. *subnodosa* was recorded recently from the Rhaetian of western Lombardy (northern Italy) by Chiesa (1949, p. 32).

sented by a single incomplete shell in the same lot, is merely superficial. The latter form exhibits a somewhat similar whorl profile, but its middle keel, much thicker than that of *P. subnodosoides*, is a slit band keel and even at a much greater size lacks the coarse tuberculation characteristic of the present species.

OCCURRENCE: Common only in lot 48 where it is represented by 208 surely identifiable shells and fragments (A.M.N.H. No. 27155). More may be among the *Promathildae* of lot 48 that were necessarily not determined specifically.

Promathilda (Promathilda) alia, new species

Plate 12, figures 17, 21, 24, 26, 27, 31–34

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27156/1:1	1.57 mm.	53½	39½	41°
27156/1:2	2.13	52½	45	42°
27156/1:3	2.24	45	42½	37°
27156:1	*ca.* 2.24	*ca.* 61	*ca.* 42½	42½°
27156/1:4	*ca.* 2.30	*ca.* 53½	*ca.* 39	44°
27156/1:5	2.30	46½	44	32°
27156/1:6	*ca.* 2.35	*ca.* 54½	*ca.* 40½	38°
27156/1:7	2.58	52	41½	37°
27156/1:8	2.69	50	41½	39½°
27156/1:9	3.07	50	*ca.* 40½	41°
27156/1:10	*ca.* 3.14	*ca.* 56	*ca.* 44½	43½°
27156/1:11	*ca.* 3.25	*ca.* 47½	*ca.* 48½	34°
27156/1:12	3.32	46	42½	36°
27156/1:13	3.40	50	51	41°
27156/1:14	3.40	51	41½	44°
27156:2	3.64	53	38½	42½°
27156/1:15	*ca.* 3.82	*ca.* 45½	*ca.* 50	33½°
27156/1:16	3.82	50	45½	38°
27156/1:17	4.55	43	47½	33½°
27156/1:18	4.91	41	47½	33°
27156/1:19	5.29	45	47½	34½°
27156:3	*ca.* 5.41	*ca.* 52½	*ca.* 38½	37°
27156/1:20	6.15	42	48	30°
27156:4 (holotype)	6.76	42½	47½	30°
27156:5	7.99	43	49	29½°
27156:6	*ca.* 10.45	*ca.* 46[1]	*ca.* 41	28°[1]
27156:7[2]	*ca.* 11.19	*ca.* 36½	*ca.* 47	25°
27156:8	*ca.* 13.78	*ca.* 36½	*ca.* 47½	18°

The largest specimen measured does not fully indicate the size attained by this species. The incomplete shell A.M.N.H. No. 27156:9 when complete must have reached a height of about 17 mm.

The general trends prevailing in this genus of the width of the conch and the pleural angle to decrease, and the height of the spire to increase, with growth are also present in this species, but except for a few individuals with acclerated development (A.M.N.H. Nos. 27156/1:3, 27156/1:5, 27156/1:12, 27156/1:15, and 27156/1:19) they gain momentum only at a comparatively late stage. Only above the size of about 4½ mm. is there a decisive decrease in W and π, whereas h reaches its maximum at an earlier stage (A.M.N.H. No. 27156/1:13, H=3.4 mm.). As a further characteristic of the development of this species the contrast between the rather stout young shells (e.g., A.M.N.H. No. 27156/1:10; figs. 17) and the slender mature ones (e.g., A.M.N.H. No. 27156:8; fig. 34) should be noted. Whereas h may amount to three-quarters (rarely only two-thirds) of W in the earliest stages, the inverse ratio develops in maturity.

SELECTION OF TYPES: The medium-sized shell A.M.N.H. No. 27156:4 is so well preserved and exhibits the distinctive features of the species so clearly that it is designated holotype.

DESCRIPTION: *Promathilda* (*P.*) *alia* is closely related to *P. subnodosoides*, but, as is indicated in the name, is not conspecific. Although *P. alia* resembles *P. subnodosoides* in shell shape, it does not become equally high-spired, even at a markedly larger size, so that the shells do not appear quite so slender. Nor do the middle zones of the whorls project so far; this makes for a less angular and therefore somewhat less indented shell profile. The inner lip is slightly reflexed in its lower part only, and the umbilical niche is narrow and inconspicuous.

The most noticeable difference from *P. subnodosoides*, however, is in the arrangement and relative strength of the revolving keels. The subsutural keel develops at a much earlier stage and is, in later ones, more distinct. The second keel, in this species also, is situated at about the middle of the whorl height, precisely speaking somewhat above it in medium-sized shells, as in the holotype (figs. 26, 27), and somewhat below it in large ones, as in paratypes A.M.N.H. Nos. 27156:8 and 27156:9 (figs. 34, 21). However, what makes the character of ornamentation differ most widely from that of the preceding

[1] Crushed.
[2] Slightly crippled.

species and influences the whorl profile most is the fact that the third ("supersutural") keel throughout development is equally strong and projects equally as far as the middle one. Thus, whereas the whorl profile is essentially triangular, with the middle keel marking the vertex of the triangle, in *P. subnodosoides*, the whorls of the present species may rather be said to consist of a steeply conical apical band above the middle keel and a more or less cylindrical one beneath it. Both these bands are gently concave between the respective keels. In shells of the size of the holotype both bands are about equally high (figs. 26, 27), but in later stages the apical band becomes markedly higher than the lateral one (paratype A.M.N.H. No. 27156:8; fig. 34). In this species also the fourth keel (from above) is only rarely visible as a fine thread immediately above the suture. On the body whorl it can be seen to be somewhat weaker than the third and to be accompanied on the inside by an even weaker fifth. Between the fifth keel and the columellar border two faint revolving ridges are recognizable on the base of the holotype (fig. 31), but as many as four in the much larger paratype A.M.N.H. No. 27156:8 (fig. 34).

The character of the transverse ornamentation also differs from that of *P. subnodosoides*. As seen best in the holotype (figs. 26, 27), it consists of regularly but comparatively widely spaced single growth lamellae, 30 to 35 of which are present on the body whorl and which form uniform, neatly rounded beads on the three main keels. Those on the middle keel are the largest, those on the upper the smallest, and those on the lower are intermediate in size. As seen in the juvenile paratype A.M.N.H. No. 27156/1:2 (fig. 33), these beads appear in *P. alia* as early in ontogeny as, if not earlier than, in *P. subnodosoides*. No bundles of growth striae form in this species which thus does not develop the coarse character of the mature ornamentation of *P. subnodosoides*. The growth lamellae run obliquely backward across the apical band, as in *P. subnodosoides*, but then they run vertically from the middle keel to the lower one and turn forward only after crossing the latter. This difference is undoubtedly in line with differences in whorl profile and arrangement of the main keels, a dominant middle keel making for a triangular, but two equally prominent keels for a trapezoidal, course of the growth lamellae in space. In some individuals (A.M.N.H. No. 27156/1:19) the course of the growth striae is more like that in *P. subnodosoides*.

EARLIEST ONTOGENETIC STAGES: In not a few shells, mostly juveniles from lot 48 (A.M.N.H. Nos. 27156/1:1, 27156/1:2, 27156/1:3, 27156/1:7, 27156/1:11, 27156/1:13, 27156/1:20) the alloiostrophy of the nucleus can well be observed; as examples, the nuclei of paratypes A.M.N.H. Nos. 27156/1:3 and 27156/1:13 are illustrated in figures 24 and 32. The early ontogeny of whorl profile and ornamentation seems to be the same as in *P. subnodosoides*.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27156	40
48	27156/1	27
Total		67

Some specimens of *Promathilda, sensu lato*, not determined as to subgenus and species may also belong to *P. alia*.

Promathilda (Promathilda) aff. **perarmatae** (Münster)

Plate 12, figures 25, 35, 36

Aff. *Promathildia perarmata* Mstr. sp.; KITTL, 1894, p. 226, *cum synon.*, pl. 9, figs. 47, 48.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27157:1	*ca.* 2.8 mm.	*ca.* 42½	*ca.* 50	30½°
27157:2	*ca.* 4.15	*ca.* 41	*ca.* 52	30½°

Since the only two specimens present exhibit nearly identical dimensions, no inferences as to growth trends are possible.

DESCRIPTION: The two specimens differ from both *P. subnodosoides* and *P. alia* by being narrower in width, having higher spires and more acute pleural angles, the supersutural keels markedly less strongly developed than the subsutural ones,[1] less

[1] In the penultimate whorl of specimen number 1 two thread-like revolving elements can be recognized between the nodose middle keel and the lower suture. They are homologues of the third and fourth keels of *P. subnodosoides* and *P. alia*.

deeply channeled sutures, and chiefly by the heavy and comparatively few (eight per whorl) tubercles. The two shells have in common with *P. subnodosoides* the coarse transverse sculpture and the angular whorl profile, the farthest projection of which is marked by the strong middle keel.

The two specimens differ from each other in that the transverse nodes, although strongest on the middle keel, extend almost over the full height of the whorl in number 2, whereas they appear to be more or less restricted to that keel in number 1. Also the revolving ornamentation is more distinct in the former than in the latter. Both these differences are, however, believed to be due in part to age and in part to the corrosion of number 1.

Alloiostrophy of the nucleus is just recognizable in specimen number 1 despite its poor preservation.

REMARKS: The characters pointed out above suggest relationship of this form with *P. perarmata* (Münster), but they cannot be considered fully conspecific owing to differences in ornamentation. In the St. Cassian form the nodes are more closely set and the upper keel, if present at all, is much less conspicuous than the lower. Still, the form from Tilarnioc comes closer to *P. perarmata* than to the even less densely tuberculated *P. pulchella* (Laube) (see Kittl, 1894, p. 226, pl. 9, fig. 46), which is readily distinguished by a quadrate outline in apical view. The specimen illustrated by Kittl as a transitional form between *P. subnodosa* and *pulchella* under the former name in figure 45 of the same plate resembles in side view our specimen number 1, which, however, does not present such a polygonal outline. Specimen number 2 does, but its outline is octagonal, not hexagonal as is that of Kittl's figure.

The heavy transverse sculpture readily distinguishes this form from all the Peruvian species of *Promathilda* described below.

The almost rib-like, transversely elongated tubercles make for some resemblance of specimen number 2 to some of the Procerithiidae of the Peruvian assemblage. In all the latter, however, the revolving keels are more clearly subordinate to the transverse sculpture and more numerous.

OCCURRENCE: Two small shells in lot 48 (A.M.N.H. No. 27157).

SUBGENUS **TERETRINA** COSSMANN

The terebroid shell shape and the lack of transverse growth folds are considered distinctive of this section by Cossmann (1912, p. 6) who designated *Turritella bolina* Münster as type species. *Teretrina* contributes by far the greatest portion (about 5500, if a proportionate part of the specimens left specifically undetermined is added) to the total number of Peruvian individuals referable to *Promathilda, sensu lato.* Within this huge total seven named species can be distinguished, divided into two subgroups.

The first subgroup is characterized by the dominance in its ornamentation of two lateral main keels. It includes the three most abundant species, *bolinoides*, *intermedia*, and *obtusa* (all entirely or largely concentrated in lots 86 and 48). In addition, *P.* (*T.*) *aculeata*, a particularly aculeate species, fairly close to *P.* (*T.*) *bolinoides*, and the opposite extreme, *P.* (*T.*) *eucycloides*, which may best be attached to *P.* (*T.*) *obtusa*, are also referred to this subgroup; of these two species *aculeata* is very rare and *eucycloides* rare.

A second subgroup, characterized by the dominance of only one main keel and by a highly angular whorl profile, is represented, in lots 86 and 48 only, by two species, *P.* (*T.*) *tilarniocensis* and *P.* (*T.*) *terebraeformis*, which between them do not reach a total of 100 individuals.

Promathilda (Teretrina) bolinoides, new species

Plate 12, figures 28–30, 38–50, 52

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27158/1:1	1.68 mm.	50	41½	35½°
27158/1:2	1.68	46½	46½	36°
27158/1:3	1.68	50	40	34°
27158/1:4	1.79	47	43½	36½°
27158:69	1.79	47	50	33°
27158:13	*ca.* 1.79	*ca.* 54½	*ca.* 47	34°
27158/1:5	1.85	45½	48½	33°
27158/1:6	1.96	45½	40	39°
27158/1:8	2.02	41½	45½	31°
27158/1:9	2.13	44½	44½	37½°
27158:1	2.13	44½	47½	32°
27158/1:10	2.24	*ca.* 38½	42½	28°
27158:14	*ca.* 2.30	*ca.* 44	*ca.* 41½	33°

A.M.N.H. Nos.	H	W	h	π
27158:15	*ca.* 2.30	*ca.* 46½	*ca.* 46½	35°
27158:16	2.35	47½	40½	34°
27158/1:11	2.35	47½	47½	35½°
27158/1:12	2.35	48½	45	34°
27158/1:13	2.46	43	47½	*ca.* 30°
27158/1:14	2.46	41	43	38°
27158:22	2.46	50	38½	38°
27158:18	2.52	38	52	29°
27158/1:15	2.58	44	50	37°
27158:19	2.63	44½	42½	34°
27158:20	2.63	45½	44½	36°
27158:27	*ca.* 2.80	*ca.* 42	*ca.* 48	31°
27158/1:16	*ca.* 2.80	*ca.* 46	*ca.* 50	34°
27158/1:17	2.80	44	46	34½°
27158:23	2.86	40	55	26½°
27158:24	2.86	41	47	32½°
27158:37	2.86	42	53	27½°
27158:35	2.91	42½	42½	35°
27158/1:18	2.91	46	46	35°
27158:25	3.02	39	50	23°
27158/1:19	3.07	43	54	31°
27158:36	3.08	43½	45½	33°
27158:38 (syntype A)	3.08	40	51	32°
27158:31	3.15	39½	50	32°
27158:17	3.22	50½	48½	31°
27158:33	3.24	38½	46	28°
27158:2	3.32	36½	51½	28½°
27158:30	3.32	50	42½	32°
27158:34	3.32	40	47½	35°
27158:40	3.36	33½	50	23½°
27158:42	3.49	47½	47½	37°
27158/1:20	3.65	42	52½	35°
27158/1:21	*ca.* 3.73	*ca.* 44½	*ca.* 44½	36°
27158:44	3.73	45½	46½	33°
27158:46	3.98	41½	50	36°
27158:50	3.98	36½	50	24°
27158/1:22	4.07	43	51	30½°
27158:52	4.15	35	56	25°
27158/2:1	4.15	38	42	35½°
27158:53	*ca.* 4.22	*ca.* 46	*ca.* 52	36°
27158:58	4.30	31½	51½	23½°
27158:68	4.30	*ca.* 41½	48½	36°
27158/1:23	4.42	39	50½	28°
27158/1:24	4.43	41½	55½	35°
27158:54	4.43	34½	53	27°
27158:66	4.43	41½	47½	35°
27158/1:26	4.55	43	48½	33½°
27158:55	4.55	38	48½	31°
27158/1:27	4.56	40	49	33½°
27158/2:2	4.65	44½	48	34°
27158:64	4.92	37½	55	28°
27158/1:28	4.92	37½	45	*ca.* 30°
27158/1:29	5.04	41½	49	*ca.* 28°
27158/1:30	5.04	44	49	29½°
27158/1:31	5.04	40	51	26½°
27158:3	5.06	38½	52½	26½°
27158/1:28	5.17	40½	50	30°
27158/1:32	5.17	40½	47½	34°
27158/1:33	5.29	40½	51	28½°
27158:56	5.41	36½	52½	25°
27158:4	5.53	37½	51	26°

A.M.N.H. Nos.	H	W	h	π
27158:5	5.53	35½	55½	26½°
27158:29	5.53	40½	44½	29°
27158:59	5.66	43½	48	29°
27158:6	5.90	41½	48	30°
27158/1:34	5.90	35½	50	28°
27158/1:35	6.15	42	52	32°
27158:7	6.15	36	50	27½°
27158:60	6.15	40	50	30°
27158:8	6.27	34	51	24°
27158:61	6.27	40	45	29°
27158/1:36	6.52	39½	53	27°
27158/4:1	6.76	38½	47½	29°
27158:32	6.76	36½	49	23°
27158:39	6.76	33½	53½	24°
27158/1:39	6.89	39½	53½	28½°
27158/1:40	7.01	38½	49	27½°
27158:43	7.01	40½	52½	31½°
27158:45	7.13	39½	46½	31°
27158:48	*ca.* 7.26	*ca.* 35½	*ca.* 54	28°
27158:49	7.38	34	55	26°
27158:51	7.50	32	60½	24°
27158/1:41	7.53	38	53	28°
27158:42	7.75	35	54	26½°
27158:43	8.12	33½	57½	25°
27158:44 (syntype B)	8.12	36½	50	33°
27158:57	8.12	37	47	27°
27158:62	*ca.* 8.24	*ca.* 42½	*ca.* 50½	29½°
27158:63	8.24	36	54	24°
27158:9	8.49	37	50½	26°
27158:10	8.61	33½	55	22½°
27158:11 (syntype C)	8.73	31	54	24½°
27158:12	10.33	33½	52	22½°
27158:26	10.95	33½	49½	23°

In addition to exhibiting the growth trends common in this genus, the present species is particularly characterized by the speed at which h outgrows W. After equaling it first at a total height of 1.68 mm. (paratype A.M.N.H. No. 27158/1:2), it exceeds it, with only few exceptions, almost regularly above the size of 2½ mm., and falls only exceptionally below the 50 mark above that of 6 mm. (Its maximum of 60½ is, however, not encountered in one of the largest shells present but in paratype A.M.N.H. No. 27158:51 which attains a total height of only 7½ mm.) Accordingly the pleural angle (of which the maximum for this species is 39° in paratype A.M.N.H. No. 27158/1:6) gradually decreases to from 22½ degrees to 24½ degrees in the four largest measured shells, and so does the width, though hesitantly as it were, from a maximum of 54½ (in paratype A.M.N.H. No. 27158:13) to the minimum of 31 attained in syntype C. These

developments make this species the most highly spired and most slender among the three most common of the subgenus *Teretrina* (*bolinoides*, *intermedia*, and *obtusa*). However, another species of this subgenus, *P.* (*T.*) *aculeata*, established on this character, attains an even higher spire, as does *P.* (*T.*) *tilarniocensis*. (Among the Peruvian species referred to the two other subgenera of *Promathilda*, *P. subnodosoides* almost matches the present species in height of spire and *P. alia* exhibits an even more acute pleural angle, as does *P.* (*?Clathrobaculus*) *gracillima*, although the two other species of *Clathrobaculus* exceed it in height of the spire.)

SELECTION OF TYPES: An excellently preserved juvenile (A.M.N.H. No. 27158:38) with characteristic nucleus, one of the two largest shells present in lot 48 (A.M.N.H. No. 17158/1:44) representative of those with distinct growth striation, and the best preserved among the largest individuals in lot 86 (A.M.N.H. No. 27158:11) are designated syntypes A, B, and C, respectively.

DESCRIPTION: Shell consisting of up to 10 or 11 volutions, slender-turritellid in shape. Shell profile rather deeply indented by narrowly engraved sutures. Whorl profile rather angular, divided by the upper main keel into a conical apical and a cylindrical lateral band, both of which are gently concave and about equally high. The apical band rises at an angle of about 60 degrees, and the lateral one is embedded between the two main keels. Body whorl not so high; base comparatively high, slightly concave; columella straight, running vertically downward. Aperture that common in the genus, with comparatively long, shallow canal; inner lip, as best seen in paratype A.M.N.H. No. 27158/1:46 (fig. 48), clearly reflexed; umbilical niche, if present, very narrow and hardly discernible.

The revolving ornamentation is dominated by the two main keels which border the lateral band; they are moderately and equally strong and as a rule project equally far. Only in the latest stages studied, as in syntypes B and C (figs. 43, 44, 38, 39), both subsutural and supersutural keels appear. In syntype C the supersutural keel is just visible as a thin thread immediately above the penultimate and last sutures. In the fragment A.M.N.H. No. 27158:10 the suture can be seen to be neatly engraved between these two keels (fig. 40). Freed from concealment by the following volution, the supersutural keel can be recognized to be quite sharp, though somewhat weaker than the lower main keel. Mostly, though not regularly, it is closely followed on the inside by a fifth, markedly weaker keel. Two revolving lirae can be seen on the base, faintly in syntype B, but quite distinctly in paratypes A.M.N.H. Nos. 27158/1:46 (fig. 48) and 27158/1:47, thus raising the number of revolving elements on the base (including the keel beneath the lower lateral one) to four. In syntype C, however, and in the somewhat larger, but otherwise very similar paratype A.M.N.H. No. 27158:12 no revolving ornamentation is present beyond the sharp keel just below the shoulder which is here not even accompanied, as is usual, by an inner one (fig. 41).

A dense growth striation is recognizable only in some individuals, mostly from lot 48, best in syntype B and in paratypes A.M.N.H. Nos. 27158/1:26, 27158/1:35. 27158/1:36, 27158/1:38, 27158/1:41, 27158/1:45, and 27158/1:46. In the last, a shallow groove between two growth lamellae serves to illustrate their course (fig. 48). Between the upper suture and the second keel below the lower lateral keel the growth lamellae form a wide, forward open angle, with its vertex on the upper main keel. At the second keel below the lower main keel they turn gently to run in a forward convex arc radially towards the columella. In side view, however, this part of the course appears to run backward, thus lending to the growth striae the aspect of a large inverted S, as mentioned for this genus by earlier authors, such as Kittl (1894, pp. 216–230, *passim*) and Cossmann (1912, p. 4). As other good examples of growth striation in this species, the shell fragment A.M.N.H. No. 27158/1:7 and paratype A.M.N.H. No. 27158/1:47 are shown in figures 49 and 46. In the former the growth striae remain strictly single and produce uniform small beads on the lateral keels, particularly on the upper. In the latter some stand out by greater strength, and accordingly the beads produced are somewhat stronger than the others, without, however,

being comparable to the nodes of even the less coarsely sculptured shells of *P. subnodosoides* or to the more pronounced beads of *P. alia*. Syntype B (figs. 43, 44) exhibits a growth striation similar to, though less distinct than, that of paratype 47.

EARLIEST ONTOGENETIC STAGES: In about 1000 shells of this species the alloiostrophic nuclei can well be seen. Among them those of paratype A.M.N.H. Nos. 27158/1:14 and 27158/1:15 are shown, sufficiently enlarged, in figures 47 and 42, in addition to those of the three syntypes which can be recognized in their respective illustrations (figs. 28, 29, 43, 44, 38, 39). In this species, too, the characteristic whorl profile begins to take shape in the first post-nuclear volution. The two lateral keels are already recognizable in the second.

REMARKS: As indicated in the specific name, this form is undoubtedly very close to the much larger *P.* (*T.*) *bolina* (Münster), selected by Cossmann (1912, p. 6) as the type species of his section *Teretrina*. However, after careful comparison and examination of several topotypes of *P. bolina* from the Yale collections, the St. Cassian and the Peruvian species cannot be considered conspecific. It is true that they resemble each other considerably in shell shape, particularly in the amount of the pleural angle, but the base is not truncate in *P.* (*T.*) *bolinoides*, as it is said to be by Kittl (1894, p. 218) in his redescription of Münster's species, and the aperture in our species is not, as Kittl (*loc. cit.*) states for the true *bolina*, "mostly wider than high," but rather higher than wide. There is also a difference in whorl profile, the two main keels being not so closely set and not so near the lower suture in the Peruvian species as in the St. Cassian one, which in these characters comes closer to *P.* (*T.*) *obtusa* than to *P.* (*T.*) *bolinoides*.

In some features, as in the shape of the base and the aperture, this species might be said to resemble the Liassic species *Cerithium semele* d'Orbigny (Martin, 1859, p. 75, pl. 2, figs. 8–10; Cossmann, 1902, p. 183, pl. 3, fig. 10; Dareste de la Chavanne, 1912, p. 563, pl. 15, figs. 8, 8a) and *Turritella dunkeri* Terquem (1854, p. 252, pl. 14, fig. 5; von Bistram, 1903, p. 64, pl. 5, figs. 3–8)[1] even more closely than the Triassic *P. bolina*, but d'Orbigny's species seems to show a less angular profile and to have its two main keels closer to each other, and Terquem's exhibits on an average an even more acute pleural angle than *P.* (*T.*) *bolinoides*.

Within the Peruvian material, *P.* (*T.*) *bolinoides* most closely resembles *P.* (*T.*) *aculeata*, *P.* (*T.*) *intermedia*, and *P.* (*T.*) sp., with which it is compared in the discussions of those various species. It also resembles two species referred above to *Promathilda, sensu stricto*. It seems indeed a far cry from the richly and coarsely ornamented shell of syntype C of *P. subnodosoides* (pl. 12, figs. 1–3) to that of syntype C of *P.* (*T.*) *bolinoides* which is smooth except for three revolving keels on the spiral whorls and four on the body whorl. Where the transverse ornamentation and resulting nodes are less coarse, as they are in some individuals of *P. subnodosoides* (best exemplified by its syntype B; pl. 12, figs. 19, 20), distinction from shells of *P.* (*T.*) *bolinoides* with well-developed growth striation (syntype B or paratypes A.M.N.H. Nos. 27158/1:35, 27158/1:36, and 27158/1:47) becomes less obvious, particularly where the striae tend to form bundles or to become somewhat irregular in *P.* (*T.*) *bolinoides* also. Even such shells can, however, be distinguished from those less coarsely ornamented of *P. subnodosoides* by the following differences: They lack the characteristic triangular whorl profile and the heavy dominant middle keel of that species; the more or less equal strength and prominence and greater distance of the two lateral keels lend them a quite different whorl profile. Furthermore, they have only a very faint, if any, subsutural keel. Still, in a few shells of this species the upper lateral keel is stronger and projects farther than the lower, without, however, becoming quite so dominant as in *P. subnodosoides*. Such shells (A.M.N.H. No. 27158/1:27) may be considered transitional to the latter species.

The same features as to whorl profile and arrangement of keels which are helpful for the distinction of this species from *P. subnodosoides* are, on the other hand, common to *P.* (*T.*) *bolinoides* and *P. alia*. The latter

[1] Recently found also in the Rhaetian of western Lombardy (northern Italy) by Chiesa (1949, p. 32).

differs, however, from the present species by its extremely regular, more widely spaced growth lamellae, which run perpendicularly, not obliquely, forward across the lateral band and form much more pronounced beads on the lateral keels, and by the presence of a quite conspicuous subsutural keel.

OCCURRENCE: Extremely common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27158	2250
48	27158/1	102
70	27158/2	15
71	27158/3	10
78	27158/4	12
		2389

In consideration of the fact that the majority of specimens left undetermined specifically probably belong to this species, the total number of individuals can be estimated as about 2830. This makes *P. (T.) bolinoides* the most abundant species not only of *Promathilda* but of the whole fauna, so that it qualifies as its leading index fossil.

Promathilda (Teretrina) aculeata, new species

Plate 12, figures 51, 53, 54, 61

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27166:1	*ca.* 3.49 mm.	*ca.* 27	*ca.* 63	26°
27166:2 (holotype)	*ca.* 6.22	*ca.* 28	*ca.* 64	27½°

A fragment 11.5 mm. high of a shell from lot 38 (A.M.N.H. No. 27166/1), which is believed to be conspecific and which, when complete, must have reached a height of at least 17 mm., has a pleural angle of only about 16 degrees.

SELECTION OF TYPE: The larger of the two shells in lot 26 is designated holotype.

DESCRIPTION: This species is dealt with by way of appendix to *P. (T.) bolinoides* to which it seems to be closely related. It differs from the latter chiefly by assuming an acute pleural angle at a much earlier ontogenetic stage and consequently by a considerably more slender, more aculeate shell shape, as indicated in the specific name. This shell shape allows for the presence of as many as 10 volutions (including nuclear ones) in the smaller shell and of as many as 12 in the holotype.

There are in addition minor differences in whorl profile and ornamentation: The two lateral keels are somewhat closer to each other, the lower being slightly higher above the suture. Also, the upper is somewhat thicker and projects a little farther than the lower, so that it may well be called the main keel. Minor revolving elements develop at the late stage represented by the fragment A.M.N.H. No. 27166/1 (fig. 61). There a subsutural ledge ("Nahtfacette") is present, the edge of which carries a weak keel. Another secondary keel develops halfway between that edge and the main keel, and faint lirae are intercalated first above, then below, the halfway keel. The keel beneath the lower lateral keel becomes just visible above the last preserved suture of this fragment. It can also be recognized on the bases of the two smaller shells from lot 26, but their surfaces are so poorly preserved that it is not possible to decide whether or not more keels follow, and if so how many.

Growth lamellae, which do not seem to form bundles, are recognizable on the holotype and even better on the afore-mentioned fragment. They run particularly steeply backward over the apical band. Thus the angle which here also has its vertex on the upper lateral keel is very obtuse. In crossing the revolving keels these growth lamellae produce the usual beads, most distinctly so on the main keel.

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the nucleus is just recognizable in both shells from lot 26, but encrustation of their surfaces permits no further observations of the early ontogeny, except that the first post-nuclear volutions seem to be extraordinarily high.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
26	27166	2
38	27166/1	1
	Total	3

The incomplete shell in lot 38 is much larger than the shells in lot 26.

Promathilda (Teretrina) intermedia, new species

Plate 12, figures 55–60, 62, 66–70, 73

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27159/1:1	0.90 mm.	56½	37½	*ca.* 46°
27159/1:2	1.23	50	41	37°
27159/1:3	1.34	50	37½[1]	36°
27159/1:4	1.46	50	46	43°
27159/1:5	1.46	50	42½	44°
27159/1:6	1.51	52	37	41°
27159/1:7	1.68	53½	40	41°
27159/1:8	1.74	53	42	38°
27159/1:9	1.79	50	50	45°
27159/1:10	1.79	51½	47	40°
27159/1:11	1.79	51	40½	44°
27159/1:12	1.85	51½	42½	37°
27159/1:13	2.02	50	39	42½°
27159:30	2.02	53	36	46½°
27159/1:15	2.13	55½	39½	44°
27159/1:16	2.24	50	37½	37°
27159:1	2.24	52½	42½	45°
27159/1:17	2.30	53½	46½	42°
27159/1:18	2.35	50	45	37°
27159/1:19	2.35	49	40½	39½°
27159/1:20	2.35	50	43	40°
27159/1:21	2.41	49	44	*ca.* 38°
27159/1:22	2.41	46½	44	37½°
27159:2	2.41	51	39½	44½°
27159:31	*ca.* 2.52	*ca.* 49	*ca.* 46½	40°
27159/1:23	2.52	46½	44½	35°
27159/1:24	*ca.* 2.63	*ca.* 47	*ca.* 42½	43°
27159:3	*ca.* 2.69	*ca.* 50	*ca.* 46	42°
27159/1:25	2.74	53	45	43°
27159/1:40	2.74	53	39	40°
27159:4	2.80	50	42	39°
27159:5	2.80	52	48	39°
27159:6	*ca.* 2.80	*ca.* 50	*ca.* 50	35½°
27159:28	2.90	48½	48½	37°
27159:7	*ca.* 2.91	*ca.* 48	*ca.* 42½	41½°
27159:8	3.19	49	42	43°
27159/1:29	*ca.* 3.23	*ca.* 46	*ca.* 41	39°
27159/1:31 (syntype A)	3.32	46	50	37½°
27159:9	3.32	45	40	41°
27159/4:1	3.32	47½	42½	42½°
27159/4:2	3.32	51½	47½	42°
27159/1:32	*ca.* 3.40	*ca.* 52½	*ca.* 46½	45°
27159/2:1	3.44	47	46	40°
27159/1:28	3.49	47½	45	40°
27159:10	*ca.* 3.49	*ca.* 53½	*ca.* 40½	43°
27159:11	3.57	52½	44	46°
27159:12	*ca.* 3.64	*ca.* 47½	*ca.* 46	42°
27159/1:33	3.65	47½	45½	39°
27159:29	3.73	49	44½	40°
27159/1:34	3.82	45½	45½	39½°
26159:13	3.94	46½	46½	39°
27159/1:35	3.98	52	46	42°
27159/1:36	4.23	45	51	38°
27159:14	*ca.* 4.32	*ca.* 48	*ca.* 46	36½°
27159:15	4.48	52	39	43°
27159:16	4.48	45½	42½	39°
27159/4:3	*ca.* 4.48	*ca.* 50	*ca.* 46½	38°
27159:17	4.55	44½	43½	40°
27159:18	4.67	47½	47½	38°
27159/1:38	*ca.* 4.92	*ca.* 45	*ca.* 47½	38°
27159:33	*ca.* 5.29	*ca.* 44	*ca.* 50	39°
27159:19	*ca.* 5.53	*ca.* 45½	*ca.* 44½	37°
27159/1:39	5.90	43½	48	36°
27159:20	6.15	50	42	42°
27159:21	6.40	52	44	41°
27159:22	6.40	48	46	35°
27159:23	6.64	44½	42½	32°
27159:24	7.50	49	46	35°
27159:25	*ca.* 8.61	*ca.* 48½	*ca.* 45½	38°
27159:26 (syntype B)	9.29	47	46½	36°
27159:27 (syntype C)	*ca.* 17.2	*ca.* 46½	*ca.* 46½	35°

[1] The strong curvature of the spire reduces this measurement.

Although this species partakes in the trends common in this genus of W and π to decrease, and of h to increase, with growth, the amplitude between the extremes of all these values is markedly smaller than in related species, so that the shell shape does not undergo such marked changes in the course of development. It will be further noted that, with the exception of the maximum for W (56½) encountered in the smallest specimen measured (27159/1:1), all the other maxima and minima are not found at the ends of the ontogenetic series shown in the above table, but far remote from them. Thus the maximum for π (46½°) and the minimum for h (36) occur in A.M.N.H. No. 27159:30 (twice as large as the smallest), and the maximum for h (51) and the minima for W (43½) and π (32°) in paratypes A.M.N.H. Nos. 27159/1:36, 27159/1:39, and 27159:23, respectively, all of which can at best be termed middle sized (but only if syntype C, almost twice as large as syntype B, is disregarded). This is quite in line with the fact that values between 50 and 53½ for W, or between 39 and 48½ for h, or between 37 degrees and 45 degrees for π can be encountered throughout the table. Finally, for the first time at a size of 1.79 mm., but more frequently from that of 2.8 mm. to the end of the table, examples of h's equaling W, or nearly so, repeatedly occur. Thus it would seem that while in *P. (T.) bolinoides* a trend of h to outgrow W has been recognized, it tends in general only to equal it in the pres-

ent species, as it does in the largest shell measured (syntype C). However, in some individuals of *P.* (*T.*) *intermedia* also the height of the spire exceeds the width of the conch (e.g., syntype A and paratypes A.M.N.H. Nos. 27159/1:36 and 27159:33).

SELECTION OF TYPES: Specimens A.M.N.H. Nos. 27159/1:31, an excellently preserved juvenile, 27159:26, a perfect larger shell, and 27159:27, the largest complete shell present, are designated syntypes A, B, and C, respectively.

DESCRIPTION: This species deviates from *P.* (*T.*) *bolinoides*, in addition to growing considerably larger and to having some minor ornamentational differences, mainly in dimensions and shell shape. Thus, it is best described by pointing out these differences. Owing to generally higher values of W and π and lower ones of h the shell shape is conical rather than aculeate as in *P.* (*T.*) *bolinoides*, the body whorl is somewhat larger in proportion to the whole conch, but since the base is not only higher but also broader than in *P.* (*T.*) *bolinoides*, its shape is about the same in both species. The same holds true for the aperture which in *P.* (*T.*) *intermedia* also is markedly higher than wide. The columella runs vertically downward. As seen by comparing the apertural views of the three syntypes (figs. 56, 68, 62), the reflection of the inner lip becomes ever more conspicuous and extends higher up the columella the larger the size. In the largest syntype (C; figs. 62, 70) and in the incomplete paratypes A.M.N.H. Nos. 27159:32 (figs. 66, 73) and 27159:34, which correspond to about the size of syntype C, the narrow umbilical niche can be followed under the reflexed inner lip all the way up to the center of the base and can be seen there to continue into an open though extremely narrow umbilicus.[1]

In this species the two lateral keels are also equally strong and project equally far, but they are throughout development stronger than in *P.* (*T.*) *bolinoides* and somewhat closer to each other. Consequently, the apical band exceeds the lateral one in height, mostly in the latest stages (e.g., in paratype A.M.N.H. No. 27159:32, where the former is one and a half times as high as the latter), and there is also more space left between the lower lateral keel and the suture. At the lower end of this supersutural band a keel is recognizable in spiral whorls, usually only in the largest shells present, but occasionally at an earlier stage, as in the small paratype A.M.N.H. No. 27159:28 (fig. 59). The largest syntype (C) also exhibits here and there an indication of a subsutural keel. On the base the supersutural keel can be seen to be only moderately weaker than the lateral keels and to be separated from the lower keel by a band as concave as, or even more furrow-like than, the lateral one. In young and medium-sized shells (syntypes A, B) this band is markedly narrower than the lateral band, but it equals it in width in maturity (syntype C, paratype A.M.N.H. No. 27159:32). On the inside, this boundary keel is always accompanied by a second, weaker keel. Two faint revolving lirae are recognizable, about halfway between the last keel and the umbilicus, in syntype C (figs. 62, 70) and indistinctly in paratype A.M.N.H. No. 27159:34.

Growth striation can usually be studied better in the shells from lot 48 than in those from lot 86. Of the former, paratype A.M.N.H. No. 27159/1:41 is shown in figure 58. The course of the growth striae is seen to be the same as in *P.* (*T.*) *bolinoides*. In the present species, too, they produce small, slightly compressed beads on the keels they cross. Among the shells from lot 86 the two largest (syntype C and paratype number 32; figs. 66, 73) show the growth striae best. In the latter specimen they can be seen to begin their forward turn at some distance above the upper main keel, so that the vertex of the forward open angle, considerably rounded out at this late stage, is shifted upward accordingly.

EARLIEST ONTOGENETIC STAGES: The nuclear and early post-nuclear features are the same as described in *P.* (*T.*) *bolinoides*. The nuclei of syntypes A and B are illustrated in figures 55, 56, and 68; the nucleus of the small paratype A.M.N.H. No. 27159/1:3 is shown in figure 60.

[1] Cf. Kittl's (1894, p. 218) remark in his description of *P. bolina*, "so dass man beinahe von einem echten Nabel sprechen kann."

REMARKS: As indicated in the specific name, this species is in shell shape and other characters intermediate between its two nearest relatives, *P.* (*T.*) *bolinoides* and *P.* (*T.*) *obtusa*. Comparison with the former species is integrated in the above description. The differences from *P.* (*T.*) *obtusa* are discussed under that species.

OCCURRENCE: Extremely common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27159	978
48	27159/1	146
70	27159/2	6
71	27159/3	3
78	27159/4	13
		1146

If a proportionate part of the specimens left specifically undertermined be added, the total number of individuals belonging to the present species can be estimated at about 1360, less than half that of *P.* (*T.*) *bolinoides*, but still larger than that of *P.* (*T.*) *obtusa*.

Promathilda (Teretrina) sp.

Plate 12, figures 63, 65

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27163	5.04 mm.	49	44	39°

DESCRIPTION AND REMARKS: A single shell from lot 86 must be dealt with separately by way of appendix to the preceding species. Although closely resembling shells of approximately the same size of *P.* (*T.*) *intermedia* in shape and occasionally (e.g., A.M.N.H. No. 27159:20) also in dimensions, it differs from that species in that its upper main keel projects much farther than the lower, thus causing the whorl profile to be decidedly triangular, with the upper main keel marking its greatest width.

In this character it approaches *P.* (*T.*) *terebraeformis* and may thus be considered transitional between that species and *intermedia*.

OCCURRENCE: A single shell in lot 86 (A.M.N.H. No. 27163).

Promathilda (Teretrina) obtusa, new species

Plate 12, figures 64, 71, 72; plate 13, figures 1–9, 11–18, 26

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27160/1:7	1.34 mm.	54	37½	45°
27160/1:1	*ca.* 1.68	56½	40	47°
27160:8	1.71	60	39½	47½°
27160/9[1]	1.96	57	40	53°
27160/1:9[2]	1.96	57	43	42°
27160:14[2]	2.02	57	36	48°
27160:11	2.07	54	46	44°
27160/1:2	2.07	51½	43	50°
27160:3	2.24	50	50	40°
27160:12	2.24	53½	42½	45°
27160:1[1]	2.24	56	35	48½°
27160:68[1]	2.30	58½	34	54°
27160:2	2.30	58½	41½	42°
27160/1:8	2.35	47½	46½	48½°
27160:13	2.41	54½	37	46°
27160:16	2.41	52½	42	41°
27160:3	2.41	56	38½	43°
27160:15	*ca.* 2.46	*ca.* 55½	*ca.* 41	47½°
27160/1:4	2.46	*ca.* 45½	43	*ca.* 42°
27160/1:5	2.52	46½	44½	*ca.* 46°
27160:17[1]	*ca.* 2.52	*ca.* 55½	*ca.* 34½	50°
27160:18	2.58	54½	39	46°
27160:19[1]	2.63	57½	34	52°
27160:20	2.69	54	46	45°
27160:21[1]	2.69	55	35½	48½°
27160/1:6	2.69	52	41	44°
27160:22	*ca.* 2.80	*ca.* 54	*ca.* 40	46½°
27160:23	*ca.* 2.80	*ca.* 52	*ca.* 44	44°
27160:24[1]	*ca.* 2.86	*ca.* 59	*ca.* 37½	49°
27160:25	*ca.* 2.91	*ca.* 58	*ca.* 40½	48½°
27160:26	3.08	60	40	56°
27160:27	3.14	52	53	41°
27160:5	3.15	*ca.* 55½	39½	*ca.* 48°
27160:6	3.30	50	40½	45°
27160:29	3.32	50	42½	45°
27160:30	3.50	56	38½	*ca.* 48°
27160:7	3.57	52½	40½	49°
27160:31[1]	*ca.* 3.65	*ca.* 57	*ca.* 38½	53°
27160:32[3]	3.73	51	40	43°
27160:61[3] (syntype A)	3.82	45½	43½	48½°
27160:69[1]	3.86	50½	43	55½°
27160:62[3]	3.90	50	41½	48°
27160:63[3]	3.90	48	42½	47°
27160:64[3]	*ca.* 4.15	*ca.* 48	*ca.* 42	48°
27160:33[3]	4.23	50	43	49½°
27160:34	*ca.* 4.23	*ca.* 57	*ca.* 41	45°
27160:35[3]	*ca.* 4.40	*ca.* 46	*ca.* 55½	35°
27160:36[3]	4.43	53	41½	43½°

[1] Transitional to *P.* (*T.*) *eucycloides*.

[2] Disregarding incomplete last whorls.

[3] Approximating *P.* (*T.*) *intermedia* in shell shape, but otherwise exhibiting the distinctive characters of *P* (*T.*) *obtusa*

A.M.N.H. Nos.	H	W	h	π
27160:37	*ca.* 4.73	*ca.* 54½	*ca.* 43½	50°
27160:38[1]	5.04	49	41½	46½°
27160:42 (syntype B)	5.04	49	42½	49°
27160:39	5.17	47½	45	46°
27160:40	5.17	52½	40½	48°
27160:41	5.17	50	45	48°
27160:43	5.41	50	45½	*ca.* 45°
27160:44	*ca.* 5.41	*ca.* 51	*ca.* 43	46°
27160:45	*ca.* 5.41	*ca.* 58	*ca.* 43	48°
27160:46	*ca.* 6.15	*ca.* 55	*ca.* 40	49°
27160:47	*ca.* 6.15	*ca.* 55	*ca.* 42	48½°
27160:48[1]	6.15	48	48	46°
27160:49[1]	6.90	48	46½	39°
27160:50	*ca.* 7.63	*ca.* 50	*ca.* 43½	46°
27160:51	*ca.* 7.99	*ca.* 49	*ca.* 46	47°
27160:65	8.24	48½	43½	46½°
27160:52	*ca.* 8.49	*ca.* 48	*ca.* 45	*ca.* 36°
27160:53	*ca.* 8.86	*ca.* 49½	*ca.* 41½	44°
27160:66	*ca.* 8.86	*ca.* 54½	*ca.* 41½	49°
27160:67[1]	*ca.* 9.57	*ca.* 46	*ca.* 44	38½°
27160:54	11.19	46	47	32°
27160:55	*ca.* 12.3	*ca.* 50	*ca.* 40	36°
27160:56	*ca.* 12.91	*ca.* 52½	*ca.* 41	36½°
27160:57	*ca.* 14.14	*ca.* 53	*ca.* 49	40°
27160:58	*ca.* 14.88	*ca.* 46	*ca.* 54	30°
27160:59	*ca.* 16.6	*ca.* 46½	*ca.* 44½	34°
27160:60 (syntype C)	*ca.* 19.06	*ca.* 45	*ca.* 51½	35°

The over-all picture given by the above table confirms the fact that this species is also subject to the general rule governing growth in this genus; W and π tend to decrease, and h tends to increase, with size, but this rule is, in the present species as well as in *P.* (*T.*) *intermedia*, broken by the recurrence of the same ratios at very different sizes. The situation is further complicated by the fact that three morphologically somewhat different groups are comprised in this species. One deviates from the mean by being more slender and thus approximates *P.* (*T.*) *intermedia* in shell shape. Another, with large body whorls and short spires, is transitional to *P.* (*T.*) *eucycloides*. With these complicating factors, it is not surprising that maxima and minima occur in the middle of the above table as well as at the ends. Thus, the maximum for W (60) is found in a very small specimen (A.M.N.H. No. 27160:8) as well as in one almost twice as large (A.M.N.H. No. 27160:26). The lowest values for W (45 and 45½, respectively) occur in the largest shell measured (A.M.N.H. No. 27160:60) and in a rather small one (A.M.N.H. No. 27160/1:4). As expected, the maximum for h (55½) is found in a shell transitional to *P.* (*T.*) *intermedia* in shape, although not large (A.M.N.H. No. 27160:35), and the minimum (34) in two specimens transitional to *P.* (*T.*) *eucycloides* (A.M.N.H. Nos. 27160:68 and 27160:19), both small. Finally, the widest pleural angle (56°) was measured in one of two shells (A.M.N.H. No. 27160:26) of maximum width, and the most acute angle (30°) in one of the largest (A.M.N.H. No. 27160:58).

[1] See footnote 3 on page 199.

SELECTION OF TYPES: A comparatively small specimen (A.M.N.H. No. 27160:61) belonging to the slender group, a somewhat larger one (A.M.N.H. No. 27160:42) belonging to the middle group, and the largest one measured (A.M.N.H. No. 27160:60), which, although incomplete, exhibits mature shell shape and ornamentation best, are designated syntypes A, B, and C, respectively.

DESCRIPTION: Of the three most common Peruvian *Teretrina* species, *bolinoides*, *intermedia*, and *obtusa*, the last-named has the widest shells, largest body whorls, most obtuse pleural angles, and attains the greatest size. The shell shape is well illustrated by the natural fracture presented by paratype A.M.N.H. No. 27160:72 (pl. 13, fig. 13), which shows that the columella is corkscrew-shaped in this species and genus. A natural cross section of the body whorl can be studied in paratype A.M.N.H. No. 27160:70, a shell about 20½ mm. high, which even exceeded syntype C in size. This fragment shows well the wide and shallow anterior notch of the aperture, its reflexed inner lip, and the very narrow but open umbilicus (pl. 13, fig. 18).

Most characteristic of this species, however, are its whorl profile and strength and site of its lateral keels. The former is distinguished by a high, gently concave apical band which slopes at an angle of about 40 degrees, thus jutting out farther than in any of the preceding species. It occupies the upper half or more of the whorl height, whereas the two thick, heavy lateral keels are crowded together in the lower half. They look as if they had slid down the far-projecting, conical apical band until they came to a

standstill just above the lower suture. Each is as broad as, sometimes even broader than, the band between them which thus assumes the aspect of a deep furrow. In mature shells the band between the lower lateral keel and the following one is somewhat wider and shallower than that between the two lateral keels. Only in late stages that third keel shows just above the suture. On the base it encircles another, weaker keel which is followed in some shells (e.g., paratype A.M.N.H. Nos. 27160:73 [pl. 13, fig. 16] and 27160:74) by two revolving lirae on the inner part of the base. No indication of a subsutural keel was encountered even in the largest shells examined.

The growth striation, observable only in a few shells (syntype C; pl. 13, fig. 15), follows the same course as in *P.* (*T.*) *intermedia*, but is dense and consists mostly of fine single striae. Only occasionally, as in shell fragment A.M.N.H. No. 27160:75, some become somewhat coarser and slightly irregular (pl. 13, fig. 26). In crossing the revolving keels, the striae produce some asperities but no regular beads. Altogether the growth striation is much less conspicuous than that of *P.* (*T.*) *bolinoides* and *P.* (*T.*) *intermedia*, not to speak of the species referred to *Promathilda, sensu stricto.* This may, however, be due, at least in part, to the fact that full-grown individuals of *P.* (*T.*) *obtusa* were found only in lot 86, and that the surfaces of these shells are somewhat glazed so as not to reveal the details of ornamentation with the same distinctness as, for example, the shells from lot 48.

EARLIEST ONTOGENETIC STAGES: As seen in the illustrations of syntypes A and B and of paratypes 69, 71, and 58 (pl. 13, figs. 1–3, 5–8, and 11), the nucleus is alloiostrophic, as it is throughout this genus. The small paratype A.M.N.H. No. 27160:76 exhibits a particularly pronounced case of alloiostrophy (pl. 13, fig. 17). Early development of whorl profile and keels progresses as in the related species. In syntype A, for example, the two lateral keels are clearly recognizable as early as at the end of the first post-nuclear volution.

In addition to the three syntypes and the paratypes already quoted, the following, all from lot 86 (A.M.N.H. No. 27160), are illustrated: number 69, of about the same size as syntype A, but of sturdier shell shape and thus belonging to the group transitional to *P.* (*T.*) *eucycloides* (pl. 13, figs. 5, 6); number 35, as an unusually slender shell with the highest spire (see above), representing the group transitional in shell shape to *P.* (*T.*) *intermedia* but exhibiting the distinctive specific characters as to whorl profile and main keels (pl. 12, figs. 71, 72); number 71, belonging to the middle group (pl. 13, figs. 7, 8); number 4, of the sturdy type (pl. 12, fig. 64); numbers 77 and 78, illustrating a mature body whorl and a well-preserved aperture, respectively (pl. 13, figs. 12, 14); number 58, a fine example of a full-grown shell (pl. 13, fig. 11).

REMARKS: The description emphasizes the distinctive characters by which this species differs from *P.* (*T.*) *intermedia* and, therefore, even more so from *P.* (*T.*) *bolinoides.* These distinctive characters appear enhanced in the following species, *P.* (*T.*) *eucycloides.*

The shift of the two lateral keels towards, and their crowding in, the lowermost part of the volution is also found in the true *P.* (*T.*) *bolina*, even more distinctly in Kittl's (1894, pl. 9) figures 7 and 8 than in his drawing (*ibid.*, fig. 6) of Münster's type. However, the St. Cassian species does not show the broad shell shape, large body whorl, and high aperture of *P.* (*T.*) *obtusa.*

OCCURRENCE: Extremely common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27160	963
48	27160/1	22 (juveniles)
		985

This species is concentrated in lot 86. Including some of the specifically undetermined shells the total is estimated at about 1170 individuals for this species, which thus ranks third among the three most common species of *Teretrina* from Peru.

Promathilda (Teretrina) eucycloides, new species

Plate 13, figures 10, 19–21, 27, 29

?Eucyclus tricarinatus spec. nov.; COX, 1949, p. 38, pl. 2, fig. 16.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27161/1:1	1.74 mm.	58	40½	55°
27161:1	1.90	64½	33½	56°
27161/1:2	1.96	57	35½	54½°
27161/1:3	2.07	55½	43	51°
27161:2	2.46	63½	34	56°
27161:3	*ca.* 2.58	*ca.* 63	*ca.* 32½	56°
27161:4 (syntype A)	*ca.* 2.8	*ca.* 66	*ca.* 36	69½°
27161/1:4	2.80	55	39	56°
27161:5	*ca.* 3.07	*ca.* 63½	*ca.* 35	61°
27161:6 (syntype B)	6.03	55	30½	54½°

These dimensions yield results quite unusual in this genus. Not only do W and π hardly change from the smallest shell measured to the largest one (the largest attains about three and one-half times the size of the smallest), but the usual growth trend of h appears to be reversed, this ratio decreasing rather than increasing in the over-all picture, with the maximum found in A.M.N.H. No. 27161/1:3, almost in the middle of the table, and the minimum at the bottom rather than at the top, where it would generally be found in this genus. W varies within a comparatively narrow range, between 55 and 66, with the maximum represented by syntype A, a medium-sized shell. The same individual exhibits the widest pleural angle (69½°), which otherwise varies, without any clear trend, between only 51 and 61 degrees.

The only inference that can be drawn is that rapid growth in width produces extraordinarily large body whorls which make for wide pleural angles and prevents increase in the relative height of the spire, as common in congeneric species.

SELECTION OF TYPES: The excellently preserved, medium-sized specimen A.M.N.H. No. 27161:4 is designated syntype A, and the worn but characteristic largest shell present, A.M.N.H. No. 27161:6, syntype B.

DESCRIPTION: This species is unmistakably characterized by its large and high body whorls, and accordingly high bases and apertures, and by its whorl profile. The characters of the first group tend to appear in *P.* (*T.*) *obtusa* also, but they reach a far higher degree in the present species.

The columella is straight and vertical. The aperture tapers rather abruptly downward towards a wide, shallow, moderately long anterior canal. Its inner lip is thinly reflexed, up to the center of the base, over a narrow and inconspicuous umbilical niche. There is no open umbilicus.

As in other species of the genus, the whorl profile is strongly influenced by the arrangement and the characters of the lateral keels. The lateral band they enclose occupies half the whorl height or a little more, and the apical band about a third, with but little left for the interspace between the lower main keel and the suture. The apical band is conical, rising at an angle of some 30 to 35 degrees, and flat in earlier stages, later slightly convex. The lateral band is cylindrical and gently concave. In profile the lateral band appears vertical, only rarely, as in the penultimate whorl of syntype A, slightly overhanging. Owing to the fact that the lateral keels are not so thick in this species as in *P.* (*T.*) *obtusa*, this band appears wider. The two keels project equally far and are as a rule also equal in strength. Only in the body whorls of both syntypes can the lower keel be recognized as thicker than the upper. In the body whorl the lower main keel is separated by a narrow, groove-like interspace from the first basal keel, beyond which follows a second, weaker one. Only in the largest shell present (syntype B) can a faint indication of a third, innermost revolving ridge barely be perceived on the base (fig. 27).

Growth striae are recognizable only here and there, best on the body whorl of paratype A.M.N.H. No. 27161/1:4 on the side of which they can clearly be seen to follow the course common in this genus, namely, to form a wide, forward open angle with its vertex on the upper lateral keel (fig. 10).

EARLIEST ONTOGENETIC STAGES: The nucleus is well seen to be alloiostrophic in paratype A.M.N.H. No. 27161:1 and in syntype A (fig. 29). In the latter the whorl profile characteristic of this species is assumed at the end of the first post-nuclear volution.

REMARKS: The large body whorl and the shape of the aperture produce a remarkable resemblance of this species to the genus *Eucyclus* which has suggested its name. Its other characters, mostly the course of the growth striae and the alloiostrophic nucleus.

leave no doubt as to its true generic affinities.

To judge by Cox' description and illustration (*loc. cit.*, in synon.), his *Eucyclus tricarinatus* is almost certainly a *Promathilda* not a *Eucyclus*. Only the lack of any indication as to the course of the growth striae and as to the nuclear characters in both text and figure necessitates the reservation, for only those characters would with full certainty exclude any doubt as to generic reference (see above). Within the present genus Cox' form would seem to belong to Cossmann's "section" *Teretrina*. Among the Peruvian species of *Teretrina* it is the present one which the form from Carhuamayo resembles most closely in dimensions and other characters. If allowance is made for the fact that the beak of the aperture seems to be missing in Cox' specimen, a close resemblance will be found between his figure and the corresponding view (fig. 19) of my syntype B which is about one and one-half times as large, but similarly worn. Without making allowance for the assumed incompleteness of Cox' shell, measurements taken from his figure yield the following values:

H	W	h	π
ca. 4.0 mm.	*ca.* 57½	*ca.* 33	*ca.* 47°

which would fit in fairly well with the dimensions of *P.* (*T.*) *eucycloides*. It is true that most specimens of this species, all smaller than Cox', show only two revolving keels on the base and only the largest, syntype C, a faint third, whereas Cox records "four narrow concentric ridges" on the base of his. This difference is, however, of minor relevance, for such a larger number than usual of revolving elements on the base has been observed above in individual shells of most of the *Promathilda* species hitherto discussed in this report [paratypes 40 and 46 of *P. subnodosoides*, holotype and paratype A.M.N.H. No. 27156/8 of *P. alia*, syntype B and paratype A.M.N.H. No. 27158/1:46 of *P.* (*T.*) *bolinoides*, syntype C and paratype A.M.N.H. No. 27159:34 of *P.* (*T.*) *intermedia*, paratypes A.M.N.H. Nos. 27160:73 and 74 of *P.* (*T.*) *obtusa*].

Thus Cox' specimen is, though doubtfully, listed above in the synonymy of the present species. However, this species could not be given his name, even if his form should prove to be fully conspecific as there is every reason to suspect, for Cox' name is not available. It is a junior homonym of *Eucyclus tricarinatus* (Martin), which was originally referred to the genus *Purpurina* (1859, p. 75, pl. 2, figs. 6, 7) but was later properly transferred by Cossmann (1902, p. 194, pl. 4, figs. 13, 14) to *Eucyclus* (p. 86). That the specimen named *Eucyclus tricarinatus* by Cox is most probably a *Promathilda*, not a *Eucyclus*, does not prevent that homonymy (Article 36 of the Rules).

Among the *Promathilda* species present *P.* (*T.*) *obtusa* most closely resembles *P.* (*T.*) *eucycloides*. Each of the other *Teretrina* species of the Peruvian Triassic differs more from *P.* (*T.*) *eucycloides* than from *obtusa*.

There is, however, a striking resemblance between smaller specimens of this species and *Pseudoscalites*, new species (above, p. 184). These specimens can be distinguished by more acute pleural angles, by a much less conspicuous umbilical niche, and especially by having two lateral keels which project equally far, whereas in *Pseudoscalites*, new species, a strongly projecting shoulder keel marks the maximum width of the conch and makes for a triangular rather than trapezoidal whorl profile.

Finally, a rare species from St. Cassian named *Promathildia* (*?*)*intermittens* by Kittl (1894, p. 216, pl. 9, fig. 1) but made the type of a new subgenus *Protuba* of the genus *Tuba* by Cossmann (1912, p. 15),[1] considerably resembles *P.* (*T.*) *eucyloides* in shell shape, but differs by having its base all covered with about 10 revolving lirae, with finer lirae intercalated between the primary ones and between the keels. It is questioned whether such ornamentational differences should be granted generic significance.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	27161	14
48	27161/1	7
51	27161/2	3 (fragments)
73	27161/3	3 (most doubtful fragments)[2]
Total (including fragments)		24 (? or 27)

[1] See also Wenz (1939, p. 664) who raises *Protuba* to generic rank.

[2] Not entered in chart 1.

Promathilda (Teretrina) tilarniocensis,[1] new species

Plate 13, figures 22–25, 28, 31, 41

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27162:1	*ca.* 1.57 mm.	*ca.* 46½	*ca.* 39½	*ca.* 35°
27162:2	*ca.* 2.13	*ca.* 47½	*ca.* 47½	37½°
27162:3[2]	*ca.* 2.13	*ca.* 44½	*ca.* 46	37½°
27162:14	2.52	46½	46½	38°
27162:15	*ca.* 2.91	*ca.* 43½	*ca.* 50	36°
27162:4	*ca.* 3.14	*ca.* 37½	*ca.* 43	*ca.* 35°
27162:5	*ca.* 3.24	*ca.* 43½	*ca.* 43½	29°
27162:17	3.49	43	50	30½°
17262:6	3.73	?	49	?
27162:7	4.07	*ca.* 39	51	29°
27162:8	4.07	*ca.* 39	45	33½°
27162:9	4.56	*ca.* 38	47½	*ca.* 31½°
27162:10 (holotype)	4.65	41	53½	28°
27162:11[3]	4.67	39½	50	31°
27162:12	*ca.* 6.15	*ca.* 40	*ca.* 50	27°
27162:13	*ca.* 6.76	?29	62	?22°
27162:16	8.73	34	53½	27°

Although showing but little change in ratios in the upper third, the table later on clearly reveals the trends, common in this genus, of W and π to decrease, and of h to increase, with growth. The present species early exhibits the same tendency of h first to equal, then to exceed W, as does *P. (T.) bolinoides;* h outdistances W even faster than in that species. Thus, about the same minimum for π and an even considerably higher maximum for h are attained at smaller sizes than in *P. (T.) bolinoides* which this species otherwise resembles in its slender shell shape.

SELECTION OF TYPE: Specimen A.M.N.H. No. 27162:10, excellently preserved except for its nucleus, which is unfortunately broken off, is designated holotype.

DESCRIPTION: This species, the first of those species of *Teretrina* characterized by the dominance of only one keel and by a highly angular whorl profile, exhibits both characters very clearly. The main keel accentuates both the middle and the greatest width of the whorl profile. From it the apical band rises at an angle of from 45 to 50 degrees, and the lateral one reënters at an angle of about 20 degrees. Both these bands are concave, the upper more distinctly so than the lower, and thus make the main keel project even more decidedly. In the spiral whorls there is as a rule only one more keel, the subsutural one, markedly weaker than the main keel, and crowned by a narrow ledge ("Nahtfacette") which adds to the channeled appearance of the sutures. With the single exception of paratype number 17, which shows on its antepenultimate and penultimate volutions a faint keel between the middle keel and the lower suture, which then gradually vanishes again on the last whorl, a third keel appears only on the body whorl. It is about as strong as the subsutural one and marks the boundary of the gently concave, rather short base. It is believed to be homologous with the lower lateral keel of the several preceding species. It is followed on the base by a fourth, which encircles a fifth, weaker one, beyond which two faint revolving lirae can just be perceived on the inner part of the base in the holotype (figs. 24, 31). In paratype number 12, on the other hand, both the fourth and fifth revolving keels are more pronounced than in the holotype, but no innermost lirae are recognizable in this specimen (figs. 22, 23).

Fine, single growth lamellae, well seen in both paratype number 12 and the holotype (figs. 22–25), form a wide, forward open angle on the sides, which culminates on the middle keel, and produce delicate little beads on both that keel and the subsutural one.

The aperture exhibits the shape common in this genus and a wide and shallow anterior notch.

The columella runs straight and vertically downward and is accompanied, in its lowermost part, by a shallow umbilical niche over which the inner lip is slightly reflexed (paratype no. 12; fig. 22).

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the nucleus is seen in several specimens, best in paratypes numbers 1, 6, and 15 (fig. 28). In the first- and last-mentioned the main keel and with it the characteristic whorl profile are well developed in the second post-nuclear volution.

REMARKS: This species somewhat resembles *P. (T.) bolinoides* in shell shape, but it can readily be distinguished by having one middle keel rather than two lateral ones and

[1] From Tilarnioc, the village near which lot 48 was collected.

[2] Attached part of last whorl omitted.

[3] Crippled.

accordingly a triangular whorl profile. *P.* (*T.*) *tilarniocensis* is more easily distinguished from *P.* (*T.*) *intermedia* and *P.* (*T.*) *obtusa*, not to speak of *P.* (*T.*) *eucycloides*, all of which differ from it, in addition, by their stouter shell shapes and larger body whorls.

Among the Peruvian species left in *Promathilda, sensu stricto*, *P. subnodosoides* resembles *P.* (*T.*) *tilarniocensis* in both shell shape and whorl profile, which is in both dominated by the middle keel. However, *P. subnodosoides* has a supersutural keel, which *P.* (*T.*) *tilarniocensis* lacks, distinct nodes on the main keel, and more or less coarse growth folds, whereas growth lamellae are single and delicate in the present species and produce only small beads on the keels they cross. This species is compared with its closest relative, *P.* (*T.*) *terebraeformis*, in the discussion of that form below.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27162	34
26	27162/1	1 (a poor fragment)
	Total	35

Promathilda (Teretrina) terebraeformis, new species

Plate 13, figures 30, 32–40, 42, 53

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27164/1:1	1.29 mm.	48	39	37½°
27164/1:2	1.71	46½	33½	*ca.* 39°
27164:1	2.02	48	44½	35°
27164:2	2.16	44½	47	31½°
27164:3	2.41	38½	46½	30½°
27164:4	2.46	43	45½	35°
27164:5	2.52	39	44½	35°
27164/1:3	*ca.* 2.52	45½	51	32½°
27164:6	2.58	41½	50	29°
27164:7	*ca.* 2.80	*ca.* 43	*ca.* 48	38°
27164:8	2.80	39	46	33°
27164:9	2.86	*ca.* 39	51	30°
27164:10	2.91	42	44	37°
27164:11 (syntype A)	3.32	42½	47½	35½°
27164:13 (syntype B)	3.90	43	47	33°
27164/1:5	3.98	37½	52	31°
27164:14	4.56	36½	51	32½°
27164:15	5.23	36½	49	33°
27164:16	*ca.* 7.50	?	*ca.* 54	27½°
27164/1:6	7.75	38	47½	28°
27164/1:7	8.49	*ca.* 37½	50½	*ca.* 28°

Being incomplete, the largest specimen referred to this species, paratype A.M.N.H. No. 27164:17, could not be included in the above table. When complete, it may have been between 13½ and 15 mm. high. The pleural angle is unusually obtuse for this size (37°), but shell shape and whorl profile undoubtedly refer this shell to this species.

As seen in the table, the growth trends common in the genus prevail in the present species also, but the ratios change, and the pleural angle decreases, only slowly, hesitantly, as it were; specimen A.M.N.H. No. 27164:3 stands out by accelerated development. The ranges within which all three values measured vary appear to be rather narrow, although the largest shell in the table is almost seven times as large as the smallest.

SELECTION OF TYPES: Two medium-sized shells from lot 86, more or less complete and believed to exhibit best the distinctive characters of this species (A.M.N.H. Nos. 27164:11 and 27164:13), and a body whorl from lot 48 (A.M.N.H. No. 27164/1:4) which shows the shapes of aperture and base and the latter's ornamentation best, are designated syntypes A, B, and C, respectively.

DESCRIPTION: Most distinctive of this species, in which the shell shape closely resembles that of *P.* (*T.*) *tilarniocensis* and *P.* (*T.*) *bolinoides*, is the strong angularity of the whorl profile which culminates in the prominent and sharp middle keel. It is as a rule the only one, except in the body whorl. Thus comes about a shell profile reminiscent of a screw or a borer, as indicated in the specific name (*terebra* = borer, drill). Another characteristic of this species is the fact that, despite the deep indentation of the shell profile, the sutures are in most specimens hardly engraved, much less channeled, so that they are sometimes difficult to locate. This contributes to the general impression of smoothness of the shell, further enhanced by the usual lack of any revolving keels other than the middle keel and by the utter fineness of the growth striation, if at all recognizable. It should, however, be noted, that in a few shells from lot 48 (A.M.N.H. Nos. 27164/1:6[1]–27164/1:8; figs. 40, 39, 30) the

[1] This specimen is noteworthy for the steeper than usual gradient of the suture ("Nahtanstieg" Häberle)

sutures can be seen to be finely engraved. In the short fragment A.M.N.H. No. 27164/1:8 two sutures are even accompanied by faint subsutural ridges which, however, do not deserve the designation "keel" (fig. 30).

The afore-mentioned main keel is mostly situated at half the whorl height or, as in syntype B, slightly below. The bands above and beneath it slope at about the same angles from it, which makes for another difference from *P.* (*T.*) *tilarniocensis* in which the slope of the lateral band is markedly steeper. Only on the body whorl a second, somewhat weaker, but equally sharp keel becomes visible; it marks the boundary of the base. Only in the largest shells examined (syntype C and paratypes A.M.N.H. Nos. 27164/1:6 and 27164:17) is this boundary keel accompanied on the inside by a third keel. It can best be observed in syntype C (fig. 42), where it follows the second so closely that the two might almost be considered twin keels. Whereas, for example, in syntype B the band between middle and boundary keels is almost as high as the one above the middle keel, the former measures in syntype C, where there is a third keel, only about two-thirds of the height of the upper band. The distance between third keel and middle keel, however, exactly equals that between middle keel and upper suture.

Beyond this third keel, only an indistinct swelling can be seen on the rather high base of syntype C (fig. 42). This swelling, or ridge, encircles the narrow but distinct umbilical niche and leaves a slight concavity between itself and the outer periphery of the base. Like the base, the aperture and the columella also can best be studied in syntype C (fig. 53). The aperture is slightly more oblique than in related species, particularly so than in the preceding one, since its narrow and shallow, not so short anterior canal follows the slight turn to the left of the lowermost part of the columella.

Two shells from lot 86 (paratypes A.M.N.H. No. 27164:12 and 27164:15) deserve special mention for being transitional to *P.* (*T.*) *bolinoides*. In the first-named and smaller shell the middle keel is developed as a twin keel, as far as preserved, but otherwise whorl and shell profiles are exactly like those of the present species. In the larger of these two shells (figs. 35, 36) there are two lateral keels, the lower only slightly weaker and projecting only a little less than the upper and vanishing about in the middle of the penultimate volution, and from there on the shell is in no way different from others of this species at the same size. Were its last two volutions not preserved, no one would refer it to any species other than *P.* (*T.*) *bolinoides*. Palingenetic interpretation of this anomaly may suggest derivation of *P.* (*T.*) *terebraeformis* from *P.* (*T.*) *bolinoides*, with which it is associated in both lots 86 and 48.

Occasionally, as in syntype B, a fine crenulation of the main keel indicates the presence of growth lamellae which are otherwise not perceptible. Only in syntype C can a fine and dense growth striation be recognized, with a few striae standing out in bolder relief as indistinct folds. Here, too, as in paratype A.M.N.H. No. 27159:32 of *P.* (*T.*) *intermedia*, the vertex of the forward open angle formed by the growth striae is rounded out and situated not on the main keel, as usual, but somewhat above it (fig. 42).

EARLIEST ONTOGENETIC STAGES: The alloiostrophy of the nucleus, observable in a considerable number of specimens, among them syntype A, is most accentuated, and even somewhat overdeveloped in paratype A.M.N.H. No. 27164:14 (fig. 32) where it can be seen to encroach on part of the first postnuclear whorl. Immediately afterward, however, the whorl profile characteristic of this species is achieved.

REMARKS: From its closest relative, *P.* (*T.*) *tilarniocensis*, this species differs by its more angular whorl profile, its sharper and farther-projecting middle keel, the lack of a subsutural keel, and by inconspicuousness of the sutures. Some minor differences are pointed out in the above description. The presence, as a rule, of only one strong and sharp keel serves, with other features described above, for distinction from *P.* (*T.*) *bolinoides* and *P.* (*T.*) *aculeata*, which it somewhat resembles in shell shape. The occurrence of rare transitional specimens between this species and *P.* (*T.*) *bolinoides* is reported above. *P.* (*T.*) *terebraeformis* is more easily distinguished from the stouter

which is, however, considered merely an individual abnormality.

species of *Teretrina* by the slender shell shape and, in addition, by the presence of only one keel on the spiral volutions, and from *P. subnodosoides* by the almost complete lack of transverse ornamentation. The differences in whorl profile between the two species are of degree rather than kind.

A certain resemblance, mainly due to the strongly projecting sharp middle keel and the screw- or drill-like shell profile thus produced, between this species and the extremely rare *P.* (*T.*)[1] *trochleata* (Münster) from St. Cassian (see Kittl, 1894, p. 216, *cum synon.*, pl. 8, fig. 31, pl. 9, fig. 2) may be mentioned. If the latter species is judged not by Münster's type (Kittl, pl. 9, fig. 2), but by Kittl's second specimen, said by that author to be better preserved, it can be seen to differ from the Peruvian one by a less acute pleural angle, lower whorls, and mostly by its low, somewhat truncate base and depressed aperture.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	NO. OF SPECIMENS
86	27164	37
48	27164/1	28
71	27164/2	1(a doubtful juvenile)
Total		66

Promathilda (?Teretrina) sp. indet.

DESCRIPTION (INCLUDING DIMENSIONS): By way of appendix to the subgenus *Teretrina* some shells from lot 87 are here dealt with.

They range in total height from about 3.5 mm. to about 22 mm.; their pleural angles vary from 38 degrees in the smallest shell to 28 degrees in the largest, and their widths and heights of spires, where measurable, between *ca.* 44 and *ca.* 43, and *ca.* 42 and *ca.* 48, respectively.

The surfaces are badly worn and in part encrusted, but revolving keels of the pattern common in *Teretrina* are recognizable in some specimens, best in A.N.M.H. No. 27557:4.

EARLIEST ONTOGENETIC STAGES: In two individuals (A.M.N.H. Nos. 27557:1 and 27557:3) the nucleus can be recognized to be alloiostrophic.

REMARKS: These poorly preserved specimens seem to belong to *Promathilda, sensu lato*, and within this genus to *Teretrina* whose arrangement of revolving keels they show. These keels seem, however, to be much less pronounced than they usually are in that subgenus. The present form is therefore only doubtfully referred to *Teretrina*. It can even less be assigned to any of the species of *Teretrina* described above, not excluding *P.* (*T.*) *intermedia* with which it agrees fairly well in dimensions.

The specimens here dealt with somehow resemble, perhaps in poor preservation as much as in shell shape, *Tyrsoecus* (*T.*) *obtusus* from the lithologically similar lot 37 (above, p. 131). The latter species can readily be distinguished by the presence of peripheral nodes.

OCCURRENCE: Occurs in lot 87 only, eight specimens (A.M.N.H. No. 27557).

SUBGENUS **CLATHROBACULUS** COSSMANN

When establishing this section, Cossmann (1912, pp. 3, 7) made the "galbe cylindracé" and the "base imperforée" its distinctive characters. In addition to the subulate, subcylindrical shell shape and the lack of an umbilical opening or even an umbilical niche, the flat or gently convex but not angular whorl profile may be mentioned as a characteristic feature of *Clathrobaculus*, which deviates so far from the main groups of this genus that it may be considered a true subgenus rather than a section. Another peculiarity is that the keels do not ride like gables on angulations of the whorl profile but, although projecting, somehow cling to the shell surface.

In the material under study this subgenus is represented by a comparatively rare new species, *P.* (*C.*) *subulata*, in lots 48 and 86 and by a single shell, which is apparently not conspecific, in lot 31. Furthermore, a rare form in lot 26, of turritellid shell shape with gently convex, rounded whorl profile and up to eight closely set, almost uniform revolving keels, *P.* (*?C.*) *gracillima*, is, though doubtfully, also referred to this subgenus. With altogether only 31 specimens, it is by far the most rare subgenus of *Promathilda* in Peru.

[1] Cf. Cossmann (1912, p. 6).

Promathilda (Clathrobaculus) subulata, new species

Plate 13, figures 43–52, 59, 69

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27167:1	*ca.* 1.51 mm.	*ca.* 44½	*ca.* 55½	32°
27167:2	*ca.* 1.90	*ca.* 44	*ca.* 48½	34°
27167:3	2.13	39½	60½	29°
27167:4	2.35	41	57	29°
27167:5	2.41	39½	53½	28°
27167:6	2.90	37	65½	27½°
27167:7 (syntype A)	*ca.* 3.24	*ca.* 39	*ca.* 61½	26°
27167:8	*ca.* 3.73	*ca.* 32	*ca.* 62	25°
27167:9	5.31	28	64	23½°

The largest specimen measured above is surpassed in size by the incomplete shell A.M.N.H. No. 27167:10 (syntype B) which, when complete, may have reached a height of about 6½ mm.

With the exception of specimens 2 and 6, whose development appears to be retarded and accelerated, respectively, the above table excellently displays the continuous decrease of W and π and increase of h, thus confirming the validity of the growth trends observed throughout this genus.

SELECTION OF TYPES: The well-preserved, medium-sized shell number 7 and the fragment number 10, which shows mature whorl profile and ornamentation best, are designated syntypes A and B, respectively.

DESCRIPTION: Shell shape subulate, with low whorls, 13 of which can be counted in the largest complete shell (no. 9), short, truncate, gently concave base, and solid, heavy columella which can be seen in the partly broken paratype number 11 (fig. 52) to be slightly cordscrew-shaped. No umbilical niche. Aperture depressed, subrhomboidal, with short, wide, shallow anterior notch pointing slightly to the left (paratype no. 9; fig. 50).

The greatest width of the whorl profile is marked by a strong, far-projecting main keel which is situated at the lower third of the whorl height and in maturity even a little lower. As seen best in paratype number 9, this keel carries even at a medium stage about 18 distinct, fair-sized beads per whorl. In syntype B, representing the mature stage, about 12 rather heavy, spirally elongated nodes can be counted per whorl instead. In the body whorl the main keel is closely followed by, and separated by a furrow-like interspace from, a single base keel which is weaker but quite sharp. Inside this keel a faint indication of a revolving striation can be seen on the base of syntype B only. There is furthermore a weak subsutural keel which appears only comparatively late. Thus it cannot be seen in syntype A which attains about 3¼ mm. in size but is well recognizable in the somewhat larger paratype number 11 (figs. 51, 52). In syntype B only it is crowned by a subsutural ledge ("Nahtfacette"). This ledge makes the sutures, which at the most can be said to be shallowly engraved at earlier stages, appear distinctly channeled. In the same shell both subsutural and base keels show faint undulations corresponding in site to the nodes of the main keel. Indistinct continuations of these nodes on the band above the main keel may be growth folds, just as the beads mentioned in earlier stages may be produced by growth folds or bundles of growth striae crossing the main keel. However, no individual striae can clearly be observed in any specimen examined.

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the nucleus can be observed in paratypes 1, 4, and 8, best in the last, where the nuclear volutions are somewhat loosely coiled (fig. 59). In the same shell the main keel becomes recognizable in the second postnuclear volution (fig. 69).

REMARKS: The characteristics of *Clathrobaculus* serve readily to distinguish *P.* (*C.*) *subulata* from all other Promathildae so far dealt with in this report. The two following forms, both only doubtfully referred to the same subgenus, are compared with *subulata* below.

There exists a *P.* (*C.*) *subulatissima* (Hébert and Eudes-Deslongchamps, 1860, p. 200, pl. 1, fig. 10) from the Callovian of Montreuil-Bellay, France, originally described under the generic name *Turritella*, but transferred to this genus and subgenus by Cossmann (1912, p. 8). With a pleural angle of only about 13 degrees, its trivial name may well be the superlative of that of the Peruvian species. It differs from the latter by having two lateral keels.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27167	21
86	27167/1	1 (incomplete juvenile)
Total		22

?Promathilda (Clathrobaculus), new species

Plate 13, figures 54, 60

DIMENSIONS

A.M.N.H. No.	H	W	h	π
27168	7.87 mm.	29½	73½	25°

DESCRIPTION: This single shell, consisting of at least 15 volutions, agrees with *P.* (*C.*) *subulata* in shell shape, whorl profile, number, site, and relative strength of the revolving keels, and in the characters of base and aperture. But two minor differences in ornamentation seem to exclude conspecificity. Although the main keels of two early volutions have a faint indication of beads, those of later ones show no sign of beads or nodes but are smooth. Furthermore, a fine and dense revolving ornamentation, consisting of from eight to 10 lirae, covers the whorl, not excluding the main keel.

Here and there eight or nine growth folds per half whorl can be seen to run unusually steeply backward over the apical band.

EARLIEST ONTOGENETIC STAGES: Strangely enough, the protoconch is inflated like a balloon, and twice as high as, and somewhat wider than, the following (second nuclear) volution. The next (first post-nuclear) whorl assumes the characteristic profile of this species.

REMARKS: Despite the close similarity of this shell to *P.* (*C.*) *subulata*, the peculiarities of the nucleus, so different from the nuclear characters otherwise prevailing in *Promathilda*, make reference even to this genus doubtful. Of course they may represent some individual abnormality, but caution requires a question mark in referring this specimen, which would not justify creation of a named species, to this genus and subgenus.

OCCURRENCE: A single specimen in lot 31 (A.M.N.H. No. 27168).

Promathilda (?Clathrobaculus) gracillima, new species

Plate 13, figures 55–58, 64, 65

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27165:1	*ca.* 2.24 mm.	*ca.* 30	*ca.* 57½	27½°
27165:2	2.63	34½	57½	27°
27165:3 (syntype A)	3.14	28½	59	26°
27165:4	3.64	24½	67	23°
27165:5 (syntype B)	6.14	24½	70½	20°

Both syntype B and a shell of which only the body whorl is preserved (no. 8) may be estimated to have reached, when complete, a total height of about 9 mm.

In the above measurements decrease of W and π, and increase of h, with growth can clearly be recognized.

SELECTION OF TYPES: The juvenile number 3, complete with nucleus, and the largest specimen present (no. 5), which lacks the body whorl but shows the revolving ornamentation best, have been selected for syntypes A and B, respectively.

DESCRIPTION: Syntype B consists of 13 volutions but when complete must have had at least one more. Shell turritellid in shape, with rounded-convex whorls, moderately high, concave base, and subelliptical aperture which ends in a shallow, comparatively long canal pointing slightly to the left (figs. 56, 57). Columella solid. No umbilical niche present.

The revolving ornamentation consists of altogether eight keels which are equally spaced all over the whorl height but not equally strong. The keel immediately above the suture is rather weak and is separated by an interval, somewhat more deeply engraved than the others, from a group of four keels which cover the lower two-thirds of the whorl and seem to decrease in width upward. Their intervals are considerably narrower than the keels. Three more, weaker and less conspicuous keels, or lirae, follow in the upper third of the whorl height (syntype B; fig. 65). No keel can be seen on the base of any examined specimen beneath the supersutural keel.

Growth folds which run in a flat, forward open arc all over the whorl can only indis-

tinctly be recognized here and there in both syntypes.

EARLIEST ONTOGENETIC STAGES: Almost all of the seven shells present have the nucleus preserved. In all but one (no. 6) it is alloiostrophic, as it is throughout the genus *Promathilda*, most distinctly so in paratype number 1 and syntype A (figs. 58, 55, 56). In the latter, already the first post-embryonic volution has the same shape as all the following volutions. Paratype number 6 is remarkable for having even a slightly heterostrophic nucleus. It consists of about one and two-thirds volutions coiled in a plane which stands vertical, i.e., at a right angle, to the planes of coiling of the post-embryonic whorls, thus agreeing with Cossmann's (1912, p. 4) description of the nucleus in *Promathilda, sensu stricto*, as a "protoconque in forme de crosse [=crosier]" even better than his text figure 2, which shows merely an obliquely inclined nucleus. This initial coil of paratype number 6 starts sinistrally and turns dextral only about one volution later. This is the more remarkable since the genus *Mathilda* is truly heterostrophic (Cossmann, 1912, p. 9). Most unfortunately, the smaller half of the initial coil under discussion (the diameter is about $\frac{1}{3}$ of 1 mm.) was knocked off by accident in the course of microscopic preparation, before the photograph (fig. 64) was taken, and could not be recovered.

REMARKS: The rounded convex whorls and the considerable number of revolving keels readily distinguish this species, which considering the size is the most aculeate of all the Peruvian Promathildae, from all the others.

Similar species are found thoughout the Jurassic rather than in Triassic faunas, for example, *P. (C.) multilirata* Cossmann (1912, p. 8, pl. 6, fig. 11), *P. (C.) abbas* (Hudleston, 1892, p. 230, pl. 17, fig. 2), and *P. (C.) strangulata* (Hudleston, *op. cit.*, p. 233, pl. 17, fig. 5), all of which are referred to the subgenus *Clathrobaculus* by Cossmann (1912, p. 8). On the other hand, that author (1912, p. 5) includes *Turritella opalina* Quenstedt (see Hudleston, *op. cit.*, p. 231, pl. 17, fig. 3) and its var. *canina* Hudleston (*op. cit.*, p. 232, pl. 17, fig. 4) in *Promathilda, sensu stricto*. However, they are believed also to belong to the subgenus *Clathrobaculus* which they resemble not only in shell shape but also in lacking an umbilical niche.

This last (negative) character suggested, *faute de mieux*, reference of the present species to *Clathrobaculus* within the genus *Promathilda, sensu lato*. It is believed that all these "multilirate" forms differ, however, by their numerous keels and rounded whorl profile essentially from the typical *Clathrobaculus*. For in the latter, to judge by the subgenotype, *Cerithium zic-zac* Eudes-Deslongchamps (1842b, p. 198, pl. 11, figs. 8. 9), the ornamentation is dominated by a thick main keel at or about the middle of the whorl and the profile is, regardless of that main keel, essentially cylindrical, not convex. Therefore *P. (C.) subulata* and *?P. (C.)*, new species, appear to be properly referable to *Clathrobaculus*, whereas *P. (?C.) gracillima*, although belonging to *Promathilda, sensu lato*, can, within this wide genus, only tentatively be included in that subgenus. Establishment of a separate subgenus for these "multilirate" forms with rounded, convex whorl profile may be necessary.

Finally, the resemblance between these forms and the Carboniferous genus *Aclisina* de Koninck, type species *A. striatula* de Koninck (see Cossmann, 1915, p. 258, fig. 61), should be noted, which extends even (according to Cossmann) to the "protoconque deviée en crosse."

OCCURRENCE: Occurs only in lot 26, eight specimens, including fragments (A.M.N.H. No. 27165).

VERMETIDAE

?VERMICULARIA LAMARCK

The two following fragments would agree in geologic age best with *Provermicularia* Kittl (1899, p. 86), relegated to subgeneric rank by both Cossmann (1912, pp. 133, 143) and Wenz (1939, p. 678), but they show no indication of the strong longitudinal keels characteristic of Kittl's genus. They are therefore tentatively referred merely to *Vermicularia, sensu lato*, although that genus is in general dextral, whereas the two following forms are sinistral. Still, the possibility that they may be merely worm tubes cannot be excluded; thus even their treatment as gastropods is tentative.

?Vermicularia sp. indet. 1

Plate 13, figures 61–63

DESCRIPTION (INCLUDING DIMENSIONS): The incomplete single specimen, measuring about 1.25 mm. in maximum width and, as preserved, about 0.8 mm. in height, consists of one and a half sinistrally coiled volutions. The first, the first quarter of which is missing, is a wide open ring, whose opening occupies about two-fifths of the total diameter, and lies in one plane. In its first quarter the outer volution is gradually losing contact with the inner one and descends only quite gently. After this stage it becomes wholly detached and starts rather abruptly to descend at an angle of nearly 60 degrees. In so doing, it remains coiled, even a little more tightly than the first whorl.

At the anterior end the whorl profile is transversely elliptical, but the apical face of the first volution is definitely flattened and separated by a pronounced shoulder from the lateral face. The boundary of the latter with the inner whorl face is marked by a second, less distinct edge.

There is no ornamentation except for extremely fine growth striae which in the anteriormost part of the first volution can be recognized to run in a very shallow forward convex arc steeply obliquely backward across the outer face.

REMARKS: As indicated in the paragraph on the genus, the absence of a longitudinal ornamentation, as it is strongly developed in *Provermicularia circumcarinata* (Stoppani; Kittl, 1899, p. 86, *cum synon.*, pl. 18, figs. 1–3), the type species,[1] and in a lesser degree in *P. torsa* (Böhm, 1895, p. 260, pl. 9, fig. 23) and *P. alternans* (Böhm, *ibid.*, fig. 36), constitutes the main obstacle to reference of the Peruvian juveniles to *Provermicularia*. Also the coiling is dextral in that subgenus and, at least in the type species, much steeper than in our juveniles. The latter exhibit an extremely early stage, entirely missing in the known representatives of *Provermicularia*, and the possibility cannot be excluded that the Peruvian juveniles represent the hitherto unknown earliest stage of that subgenus. Still this possibility alone would not justify an otherwise unwarranted subgeneric reference.

A tendency of the last volution to become detached and to descend rather abruptly, as in this specimen, is also noted in a specimen referred above to *Anomphalus helicoides* (A.M.N.H. No. 27548:3), but up to the moment of detachment, it is much more regularly and tightly coiled. This coincidence is not believed therefore to indicate any relationship.

OCCURRENCE: A single incomplete specimen in lot 26 (A.M.N.H. No. 27553).

?Vermicularia sp. indet. 2

Plate 13, figures 66–68

DESCRIPTION (INCLUDING DIMENSIONS): This specimen, measuring also about 1.25 mm. in maximum width and, as preserved, about ⅔ mm. in height, consists of the first whorl and about one-third of the second. Here, too, the initial quarter of the first seems to be missing. In both apical and basal views the central opening occupies a little less than a third of the diameter of the respective coils. In basal view the outline is strongly elliptical but not circular. This shell, too, is sinistrally coiled, but its volutions are nowhere in contact, not even loosely, and the spiral descends, without any abrupt change, at about the same very acute angle (of about 15°) as far as it can be followed.

The apertural opening is transversely elliptical in outline as in the preceding form, but the whorl profile seems to remain so throughout development, without exhibiting any shoulders or edges.

The course of the growth striae seems to be the same as in *?Vermicularia* sp. indet. 1.

REMARKS: The differences in the mode of coiling and in the whorl profile seem to exclude conspecificity of this form with the preceding one.

The remarks in the discussion of *?Vermicularia* sp. indet. 1 on possible relations to *Provermicularia* Kittl and on the inadvisability of referring these juveniles to that subgenus apply to this specimen also.

OCCURRENCE: A single specimen in lot 48 (A.M.N.H. No. 27554).

[1] It is true that the earliest part of the specimen illustrated in Kittl's figure 2 is smooth, but so are mature portions of both this individual and the one shown in figure 1 also, wherever the test is broken off. The same fact may account for the smoothness of that early part also.

PROCERITHIIDAE

Within the material under study this family is represented by six genera (*Protofusus*, *Paracerithium*, *Pseudotritonium*, *Rhabdocolpus*, *Kittlistylus*, and *Cryptaulax*). Three of these (*Paracerithium*, *Rhabdocolpus*, and *Cryptaulax*) have hitherto been believed to appear only in the Jurassic and have not yet been recorded from Triassic deposits.[1] However, as is shown below, *Paracerithium* and *Cryptaulax* actually are represented in the St. Cassian fauna, as are *Pseudotritonium* and *Kittlistylus*, and *Rhabdocolpus* seems to occur with *Protofusus* in the "Horizonte calcáreo-dolomítico" of northwestern Argentina, believed to be of late Triassic age.

Close affinities and gradual transitions between at least some of the above genera can be observed in the Peruvian fanua, suggesting that in later Triassic times they were still nearer to their common origin than later. A phylogenetic evaluation of their similarities and dissimilarities is attempted below (p. 293), and brief remarks on a possible phyletic connection between *Rhabdocolpus* and *Andangularia* are given above (p. 184). At any rate, even the morphologic observations made in this respect, as reported in many of the following descriptions and discussions, suggested certain deviations from the taxonomic sequence of Wenz' handbook, otherwise generally followed throughout the present report. For a proper understanding of these transitions it seemed preferable to begin with the genus *Protofusus* and to proceed first to *Paracerithium*, dealing with *Pseudotritonium* by way of appendix to these first two genera, then to *Rhabdocolpus* and the new genus *Kittlistylus*, here transferred from the Coelostylinidae to this family, and to deal with *Cryptaulax* at the end. For similar reasons, Cossmann's subdivision of the Procerithiidae into the three subfamilies of the Procerithiinae, Paracerithiinae, and Metacerithiinae could not well be applied in the present paper, since it would place *Rhabdocolpus* (treated as a subgenus of *Procerithium* by Cossmann and Wenz, but as an independent genus here) and *Paracerithium* in two different subfamilies, viz., the former in the Procerithiinae, the latter in the Paracerithiinae, whereas the present investigation proves their close relationship. The same holds true for the relation between *Protofusus* and *Paracerithium;* the former genus, although considered a subgenus of *Paracerithium* and thus implicitly referred to the subfamily Paracerithiinae by Cossmann (1925, p. 208), is placed in the Metacerithiinae by both Bonarelli (1927, p. 83) and Wenz (1940, p. 735). It would seem that the correct systematics of this family must await further investigations like the present one on hitherto unknown or insufficiently known Triassic faunas. That its roots reach down into that period can no longer seriously be doubted.

Represented by altogether 25 forms with a total of about 1800 individuals, this family ranks fourth in abundance among those represented in the late Triassic of Peru.

PROTOFUSUS Bonarelli

Bonarelli proposed this genus (1921, p. 73) for three species from Carbajal (Salta province, northwestern Argentina), all three of which together were, however, based on a total of only four individuals.

In revising Bonarelli's study, Cossmann (1925a, p. 208) lumped all three of these species into one (*P. saltensis* Bonarelli) in which he included, in addition, two more species of Bonarelli's which that author had referred to his genus *Brachycerithium* (*B. pauciornatum* and *B. carvajalense*). Simultaneously, Cossmann relegated *Protofusus* to the rank of a subgenus of his genus *Paracerithium*.

In his second paper on the fossils of the petroliferous formation Bonarelli (1927, pp. 83–86) maintained *Protofusus* as an independent genus, not until then giving an elaborate generic diagnosis. Also he maintained the three species originally distinguished by him, while he followed Cossmann in transferring *Brachycerithium carvajalense* to the present genus.[2] Although Cossmann had quite unequivocally designated *P. saltensis* Bonarelli, in the circumscription given that species by its author (i.e., the form illustrated in figs.

[1] Cossmann's (1906, p. 46) reference to two Triassic *Paracerithium* species is doubtful and owing to a confusion in the names used by that author inconclusive with regard to one of them (see below).

[2] He maintained, however, reference of *B. pauciornatum* to *Brachycerithium* (1927, p. 110).

29 and 30 of pl. 11), as the genotype, Bonarelli (1927, p. 83) selected *P. andinus* instead. However, since he could not validly change Cossmann's earlier designation, *P. saltensis* Bonarelli but not *P. andinus* Bonarelli must be considered the type species of *Protofusus*.

In the present report *Protofusus* is treated as an independent genus, as it was by Bonarelli (1921, p. 73; 1927, p. 83) and by Wenz (1940, p. 735).

The generic characters have been elaborated by both Cossmann (1925a, p. 208) and Bonarelli (1927, p. 83) and summarized by Wenz (*loc. cit.*). The two first authors agree in emphasizing the "subcanaliculate" character of the aperture,[1] which shows a true though short beak projecting beyond the outline of the conch, in contradistinction to *Paracerithium*, which has, according to Cossmann, "un péristome arrondi et à peine versant en avant." That author's negative character of the genus "coquille dépourvue de rampe" cannot, however, here be maintained since one of our species, *P. transitorius*, exhibits, except at the earliest stages, a distinct subsutural ledge. That species, it is true, is transitional to the genus *Paracerithium*, but once the short beak of the aperture is considered the distinctive generic character of *Protofusus*, *P. transitorius* must be referred to the latter genus rather than to the former. Moreover, the words "suturis gradatis" in Bonarelli's generic diagnosis seem to suggest that there is indeed a subsutural ledge in his specimens. Actually such a ledge, strongly oblique, is clearly visible in his illustration of *P. andinus* (1927, pl. 3, fig. 12), the species he selected, though invalidly, for genotype, and, though less distinctly, also in that of *P. carvajalensis* (*ibid.*, fig. 10).

Within the present material altogether eight forms are referred to this genus; only five of them have, however, been given specific names. All these forms add to a total of about 920 specimens, as compared to only six in Bonarelli's material. With that total, *Protofusus* is by far the most abundant genus of the Procerithiidae in the Triassic of Peru.

[1] Cossmann: ". . . un véritable bec échancré. . . ." Bonarelli: ". . . canale brevissimo. . . ."

Protofusus peruvianus, new species

Plate 14, figures 1–8, 10–12, 16, 19, 20

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26584/1:1	*ca.* 1.34 mm.	*ca.* 62½	*ca.* 29	*ca.* 53°
26584/2:1	1.46	61½	31	54°
26584/1:20	2.00	59	25½	50°
27584/1:16	2.02	58½	25	60°
26584/1:21	2.02	55½	28	55°
26584/1:25	2.18	56½	31	53°
26584/1:22	2.24	57½	30	60°
26584/1:17	2.30	58½	29½	58½°
26584/1:18	2.35	65½	35½	51°
26584/1:2	2.35	59½	28½	62½°
26584/1:3	2.38	57½	30½	57½°
26584/1:4	2.41	58	30	55°
26584/1:5	2.74	57	34½	52°
26484/1:6	2.80	58	32	51°
26584/1:7	2.90	57	30	50°
26584/1:23	2.90	60	34½	52½°
26584/1:8	2.99	53	33½	50°
26584/1:24	3.00	55½	30½	51°
26584:1	3.07	59½	32½	56½°
26584/1:10 (syntype A)	3.15	57½	34½	51°
26584/1:11	3.49	52½	36	48°
26584/1:26	3.73	51	33½	50°
26584/1:12	*ca.* 4.32	*ca.* 51½	*ca.* 36	45°
26584/1:13	4.44	48½	35	41°
26584/1:14	4.68	48½	38½	42°
26584/1:15	4.92	53½	34	41°
26584:2 (syntype B)	6.00	50	34	42°
26584:3 (syntype C)	9.12	43½	34½	33½°
26584:4	10.92	45	37½	32½°

As in other members of this family, in this species also W decreases and h increases with growth, whereas the pleural angle seems first somewhat to increase and to decrease only from a size of about 2½ mm. on, most decidedly so after a height of about 3½ mm. is reached.

SELECTION OF TYPES: One more or less complete and representative individual each among the small, medium-sized, and large shells have been selected as syntypes A (A.M.N.H. No. 26584/1:10), B (A.M.N.H. No. 26584:2), and C (A.M.N.H. No. 26584:3), respectively.

DESCRIPTION: Shell shape rather high-spired but with a somewhat bulging body whorl. The volutions, nine of which can be counted in the largest shell present (A.M.N.H. No. 26584:4), are quite convex, thus making the sutures appear deeper than

in other species of this genus. There is an indication of an apical band, at least in later growth stages (syntype C; figs. 4, 5), but it is not separated by a clear-cut shoulder from the lateral whorl face and thus not so clearly defined as the ramp is in the following genus *Paracerithium* or in the transitional species *P. transitorius*. The spiral whorls exhibit the maximum width somewhat below half the height. The base is not separated by any distinct shoulder from the upper part of the body whorl; it is comparatively high and distinctly concave. The aperture is ear-shaped and rather narrow; it has a distinct angulation at its upper end and a rather short and narrow canal which points slightly to the left, as does the columellar border. In both syntypes B and C and, better still, in the largest paratype (A.M.N.H. No. 26584:4) the inner lip can be seen to be thickened and reflexed over the columella; it is accompanied at the outside by a shallow but distinct groove which simulates an umbilical niche. In the crippled paratype A.M.N.H. No. 26584/1:29 (which almost equals the largest individuals from lot 78 in size, while being almost twice as large as the second largest from lot 48, A.M.N.H. No. 26584/1:15), this furrow is filled in with shell substance except in its lowermost part. The columella, which is slightly sinuous in its visible part, is found at a transverse fracture of that crippled shell to have a fine perforation.

The ornamentation consists predominantly of transverse ribs which run in a shallow, forward concave arc from suture to suture. They follow a radial direction in the early stages (syntype A; figs. 11, 12) and maintain it in many individuals (syntypes B and C; figs. 1–5), still in maturity, whereas in others (paratype A.M.N.H. No. 26584:4) they change to a slightly backward direction. The last-mentioned shell also serves well as an example of those in which the ribs of consecutive volutions (the three last in this particular example) touch each other with their contiguous ends so as to form continuous ledges across several whorls (figs. 16, 19, 20). In some individuals, as in syntypes B and C, the upper ends of the ribs tend slightly to overtop the suture, thus lending it a somewhat undulant aspect (figs. 1–5). Especially in maturity, the ribs do not end at the boundary of the base but pass into it, gradually vanishing as in syntype C, or remaining quite distinct as in paratype A.M.N.H. No. 26584/1:29 (fig. 7). Syntype C deserves special mention as one of those shells in which the costae assume the shape of broad, low folds on the body whorl (figs. 4, 5). The costation tends, as a rule, to become less dense in the course of development. Ten ribs can be counted on the body whorl of the smallest syntype (A), nine on that of the medium-sized syntype (B), and only eight on the largest syntype (C). However, the largest paratype (A.M.N.H. No. 26584:4), although somewhat exceeding syntype C in size, and the incomplete paratype A.M.N.H. No. 26584:6 have 10 ribs each still on their body whorls, and paratype A.M.N.H. No. 26584:5 (figs. 19, 20) even has 11. A revolving striation is just discernible, thanks to the denticulations it produces on the ribs, in some shells, best in paratype A.M.N.H. No. 26584:6 on the penultimate whorl of which seven such denticulations can be counted. In others (syntype C) only faint traces of such a striation can be recognized, but individual revolving threads cannot be made out in any shell.

EARLIEST ONTOGENETIC STAGES: The nucleus, in most of the shells where it is well preserved, such as syntype A and paratypes A.M.N.H. Nos. 26584/1:27, 26584/1:28, 26584/1:30, and 26584/1:31 (fig. 10), is just a little inclined towards the axis of the conch, but it can clearly be recognized to be alloiostrophic in paratype A.M.N.H. No. 26584:5 (fig. 20). In this species also the nuclear and the first post-nuclear volutions are smooth; costation sets in on the fourth whorl only.

REMARKS: From all the other species of this genus in the present material this one is readily distinguished by its more convex whorl profile, particularly by its bulging body whorl. The discussions of *P. gracilis*, *P. pyramidalis*, and *P. transitorius* contain comparisons with *P. peruvianus*.

Protofusus peruvianus is the only species of this genus in the assemblage under study that somewhat resembles in general shell shape and sculptural character one of Bonarelli's Argentinian species, namely, *P. carvajalensis* [Bonarelli, 1921, p. 73 (*sub Brachycerithium*), pl. 11, fig. 28; 1927, p. 84, *cum synon.*, pl. 3, fig. 10], but aside from

CHART 1

LATE TRIASSIC GASTROPODS FROM CENTRAL PERU– DISTRIBUTION BY LOTS AND CORRELATION WITH SOME OTHER FAUNAS

CERRO DE PASCO REGION

- JENKS' WESTERN FACIES
  - "MYOPHORIA" LIMESTONES
  - BITUMINOUS LIMESTONES
- JENKS' EASTERN FACIES
  - "MYOPHORIA" LIMESTONES
  - BITUMINOUS LIMESTONES
  - nr. HUACHON
  - LIGHT LIMESTONES

4 KM. E. OF TILARNIOC

OVER-ALL ABUNDANCE

PERU

- NORTHERN
  - Suta (Jaworski)
  - Acrotambo (Körner)
  - Huairas (Jaworski)
- CENTRAL
  - CERRO DE PASCO REGION (Jaworski)
    - "Myophoria" Limestones
    - Junin Boulders
    - Ulachin Boulders
  - (Cox)

N.W. ARGENTINA (Bonarelli)

- Carbajal
- Tres Cruces

EUROPE

- ALPS
  - HALLSTATT LIMESTONES (Koken)
    - Carnian
    - Norian
  - SOUTHERN ALPS (Kittl and Others)
    - Marmolata Limestones
    - Esino Limestones
    - St. Cassian, etc.
    - Rhaetian, M. Nota (von Ammon)
- FRANCE
  - Liassic (Cossmann and earlier Authors)

TAXONOMIC NAMES	37†	15†	16A*	35*	87	91	2†	3†	19†	21†	40†	#49	51†	53†	22†	56*	57*	96	97*	33*	34†	42†	29†*	45	31*	38*	67†	24*	26†*	76*	73*	69	70	71	78	86	48	O.A.
Pleurotomariidae																																						
?Worthenia rhombifera																				vr									er									
new species 1																													vr									
new species 2														er							vr								vr									
basifalcata														?vr								er							vr									
Sisenna																																er						
new species 1																																						
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aff. excelsiori																																						
Pareuryalox perornata																																						
Ptychomphalina cf. protei																																						
discoidea																																						
species indet. 1																																						
species indet. 2																																						
Pleurotomaria ex affin. P. haueri																																						
Murchisoniidae																																						
Trypanocochlea new species																																						
Euomphalidae																																						
Euomphalus new species																																						
Phymatifer peruvianus																																						
Discohelix species																																						
Brochidium vareasense																																						
species indet. 1																																						
species indet. 2																																						
Platyacridae																																						
Platyacra (Asperilla) species indet.																																						
?Lepidotrochus species indet.																																						
?Hyperacanthus juvenile form 1																																						
juvenile form 2																																						
Cirridae																																						
Hesperocirrinae																																						
Hesperocirrus robusteornatus																																er	vr			nr	nr	
triasicus																																				nr	nr	
new species																																vr					vr	
striatus																																				r	r	
modestus																																? er				nr	nr	
species indet.																																er				r	nr	
Sororcula gracilis														vr						vr			er				er	r							vr	r	
costata																													vr							r	r	
species indet. ?														er			er																				vr	
Acmaeidae																																						
?Acmaea species indet.																																				vr	vr	
Trochonematidae																																						
Guidonia peruviana																																	r			c	c	
planetecta																													vr				r			fc	?er	c
intermedia																																	vr			fc		fc
parvula																																				c		c
bifasciata																																				c		c
species ?			vr																																	vr		
Anomphalidae																																						
Anomphalus helicoides																																				r		r
biconcavus																				er																vr	vr	
amorphus																																				vr		vr
Paraturbinidae																																						
Chartroniella pacifica												r	er		vr					vr		er	vr		vr	vr		vr								nr		
wortheniaeformis												?vr	er							vr								vr								r		
species indet. ?																																er				er		
Amberleyidae																																						
Eucyclus denticulatus													er																							r	nr	
Trochidae																																						
Solariella (Eosolariella) pusilla																																						
brevispira																				er																		
distincta																																	vr	er	nr	r	vr	r	
Solarioconulus ?nudus																																						
elegans																																				?er	vr	vr	
ninacacanus																																				r	r	
infrequens																																				r	r	
?Callotrochus species indet.														vr																						vr	vr	
Calliostoma (Eocalliostoma) concavum																																				vr	vr	
?körneri																													r								r	
?Amphitrochus species indet.																																				er	er	
Turbinidae																													vr								vr	
Eucycloscala pascoensis												er				er				vr									vr								r	
cf. baltzeri																													er								er	cf
Homalopoma (Boutillieria) subcinctum												vr																	er						er	er	r	=
spec. nov.																													er								er	?
Pseudomelaniidae																													vr								vr	
?Oonia ?subtortilis																																						?
?Ramina andina																														er								?
Loxonematidae																																						
Loxonematinae																																						
Loxonema (Polygyrina)																																						
species indet. 1						?er									?er														vr						?er		vr	
species indet. 2																													er								er	
Zygopleurinae																																						
Zygopleura (Katosira)																																						
species indet. 1																	er								vr											vr	
species indet. 2																				er		er							er								vr	
cf. beneckei,			er																		er								er								vr	cf
species ?											er																		er								er	
(Kittliconcha) peruviana																																			nr	?vr	fc	c	=	=
dissimilis																																			c	r	c	
species indet. ?																																				er		er		=
(Allostrophia) species indet.									er																												er		
(Anoptychia) tambosolensis																									er				c							?vr	c	
tilarniocensis																													c							r	c	
ninacacana					?er																															vr	r	
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species indet. 2																												er									er	
(?Allocosmia) species indet.																										er											er	
Tyrsoecus (Tyrsoecus) andinus	vr																																				vr	
obtusus	vr																																				vr	
species indet. ?			er																																		er	
Coelostylinidae																																						
Coelostylina cylindrata																					er								r							vr	r	
species indet. 1																													er								er	
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cf. medea																													er								vr	cf
species indet. 2	vr																												vr								vr	
Omphaloptycha jaworskii																													er			er	r	r	r	ec	fc	ec	cf
jenksi																																	r	vr	r	?er	vr	nr	?
speciosa						er																														fc	nr	c	
cf. speciosa																													vr								vr	
new species																																				vr		vr
cacuana				?er	?er	fc																																fc
?Gigantogonia species											er																											er
Undularia cf. disputata																													er	?er							vr	cf
Pustulifer peruvianus	vr							vr		vr	er								er																	r	
species indet.																														vr							vr	
Toxoconcha gracilis																er											?er		vr								vr	=
Protorcula new species																													er								er	=
?Glyptochrysalis juvenile form, aff. anthophylloidi																													er						er	vr	aff
Spirostylidae																																						
Spirostylus peruvianus																													r							r	r	=
species indet.																													er								er	
Euthystylus species indet.																													er								er	=
Neritopsidae																																						?
Naticopsinae																																						
?Marmolatella species								er																													er	
Neritopsinae																																						
Neritopsis decussata					?er																								er							r	r	=
Neritidae																																						=
Neritinae																																						
Neritaria obliqua																													er							ec	ec	
dicosmoides		er			vr																												vr	?er	er	vc	r	vc
hologyroides					?vr																												vr	vr	?vr	c	vr	c
ninacacana																																		vr		c		c
distincta																																	r	r	nr			fc
aff. distinctae																																				er		er
species ?								vr																												vr		vr
Trachynerita tambosolensis																																			?			
porrecta																													er					vr			vr	=
evoluta							vr	vr		r																				?er							er	=
Oncochilus peruvianus																																						
Lacunidae																																						
Heterospira simulatrix																																						
Purpurinidae																																						
Andangularia aff. subarmatae																												er		?er						er	vr	aff
Pseudoscalites new species																													vr								vr	=
Mathildidae																																						
Promathilda (Promathilda) subnodosoides																																						
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aff. perarmatae																																				nr	nr	
(Teretrina) bolinoides																																				vr	vr	aff
aculeata																																	r	r	r	ec	fc	ec	sim
intermedia																																	r	vr	r	ec	c	ec	
species																																				er		er	
obtusa																																				ec	nr	ec	
eucycloides													vr																	?vr							r	r	r	
tilarniocensis																													er							nr	nr	nr	
terebraeformis																																		?er		nr	nr	r	
species indet.					r																																	
(Clathrobaculus) subulata																													er							r	r	
new species																									er												er	
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sensu lato, species indet.														er										er												vr	
Vermetidae																																						
?Vermicularia species indet. 1																													er								er	
species indet. 2																																				er	er	
Procerithiidae																																						=
Protofusus peruvianus																																			nr	vr	fc	fc	
gracilis																																				r	c	c	
delicatulus						er																														c	c	c	
species indet.																																				er		er	
pyramidalis																																				r	fc	fc	
aff. pyramidali																													vr							er	vr	r	
transitorius																																				nr	fc	fc	
aff. transitorio																																				vr		vr	
Paracerithium tambosolense																																			nr	?er	vr	nr	=	=
turritellare																														?er			nr	r			nr	fc		
porrectum																																	nr	r		r	nr			
aff. porrecto																																				er		er		
vixstriatum																																				fc	r	c		
aff. vixstriato																																				vr		vr		
?Pseudotritonium species indet.																																						?
Rhabdocolpus subulatus																													vr							er	vr	
species indet. 1, aff. subulato																													r								r	
species indet. 2, aff. subulato																													r								r	
praeco					?er												vr												r	?er							vr	c	c	
rursicostatus																																						r	r	
emaciatus																																						r	r	
Kittlistylus flexuosus																													vr								vr	
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Cryptaulax rhabdocolpoides																													r								r	
tilarniocensis																																				r	r	
Xenophoridae																																						
Jurassiphorus triadicus																													vr								vr	
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?Aporrhais (Cuphosolenus) new species																													vr								vr	
Acteonidae																																						
Cylindrobullina (Cylindrobullina) vespertina					?er																er												er	er	nr	c	c	vc
avenoides												?er		vr																					vr	r	r	nr
aff. avenoidi																																				vr	vr	r	
obesa																																			r	fc	nr	c	
pyrulaeformis																																			vr	?vr	vr	r	
aff. pyrulaeformi																																					vr	vr	
tenuicostata																																					r	r	
(Conactaeon) peruviana																													vr	?er					r	fc	fc	c	=
aff. peruvianae													er																	er									er	
cf. decorata																																		er			vr	vr	r	cf
tilarniocensis																														er							r	r	
(Euconactaeon) tambosolensis																																							=
ninacacana																																			nr	vr	r	nr	
Consobrinella elegantula																																				r		r	
	37†	15†	16A*	35*	87	91	2†	3†	19†	21†	4†	#49	51†	53†	22†	56*	57*	96	97*	33*	34†	42†	29†*	45	31*	38*	67†	24*	26†*	76*	73*	69	70	71	78	86	48	O.A.

being smaller, it has a more convex whorl profile, deeper sutures, and a denser costation.

In general shell shape it also superficially resembles *Paracerithium tambosolense*, with which it is associated in lot 78; it is compared with it in a discussion of that species below.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	26584	28
48	26584/1	79
86	26584/2	3 (juveniles)
Total (including fragments)		110

It is worth noting that most of the specimens in lot 48 are of small or medium size; the largest occurs in lot 78.

Protofusus gracilis, new species

Plate 14, figures 9, 13–15, 17, 18, 21–29

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26587/1:1	2.13 mm.	52½	34	44°
26587:15	2.3	51	31½	47°
26587/1:2	2.46	47½	36½	38°
26587:2	2.63	51½	32	41°
26587/1:3	*ca.* 2.63	*ca.* 53	*ca.* 38	45°
26587/1:4	*ca.* 2.63	*ca.* 49	40½	40°
26587:3	2.80	48	36	41°
26587:16	2.82	?56	35½	43½°
26587:4	2.90	48½	37	40°
26587:17	2.90	47	33½	44°
26587:19	2.90	53	37	43°
26587:5	*ca.* 3.07	*ca.* 48½	*ca.* 38	42°
26587:18	3.07	48½	35	40°
26587:30	3.32	50	35	40°
26587/1:5	3.32	47½	37½	39°
26587/1:6	3.49	47½	40½	36½°
26587:13	3.49	47½	38	38°
26587:20	3.49	47½	35½	38°
26587:14	3.65	45½	38½	39°
26587:21	3.65	45½	?32	38°
26587:22	3.73	42	40	37°
26587:6 (syntype A)	3.73	49	40	41°
26587:7	4.07	48	39	37°
26587:23	*ca.* 4.15	*ca.* 46	*ca.* 40	35°
26587:9	4.23	43	41	29°
26587/1:7	*ca.* 4.32	40½[1]	44	30°[1]
26587:10	4.44	51½	40½	35°
26587:8 (syntype B)	4.44	44½	43½	32°
26587:24	*ca.* 4.56	*ca.* 42	*ca.* 39½	32°
26587:25	4.56	47½	39½	35½°
26587:26	4.68	43½	38½	29°
25687:28	4.80	42½	40	30°
26587:11	*ca.* 4.92	*ca.* 46½	*ca.* 39	34½°
26587:29	*ca.* 5.04	*ca.* 39½	*ca.* 43	30°
26587:12 (syntype C)	5.88	41	41	30°

[1] Worn.

The table shows the usual trends, viz., of W and π to decrease, and of h to increase, with growth, but these trends are not so pronounced as in some other species. Several cases of accelerated development are recognizable in some individuals which reach an advanced stage, as expressed in dimensional rates, at a smaller size, i.e., at an earlier age, than others.

SELECTION OF TYPES: Two medium-sized specimens (A.M.N.H. Nos. 26587:6 and 26587:8), one stouter, the other more slender, and the largest well-preserved shell present (A.M.N.H. No. 26587:12), all from lot 48, are designated syntypes A, B, and C, respectively.

DESCRIPTION: This species, except for being markedly more slender, so closely resembles *P. peruvianus* that its description may, to a large extent, refer to that one. Eight volutions are counted in the largest shell measured (syntype C) which attains, however, only a little more than half the size of the largest individual of *peruvianus*. Despite the slenderness of the conch the whorls are clearly convex and the sutures channeled. Only occasionally, as in syntype C (figs. 25, 26), do the projecting upper ends of the ribs produce the impression of an apical band, but even in such shells none can be found in the intercostals. In this species, too, the boundary between the base and the upper portion of the body whorl, which is markedly less gibbous than in the preceding one, is not marked by any pronounced shoulder. The base, otherwise agreeing with that of *P. peruvianus*, appears even higher owing to the slenderness of the conch. The aperture is also quite similar to that of the preceding species, except for its somewhat narrower opening. The anterior canal, best seen in the

fragment A.M.N.H. No. 26587:31 (fig. 24), seems to be slightly longer. Only in a few shells, for example, in syntype A (fig. 29) or in the fragment A.M.N.H. No. 26587:1, can the thin inner lip be seen to be slightly reflexed in its lower part. There is, at the most, only a faint indication of the false umbilical niche observed in *P. peruvianus*, for example, in syntype B (fig. 15), but it must be kept in mind that in the latter species it becomes pronounced only at sizes which are not attained by *P. gracilis*. The fragment A.M.N.H. No. 26587:1 is illustrated in figure 9 for showing clearly not only the shape of the aperture and the anterior canal but also the corkscrew shape of the columella.

The costation resembles in every respect that of *P. peruvianus*. The ribs, which almost without exception follow a radial direction, are either clearly forward concave, as in syntypes A and B (figs. 29, 15), or straight and rather stiff, as in syntype C (figs. 25, 26) in which they run continuously across the two last volutions. At a comparatively early stage their upper ends begin in some shells, for example, syntypes B and C and paratype A.M.N.H. No. 26587:11, to project above the suture. On the other hand, they can in that paratype (figs. 22, 23) and in the anteriormost part of the body whorl of syntype C be followed down into the base. Nine ribs can be counted on the body whorls of syntypes A and C and of paratype A.M.N.H. No. 26587:11 and eight on that of syntype B. Thus the decrease in density of costation seems to make itself felt in this species only in that the total number of ribs does not increase with growth. Revolving striation is discernible in some shells, best on the penultimate and antepenultimate whorls of syntype B, where six revolving striae, or denticulations of the ribs, can individually be recognized (fig. 14), and, though less distinctly, in paratype A.M.N.H. No. 26587:11 where it extends even to the body whorl, not excluding the upper part of the base (figs. 22, 23).

EARLIEST ONTOGENETIC STAGES: Syntypes A and B and paratypes A.M.N.H. Nos. 26587:4, 26587:27, 26587:32, 26587:33, 26587/1:2, 26587/1:5, and 26587/1:6 have the nuclei more or less completely preserved. In most of these shells, for example in A.M.N.H. No. 26587:4 (fig. 13) and in syntype A (fig. 28), the nucleus seems just somewhat inclined towards the axis of the conch. Only in paratypes A.M.N.H. Nos. 26587:27 (fig. 21), 26587:32, and 26587:33 can it be recognized to be alloiostrophic. In this species also, the first ribs appear on the fourth volution.

REMARKS: *Protofusus gracilis* is distinguished from *P. peruvianus* in the description. It is compared with *P. delicatulus*, which it closely resembles in general shell shape and dimensions, and with *P. pyramidalis* and *P. transitorius* in the discussions of these respective species.

The single incomplete shell on which Bonarelli (1921, p. 73, pl. 11, figs. 31, 32; 1927, p. 85, *cum synon.*, pl. 3, fig. 12) established his *P. andinus* seems, to judge by his illustrations, to resemble the present species, but differs, according to his description, by its denser costation ("11 [costae] in quovis anfractu") and by its accentuated revolving ornamentation.

Finally, the close resemblance between juveniles of this species and of *Zygopleura* (*Kittliconcha*) *peruviana* (above, p. 117) should be mentioned, admitting that in some cases they become practically indistinguishable. However, although the other dimensions are about equal, the pleural angle at the same growth stage is more acute in *Z.* (*K.*) *peruviana* and its costation is somewhat denser, sigmoidal and altogether different in character. Whereas there the ribs are hardly perceptible immediately below the suture and reach full strength only in the middle of the whorl height, here they reach in full strength up to the suture or even project above it. That juveniles of both *Kittliconcha* and *Protofusus* also closely resemble in shell shape those of certain species of *Omphaloptycha* is mentioned above, but except in the nuclear and earliest post-nuclear stages the latter can readily be distinguished by the lack of any transverse costation.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	NO. OF SPECIMENS
48	26587	172
86	26587/1	23
Total (including fragments)		195

Among the *Protofusus* species in the present material this species is second in abundance only to *P. delicatulus*.

Protofusus delicatulus, new species

Plate 14, figures 30–52, 55, 63

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26588/1:2	1.79 mm.	59½	34½	41°
26588/1:3	1.85	57½	36½	44°
26588:1	1.96	57	31½	46°
26588/1:21	2.00	56½	28	45°
26588:2	2.02	53	33½	40°
26588:3	2.07	56½	35	45°
26588/1:5	2.07	59½	30	44°
26588/1:6	2.24	52½	32½	42°
26588:7	2.30	49	36½	43°
26588:8	2.35	54½	38	41°
26588/1:7	2.35	53½	31	45°
26588/1:1	*ca.* 2.35	*ca.* 59½	*ca.* 32	46°
26588/1:8	2.46	52½	34	41°
26588/1:24	*ca.* 2.52	*ca.* 55½	*ca.* 33½	45°
26588:11	2.52	49	33½	42½°
26588/1:10	2.58	49	30½	38°
26588/1:11	2.69	52	39	35°
26588:12	2.74	47	39	34°
26588/1:22	2.80	53½	34	44°
26588:13	2.80	49	44	39°
26588:19 (syntype A)	*ca.* 2.80	*ca.* 53	*ca.* 37	39°
26588/1:25	2.90	51½	31½	42°
26588:15	2.91	45	42½	34°
26588/1:12	2.94	48	39½	40°
26588:17	3.07	48½	34	38°
26588:20 (syntype B)	3.15	47½	37	34°
26588:21	3.24	51½	41	35°
26588/1:14	3.24	43½	31	39°
26588/1:15	3.32	50	32½	40°
26588:24	*ca.* 3.57	*ca.* 46½	*ca.* 44	35°
26588:26	3.73	44½	40	*ca.* 31°
26588:27	*ca.* 4.0	*ca.* 43½	*ca.* 39½	37°
26588:28	4.15	44	38	30°
26588/1:17	4.15	44	35	40°
26588:30 (syntype C)	4.32	39	41½	32°
26588/1:18	*ca.* 4.8	*ca.* 43½	*ca.* 42½	33°

The incomplete shell A.M.N.H. No. 26588:31 seems to have reached, of all those present, the greatest size, namely, about 6 mm. in total height.

The table shows about the same over-all picture as that of *Protofusus gracilis* except that here decreases in W and π and increases in h make themselves felt at earlier stages. This holds true particularly for the population in lot 86 (A.M.N.H. No. 26588) where development is somewhat accelerated as compared to that in lot 48 (A.M.N.H. No. 26588/1). It is worth noting that in *P. delicatulus* as well as in *P. gracilis* W, which starts from almost twice the amount of h in the very young, eventually falls below it in the latest stages measured (A.M.N.H. No. 26587:29 in the preceding species, A.M.N.H. No. 26588:30 in the present one). A similar development is observed in the Zygopleurinae, for example, in *Kittliconcha peruviana*, *Anoptychia tambosolensis*, and *A. tilarniocensis* (see above).

SELECTION OF TYPES: A comparatively small shell (A.M.N.H. No. 26588:19) which shows shell shape and character of ornamentation of the earlier stages best is designated syntype A, but since its aperture is incomplete, the somewhat larger shell A.M.N.H. No. 26588:20 with complete anterior canal has in addition been selected as syntype B. Furthermore, the largest shell present with anterior canal preserved (A.M.N.H. No. 26588:30) is, though slightly crushed, designated syntype C to represent mature shell shape and ornamentation.

DESCRIPTION: As the description of *P. gracilis* was given by comparing it with *P. peruvianus*, so the present species, closely resembling *P. gracilis* in general shell shape and dimensions, can best be described by stressing the differences which justify their separation.

The shell shape is slender, biconical; the whorl profile is less convex than in *P. gracilis* and has its greatest width nearer the lower suture; consequently, the sutures appear less deep. Eight volutions can also be counted in this species in the two largest measured shells (syntype C and paratype A.M.N.H. No. 26588/1:18). Body whorl and base seem to be somewhat higher, and the aperture seems to be a little narrower than in *P. gracilis*. In all three syntypes as well as in paratypes A.M.N.H. Nos. 26588/1:12 and 26588/1:18 the thin inner lip can be recognized to be reflexed and accompanied by a fine, narrow groove. The anterior canal is not different from that of *P. gracilis* (paratype A.M.N.H. No. 26588/1:12; fig. 45).

The ribs are more clearly and without exception forward concave and the costation is finer and denser than in *P. gracilis*, there being from 10 to 12 ribs on the body

whorls of all 14 shells in which they were counted. The highest total (12) is found, as a rule, in small and medium-sized specimens; of full-grown ones only paratype A.M.N.H. No. 26588/1:18, the largest shell measured, has 12 ribs on the body whorl. Thus the same relative decrease of density of costation as in other species of this genus is observed in the present one. Paratype A.M.N.H. No. 26588/1:26 stands out by its particularly delicate costation. Furthermore, the costation fades on the body whorl, particularly so in its lower part, in a considerable number of shells (e.g., in paratypes A.M.N.H. Nos. 26588/1:16 and 26588/1:17; figs. 51, 63). Such fading occurs sometimes even at a comparatively early stage (paratype A.M.N.H. No. 26588:23; fig. 52). The upper ends of the ribs do not tend to become prominent and to project above the suture as they do in *P. gracilis*, *P. peruvianus*, and *P. pyramidalis*. Both characters here described are quite in line with the altogether more delicate character of the ornamentation of this species.

Revolving ornamentation can also occasionally be observed, and where this is the case is manifested only by the denticulations produced on the ribs. Five such denticulations can be counted on both penultimate and last whorls in paratypes A.M.N.H. Nos. 26588/1:12 (figs. 44, 45) and 26588/1:16.

EARLIEST ONTOGENETIC STAGES: Most of the many shells with more or less completely preserved nuclei show the usual slight inclination of the nucleus. In only three (syntype C and paratypes A.M.N.H. Nos. 26588:5 and 26588/1:18, figs. 32, 46, 30) it seems alloiostrophic. In this species costation seems to set in only on the third or fourth volution.

REMARKS: Among the congeneric species *P. delicatulus* is well characterized by its graceful shell shape and by its delicate ornamentation which has suggested its specific name.

It is compared below with a single specimen referred to *Protofusus*, but undetermined as to species, and with *Paracerithium vixstriatum*.

The remarks in the discussion of *P. gracilis* concerning the close resemblance between juveniles of *Protofusus* and *Kittliconcha* also hold true for *P. delicatulus*. This species differs from *P. gracilis* in a similar way as *K. dissimilis* differs from *K. peruviana;* thus *K. dissimilis* is the species of *Kittliconcha* which *P. delicatulus* resembles most. Still, the following differences can be recognized: The present species is, at the same size, markedly more slender than *K. dissimilis* and its ribs are stiffer, reach from suture to suture, and fade, if at all, only at a late stage, whereas in *K. dissimilis* they appear rather late and soon disappear again.

A certain similarity between the juveniles of this species and those of both *Rhabdocolpus subulatus* and *R. aculeatus* and the means of distinguishing them are dealt with in the discussions of these species.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
86	26588	205
48	26588/1	153
91	26588/2	1
	Total	359

This species is by far the most abundant of the genus in the late Triassic of Peru.

Protofusus sp. indet.

Plate 15, figures 1, 10

DIMENSIONS

A.M.N.H. No.	H	W	h	π
26589	*ca.* 5.16 mm.	*ca.* 44	*ca.* 42	33°

DESCRIPTION (INCLUDING REMARKS): Although this single shell agrees in dimensions almost perfectly with the largest measured paratype of *P. delicatulus*, it differs so much in certain characters from that species that it cannot be considered fully conspecific. The frustum shape of the spiral whorls and the shallowness of the sutures are even more pronounced, thus causing the shell profile to appear almost unbroken. The ribs, 10 of which are present on the body whorl, are straight and rather stiff and run clearly backward. The revolving ornamentation, producing five denticulations on the ribs between lower shoulder and upper suture, is not so faint, and there is even a distinct lower shoulder, with indication of a revolving keel, at which the ribs end abruptly.

All these differences from the typical *P. delicatulus* bring this shell, on the other hand, closer to the following species, *P. pyramidalis;* it must be considered transitional between both species. In the shape of its body whorl, however, it resembles the former species rather than the latter.

OCCURRENCE: A single specimen in lot 86 (A.M.N.H. No. 26589).

Protofusus pyramidalis, new species

Plate 14, figures 53, 54, 56–62, 64–75; plate 15, figures 5, 6, 15

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26585:37	1.29 mm.	65	26	47°
26585:38	1.45	60	31	49½°
26585:39	1.51	59½	29½	47°
26585:31	1.57	60½	28½	47°
26585:1	*ca.* 1.79	*ca.* 62½	*ca.* 33	50°
26585:2	*ca.* 2.17	*ca.* 62½	*ca.* 35	47°
26585:3	2.17	59½	32½	51½°
26585:4	2.24	57½	27½	50°
26585:5 (syntype A)	2.35	54½	35½	48½°
26585:6	2.52	58	31	48°
26585:8	2.58	56½	32½	48°
26585/1:1	2.63	53	32	46°
26585:29	2.80	50	27	48°
26585:9	2.80	59	32½	48½°
26585:10	2.86	51	35½	48°
26585:30	2.86	49	24½	49°
26585:11	2.90	57	37½	47½°
26585:12	2.90	51½	37	46°
26585:34	2.90	48½	34½	50°
26585:13	2.99	50	36	51°
26585:14	2.99	53	36	51½°
26585:15	*ca.* 3.07	*ca.* 54	*ca.* 40½	52½°
26585:16	3.15	51½	34	50°
26585/1:2	*ca.* 3.15	*ca.* 52½	*ca.* 37	44°
26585:17	3.15	52½	31½	46°
26585:18	3.20	52	27½	55°
26585:32 (syntype B)	3.24	48½	33½	42½°
26585/1:3	*ca.* 3.24	*ca.* 51½	*ca.* 38½	49°
26585:19	3.32	56	32½	44°
26585:20	*ca.* 3.4	*ca.* 53½	*ca.* 34	50½°
26585:21	3.54	47½	37½	42°
26585:22	*ca.* 3.73	*ca.* 51	*ca.* 37½	37°
26585:23	3.90	49	34	37°
26585:24 (syntype C)	4.20	46½	34½	34°
26585:35	4.20	48½	37	37°
26585:25	4.27	43½	37	*ca.* 32°
26585:26	4.32	48½	34½	32°
26585:27	*ca.* 4.8	*ca.* 50	*ca.* 37½	38°
26585:28	5.76	42	35½	32°

A specimen in lot 86 (A.M.N.H. No. 26585/1:4) of which the base is damaged must, when complete, have attained a total height of about 7 mm. The width of the conch tends to decrease with growth, as in other forms of this group. The pleural angle also decreases, but decidedly so only above the size of about 3½ mm. No clear growth trend is, however, recognizable in the height of the spire which remains, with the exceptions presently to be dealt with, throughout development between the limits of 31 and 40½. Specimens A.M.N.H. Nos. 26585:37, 26585:39, 26585:31, 26585:4, 26585:29, 26585:30, and 26585:18, (pl. 14, figs. 64, 65) deviate from the mean by their unusually low spires, but this deviation occurs too sporadically to justify their separation as a morphologic variety. Some other individuals (A.M.N.H. Nos. 26585:21, 26585:25) attain considerably earlier the slenderness and the acute pleural angle that are characteristic of the latest stages examined, obviously owing to accelerated development.

SELECTION OF TYPES: The best-preserved juvenile, medium-sized, and mature specimens (A.M.N.H. Nos. 26585:5, 26585:32, and 26585:24) have been chosen as syntypes A, B, and C, respectively.

DESCRIPTION: Shell shape biconical, characterized, particularly in adults, by the almost unbroken outline of the shell profile all the way from the point of greatest width of the body whorl to the apex. The shell is decidedly stout in the young but becomes increasingly more slender with growth (compare fig. 72 with figs. 66 and 75 of pl. 14). The relative height of the spire, about equaling that of related species in early stages, does not increase in maturity as it does in *P. gracilis*, *P. delicatulus*, and chiefly in the following species, *P. transitorius*. Thus the spire of full-grown specimens is comparatively short, as it is in *P. peruvianus*. Altogether eight or nine whorls, including the nuclear ones, can be counted in the largest shells examined. The spiral volutions have the shape of the frustum of a cone throughout development, with their maximum width at or slightly above the lower suture. The body whorl is decidedly ventricose in the young and soon develops a narrow upper ramp, more distinctly in some shells (syntype A, paratypes A.M.N.H. Nos. 26585:34, 26585:16; pl. 14, figs. 57–60, 73, 74) than in

others, but with growth this apical band becomes less pronounced (syntype B; pl. 14, figs. 53, 54), and almost disappears in maturity (syntype C; pl. 14, figs. 70, 71; paratype A.M.N.H. No. 26585:28; pl. 14, figs. 66, 75). Similarly, the boundary between the lateral face of the body whorl and the base is marked by a blunt edge, sometimes accentuated by revolving twin keels, in early and middle growth stages (paratypes A.M.N.H. Nos. 26585:1, 26585:8, and 26585:16; pl. 14, figs. 72, 56, 59, 60; and syntype A; pl. 14, figs. 57, 58), becomes less distinct later on and has all but disappeared in full-grown shells like syntype C and paratype A.M.N.H. No. 26585:28 (pl. 14, figs. 70, 71, 66, 75). Throughout development the base is somewhat concave, more distinctly so in earlier stages than in late ones, and the aperture ear-shaped and even a little narrower than in *P. peruvianus*. It has a not too pronounced angulation at its upper end and a distinct anterior canal which points at an angle of about 30 degrees to the left. Since the columella must follow this deflection, it is gently sinuous. With growth the beak housing the canal projects to an increasing extent beyond the outline of the conch. Only in some shells, for example, in paratype A.M.N.H. No. 26585:34 and in syntype B, can the thin outer lip be recognized to be slightly reflexed in its lowermost part.

The ornamentation of this species is dominated by its more or less dense and rather stiff costation. The ribs run straight or in a very shallow forward concave arc from suture to suture. Their direction is radial or slightly forward, only at the growth stage exemplified by syntype A and paratype A.M.N.H. No. 26585:11 (pl. 14, figs. 57, 58, 69) a little backward. They cling to the whorl profile, whether or not there be a distinct ramp. At late stages, best exemplified by syntype C and paratypes A.M.N.H. Nos. 26585:26 and 26585:35 (pl. 14, figs. 70, 71, 67, 68; pl. 15, figs. 5, 6, 15) their upper ends distinctly overtop the suture, thus lending it an undulating aspect.[1] As long as there is a distinct laterobasal shoulder, the ribs end there in this species, as they do in *P. transitorius* and throughout the genus *Paracerithium*. As soon as that shoulder has disappeared, that is, in the latest growth stage, the ribs no longer end abruptly but gradually vanish in the boundary zone, as seen in syntype C (pl. 14, figs. 70, 71), or even continue into the base, most distinctly so in paratype A.M.N.H. No. 26585:28 (pl. 14, fig. 66). This mature behavior of the ribs of the body whorl constitutes one of the most distinctive characters of typical members of this genus, as compared with *Paracerithium*. The density of costation decidedly decreases with growth. Sixteen ribs can be counted on the body whorl of one of the smallest shells measured (A.M.N.H. No. 26585:38), the ribbing of which is, however, unusually dense and fine, even compared with that of similarly small shells. There are 11 on paratype A.M.N.H. No. 26585:1, which is not so much larger, but also in the considerably larger paratype A.M.N.H. No. 26585/1:2, 10 in syntype B and in the paratype A.M.N.H. No. 26585/1:3 of the same size but also in the smaller paratype A.M.N.H. No. 26585:12 and in the larger syntype C. In most of the other shells examined, counts on the body whorls yielded a result of nine ribs regardless of size (syntype A and paratypes A.M.N.H. Nos. 26585:8, 26585:34, 26585:14, 26585:16, 26585:18, 26585:35, and 26585:28; all figured) and in only a few (e.g., paratypes A.M.N.H. Nos. 26585:11 and 26585:26; pl. 14, figs. 67–69; the first of medium, the second of full size) of only eight ribs.

As long as there is a pronounced lower shoulder, it is marked more or less distinctly by twin keels which correspond to the peripheral keel of *Paracerithium* plus the keel accompanying it beneath (syntype A and paratypes A.M.N.H. Nos. 26585:1, 26585:8, and 26585:16; pl. 14, figs. 56–60, 72). As a rule a faint striation consisting of five or six revolving threads and producing an equally fine crenulation on the transverse ribs is best observable in specimens with distinct twin keels, as in the three paratypes just mentioned and to a lesser degree in syntype A. Sometimes, however, this fine revolving ornamentation is present even in full-grown shells (e.g., in paratypes A.M.N.H. Nos. 26585:35, 26585:26, and 26585:28; pl. 15, fig. 15; pl. 14, figs. 66–68, 75). With this revolving ornamentation the shallow furrow just above the peripheral keel pres-

[1] Compare Wenz' (1939, p. 732) subgeneric diagnosis of *Paracerithium, sensu stricto:* "... kräftigen axialen Rippen, welche die Naht gezackt erscheinen lassen."

ent in *Protofusus transitorius* and throughout the genus *Paracerithium* can also be recognized here and there, e.g., in syntype A.

EARLIEST ONTOGENETIC STAGES: A considerable number of shells exhibit well-preserved nuclei. As a rule, they are somewhat inclined towards the axis of the conch, for example, in syntype B and paratype A.M.N.H. No. 26585:28 (pl. 14, figs. 54, 66, 75). In a few shells, however, the nucleus can clearly be recognized to be alloiostrophic, best in paratypes A.M.N.H. Nos. 26585:35 (pl. 15, fig. 15) and 26585:36. The nuclear volutions and the first post-nuclear volution are rounded in profile and smooth, as usual. Costation sets in on the second post-nuclear whorl.

REMARKS: *Protofusus pyramidalis* has certain features usually characteristic of *Paracerithium*, namely, an upper ramp and a peripheral shoulder marked more or less distinctly by twin keels, in common with *P. transitorius*, but it is much more readily distinguished from *Paracerithium* than *P. transitorius*, particularly in maturity, when the peripheral shoulder has disappeared and the ribs no longer end abruptly at the boundary between body whorl and base or even continue into the latter.

This species is distinct from all congeners from Peru and northwestern Argentina in its virtually unbroken outline, which suggested the specific name, and from all except *P. peruvianus* in its comparatively short spire. Although it somewhat resembles the last-named species in dimensions, it can readily be distinguished by its narrower aperture, narrower and perhaps slightly longer canal, and the costation which is stiffer and as a rule denser. From *P. gracilis* the present species differs in a similar way as it does from *P. peruvianus*. *P. delicatulus* somewhat approaches *P. pyramidalis* in its shallow sutures, the shape of the spiral whorls, which is like the frustum of a cone, and the rather dense costation. This last character makes distinction of juveniles of both species sometimes rather difficult. In later growth stages, however, the ribbing is much stiffer in *P. pyramidalis*, and the shell profile of *P. gracilis* never appears unbroken to the same extent nor does its body whorl bulge out so widely.

Moreover at early and middle growth stages the paracerithoid characters often serve more easily to distinguish *P. pyramidalis* from all three congeneric species.

A comparison of *P. transitorius* with *P. pyramidalis* is given in the discussion of *transitorius*.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26585	137
86	26585/1	9
Total (including fragments)		146

Protofusus aff. **pyramidali** Haas

Plate 15, figures 2, 3, 11, 12

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26586/2	1.23 mm.	57	32	38°
26586/1:1	*ca.* 2.52	*ca.* 51	*ca.* 35½	36°
26586:1	3.07	46	32½	35°
26586:2	*ca.* 3.49	*ca.* 45	*ca.* 33½	35°

DESCRIPTION: A few shells that otherwise agree with *P. pyramidalis* deviate from it by their markedly more slender shell shape and narrower pleural angle (compare the dimensions) and are therefore here dealt with separately by way of appendix to the preceding species, of which they may represent a variety. Within the sample from lot 26 (A.M.N.H. No. 26586/1) two shells stand out because of denser costation.

REMARKS: Although undoubtedly belonging near *P. pyramidalis*, this form approaches in its slenderness and the flatness of its whorl profile the genus *Rhabdocolpus*. It can readily be distinguished by its more delicate and denser costation, less distinct revolving ornamentation, and chiefly by the lack, even at a comparatively advanced stage, of a pronounced apical band and of true tubercles at the upper ends of the ribs.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26586	2
26	26586/1	3
86	26586/2	1
Total (including fragments)		6

Protofusus transitorius, new species

Plate 15, figures 4, 7–9, 13, 14, 16–24, 28, 29

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26582:1	1.23 mm.	57	36½	40°
26582:2	1.29	52	32½	36°
26582:3	1.43	55	35	37°
26582:4	1.46	54	31	36°
26582:5	1.48	56½	36	39°
26582:6	1.57	50	32	38°
26582:7	1.57	55½	36	37°
26582:10	*ca.* 1.79	*ca.* 53	*ca.* 37½	39°
26582:11	*ca.* 1.79	*ca.* 48½	*ca.* 40½	37½°
26582:12	*ca.* 1.85	*ca.* 54½	*ca.* 38	41°
26582:14	1.90	50	34½	39°
26582:15	1.96	51½	37	38°
26582:17	2.02	53	39	42°
26582:18	2.10	50½	38½	35°
26582:19	2.13	*ca.* 50	37	40°
26582:20	2.21	45½	30½	37½°
26582:21	*ca.* 2.24	*ca.* 48½	*ca.* 37½	35°
26582:22 (syntype A)	2.35	47½	38	40°
26582/1:2	2.44	*ca.* 46	41½	42°
26582:23	2.58	50	39	42°
26582:24	2.86	45	41	36°
26582:26	2.90	45½	42½	39°
26582/1:3	3.32	50	40	46°
26582/1:4 (syntype B)	3.40	49	46	41°
26582/1:5	3.82	41½	41½	39½°
26582/1:6	*ca.* 4.68	42½	48½	36°
26582/1:10	5.40	42	40	35½°
26582/1:7	5.76	35½	44	33°
26582/1:11	6.60	39	47½	31°

The maximum size of this species seems to have been reached by syntype C (A.M.N.H. No. 26582/1:8; figs. 7, 16) which, when complete, must have attained at least 8 mm. in height. The pleural angle in this shell amounts to 28½ degrees.

In this species, too, W tends to decrease, and h to increase, with growth, but both these trends seem to gain momentum only at a late stage, after a height of about 3 mm. is surpassed. It is at the same stage only that the pleural angle, which until then oscillates within the range of from 35 degrees to 42 degrees begins markedly to decrease.[1] It is worth noting, however, that this decrease sets in somewhat earlier in the sample A.M.N.H. No. 26582 from lot 48, in which most of the larger shells exhibit comparatively narrow pleural angles, than in that from lot 86 (A.M.N.H. No. 26582/1).

SELECTION OF TYPES: The small shell A.M.N.H. No. 26582:22, an excellently preserved juvenile, is chosen for syntype A, and specimen A.M.N.H. No. 26582/1:8, which shows nucleus and mature shell profile and ornamentation best, for syntype C, but since the aperture of the latter is missing, the medium-sized shell A.M.N.H. No. 26582/1:4, in which it is quite well preserved, is designated syntype B.

DESCRIPTION: Shell slender, turreted-conical, the surface of the cone from medium growth stages on becoming slightly concave owing to the fact that the whorls increase faster in width than in height. This accounts for the wider and lower aspect of the later spiral whorls, as compared with those of congeneric species (figs. 16, 19, 21, 29). Ten or 11 volutions can be counted in syntype C, but since it is a broken-off spire, there must have been at least one more. Nine are observable in the similar paratype A.M.N.H. No. 26582/1:6, which is not complete either, and seven in syntype B. The early postnuclear whorls are gently convex in profile, with the maximum width somewhat above the lower suture, but at a height of the conch of about 2 mm. a marked upper ramp develops which slopes only gently and is separated by a pronounced shoulder from the lateral whorl face (syntype A, paratype A.M.N.H. No. 26582:26; figs. 8, 22). With growth this apical band becomes ever more pronounced and less inclined, thus causing the upper shoulder to move closer to the upper suture and the whorl profile to become almost rectangular and to approach in this characteristic the genus *Rhabdocolpus*. Still, even at the latest stage observable, the lateral whorl face can be recognized to be slightly convex, with the maximum width now halfway between lower suture and upper shoulder. It is mostly the pronounced ramp that accounts for the deeply channeled appearance of the sutures (figs. 7, 16, 18, 19, 28). The body whorl tends somewhat to bulge out, a character observable at as early a stage as that represented by syntype A (figs. 8, 9) and becoming more distinct at medium (syntype B; figs. 18, 19) and large sizes (paratype A.M.N.H.

[1] The extraordinarily high amount (46°) in paratype A.M.N.H. No. 26582/1:3 is caused by its irregularly gibbous body whorl.

No. 26582/1:10; fig. 17). Its lateral face is separated from the base by a lower shoulder, more distinctly so in youth than in maturity, since the revolving keel accentuating the shoulder is more pronounced in the earlier than in the later stage. The base is rather high and slightly concave. The aperture is oval and its axis runs only a little obliquely to the lower left. There is a blunt angulation at its upper and a distinct though shallow canal at the lower end. The beak housing this canal clearly projects beyond the outline of the conch and points obliquely to the left, as does the lower end of the columella (figs. 9, 17, 18).

The transverse ornamentation consists in youth of perpendicular transverse ribs which run in a straight or slightly forward concave course from the upper suture to the lower shoulder. Nine, which are about as wide as the intercostals, can be counted on the body whorl of syntype A (figs. 8, 9), but only eight, which are much more widely spaced, on that of paratype A.M.N.H. No. 26582:26 (fig. 22) which is only a little larger. This difference foreshadows a trend which becomes even more manifest in the further course of development. For then these ribs increase not so markedly in number (there are 11 on the body whorl of syntype B, 10 each on that of paratype A.M.N.H. No. 26582/1:6 and syntype C, and only nine in paratype A.M.N.H. No. 26582/1:10), but they become increasingly more widely spaced, thinner, sharper, and higher. Their course is, now, straight and perpendicular as a rule. They are clearly recognizable on the apical band as well as on the lateral whorl face and form on the upper shoulder a sharp tubercle, which points outward and slightly upward. In juveniles, as best exemplified by syntype A and paratype A.M.N.H. No. 26582:26 (figs. 8, 22), the peripheral revolving keel is well developed, as is the one accompanying it on its inner side. There are six more thread-like revolving keels, which decrease upward both in strength and in width of interval, on the lateral face of the body whorl. The lowermost is separated by a shallow furrow from the peripheral keel. This is in every respect the ornamentational pattern in most of the species of the following genus, *Paracerithium*. In the further course of development, however, the peripheral keel becomes less pronounced and the one on the base seems to disappear, but still the ribs end abruptly at the lower shoulder. That the fine revolving striation of the sides is less clearly observable in the smaller shells from lot 86 (A.M.N.H. No. 26582/1) than in those of about the same size from lot 48 (A.M.N.H. No. 26582) seems partly owing to differences in preservation. Anyway, in the larger shells from lot 86 the lateral revolving ornamentation undergoes changes similar to those affecting the costation, especially a decrease in density; there are only five thread-like keels (four with a thread intercalated between the first and second from the lower suture) in paratype A.M.N.H. No. 26582/1:6 (figs. 28, 29) and only four in syntype C (figs. 7, 16). Also the several threads become even finer. The undulating aspect, found also in some *Paracerithium* species, is clearly seen in syntype C. The shallow groove beneath the lowermost lateral keel persists throughout these later stages. In syntype C (figs. 7, 16) and even better in the fragment A.M.N.H. No. 26582/1:1 (fig. 4) beads can be seen, produced on the transverse ribs by the three revolving threads between upper and lower shoulders.

EARLIEST ONTOGENETIC STAGES: In several shells (all three syntypes and paratypes A.M.N.H. Nos. 26582:26, 26582/1:6, and 26582/1:7) the nucleus is fully preserved or nearly so. As seen best in syntype C and in A.M.N.H. No. 26582/1:7 (figs. 16, 23), it is inclined towards the axis of the conch and slightly alloiostrophic (see Wenz, 1938, p. 13, fig. 30). In paratype A.M.N.H. No. 26582:26 and syntype B the nuclear whorls and the first post-nuclear whorl are rounded-convex in profile and smooth. Costation sets in on the fourth volution (fig. 22).

REMARKS: The details of ornamentation and the presence of a sloping apical band ("rampe") clearly prove that *P. transitorius* is closely related and transitional to *Paracerithium*. For the reasons given under the heading on the genus *Protofusus* it is, however, left with this genus.

The aspect of transition is shown by the following characters: presence of a distinct subsutural ramp and of a pronounced peripheral keel, which becomes less marked only later in development; in consequence, a decidedly angular whorl profile; the sharp-

ness and prominence of the ribs in maturity and their abrupt ending at the peripheral shoulder, even after the keel there has lost distinctness; and the distinct revolving ornamentation.

This combination of paracerithioid characters and the comparatively low and wide later spiral whorls serve readily to distinguish *P. transitorius* from all other species of this genus from Argentina and Peru. Two qualifications of this statement are warranted. *P. andinus* Bonarelli (1927, p. 85, pl. 3, fig. 12) clearly shows a subsutural ramp and revolving ornamentation, which according to the description extends even into the base, but it lacks the other distinctive characters of *P. transitorius*. *P. pyramidalis* also exhibits at early and middle growth stages some characters by which it approaches the genus *Paracerithium*, but they develop to a lesser degree, the upper ramp remains narrow, and not only the peripheral twin keels found in some juveniles but the lower shoulder have altogether disappeared, and the ribs no longer end abruptly in the peripheral zone in mature individuals.

The species of *Paracerithium* to which the present form comes closest, *P. turritellare* and *P. porrectum*, are compared with *P. transitorius* below. It is also compared with *P. vixstriatum* in the discussion of that species.

Increased phylogenetic interest is given to this species by the fact that it is transitional from *Protofusus* not only to *Paracerithium* but to *Rhabdocolpus*. Its mature whorl profile markedly approaches that of the latter genus, and the tubercles on the rather high upper shoulder somehow foreshadow those of the "coronet" of *Rhabdocolpus*. Juveniles of that genus are sometimes not easy to distinguish from those of the present form. For detailed comparison reference is made to the discussion of *R. praeco* below.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26582	76
86	26582/1	32
Total (including fragments)		108

It seems remarkable that none of the shells in lot 48 exceeds 3 mm. in height, while some in lot 86 grow almost three times as large.

Protofusus aff. **transitorio** Haas

Plate 15, figures 26, 27, 30, 31

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26583:1	2.24 mm.	51	30	43°
26583:2	2.63	50	36	46°
26583:3	*ca.* 4.44	*ca.* 43	*ca.* 40½	38°

DESCRIPTION: By way of appendix to the preceding species a few specimens from lot 86, which may constitute a variety, require separate treatment for the following deviations from the typical *P. transitorius:* the shell shape is stouter, the body whorl bulges out more distinctly, thus making the concavity of the sides of the conical conch more conspicuous, the pleural angle is more obtuse, and both upper and lower shoulders seem to develop earlier in the ontogeny (specimen no. 1; fig. 30). Furthermore, the ribs appear to be higher and, at later stages, sharper; they run backward, not in a radial direction. Eight ribs can be counted on the body whorls of specimens numbers 1 and 2, nine on that of specimen number 3, and 10 on that of the deformed specimen number 4.

REMARKS: These shells show a superficial resemblance to the genus *Pseudotritonium* which is, however, caused merely by their bulging body whorls and the ensuing concavity of the shell profile. However, reference to that genus which, among other characters, lacks a true canal, is out of the question.

OCCURRENCE: Four specimens in lot 86 (A.M.N.H. No. 26583).

PARACERITHIUM COSSMANN

SUBGENUS PARACERITHIUM, SENSU STRICTO

The following six forms with altogether about 400 individuals are referred to the above genus, established by Cossmann in 1902 (p. 173; see also Cossmann 1906, p. 45; Wenz, 1939, p. 731).

They are, however, by no means the first Triassic forms referred to this genus. Even if it be taken here in its restricted sense and if the 14 or 13 species (reduced to only two

by Cossmann, 1925a, pp. 206, 207) which Bonarelli (1921, pp. 72, 73, pl. 11, figs. 7–28; 1927, pp. 104–112, pl. 5, figs. 9–12, pl. 6, figs. 1–13) described and illustrated from the Triassic of northwestern Argentina under the generic name *Brachycerithium*[1] are thus omitted, there are still two Triassic species which Cossmann (1906, p. 46), though doubtfully, referred to the present genus. One is *P. subcerithiforme* (Kittl, 1895, p. 175, pl. 6, figs. 34, 35) from the Marmolata, recently recorded by Kutassy (1937, p. 73, pl. 2, figs. 84, 85) also from the Kodru-Móma Mountains of Transylvania. Considerable confusion prevails about the other. Cossmann (*loc. cit.*) named it "*Fusus nodosocarinatus* Munst.," thus misleading Kutassy (*loc. cit.*) into the belief that he really meant that species. That, however, he certainly did not, as seen from Cossmann's figure references ("St. Cassian, III, p. 259, pl. XX, fig. 20–21") which would mean *Trachoecus gemmellaroi* Kittl. Since Cossmann only a few lines earlier emphasizes the differences between *Paracerithium* and *Trachoecus*, the latter interpretation does not make sense either. The last paragraph but one of page 206 in Cossmann (1925a) might suggest a third, namely, that in his remark of 1906 he had one of Kittl's species of "*Palaeotriton*" (=*Pseudotritonium* Wenz) in mind.

Be that as it may, we need no longer ponder about the correct interpretation of Cossmann's statement, since quite recently Leonardi and Fiscon (1948, p. 12, *pro parte*, pl. 2, fig. 8, *non* fig. 9) described and figured, though under the erroneous designation "*Katosira seelandica* Kittl, n. var. *paucispirata*," a form from the St. Cassian fauna of Cortina d'Ampezzo which so strikingly resembles the type species of the present genus, *P. acanthocolpum* Cossmann, in shell shape, shape of aperture (as far as preserved in the Italian form), and ornamentation that there is no doubt of their congenerity. It thus represents the first certain *Paracerithium* from the St. Cassian fauna and from the Triassic of Europe in general and corroborates our belief in the presence of this genus in the Peruvian Andes.

[1] Relegated to a subgenus of *Paracerithium* by both Cossmann (1925a, p. 206) and Wenz (1939, p. 732).

Paracerithium tambosolense, new species

Plate 15, figures 25, 33–39

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26576:1	*ca.* 1.85 mm.	*ca.* 60½	*ca.* 33½	53°
26576:2	*ca.* 2.24	*ca.* 57½	*ca.* 35	*ca.* 53°
26576:3	*ca.* 3.49	*ca.* 54½	*ca.* 38	54°
26576:4	*ca.* 3.53	*ca.* 58	*ca.* 33½	?61°
26576:5	*ca.* 4.23	*ca.* 51	*ca.* 39	42°
26576/1:1	*ca.* 4.44	*ca.* 51½	*ca.* 40½	38°
26576/1:2 (syntype A)	*ca.* 4.8	*ca.* 47½	*ca.* 40	38°
26576:6 (syntype B)	*ca.* 6.96	*ca.* 43	*ca.* 38	36°

The table clearly shows that W and, from a somewhat later stage on, π tend to decrease with growth, whereas h increases. In all these respects, however, development appears to be retarded in specimen A.M.N.H. No. 26576:4.

SELECTION OF TYPES: The largest more or less complete shell, A.M.N.H. No. 26576:6, is designated syntype B, but since the lower end of its aperture is broken off, specimen A.M.N.H. No. 26576/1:2, in which it is better preserved, is designated syntype A.

DESCRIPTION: Shell, consisting in syntype B of seven or eight volutions, turreted, with strongly convex whorls; the body whorl in particular is somewhat gibbous. The intercostral whorl profile reaches its maximum width about halfway between upper and lower sutures. Once the costal tubercles have developed on the upper shoulder, the latter marks the greatest width of the costal whorl profile. With growth a gently sloping apical band becomes more and more pronounced, mostly so in fragment A.M.N.H. No. 26576:7 (fig. 35). The shoulder separating this apical band from the lateral whorl face is accentuated by the laterally compressed, sharp, almost spine-like tubercles on the ribs, which in some shells (A.M.N.H. No. 26576:4; figs. 38, 39) develop quite early. The convexity of the whorls makes the sutures appear deeper than they actually are. Base rather high, conical, slightly concave, not separated by any pronounced shoulder from the upper part of the body whorl. In no individual present is the aperture entirely preserved, since the outer lip is

mostly missing. From what is preserved, it can be inferred that the aperture was ear-shaped, with only an obtuse angulation at its upper end, a corner corresponding to the upper shoulder near by, and a distinct anterior notch which points at an angle of about 45 degrees to the left. The inner lip is thickened and reflexed over the slightly sinuous columella, which also turns towards the left at its lower end.

The dominant sculptural elements are strong and rather high transverse ribs, seven of which can be counted on the body whorl of syntype A, and eight on that of syntype B. They start at the upper suture and run first back over the afore-mentioned apical band, culminate on the shoulder in the sharp tubercles already mentioned, and then continue all over the lateral whorl face. On the body whorl they end abruptly at the boundary of the base and do not continue into the latter. Their direction, from the upper shoulder down, is slightly backward at earlier stages, as best seen in syntype A (figs. 33, 34), then becomes perpendicular (syntype B; figs. 36, 37) and, finally, forward (syntype B and fragment A.M.N.H. No. 26576:7; figs. 35–37). As a rule they are rather stiff and only occasionally, as in syntype B (fig. 36), slightly forward concave.

The lower ends of these ribs are connected by a revolving keel which is followed downward by two more; wherever these spiral keels are well visible, as in the juveniles A.M.N.H. Nos. 26576:2 and 26576:4 (fig. 38), in both syntypes, in fragment A.M.N.H. No. 26576:7, and, best of all, in another small fragment of a base (A.M.N.H. No. 26576/1:3; fig. 25), they can be recognized to be considerably less prominent than the transverse ribs and to decrease in strength downward. Only in syntype A can two revolving bands be observed below the lowermost of these three keels; they are separated from it and from one another by much narrower, shallow furrows. Even finer than the lowermost of the basal keels are five revolving striae, present throughout development on the lateral whorl face. They are preserved best in the juvenile A.M.N.H. No. 26576:4, in syntype A, and in the afore-mentioned fragment A.M.N.H. No. 26576/1:3 (figs. 38, 39, 33, 34, 25). Climbing up the transverse ribs and descending into the intercostals, these revolving striae assume a slightly undulant aspect, reminiscent of that observable in Cossmann's (1906, pl. 6) figure 14 of *P. acanthocolpum*. In crossing the ribs, they produce a fine denticulation. No revolving ornamentation is present on the apical band.

EARLIEST ONTOGENETIC STAGES: The nucleus is preserved, though poorly, in syntype B only; it seems to be obtuse and rounded.

REMARKS: The present form closely resembles the type species of *Paracerithium* from the Lower Liassic of the Vendée (France), *P. acanthocolpum* (Cossmann (1902, p. 157, pl. 3, figs. 20, 21). It differs merely by its somewhat denser costation and its less distinct revolving striation.[1] Thus their congenerity is beyond doubt. *P. tambosolense* resembles the genotype more closely than any of the other Peruvian forms referred to this genus. The latter are compared with it in their respective discussions.

Leonardi and Fiscon's form from near Cortina d'Ampezzo, mentioned above, the name of which it is here proposed to change to **P. paucispiratum** (Leonardi and Fiscon), differs by its stouter shell shape from the present species.

Of Bonarelli's species of *Brachycerithium*, *B. ornatissimum* (1921, p. 72, pl. 11, fig. 14; 1927, p. 108, pl. 6, fig. 4) seems to resemble *P. tambosolense* in both shell shape and ornamentation, but it differs by having less convex whorls and somewhat denser costation. Also in neither the author's description nor his figures is any indication found of the three revolving basal keels so characteristc of the present species.

Paracerithium tambosolense superficially resembles in shell shape *Protofusus peruvianus* with which it is associated in lot 78, but it is readily distinguished by having higher, more prominent ribs, distinct upper ramp and lower shoulder, both of which produce an angular whorl profile not found in that species, and pronounced revolving ornamentation which extends into the base.

OCCURRENCE: Not so rare.

[1] The specimens illustrated by Cossmann (1906, pl. 6, figs. 12–14), two of which are also reproduced by Wenz (1940, p. 732, fig. 2118), differ more from the Peruvian form by being stouter and having higher pleural angles.

Lot	A.M.N.H. Nos.	No. of Specimens
78	26576	31
48	26576/1	3
86	26576/2	1 (doubtful)
	Total	35

Paracerithium turritellare, new species

Plate 15, figures 32, 40–47

Dimensions

A.M.N.H. Nos.	H	W	h	π
26577:1	*ca.* 2.69 mm.	*ca.* 54	*ca.* 40½	37°
26577:2	*ca.* 2.8	*ca.* 51½	*ca.* 41	35°
26577:3	*ca.* 2.8	*ca.* 52	*ca.* 38	?41°
26577:4	2.88	51½	41	35°
26577/2:1	*ca.* 3.15	*ca.* 52½	*ca.* 35½	39½°
26577:5	*ca.* 3.32	*ca.* 55	*ca.* 40	38°
26577/1:1	*ca.* 3.73	*ca.* 51	*ca.* 44½	34°
26577/1:2	*ca.* 4.44	*ca.* 48½	*ca.* 46	34°
26577:8 (syntype B)	*ca.* 4.56	*ca.* 44½	*ca.* 49	30°
26577:12	*ca.* 4.92	*ca.* 48½	*ca.* 41½	35°
26577:6	5.04	50	45	34°
26577/1:3	*ca.* 5.04	*ca.* 47½	*ca.* 43	30°
26577:7	*ca.* 5.1	*ca.* 49½	*ca.* 42	35°
26577/2:2	*ca.* 5.76	*ca.* 47	*ca.* 46	30½°
26577/2:3	*ca.* 5.88	*ca.* 47	*ca.* 49	33½°
26577:10 (syntype A)	6.12	47	46	*ca.* 30°

The maximum size reached by this species is represented by the incomplete shell A.M.N.H. No. 26577:11, the height of which can be estimated at about 8 mm., rather than by the largest specimen measured above (syntype A).

The above table shows, all in all, a decrease of W and an increase of h, but both these changes progress only hesitantly, as it were, and are not considerable. Only in two shells, namely, in the medium-sized syntype B and in the full-sized paratype A.M.N.H. No. 26577/2:3, does h exceed W; in three more specimens they exactly or almost equal each other. The figures for the pleural angle seem inconclusive at earlier stages; only after a size of about 3 mm. is reached, π shows a clear decrease. Altogether the above growth trends seem to be manifest earlier and more decidedly in the samples from lots 71 and 86 (A.M.N.H. Nos. 26577/1 and 26577/2) than in the type sample (A.M.N.H. No. 26577) from lot 70, excepting syntype B which is from the last lot.

Selection of Types: In addition to the largest measured specimen (A.M.N.H. No. 26577:10), which is chosen for syntype A, a smaller shell (A.M.N.H. No. 26577:8), which shows the details of ornamentation much more distinctly, is designated syntype B.

Description: The shell of this species has the strongly convex whorls, about eight of which can be counted in syntype A, in common with *P. tambosolense*, but it lacks the large, somewhat gibbous body whorl. Thus it appears to be more slender and somewhat turritellid, a character alluded to in the specific name. The sloping apical band ("rampe") of the typical members of the genus is recognizable here, increasingly so with growth, but even in maturity it is markedly less conspicuous than in *P. tambosolense*. The specimen A.M.N.H. No. 26577:9 (fig. 42) appears to be transitional to *P. tambosolense* in this character as well as in the development of shoulder tubercles. Furthermore, since such prominent tubercles as in that species do not form on the upper shoulder, it is here, though quite distinct, not so pronounced. Thus the maximum width of the whorl profile is in the earlier growth stages somewhat below, later at, the middle of the whorl height, but it never moves up to the upper shoulder. With the development of the upper ramp, the sutures become deeper in maturity. The base is rather short, decidedly truncate, and distinctly concave, as seen best in syntype B (fig. 41) and in the incomplete and somewhat distorted paratype A.M.N.H. No. 26577:13 (fig. 44). The boundary line between base and upper part of the body whorl is marked by a heavy revolving keel. The aperture can well be studied in paratype A.M.N.H. No. 26577:13. It is ear-shaped and rather wide and has an angulation at its upper end and at the lower end a shallow, rather wide notch which projects only a little beyond the outline of the conch and points slightly to the left. The inner lip, in the lower part only, is a little reflexed and accompanied on the outside by an indistinct ascending furrow which simulates an umbilical niche. The columella is almost straight in its lowermost part.

The transverse ornamentation consists of rather blunt and not very high ribs. Seven can be counted on the body whorl of syntype A, and nine each on that of paratype

A.M.N.H. No. 26577:13 and of syntype B. There seem to be just as many on the earlier volutions, so that they are most widely spaced on the last. They run radially or, especially in the later stages, steeply backward from suture to suture, clinging to the whorl profile and forming an angulation in crossing the upper shoulder. Only occasionally can a slight shoulder tubercle be recognized, best on the body whorl of paratype A.M.N.H. No. 26577:9 (fig. 42). The course of the ribs as a rule is straight. In some shells, as in syntype A (fig. 45), it becomes slightly backward concave in maturity. The ribs end abruptly at the heavy revolving keel separating the base from the rest of the conch.

This keel is accompanied on its inner side by a second somewhat weaker keel. In maturity these two keels are separated by a conspicuous, rather wide groove (A.M.N.H. No. 26577:13; fig. 44). In contradistinction to *P. tambosolense* no third revolving keel is present on the base, nor any other revolving ornamentation, but fine growth striae run straight towards the center of the base. They are seen best in paratype A.M.N.H. No. 26577:14 (fig. 32). Nor is there any revolving ornamentation visible on the apical band. On the lateral whorl face, however, there are usually four keels above the heavy keel marking the lower shoulder, the uppermost of which marks the upper shoulder. Only on the body whorl of syntype B can a fifth keel, weaker than the others, be recognized, intercalated between the first and second from the lower shoulder. Except for the intercalated thread, these keels are more or less equal in strength, but their intervals decrease somewhat upward. The interval between the heavy keel marking the boundary of the base and the first lateral keel especially assumes the character of a shallow furrow which, particularly in paratype A.M.N.H. No. 26577:13, is divided by the transverse ribs into as many niches which look crescent-shaped in obliquely apical view (fig. 43). The rounded-concave relief of the intercostals accounts for this cresent shape and for the somewhat undulating aspect, in side view, of the revolving ornamentation which this species has in common with *P. tambosolense*. In paratype A.M.N.H. No. 26577:13 another shallow furrow develops between the upper shoulder keel and the one beneath it. Here the former considerably exceeds in strength the three other lateral keels, and they are crowded together towards the middle of the lateral whorl face (figs. 43, 44). In crossing the transverse ribs these revolving keels produce beads which develop in some shells (A.M.N.H. Nos. 26577:8, 26577:9, and 26577:13) into slight tubercles on the upper shoulder.

EARLIEST ONTOGENETIC STAGES: In the beautifully preserved juvenile A.M.N.H. No. 26577:4 the nucleus can be seen to be rounded, almost dome-shaped. The three first volutions are rounded in profile and smooth, costation setting in only on the fourth whorl.

REMARKS: In addition to the comparison with *P. tambosolense* given in the description, *P. turritellare* is compared with other species of the genus in their respective discussions below.

It also invites comparison with two non-congeneric species, *Protofusus transitorius* and *Rhabdocolpus praeco*. From the former it differs in its less bulging body whorl, lower base, and in lacking a pronounced beak housing the anterior canal. For comparison with *Rhabdocolpus praeco*, see the discussion of that species.

OCCURRENCE: Fairly common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
70	26577	65
71	26577/1	25
86	26577/2	39
76	26577/3	1 (doubtful)
Total (including fragments)		130

Paracerithium porrectum, new species

Plate 15, figures 48–53, 56

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26578/3:1 (syntype B)	3.32 mm.	42½	42½	30°
26578:1	3.73	46½	40	29°
26578/3:2	*ca.* 4.68	*ca.* 42½	*ca.* 49	25°
26578:2	4.80	42½	45	27°
26578/1:1	*ca.* 6.0	*ca.* 44	*ca.* 44	30°
26578/1:2	*ca.* 6.24	*ca.* 38½	*ca.* 45	22½°
26578/1:3	*ca.* 6.96	*ca.* 40	*ca.* 48½	21°

A.M.N.H. Nos.	H	W	h	π
26578/2:3 (syntype C)	7.20	33½	51½	19°
26578:1 (syntype A)	7.68	39	48½	20°

These more or less complete specimens do not give a correct idea of the maximum size attained by this species; to judge by the broken spire A.M.N.H. No. 26578/2:2 (fig. 56) it may have easily reached 15 mm. As preserved, this fragment is about 11 mm. high and exhibits a pleural angle of 20 degrees.

This species also shows the general tendency, recorded for the preceding one, of W and π to decrease, and of h to increase, with growth. The two shells from lot 48 (A.M.N.H. Nos. 26578/3:1 and 26578/3:2) show accelerated development.

SELECTION OF TYPES: The largest measured specimen (A.M.N.H. No. 26578:3), which is almost complete and shows shell shape and general character of ornamentation best, is designated syntype A. Since its surface is corroded, the smallest shell measured (A.M.N.H. No. 26578/3:1) and the incomplete specimen A.M.N.H. No. 26578/2:1, both of which show the revolving ornamentation well, are in addition designated syntypes B and C, respectively.

DESCRIPTION: Except for being markedly more slender and exhibiting accordingly considerably narrower pleural angles throughout development, this species very closely resembles *P. turritellare*. Were it not for the fact that the ranges of the values for W and π do not overlap, as seen by comparing the two tables of dimensions, the present form might be considered a mere variety of the former.

In all other respects it agrees well with *P. turritellare*. That the beak with the anterior canal seems to be longer and to project farther beyond the outline of the conch in the juvenile A.M.N.H. No. 26578/3:1 and in syntype B (figs. 52, 53, 48, 49) than in any other individual of either this species or of *P. turritellare* may be owing to accidents of preservation. Resemblance of both species is indeed so close that a complete description of *P. porrectum* would to a large extent be a repetition of that of *P. turritellare*. Therefore only a few data need be given here. Eight transverse ribs can be counted on the body whorls of syntypes B and C and of paratype A.M.N.H. No. 26578/3:2, nine on those of syntype A and paratype A.M.N.H. No. 26578/1:4, and 10 on the last preserved whorl of the long spire A.M.N.H. No. 26578/2:2 (fig. 56). All shells from lot 48 (syntype B and paratypes A.M.N.H. Nos. 26578/3:2 and 26578/3:3) deviate from the others by a trend of their costae towards a slight forward concavity, especially noticeable on the body whorl of the paratype number 2. There are four thread-like revolving keels on the lateral face of the body whorls of paratypes A.M.N.H. Nos. 26578/1:4 and 26578/1:5. In syntype C this number is increased first to five by intercalation of one more keel between the first and the second from the bottom, then to six by splitting in two of the uppermost keel. There are even seven such lateral keels on the body whorls of syntype B and of paratype A.M.N.H. No. 26578/2:3, which, despite their small size, have the densest and finest revolving striation. In all these shells a shallow furrow can be observed which separates the lowermost of these keels from that marking the boundary of the base, and slight tubercles develop on the upper shoulder in the latest stages observable, most distinctly on the body whorl of syntype C.

EARLIEST ONTOGENETIC STAGES: The apex of the nucleus of syntype C lies somewhat off the axis of the conch; it may be slightly inclined. Costation sets in on the third volution. The nucleus of paratype A.M.N.H. No. 26578:1 seems to stand at an angle to the axis of the conch, but this is apparently due to a curvature of the spire as a whole. Altogether the early ontogenetic stages of this species do not seem essentially to differ from those of *P. turritellare*.

REMARKS: The differences that justify the separation of *P. porrectum* from *P. turritellare* also separate if more distinctly from *P. tambosolense*. Other species of the genus *Paracerithium* described below are there also compared with *P. porrectum*.

Paracerithium porrectum resembles *Protofusus transitorius* more closely than *Paracerithium turritellare* does, because it is more slender and pointed, but it can be distin-

guished by the differences indicated in the discussion of *P. turritellare*.

OCCURRENCE: Not so rare, but less common than *P. turritellare*.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
71	26578	11
70	26578/1	28
86	26578/2	23
48	26578/3	6
	Total	68

Paracerithium aff. **porrecto** Haas

Plate 15, figures 54, 55

DESCRIPTION (INCLUDING DIMENSIONS): In a single fragment consisting of about two and one-half volutions, measuring 7.8 mm. in height and 3.8 mm. in width and exhibiting a pleural angle of 18 degrees, the costation is markedly denser than in *P. porrectum*, there being 11 ribs on both the body whorl and the penultimate one; it seems to be equally dense on what is preserved of the antepenultimate volution. On the body whorl some of these ribs are crowded; others are much less closely set. Furthermore, the ribs run decidedly forward, not backward as in *P. porrectum* and *P. turritellare*, and the hook they form on the upper shoulder makes them appear slightly inverse-sigmoidal. Five fine keels can be counted between the upper shoulder and the peripheral keel. The lowermost is a little stronger than the others and separated from that keel by a distinct, rather wide groove.

REMARKS: The present shell may be merely an aberrant individual of *P. porrectum*, but it may be specifically different as well and is therefore separately dealt with by way of appendix to that species. It requires no further comparison with other forms of the present genus.

OCCURRENCE: A single incomplete shell in lot 86 (A.M.N.H. No. 26579).

Paracerithium vixstriatum, new species

Plate 15, figures 57–64, 69, 70, 73–75

A.M.N.H. Nos.	DIMENSIONS H	W	h	π
26580/1:8	*ca.* 1.74 mm.	*ca.* 64½	*ca.* 38½	*ca.* 49°
26580/1:9	*ca.* 1.74	*ca.* 58	*ca.* 38½	43°
26580/1:10	*ca.* 1.79	*ca.* 58	*ca.* 37½	*ca.* 45°
26580:1	*ca.* 1.96	*ca.* 63	*ca.* 34½	52°
26580/1:1	2.02	58½	36	52°
26580:2	*ca.* 2.13	*ca.* 60½	*ca.* 31½	47°
26580/1:11	*ca.* 2.2	*ca.* 61½	*ca.* 36	42°
26580/1:12	*ca.* 2.2	*ca.* 54	*ca.* 38½	40°
26580:3	*ca.* 2.24	*ca.* 65	*ca.* 30	52°
26580:4	*ca.* 2.24	*ca.* 67½	*ca.* 32½	50°
26580:5	*ca.* 2.41	*ca.* 67½	*ca.* 40	50°
26580:6	*ca.* 2.42	*ca.* 55½	*ca.* 40	40½°
26580/1:13	*ca.* 2.46	*ca.* 54½	*ca.* 38½	41°
26580/1:14	*ca.* 2.63	*ca.* 51½	*ca.* 34½	42°
26580/1:2	*ca.* 2.63	*ca.* 56½	*ca.* 34	45°
26580/1:15	*ca.* 2.69	*ca.* 56	*ca.* 35½	45°
26580/1:3	2.91	57½	36½	46½°
26580/1:16	*ca.* 3.24	*ca.* 53½	*ca.* 43½	38½°
26580/1:4	4.15	48	40	32°
26580/1:5	4.15	47	40	38°
26570/1:6	*ca.* 4.56	49	39½	29°
26580:7 (syntype A)	4.98	48½	41½	33°
27580/1:7 (syntype B)	5.04	47½	39	30°

To judge by the fragment A.M.N.H. No. 26580/1:17, the maximum size attained by this species in the present material can be estimated at about 10 mm.

As in the preceding species, W and π tend to decrease, but these trends become pronounced only in later growth stages, from sizes of from 2½ to 3 mm. on. No clear trend can be observed in h.

SELECTION OF TYPES: Specimen A.M.N.H. No. 26580:7 is unusually well preserved and seems at first sight to be fairly complete. Comparison with specimen A.M.N.H. No. 26580/1:7 reveals, however, that the lowermost part of the aperture is missing. Since the anterior notch, well observable in the latter specimen, constitutes an important diagnostic character, both specimens are designated syntypes, viz., A and B, respectively.

DESCRIPTION: This species resembles *P. turritellare* so closely that it may be described best by specifying the differences which seem to justify its separation. The shape of the shell, which consists of seven and one-half volutions in the largest individuals measured, is similar but somewhat less *Turritella*-like. As seen by comparing the tables of dimensions up to medium sizes, the present form tends to be a little stouter and to have somewhat shorter spires and wider pleural angles; at the largest sizes

reached, these differences disappear. The whorls are convex, making the sutures appear rather deep, and evenly rounded, in contradistinction to the decidedly angular whorl profile of *P. turritellare*. Except at the very latest stage observable, as represented solely by the body whorl of the largest fragment present (A.M.N.H. No. 26580/1:17; figs. 73–75), there is no indication of an upper shoulder or of a subsutural ledge ("rampe"). Even where recognizable, as in the fragment just mentioned, both are markedly less pronounced than in *P. turritellare*, even at a considerably smaller size, and there is no indication of the transverse ribs developing tubercles on the upper shoulder. Shape of base, aperture, and columella are the same as in *P. turritellare*. The fragment A.M.N.H. No. 26580/1:17 is here mentioned, and illustrated in figure 74, for showing a slightly reflexed, thin inner lip and a narrow ascending groove accompanying it at its outer side.

Most characteristic of this species is its ornamentation. The transverse ribs, 10 of which can be counted around the body whorls of both syntypes, are not so stiff and heavy as in *P. turritellare* and run in a clearly forward concave arc and as a rule more decidedly obliquely backward from suture to suture. Sometimes they assume a slightly sigmoidal appearance, especially where the upper ends of the ribs of one whorl are in contact with the lower ends of those of the preceding one, or nearly so, as in syntype A (fig. 63). On the other hand, the revolving striation is hardly perceptible on the lateral whorl faces of even well-preserved shells of this species; hence its name. Only in fragment A.M.N.H. No. 26580/1:17 is it distinct enough to permit a count of the faint revolving threads just discernible. On both the penultimate and the last whorls, there are five. The intervals between rapidly decrease upward. The fourth, which is even weaker than the others, seems to be intercalated between the third and the fifth. The heavy keel separating the base from the upper part of the body whorl is as well developed as in *P. turritellare*, as is the one accompanying it beneath. Here, too, these two revolving keels are separated by a broad though shallow furrow. Another lesser furrow can be seen to separate the first mentioned of these keels from the lowermost lateral revolving thread, just indicated in both syntypes and in fragment A.M.N.H. No. 26580/1:17. In both syntypes this upper groove can be seen to be subdivided by the ribs into the same crescent-shaped little niches as in *P. turritellare* (figs. 64, 69, 70). The revolving keel separating the base from the rest of the conch is more conspicuous in the intercostals than where it is joined by ribs. This feature, although observable now and then in *P. turritellare* and *P. porrectum*, is most noticeable in the present species. In fragment A.M.N.H. No. 26580/1:17 bundles of growth striae can be seen to run radially across the base (fig. 75).

Earliest ontogenetic stages can be studied in the small shells A.M.N.H. No. 26580/1:1, 26580/1:3, 26580/1:14, and 26580/1:15 as well as in syntype A. In the first and last of these specimens (figs. 62, 64) the apex of the nucleus is somewhat eccentric with regard to the axis of the conch, as in syntype B of *P. porrectum*, but the nucleus as such is only slightly, if at all, inclined towards that axis. In all the individuals here listed the nuclear volutions and the first one or two post-nuclear ones are less convex than the later whorls and smooth. Costation sets in in the form of indistinct folds on the fourth whorl and becomes pronounced only on the fifth.

REMARKS: Comparison with *P. turritellare*, which this species resembles most closely, is integrated in the description, and the same differences, plus the stouter shell shape, serve to distinguish it from *P. porrectum* also. *P. tambosolense* is readily distinguished from the present form by its pronounced ramp and gibbous body whorl.

Paracerithium vixstriatum also remarkably resembles the early and middle growth stages of *Protofusus transitorius* which differs from it, however, by its generic characteristic, namely, the pronounced beak housing the anterior canal, and in addition by its much less convex whorl profile, the fact that its ribs do not run obliquely backward as in the present species, and the more distinct revolving ornamentation of the lateral whorl faces. *Protofusus delicatulus* is not so dissimilar either, but can also be distinguished from the present species by its pronounced beak, its

markedly denser and more delicate costation, more perpendicular direction of the ribs, and by becoming much more slender in maturity.

It may further be pointed out that among all the transversely ribbed forms in the Peruvian material *P. vixstriatum* has the character of ornamentation most reminiscent of the living genus *Scala* (=*Scalaria auctt.*), although the abrupt ending of the ribs at the lower shoulder, the revolving keel marking that shoulder and accompanied beneath by another, and the lack of an umbilicus make it easy to distinguish it from that recent genus.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26580	25
86	26580/1	135
Total (including fragments)		160

Paracerithium aff. **vixstriato** Haas

Plate 15, figures 65, 66, 71, 72

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26581:1	4.44 mm.	40½	42	24°
26581:2	4.80	40	45	25°

DESCRIPTION: The shells here dealt with differ from the preceding species in the same way as *P. porrectum* differs from *P. turritellare*, viz., by markedly more slender shell shape and accordingly higher spires and more acute pleural angles. In all other respects they agree with *P. vixstriatum*. There are nine transverse ribs on the body whorl of specimen number 1, and 10 on that of specimen number 2.

EARLIEST ONTOGENETIC STAGES: Both these shells have the nuclei preserved; they do not differ from those of *P. vixstriatum*.

REMARKS: This form may be considered a mere variety of the preceding species, but since the material available is not sufficient for a definite statement to this effect it seems preferable to treat it separately, by way of appendix to *P. vixstriatum*.

OCCURRENCE: Represented by four shells (two incomplete) in lot 86 only (A.M.N.H. No. 26581).

PSEUDOTRITONIUM WENZ

(=**PALAEOTRITON** KITTL, NON FITZINGER)

As pointed out by Cossmann (1901, p. 144), the generic name *Palaeotriton*, proposed by Kittl (1894, p. 236) for a few St. Cassian gastropod species, is preoccupied by Fitzinger for a genus of amphibians. Wenz (1940, p. 732) therefore proposed the new name *Pseudotritonium* to replace the homonym.

The genotype, as designated by Cossmann (*loc. cit.*), is *Scalaria venusta* Münster.

The family relationships of this genus are uncertain. It was provisionally and doubtfully referred to the Fusidae by Kittl (1894, p. 235) but considered *incertae sedis* by Cossmann (1906, p. 205). Here Wenz' (*loc. cit.*) example is followed in tentatively assigning it to the Procerithiidae.

This genus is included in the present report merely owing to the presence of a small shell in lot 48 and of a few fragments in lot 26, all of which are only doubtfully referred to it.

?Pseudotritonium sp. indet.

Plate 15, figures 67, 68, 78, 79

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26516/1:1[1]	?	?	?	*ca.* 65°
26516	2.18 mm.	69	33½	70°

DESCRIPTION: The only complete shell present (A.M.N.H. No. 26516; figs. 67, 68) is here described first. It consists of about six volutions. Most striking as regards the shape is the contrast between the bulging body whorl and the rather slender spire, due to the fact that the whorls increase faster in width than in height. This also accounts for the concavity of the outline between the end points of the maximum width and the apex. The post-nuclear whorls of the spire are somewhat angular, there being an apical face sloping at an angle of about 45 degrees and an almost perpendicular lateral face. The boundary between them is, however, not so sharp but formed by a rounded shoulder. This shoulder becomes lost in the body whorl which is strongly convex. The sutures are shallowly channeled. The base, separated by

[1] Width, as preserved, 1.06 mm.

another rounded shoulder from the rest of the body whorl, is decidedly truncate and concave. In basal view the conch appears clearly elliptical. The aperture is broken at its lower end so that the presence of an anterior notch may only be assumed. The outer lip is semicircular in shape; the inner lip is only gently concave, somewhat thickened, slightly reflexed, and accompanied by a narrow false umbilical niche.

Costation is observable on the penultimate and last whorls only; thirteen transverse ribs can be counted on the last. They deserve the name of true ribs in its posterior half only where they can be seen to be almost straight and to run steeply obliquely backward, but they turn into blunt and plump folds in the anterior half of the body whorl. They end, though not abruptly, at the lower shoulder where they are somewhat thickened at that latest stage. To judge by four denticulations recognizable on one of the ribs of the penultimate whorl, there must have been a revolving striation.

Shell shape and whorl profile seem to have been similar to those just described in the broken spire A.M.N.H. No. 26516/1:1 (fig. 78), but here the upper shoulder is even less distinct. On the last preserved whorl there are 13 ribs which run, in an extremely shallow backward concave arc, obliquely backward and are crossed and denticulated by five revolving striae. In this fragment the columella can be seen to be thick and solid. About the same shell shape and ornamentation are barely recognizable in an equally small spire from the same lot (A.M.N.H. No. 26516/1:2), consisting of four volutions and exhibiting a pleural angle of about 55 degrees. Finally, in the same lot (26) are two fragments, believed to belong to the same individual, which must have attained a total height of at least 8 mm. (A.M.N.H. No. 26516/1:3). They show the same ornamentational characters as A.M.N.H. No. 26516/1:1 and may well be conspecific.

EARLIEST ONTOGENETIC STAGES: The nucleus is not entire in any of the shells with their apices preserved; to judge by the specimens A.M.N.H. Nos. 26516/1:1 and 26516/1:2 (fig. 79) it seems to have been alloiostrophic, reminiscent of that of *P. macrostoma* (Kittl), as shown in Kittl (1894, pl. 11, fig.9). The nuclear volutions and the first postnuclear volution are smooth. The first ribs appear only on the fourth whorl.

REMARKS: The few specimens here dealt with are not referable to any of the other genera of the Procerithiidae encountered in the fauna under study. By their characters they fit best in the present genus; however, the material available is too scanty to make this generic reference with any certainty. Nor is it by any means certain that all four of the specimens included would, if complete, be found to be fully conspecific.

Of the St. Cassian species of this genus *P. macrostoma* (Kittl, 1894, p. 237, pl. 11, figs. 6–9) most resembles the present form. The ornamentation of specimen A.M.N.H. No. 26516/1:1, is strongly reminiscent of that seen in Kittl's figure 6. However, since not all the specific characters reported and illustrated by that author can be recognized in the Peruvian specimens, the latter cannot be considered conspecific. Nor would their poor preservation justify creation of a new species.

The bulging body whorl, the deeply reentering base, the more obtuse pleural angle, and the decidedly backward course of the ribs, which seem to be slightly backward concave, distinguish this form from all the species of *Paracerithium* and *Protofusus* dealt with in this report.

OCCURRENCE: Very rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26516	1
26	26516/1	3
Total (including fragments)		4

RHABDOCOLPUS COSSMANN

This name, proposed by Cossmann (1906, p. 27) and maintained by Wenz (1940, p. 727) as that of a subgenus of *Procerithium* Cossmann, is here used as a generic one, not as a matter of expediency made possible by the absence of other sugbenera of *Procerithium* from the Peruvian assemblage, but because the close relationship of *Rhabdocolpus* to both *Protofusus* and *Paracerithium* revealed by the present study seems to suggest a grouping of the Procerithiidae different

from that proposed by Cossmann (1906, pp. 21–23) and followed by Wenz (1940, pp. 726–736). In such a new grouping *Rhabdocolpus* must be assigned generic rank.

The type species is *Melania scalariformis* Deshayes (1830–1832, p. 427), as figured by Eudes-Deslongchamps (1842c, p. 218, pl. 11, figs. 63–66); since neither Cossmann (1906) nor Wenz (1940) reproduces the protograph, it may not be superfluous to point out that the specimen depicted in Eudes-Deslongchamps' figure 63 must be considered the holotype of the type species, since it is the only one that represents his "Var. a," in the synonymy of which he quotes *Melania scalariformis* Deshayes.

This genus is well characterized by its peculiar ornamentation, the most diagnostic feature of which is described by Cossmann with the words, ". . . une rampe étroite que couronnent les nodosités terminales des côtes." The latter feature may best be termed the "coronet," this heraldic term designating an open circlet with rays bearing pearls at their tips, and it is therefore used in the following descriptions.

In some characters this genus assumes a striking resemblance to the older genus *Andangularia;* for a detailed comparison, see the discussion of *A.* aff. *A. subarmatae* above.

This genus has not yet been recorded from deposits older than Liassic (see Cossmann, 1906, p. 29). However, a species from the Upper Triassic of Carbajal, northwestern Argentina, doubtfully referred by Bonarelli in 1927[1] to the genus *Hypsipleura*, namely, *H.(?) binotata* Bonarelli (1927, p. 75, pl. 2, fig. 15), is suspected on the strength of certain characteristic features recognizable in the illustration as belonging to the present genus. A preliminary examination of a rich material of gastropods from the "Horizonte calcáreo-dolomítico" of Jujuy Province kindly put at my disposal by Prof. Armando Leanza, University of Buenos Aires, reënforces this suspicion.[2]

In the present material two groups can be distinguished within this genus. One consists of *R. subulatus* and two closely related forms left unnamed. This group, restricted to lot 26, comprises more or less subulate forms which assume the distinctive characters of the genus only at a comparatively late ontogenetic stage. The other group, of which most of the specimens are concentrated in lot 48, with only a few scattered over eight other lots, consists of *R. praeco* and two closely related species, *R. rursicostatus* and *R. emaciatus*. All three of these species differ only specifically from the previously known typical species of this genus of Jurassic age. In addition, there are in lots 22, 29, 53, 73, and 87 altogether about 10 specimens and fragments too poorly preserved for specific determination which, however, seem to belong to this group rather than to the first mentioned. They have been listed merely as *Rhabdocolpus* sp. indet. (A.M.N.H. Nos. 26596, 26596/1, 26596/2, 26596/3, 26596/4). All these forms, including those specifically undetermined, add up to a total of almost 450 specimens. Thus this genus is within the Procerithiidae of the present material outnumbered only by *Protofusus*.

Rhabdocolpus subulatus, new species

Plate 15, figures 76, 77, 80, 81, 85–88

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26590:1	*ca.* 1.85 mm.	*ca.* 48½	*ca.* 33½	*ca.* 34°
26590:2	2.46	44	42	30½°
26590:3	3.73	38	55½	28°
26590:6	*ca.* 3.78	*ca.* 42½	*ca.* 39	28½°
26590:4 (syntype A)	*ca.* 6.36	*ca.* 28½	*ca* 56½	13½°

Small as this sample is, it shows impressively how fast both W and π decrease, and h increases, with growth in this species. (Specimen no. 6, however, falls somewhat out of line, chiefly in the height of the spire, apparently owing to retarded development.) The conspecificity of the measured shells is proved best by the dimensions of syntype A,

[1] Two others which that author had referred to *Hypsipleura* in 1921 (p. 71, pl. 10, figs. 5–7) were transferred by both Cossmann (1925a, p. 199) and Bonarelli (1927, p. 69, pl. 2, figs. 6, 7) himself to *Katosira carvalajensis* Bonarelli, by the latter author as varieties.

[2] As far as I could ascertain, Bonarelli mentions the genus *Rhabdocolpus* only once (1927, p. 97), namely, in the consideration of the possibility that his subgenus *Eocerithium* might come under this genus. To me it would seem to have closer affinities to *Protofusus*. I hope to deal in a future paper more explicitly with the taxonomic position of *Eocerithium*.

the largest complete shell present, at an earlier growth stage; four volutions above the last whorl, i.e., at a total height of about 2.2 mm., the measurements are: W, *ca.* 50; h, *ca.* 39; π, 33°. These values are perfectly in line with those tabulated above.

SELECTION OF TYPES: The largest complete and in general best-preserved shell (no. 4) is designated syntype A. Since the lower part of the aperture is missing, a fragment about the same size, with a well-preserved canal (no. 5), is in addition designated syntype B.

DESCRIPTION: Syntype A consists of 11 volutions. At early growth stages the shell shape is clearly conical, with quite convex whorls which attain their maximum width at about the lower third of their height. Paratype number 2 is shown in figures 76 and 77 as an example of shell shape and whorl profile at this early stage still strongly reminiscent of those of the genus *Protofusus*, mostly of *P. delicatulus*. As soon as a height of about 2½ mm. is reached, the growth in width is markedly slowed, as seen in paratype number 3 (fig. 81) as well as in syntype A (figs. 85, 86). In the illustration of the former it can well be seen how little the sixth and seventh volutions exceed the preceding ones in width, and the same holds true for the last three volutions of syntype A. This rather sudden slowing of the growth in width causes the subulate shell shape of this species, alluded to in its name. Simultaneously with the change just described, the whorl profile becomes less convex and its maximum width shifts to the middle of its height. The more the crown of tubercles develops, the more the upper shoulder almost equals the middle of the whorl in width, thus rendering the upper half of the costal whorl profile almost straight, as seen best in the penultimate and last volutions of syntype A. In the last growth stage, observable best in syntype B (fig. 87), the lateral whorl face has become quite flat and in profile shows as a straight line. The sutures, shallowly channeled at the earlier stages, deeply indent the shell profile at the latest stage and stand out even more owing to the fact that they are overtopped by the tubercles. The base is not clearly separated from the lateral face of the body whorl in any of the measured specimens. Only in the fragments number 5 (syntype B; figs. 87, 88) and number 7 is there a distinct though rounded lower shoulder. In maturity the base is high and gently concave. The aperture (fig. 88) is not so wide and ear-shaped and has a rather blunt angulation at its upper end and a comparatively long and shallow canal at the lower one. The beak housing this canal points slightly to the left, with the lower end of the columella. The latter is solid and gently sinuous. No reflection of the inner lip is observed in any of the shells examined.

The dominant element of ornamentation is transverse ribs, rather closely set and running straight, in a radial or only slightly backward direction, from suture to suture. Only in the anteriormost part of the body whorl of syntype A do the lower halves of these ribs turn decidedly forward, thus causing the costae to form a shallow forward concave arc. In number the ribs clearly decrease with growth, there being 13 on the body whorl of the smallest paratype number 1, 12 on that of paratype number 2, 11 on that of paratype number 3, 10 on the penultimate volution of syntype A, and five each on the preserved half-whorls of syntype B and paratype number 7. On the body whorl of syntype A, however, 11 can be counted owing to the intercalation of one more rib between two otherwise normally equidistant from each other. On the other hand, the costae become markedly narrower, sharper, and higher in the course of development. Both these ontogenetic changes account for the much less dense aspect of the costation in late stages than in early ones (compare figs. 76, 77 with 85, 86). Simultaneously with the change in shell shape, caused by the slowing of growth in width, the ribs begin to carry tubercles at their upper ends which become more and more prominent with growth. In the latest volutions they can be seen in profile to point outward and slightly upward and markedly to overtop the suture, thus forming the coronet so characteristic of this genus. In paratypes numbers 1 to 3 and in syntype B the ribs end at the more or less indistinct keel delimiting the base from the lateral whorl face, but in fragment number 7 these lower ends of the ribs are developed as tubercles, only a little less prominent than the upper ones, and are separated by a deep furrow from the peripheral keel of the base,

which in turn is separated from a second such keel by a similarly deep but slightly narrower furrow (fig. 80). Both these grooves and both keels are also recognizable in syntype B, but here the inner of the twin keels is markedly weaker than the outer. No peripheral keel is, however, recognizable in syntype A; rather the ribs can be seen on the anterior half of its body whorl to continue into the upper part of the base where they gradually vanish.

In all the shells examined a fine revolving striation is perceptible on the lateral faces of the whorls which denticulates the ribs where crossing them. This revolving ornamentation is, however, faint when compared with that of congeneric species (e.g., *R. praeco*). Chiefly on the strength of the denticulations produced on the ribs five revolving threads can be counted above the peripheral keel in paratypes 2 and 3 and on the later whorls of syntype A, the earlier whorls of which seem to carry only four (fig. 86).

EARLIEST ONTOGENETIC STAGES: The nucleus can be recognized, best in syntype A (fig. 86), as slightly inclined towards the axis of the conch, but it cannot be termed alloiostrophic. In this species, as in many others of this family, the embryonic and the first post-embryonic volutions are smooth, and costation appears on the fourth whorl only.

REMARKS: As seen from the above description, this species closely resembles in its early stages some *Protofusus* species, mostly *P. delicatulus*, from which it can, however, be distinguished by being at the same size more slender and having a higher spire and a more acute pleural angle (compare dimensions of specimens A.M.N.H. No. 26588/1:8, above, p. 217, and A.M.N.H. No. 26590:2, both 2.46 mm. high). In maturity, however, the "coronet" serves readily to distinguish this species and all the species of *Rhabdocolpus* from those of *Protofusus* from which they might well have originated. Another character reminiscent of the latter genus, observable in syntype A of the present species only, is that the ribs do not end abruptly at the boundary of the base, as they do in larger individuals of this species and in other species of the genus *Rhabdocolpus* and those of the genus *Paracerithium*, but continue, gradually vanishing, into the base. This may be interpreted as an ancestral reminiscence.

The other forms of this genus, both from lot 26, which more or less resemble the present species, and those from other lots, which come closer to its Jurassic representatives, are compared with *R. subulatus* in the respective discussions.

OCCURRENCE: Found in lot 26 only, where it is represented by 18 specimens, including fragments (A.M.N.H. No. 26590).

Rhabdocolpus sp. indet. 1, aff. **subulato** Haas

Plate 15, figures 89–91

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26591:1	3.65 mm.	32	52½	17½°
26591:3	6.12[1]	?	?	*ca.* 17°

No inferences can be deduced from comparison of the measurements of only two specimens, less so if one is crippled. However, the apical angles in all the other shells present (too incomplete for precise measurements) vary only between 17½ degrees and 19 degrees. Therefore the assumption seems justified that this form is characterized by a remarkable constancy of π.

DESCRIPTION: Although this form resembles the preceding species to a fairly high degree, it cannot well be considered conspecific. It may best be described by stating the reasons for separating it from *R. subulatus*. It is even more subulate, and the convex whorl profile of the early stages persists much longer. At the latest stage but one present in the crippled specimen number 3, as represented by its last fully preserved volution, the whorl profile becomes flat on the side and angular, with an upper ramp, but only in the small portion of the uppermost part of the following whorl that is preserved do the tubercles characteristic of *Rhabdocolpus* appear (fig. 91). Base, aperture, and columella, best observable in the fragment number 2 (fig. 89), are like those of the preceding species, as is the costation. In the earlier volutions of specimen number 1 it has the same density as in the corresponding stages of *R. subulatus* (12 per whorl); in its later volutions the surface is much too worn to

[1] As preserved; the specimen is crippled. Total height must have been considerably greater.

permit of a rib count. There are 11 ribs on the body whorl of fragment number 2, but only eight on that of the largest specimen present (no. 3). Only in fragment number 2 are both twin keels of the lower shoulder clearly recognizable. There is a fine and dense revolving striation on the lateral whorl faces of specimen number 1 and a much more distinct one on those of specimen number 3. Although six threads can be counted above the peripheral keel in both shells, this ornamentation appears, of course, denser in the smaller than in the larger one. In this form, too, it produces the usual fine denticulations on the transverse ribs.

The earliest ontogenetic stages, observable only in specimen number 1 (fig. 90), seem to agree with those of the preceding species.

REMARKS: Although the characteristic features of *Rhabdocolpus* appear only late in *R.* sp. indet. 1, aff. *subulato*, its close affinity to *R. subulatus* is so obvious that the congenerity of the two cannot seriously be doubted.

See also the following form for further comparisons.

OCCURRENCE: Nine specimens, including fragments, in lot 26 (A.M.N.H. No. 26591).

Rhabdocolpus sp. indet. 2, aff. **subulato** Haas

Plate 15, figures 82–84

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26592:1	3.74 mm.	35½	44½	29°
26592:2	*ca.* 4.15	*ca.* 30	*ca.* 58	20°

As far as inferences are permissible from a sample of only two specimens, the table shows a marked decrease of W and π and a sharp increase of h.

DESCRIPTION: These few small shells deviate from the typical *R. subulatus* in a manner opposite to that of the preceding form. As seen in specimen number 1 (fig. 82), the whorl profile loses its convexity and becomes almost flat, and the ribs, of which there are eight or nine on the body whorls of all examined specimens, become straight and stiff and develop quite pronounced upper tubercles at an earlier stage than in *R. subulatus* and even more so than in the preceding form. The revolving keel marking the boundary between the lateral whorl face and the base is seen best in the fragments numbers 3 and 6, on the bases of which an inner revolving keel can also be recognized. The revolving striation on the lateral whorl faces is quite distinct in almost all shells examined, mostly in specimen number 1 and in fragments numbers 4 and 5 (figs. 82–84). The number of revolving threads varies; excluding the boundary keel, three can be counted in specimen number 1 and in fragment number 5, five in specimen number 2, and six in fragment number 4. The aperture and in particular the anterior canal are well preserved in fragment 5 (fig. 84); they fully agree with those of the two preceding forms.

No specimen present permits of a reliable examination of the earliest ontogenetic stages.

REMARKS: For comparison with both the typical *R. subulatus* and the preceding form reference is made to the above description. The differences of this form from the preceding one and from the true *R. subulatus*, pointed out in the description, bring this form, on the other hand, closer to *R. praeco.*

OCCURRENCE: Six specimens, including fragments, in lot 26 (A.M.N.H. No. 26592).

Rhabdocolpus praeco,[1] new species

Plate 16, figures 1–11, 13, 14, 27

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26594:1	*ca.* 1.4 mm.	*ca.* 60	*ca.* 40	62°
26594:3	1.79	56½	37½	62½°
26594:4	2.07	54	36½	58°
26594:5	2.24	50	42½	47°
26594:6	2.52	46½	42	43°
26594:8	2.58	50	41½	48½°
26594:10 (syntype A)	*ca.* 2.91	*ca.* 50	*ca.* 44	53½°
26594:12	2.97	48½	46	45°
26594:13	*ca.* 3.15	*ca.* 41	*ca.* 46	30°
26594/1:1	3.40	44	46½	32°
26594:14	3.49	47½	41	42°
26594:15	3.73	43½	49	35½°
26594:16	3.90	42½	42½	34½°
26594:17	3.98	39½	43½	39°
26594:19	*ca.* 4.15	*ca.* 38	*ca.* 46	33°
26594:21	4.32	37½	50	30°
26594:23	4.44	43	51½	33½°
26594:24	4.56	45	57½	37°

[1] *Praeco*, Latin, meaning the herald.

A.M.N.H. Nos.	H	W	h	π
26594:25	4.74	40½	48	37°
26594:27	4.80	40	47½	32°
26594:29	*ca.* 5.52	*ca.* 35	*ca.* 54½	28°
26594:31	*ca.* 5.76	*ca.* 41½	*ca.* 54	35°
26594:32	6.12	37	51	29°
26594:34 (syntype B)	*ca.* 6.6	*ca.* 38	*ca.* 47½	27°
26594:35	*ca.* 6.6	*ca.* 32½	*ca.* 54½	19°
26594:36	*ca.* 6.72	*ca.* 37½	*ca.* 55½	18°
26594:37	7.08	34	47½	26°
26594:38	*ca.* 7.2	*ca.* 33½	*ca.* 56½	21½°
26594/1:2 (syntype C)	*ca.* 7.8	*ca.* 32½	*va.* 54	19°

The last and largest of the shells of which the measurements are given in the table does not represent the maximum size reached by this species. If the shell fragment A.M.N.H. No. 26594/3, only doubtfully referred to this species, should really belong to it, it would give evidence of a maximum height of 13 mm. or more.

The same general trends as in most of the forms of the Procerithiidae, namely, of W and π to decrease, and of h to increase, with growth, are clearly recognizable in the table also. Especially in the values for the pleural angle, the range of variation, from a maximum of 62½ degrees at the earliest stages to a minimum of 18 degrees at the latest ones, is strikingly wide. Some of the measured individuals (e.g., A.M.N.H. Nos. 26594/1:1, 26594:13, 26594:21, 26594:29, and 26594:35) stand out by precociously assuming dimensional ratios which are reached by the majority of the measured sample only at a considerably later growth stage. They thus represent cases of accelerated development. On the other hand, paratype A.M.N.H. No. 26594:14 seems to be an example of retarded development. Furthermore, it deserves mention that, even excepting these individuals, there are cases in which shells of about the same size differ quite considerably in either width (e.g., A.M.N.H. Nos. 26594: 19 and 26594:24) or height of the spire (e.g., A.M.N.H. Nos. 26594:36 and 26594: 37). These divergences, however, are not of a kind that would warrant distinction of morphologic varieties, any more than do those resulting from either accelerated or retarded development. There are similarly great divergences in the pleural angles even between individuals which do not differ much in size (A.M.N.H. Nos. 26594:10 and 26594:12, 26594:17 and 26594:19, 26594:36 and 26594:37), if the precocious and the retarded individuals are again excepted. To a certain extent these divergences, as in other forms, are connected with and caused by differences in width and in height of the spire, greater width and/or lower spire causing more obtuse pleural angles, and smaller width and/or higher spire more acute ones. In this particular species, however, a third element enters, namely, the degree of prominence of the tubercles at the upper ends of the transverse ribs, more prominent tubercles making for wider pleural angles, all else being equal.

SELECTION OF TYPES: With regard to the considerable changes the shell shape undergoes in the course of ontogeny, a juvenile with still rather ventricose body whorl (A.M.N.H. No. 26594:10) is designated syntype A, and the particularly well-preserved shell A.M.N.H. No. 26594:34 and the largest one measured, also complete (A.M.N.H. No. 26594/1:2), are selected as syntypes B and C, respectively.

DESCRIPTION: Shell shape in maturity slender-conical, with a rather high, slightly concave base the height of which amounts to a little more than a fourth of the total height in syntypes B and C. At the adolescent stage the ventricose body whorl makes the shell on the whole appear considerably stouter (syntype A; fig. 4), and the height of the base amounts to a little less than a fourth of the height of the shell. Nine or 10 volutions can be counted in syntypes B and C. The early post-nuclear whorls still exhibit the shape of the frustum of a cone and are gently convex, but as soon as the "coronet" of upper tubercles develops and with it an almost horizontal narrow subsutural ledge (ramp), the maximum width of the costal whorl profile moves upward to the upper shoulder and the outline becomes virtually straight and perpendicular from the upper to the lower shoulder (syntype A; fig. 4). In maturity the costal whorl profile remains strictly angular, but the intercostal one as a rule is slightly convex again, with the maximum width somewhat above the lower shoulder (syntypes B and C; figs. 1, 2, 13, 14). The

aspect of the costal whorl profile depends to a large extent on the degree of prominence attained by the upper tubercles. Where they project the farthest, they mark the point of greatest width and make the profile appear flat or even slightly concave even at a medium size (paratype A.M.N.H. No. 26594:39; fig. 6). The boundary between the lateral face of the body whorl and the base is marked by the strongest of the revolving keels. The columella, as seen in the broken paratype A.M.N.H. No. 26594:42, is solid and corkscrew shaped (fig. 8). The aperture is obliquely elliptical, with a blunt angulation at its upper end and a shallow and rather short anterior notch which in this species, too, points a little to the left. Only exceptionally, as in syntype A, is there a faint indication of a reflexed, narrow inner lip, but nowhere can any trace of an umbilical niche be recognized, said by Cossmann (1906, p. 28) to be "plus ou moins complètement" covered in this genus by that reflexed inner lip.

Most characteristic of this form is its ornamentation. It is dominated by the transverse ribs which vary considerably in both number and prominence. Only six are present on the body whorl of paratype A.M.N.H. No. 26594:17, where they are unusually high. Both these features unite to lend to the intercostals the appearance of rather deep and wide troughs (fig. 10). Equally few ribs are present in paratype A.M.N.H. No. 26594:25 (fig. 27), but as a rule there are seven, as in syntype B, or eight, as in syntype A and on the penultimate whorl of syntype C. Only on the body whorl of syntype C are nine counted. In contradistinction to *R. subulatus*, the density of costation remains essentially constant throughout development, i.e., their number increases moderately with growth. The ribs run in a perpendicular or more often slightly backward direction from suture to suture. On the body whorl, they end abruptly at the keel which marks the boundary of the base. They are generally straight, only occasionally, as on the body whorls of syntypes B and C (figs. 1, 2, 13, 14), tending to form an extremely shallow, forward concave arc. Contrary to Cossmann's (1906, p. 27) generic diagnosis, stating that they "ne se correspondent pas d'un tour à l'autre," the ribs of consecutive volutions sometimes happen to be in line so as to create the impression of a continuous ridge running over as many as five whorls (e.g., in syntype B; figs. 1, 2). The upper ends of the costae are somewhat thickened and raised so as to overtop the upper suture, thus forming the coronet so characteristic of this genus. In profile they point outward and slightly upward. These upper tubercles vary greatly in prominence. Those seen in syntype B (figs. 1, 2) may be considered typical, whereas those of syntype C (figs. 13, 14) are rather below average. On the other hand, paratypes A.M.N.H. Nos. 26594:17 and 26594:39 (figs. 10, 6) give good examples of unusually prominent tubercles. In the latter and, in a more pronounced way, in paratype A.M.N.H. No. 26594:43 (fig. 7) they even assume the aspect of short spines.

As already mentioned, the keel delimiting the base from the rest of the body whorl is the most outstanding element of the revolving ornamentation. As in most species of *Paracerithium*, it is accompanied on its inner side by another keel which is only a little inferior in strength. However, since it is out of reach of the transverse ribs which stop at the former, it is never beaded and thus appears less heavy. These two keels are separated from each other by a comparatively wide but not deep revolving furrow. The rest of the base is smooth, except for a faint revolving ridge which is observable only in paratype A.M.N.H. No. 26594:17 and is there separated by a hardly perceptible shallow depression from the columellar border. This depression is, however, not believed to indicate an umbilical niche. Above the "boundary keel" there are, as in *Paracerithium*, more or less thread-like revolving keels which vary greatly in number and strength but are always quite distinct, much more so than in the genus *Protofusus* or, within the present genus, in *R. subulatus*. Four can be counted in syntype A and in paratypes A.M.N.H. No. 26594:44, distinguished by particularly distinct revolving ornamentation (fig. 9), and 26594/1:1, five in syntype C, six in syntype B and in the afore-mentioned paratypes A.M.N.H. Nos. 26594:43 and 26594:17, leaving even finer threads, which are here and there intercalated between them, out of account. These lateral revolving keels also vary greatly in density, distribution, and relative strength. Whereas mostly they

are more or less uniform in strength and intervals, as in syntypes A and B, they decrease in strength and increase in density upward in paratype A.M.N.H. No. 26594:17. In syntype C, on the other hand, three, of which the middle one is the weakest, are crowded together in the middle of the whorl and separated by wider intervals from both the top keel and the one immediately above the "boundary keel." Both are considerably stronger than the three middle keels. The keel above the base keel here even equals, if not exceeds, the latter in both strength and tuberculation. As a rule, these lateral revolving keels are about as wide as their intervals, but in some individuals (e.g., paratype A.M.N.H. No. 26594:17) they tend to reduce the latter to narrow furrows. The undulating aspect of this revolving ornamentation, first described in *Paracerithium tambosolense* (above), is observable in some shells of the present species also, as in syntype B and much more distinctly in paratype A.M.N.H. No. 26594:17. In the latter not only the same crescent-shaped niches as described in *Paracerithium turritellare* can be recognized above the "boundary keel," but the top keel assumes the shape of a garland connecting the pearls of the "coronet." These opposite curvatures gradually flatten out from both ends towards the middle of the whorl (fig. 10). It is obvious that they become more pronounced the deeper and wider the intercostals are. Beads are produced on the transverse ribs by the revolving keels, the larger the stronger the keels. Some, such as those of the first keel above the "boundary keel" in syntype C, almost equal the upper tubercles in strength.

EARLIEST ONTOGENETIC STAGES: Inclination of the nucleus can be seen wherever the latter is preserved, but only in a few shells, best in paratype A.M.N.H. No. 26594:25 (fig. 27), can it be recognized to be alloiostrophic. The nuclear whorls are rounded in profile and smooth, as is the first post-nuclear whorl. The first ribs appear on the fourth volution.

REMARKS: Among the Peruvian *Rhabdocolpus* forms the present one is believed to be most characteristic of a group which is represented by several hundred individuals in lot 48, but only by very few each in eight other lots, and which comes fairly close to the typical Jurassic forms of this genus. This forerunner quality of the present species is alluded to in its name. The holotype of the type species, *R. scalariformis* Deshayes, as illustrated by Eudes-Deslongchamps (1842c, pl. 11, fig. 63), differs from *R. praeco* chiefly by having a distinctly reflexed inner lip and not only one but about seven revolving keels on the base below the keel at which the transverse ribs end. However, in both respects certain developments tending in these directions are noted in the above description. It is true that none of Eudes-Deslongchamps' figures shows the anterior notch so clearly as it can be seen in the Peruvian specimens, but this may well be due to incomplete preservation of the apertures. The characteristic examples of *R. scalariformis* and *R. undulatus* illustrated in Cossmann (1906, pl. 5, figs. 21, 22, 24), also otherwise very similar to *R. praeco*, show a closer resemblance in aperture than can be inferred from Eudes-Deslongchamps' figures. This does not hold true for *R. manselli* (de Loriol), made the "génoplésiotype" by Cossmann (1906, fig. 2, pl. 5, fig. 23). It may be doubted whether the last species, in which the revolving ornamentation predominates over the transverse one, is at all congeneric. One of Cossmann's figures (1906, pl. 5, fig. 24) of *R. undulatus* clearly shows the alloiostrophy of the nucleus.

This species is readily distinguished from *R. subulatus* by its conical but not subulate shell shape and considerably wider pleural angle, earlier development of the subsutural ramp and upper tubercles, and greater distinctness of the revolving ornamentation. *R.* sp. indet. 2, aff. *subulato* occupies in some of these respects an intermediate position between the two species here compared, as is mentioned above in the discussion of that form.

Within the Peruvian material, *R. rursicostatus* and *R. emaciatus* are most closely related to *R. praeco* and are compared with it in the discussions of those species.

Certain details of ornamentation which *R. praeco* has in common with various forms of the genus *Paracerithium*, to which it is undoubtedly closely related, and in consequence with some of the genus *Protofusus*, which foreshadow some features more fully de-

veloped in *Paracerithium*, are mentioned in the description.

The comparison of the genera *Andangularia* and *Rhabdocolpus* already referred to under the heading of *Rhabdocolpus* is based on *Andangularia* aff. *subarmatae* and on *R. praeco*.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	26594	370
86	26594/1	2
57	26594/2	2 (fragments)
76	26594/3	1 (doubtful)
87	26594/4	1 (doubtful)
Total (including fragments)		376

Rhabdocolpus rursicostatus, new species

Plate 16, figures 12, 15–23, 25, 26, 33, 34

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26595:1 (syntype A)	3.40 mm.	47½	41½	38°
26595:2	*ca.* 4.8	*ca.* 42½	*ca.* 42½	30°
26595:3	*ca.* 5.64	*ca.* 36	*ca.* 51	30°
26595:5	*ca.* 6.6	*ca.* 38	*ca.* 49	27°
26595:6 (syntype B)	7.20	34	51½	21°
26595:7[1]	7.20	31	60	21½°
26595:8	7.68[2]	?	?	19°

The growth trends in this species are clearly the same as in *R. praeco*. At corresponding sizes the dimensions of both species are fairly close, except that at heights between 4½ and 6 mm. the pleural angles tend to be somewhat more acute in this species than in *R. praeco*. Deviating dimensions of specimen number 7, which is somewhat aberrant in this respect as well as in others, are dealt with below.

SELECTION OF TYPES: The smallest measured specimen (no. 1) and the best preserved among the largest (no. 6) are designated syntypes A and B, respectively; in addition, a shell with widely spaced ribs and particularly dense revolving striation (no. 9) is designated syntype C.

[1] Conspecificity not certain.

[2] Broken spire. Measurement as preserved; full height estimated at from 9 to 12 mm.

DESCRIPTION: Although this form is very close to *R. praeco*, it cannot be considered fully conspecific. Enumeration of the differences on which this opinion is based will serve best to describe the peculiarity of the present species. Shell shape, base, and aperture show the same general characters as in *R. praeco*, but it should explicitly be noted that the spires are somewhat more slender and the apices more pointed (e.g., paratype no. 8; fig. 15) and that the inner lip can clearly be seen in syntype B to be reflexed and accompanied by a faint indication of a false umbilical niche (fig. 21). As far as the whorl profile is concerned, the subsutural ramp tends to be wider and to stand farther off the suture in this form, particularly in the young (e.g., syntype A; figs. 25, 26). Also the outer edges of the ribs follow as a rule (exception: syntype C, figs. 16, 17) the convexity of the whorls so as to make the costal whorl profile more convex than it is in *R. praeco* (syntypes A and B, paratype no. 8; figs. 25, 26, 19–22, 15). Most characteristic, however, of this species is its costation. Throughout development the ribs run as a rule decidedly backward (hence the specific name), assuming a slightly sigmoidal course which becomes even more manifest if, as often happens (syntypes B and C, paratype no. 8; figs. 19–22, 16, 17, 15), the ribs of consecutive whorls become contiguous so as to unite to helicoid ridges running over four or five volutions. The number of ribs on the body whorl varies in this species also; there may be as few as five, as in syntypes A and C, six, as in paratype number 8, seven, as in paratype number 3, or, most frequently, eight, as in paratypes numbers 2 and 5 and in syntype B. As a rule, the upper tubercles are moderately prominent (example: syntype B; figs. 19–22), but sometimes, as in paratype number 10, they develop into sharp, strong spines (fig. 23). On the other hand, where the ribs are unusually high in their full length, as they are in syntype C, the tubercles are bound to stand out less than usual (figs. 16, 17). As a rule, five (paratype no. 5), six (syntype B, paratype 8), or seven (paratypes nos. 2, 3) threads are present in the last volution above the keel at which the ribs end, but some shells, among them syntypes A and C, are distinguished by particu-

larly dense revolving striation, comprising in syntype C as many as nine keels, which are much wider than the intervals between them, plus one intercalated thread. In this form, too, the revolving striae of top and bottom curve in towards the middle of the whorl, thus producing the repeatedly mentioned undulating pattern. Some of the striae, in crossing the transverse ribs, produce beads; some of them, especially those of the first revolving keel above the boundary keel, rival the upper tubercles in strength.

Specimen number 7 (fig. 12) requires separate treatment by way of appendix to this description: It stands out not only by its slenderness and particularly high spire, both W and h attaining extremes not found in any other *Rhabdocolpus* shell from lot 48, but also by the rounded-convex profile of the body whorl. It cannot safely be decided if these aberrancies represent merely an individual abnormality, but the fact that this shell is somewhat crippled makes it likely.

EARLIEST ONTOGENETIC STAGES: The nucleus is complete, or almost so, in syntype B, in paratypes numbers 3, 8, and 11, and in the specimen number 7, just discussed. Except for being more pointed, it agrees with that of *R. praeco*. In syntype B (figs. 19, 22) and in paratypes numbers 8 and 11 it can be recognized to be alloiostrophic.

REMARKS: Comparison of *R. rursicostatus* with *R. praeco* is integrated in the above description. From *R. subulatus* it differs in the same way as *R. praeco*, with the differences from the latter added. *R. emaciatus* is compared below with the present form.

It may be worth mentioning that in the upper whorls of the holotype of the type species, *R. scalariformis*, as depicted by Eudes-Deslongchamps (1842c, pl. 11, fig. 63), the ribs show a backward trend similar to that in *R. rursicostatus*.

OCCURRENCE: Represented by 21 individuals in lot 48 only (A.M.N.H. No. 26595).

Rhabdocolpus emaciatus, new species

Plate 16, figures 24, 29, 31, 32, 35, 43, 44

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26597:1	*ca.* 3.32 mm.	*ca.* 40	*ca.* 50	29°
26597:2	4.56	37	50	25°
26597:3	5.40	33½	51	26°
26597:4 (syntype A)	6.36	36	56½	25°
26597:5	*ca.* 6.96	?34½[1]	*ca.* 55	?24°
26597:6	*ca.* 7.8	*ca.* 35½	*ca.* 54	*ca.* 25°
26597:7	*ca.* 7.8	?	*ca.* 54	23°
26597:8 (syntype B)	8.04[2]	?	?	18½°

The usual trends of W and π to decrease, and of h to increase, with growth are recognizable in this species, too, but these changes are of a markedly smaller range than in both preceding species, since the shell is already slender and high-spired at the earliest stage measured, which is about the same as in *R. rursicostatus*. From there to the next size, which is only a little more than 1 mm. larger, W and π decrease distinctly, whereas a marked increase of h occurs only between the sizes of about 5½ and 6½ mm. From the stages of these decreases, and increase, respectively, all three values remain more or less constant; only the pleural angle is found to become markedly more acute, but not until a size of about 8 mm. is reached. It is worth noting that, different as the pleural angles of the three species *R. praeco*, *rursicostatus*, and *emaciatus* are at the first comparable sizes of from 3 to 3½ mm., namely, 30 degrees to 42 degrees, average 36 degrees, 38 degrees, and 29 degrees, respectively, all three species end at the largest sizes measured of about 8 mm. with virtually the same pleural angles, namely, 19 degrees, 19 degrees, and 18½ degrees.

SELECTION OF TYPES: The medium-sized shell numbered 3 is designated syntype A; in addition one of the largest shells present (no. 7), though incomplete, is selected as syntype B to illustrate the character of ornamentation in maturity.

DESCRIPTION: This species can best be described by comparison with *R. praeco* and *R. rursicostatus*, with which it is closely related. The shells, somewhat more slender, have higher spires and accordingly more acute pleural angles, particularly in the earlier growth stages. The costation is stiffer; the ribs are usually high and sharp and quite regularly run moderately obliquely backward. The upper tubercles generally project far

[1] Crushed.

[2] Incomplete. The measurement is as preserved; the full height is estimated at about 10 mm.

outward, sometimes assuming, as in paratype number 2, the shape of short but strong spines (fig. 24). In medium and large-sized shells they can be seen to continue from the peak across the upper ramp to the suture, thus making the uppermost part of the ribs more conspicuous than in the related species (syntypes A and B; figs. 31, 32, 35). More often they tend to unite into straight ridges running continuously over as many as five consecutive volutions (syntype B, paratype no. 8; figs. 35, 43). There are eight or nine on the body whorls of all shells examined for that character. Above the "boundary keel" at which the ribs end and which is, as usual in this genus as well as in *Paracerithium*, followed on the base by an inner, somewhat weaker keel, there are four revolving threads on the lateral face of the body whorl of syntype A, and six, which decrease in strength and in width of their intervals upward, in syntype B. The latter stands out by carrying, on the upper ledge immediately beneath the suture, one more revolving thread above the one that connects the peaks of the tubercles (fig. 35).

Paratype A.M.N.H. No. 26597:6 must be mentioned for the unusually convex profile its two last whorls assume, thus reminiscent of a similar character reported above for a shell (A.M.N.H. No. 26595:7) of *R. rursicostatus*.

EARLIEST ONTOGENETIC STAGES: The nucleus, more or less well preserved in all but one (no. 8) of the measured specimens and in two others (nos. 9 and 10), agrees with those of the two preceding species. Those of paratypes numbers 1 and 4 are illustrated (figs. 29, 44) for showing the alloiostrophy best.

REMARKS: The differences of this species from the two preceding ones are made clear in the description. From *R. subulatus* it can, despite a certain similarity in dimensions, readily be distinguished by its slender-conical but not subulate shell shape and by its flatter whorl profile.

OCCURRENCE: Seventeen specimens, all in lot 48 only (A.M.N.H. No. 26597).

KITTLISTYLUS, NEW GENUS

Kittl (1894, p. 192), when establishing his genus *Eustylus* (renamed *Trypanostylus* by Cossmann, 1895b, p. 63), only doubtfully included (1894, p. 196) "*Turritella*" *flexuosa* Münster (1841, p. 120, pl. 13, fig. 29), placing it within his new genus in the "Group of *Eustylus triadicus*." He seemed not quite satisfied with this procedure, gropingly (as it were) discussing other taxonomic possibilities. Of these he mentioned affinities to the loxonematids, and "perhaps also" to *Promathilda subnodosa*. Much as this species differs from "*Eustylus*" *flexuosus*, it seems from the present study that Kittl's last guess came closest to the truth. However, Münster's species and its closest relatives are believed to belong not to the Mathildidae but to the Procerithiidae. The alloiostrophy of the nucleus, hitherto never studied in this group, may allocate it to either family, but the predominance of the transverse ornamentation over the revolving one and the shape of the aperture strongly favor the Procerithiidae.

There has been much discussion on the genus *Trypanostylus* in the literature (see e.g., Häberle, 1908, pp. 390–392), but its positive results are scarce. It seems that the taxonomic problems were greatly complicated by the fact that Cossmann in his discussion of that genus (1909, p. 59) considerably changed its diagnosis without restricting its delimitation. Thus he made a columella "perforée sur toute sa longueur" a generic character, though leaving Kittl's (1894, p. 195) "Group of *Eustylus triadicus*," in which the columella is solid according to Kittl, with the genus. Wenz (1938, p. 396) did not accept this generic character of Cossmann's. Even before Cossmann's revision, Blaschke (1905, p. 205) proposed a new subgeneric name *Turristylus* for Kittl's "Group of *Eustylus triadicus*." This proposal was rejected as "excessive" by Cossmann (1909, p. 60), since he doubted the possibility of a clear separation of *Turristylus* from *Trypanostylus*. Kutassy (1937, p. 69) ignored Blaschke's subgeneric name, and Wenz (1938, p. 396) listed it merely as a synonym of *Trypanostylus, sensu stricto*.

Thus, depending on whether or not *Turristylus* Blaschke is admitted as a subgeneric name, it is from that subgenus or from *Trypanostylus* Cossmann, *sensu stricto*, that the present genus, destined to accommodate *Trypanostylus flexuosus* and its closest allies, is being split off.

TYPE SPECIES: *Turritella flexuosa* Münster (=*Eustylus flexuosus* in Kittl, 1894). Its holotype is Münster's original, as refigured by Kittl (1894, pl. 10, fig. 20).

GENERIC DIAGNOSIS: Shell shape slender-conical to needle-like; whorl profile first gently convex, later becoming flat and even slightly concave, owing to a swelling of the upper part of the whorl in maturity. Sutures shallowly engraved. Base separated by a rounded shoulder from the rest of the body whorl, somewhat truncate, and slightly concave. Aperture rhomboidal in shape, with an angulation at its upper end and a short and shallow anterior notch at the lower which points downward. Inner lip in its lower part somewhat reflexed over the columella which is solid and sinuous. Ornamentation dominated by a rather dense though not prominent transverse costation which persists throughout development. The ribs run from the upper suture to the lower one, or to the shoulder, respectively. In maturity they become thickened and slightly more prominent at their upper ends, thus accentuating the subsutural torus. Sometimes they tend to form faint tubercles at their lower ends also. In addition, there is generally a very fine and dense revolving striation. Nucleus strongly inclined towards the shell axis and decidedly alloiostrophic.

SPECIES INCLUDED: In addition to the type species, first described from St. Cassian by Münster and Kittl and here reported from Peru also, only two forms, described under the names *Trypanostylus flexuosus* and *T. duplicatus* from Transylvania by Kutassy, and another Peruvian species (below, p. 246) can with certainty be referred to this genus. *Trypanostylus* (*Turristylus*) *waageni* Blaschke (1905, p. 206, pl. 20, fig. 24) may belong to it, provided the description is correct in its mention of merely "sigmoidal lines running toward the ribs" on the base, and figure 24c, which shows sharp and strong ribs running radially all over the base instead, is grossly exaggerated.

As justly emphasized by Blaschke (1905, p. 206), the distinctness of the transverse costation and its persistence throughout the ontogeny are the most obvious marks of distinction of this group from the species with which it was hitherto united in Kittl's "Group of *Eustylus triadicus*" (=subgenus *Turristylus* Blaschke), for example, *T. triadicus* Kittl (1894, p. 195, pl. 8, figs. 26, 27) and *T. semiglaber* (Münster) (see Kittl, 1894, p. 195, pl. 6, figs. 64, 65), not to speak of the forms of Kittl's "Group of *Eustylus militaris*," i.e., the typical *Trypanostylus*, which differ in addition by the perforated columella.

FAMILY AND OTHER RELATIONS: The characters of the ornamentation and of the nucleus chiefly suggest the transfer, here carried out, of the forms comprised in the new genus from the Coelostylinidae, in which they were included by Cossmann (1909, pp. 41, 60) and Wenz (1938, p. 396), to the Procerithiidae, thus causing another deviation from Wenz' taxonomic sequence, otherwise followed throughout this report.

Within the latter family, this genus comes, at least in the present material, closest to the subulate forms of the genus *Rhabdocolpus* with which it is associated in lot 26. Dimensions, shell and whorl profiles, general shape of base and aperture, inclination of the nucleus, and presence of a more or less distinct transverse costation and a faint revolving striation, all create a high degree of resemblance, increased by the development of some kind of tubercles at the upper ends of the ribs. This similarity is not close enough to warrant the assumption of congenerity. The differences that are believed to exclude it are pointed out in the remarks on *K. flexuosus*.

Kittlistylus flexuosus (Münster)

Plate 16, figures 28, 36–39, 41

Turritella flexuosa MÜNSTER, 1841, p. 120, pl. 13, fig. 29.

Eustylus (?) *flexuosus* Mstr. sp.; KITTL, 1894, p. 196, *cum synon.*, pl. 10, fig. 20.

Non Trypanostylus flexuosus Münst.; KUTASSY, 1937, p. 69, text fig. 5.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26555:1	*ca.* 2.99 mm.	*ca.* 25	*ca.* 58½	13°
26555:2	*ca.* 4.15	*ca.* 24	*ca.* 66	13°
26555:3	7.74	21	70	14°
26555:4	10.56[1]	20	?	*ca.* 10°

[1] As preserved (incomplete).

Although all specimens present of this species have been measured, they represent only a small sample. It shows, however, clearly the decrease of W and the increase of h with growth, as usual in this family. The pleural angle, on the other hand, is practically constant up to a comparatively large size, probably owing to the early assumption of a needle shape by this form. Only the largest, but incomplete shell exhibits a somewhat more acute pleural angle, but since it is worn, its amount can be given only approximately. Measurement of Kittl's figures of the holotype yielded a result of: π, $12\frac{1}{2}$ degrees.

DESCRIPTION: Shell needle-shaped, consisting of 11 whorls (including the nuclear ones) in specimen number 2; 11 and 13 can be counted in the larger shells numbered 3 and 4, respectively, but both are incomplete and may well be estimated to have had at least 14 and 15 volutions, respectively. The early post-nuclear ones are only very gently convex; soon the whorl profile flattens and in maturity it turns slightly concave, owing to a swelling of the whorls in the upper parts. This swelling produces a subsutural torus which becomes more and more distinct and broad in the later whorls of specimen number 4 until in the last two it expands over the entire upper half of the whorl height. At its top, it carries a narrow subsutural ledge ("rampe" Cossmann, "Nahtfacette" Kittl). As long as this subsutural ledge is not developed, the sutures are only shallowly engraved. Only in the two last volutions of specimen number 3 loss of the test produces the deceptive appearance of a strongly convex whorl profile and accordingly deep sutures. The base, separated from the lateral face of the body whorl by a rounded shoulder, is rather low, truncate, and slightly concave. The aperture seems to be rounded-rhomboidal, with an angulation at its upper end and a short and shallow anterior notch, pointing downward rather than slightly to the left as in most other canaliculate forms of this family. In specimen number 2 the lower part of the inner lip seems to be slightly reflexed, as it is in Kittl's illustration of the holotype.

Except at the earliest stages, the costation in all four individuals present is almost uniform in character throughout development. It is rather dense, consisting of 11 ribs per whorl, except on the last two volutions of the largest spire (no. 4) where as many as 15 per whorl can be counted, but the ribs are neither prominent nor sharp. They are straight or, in early and middle stages only, shallowly forward concave and run in a radial or slightly obliquely forward direction from suture to suture or, in the body whorl, to the lower shoulder. Except where thickened, they are about as wide as, or in the latest stages even a little wider than, the intercostals. Already at an early stage (specimen no. 1; fig. 28) they form faint prominences, hardly deserving the name "tubercles," at both upper and lower ends which make for a slight concavity of the costal whorl profile. Later, however, the lower prominences seem to disappear, and the ribs become markedly thickened and raised towards the upper ends, thus accentuating the afore-mentioned subsutural torus. In the two smaller shells (nos. 1 and 2) there is a faint indication of a revolving keel on the lower shoulder. Strangely enough, it is visible best immediately above the suture between the last and penultimate whorls of specimen number 2 (fig. 36) where it is topped by a faint furrow. Above this "boundary" keel an extremely fine and dense revolving striation can be recognized where preservation is favorable. Eight threads can be counted in specimen number 1, as many as 10 in specimen number 3, and as many, if not more, in the largest spire (no. 4) which shows one more on the subsutural ledge. This revolving ornamentation produces an accordingly fine denticulation of the ribs, best seen on the thickened upper nodes of those of specimen number 4.

EARLIEST ONTOGENETIC STAGES: As seen in specimen number 1 (fig. 28) and even better in number 2 (figs. 36, 37), the nucleus is smooth, inclined to an unusually high degree towards the shell axis, and strongly alloiostrophic. It cannot clearly be seen when the first ribs appear, but at least two or three post-nuclear volutions also seem to be smooth.

REMARKS: The Peruvian specimens agree so well with Münster's holotype from St. Cassian that I do not hesitate to refer them to his species. It is true that Kittl (whose description is decisive, since Münster's is

rather meaningless) does not mention the occasional development of lower prominences and cautiously states that "revolving striae seem to be absent." However, his enlarged figure shows clearly an indication of "tubercles" at the lower shoulder of the body whorl as well as a fine revolving striation, and the corresponding denticulations of the ribs with the aid of a lens can be recognized along the right outline of his unenlarged figure. It is true that neither illustration shows the supersutural revolving keel mentioned in the above description, but it must be kept in mind that, within the material under study, it is found in only one shell out of four. These minor differences are therefore not believed to stand in the way of an identification otherwise warranted, mostly by the shell shape and the peculiar character of the ornamentation.

The Transylvanian specimen referred to this species by Kutassy (*loc. cit.* in synon.) has a markedly wider pleural angle and its ribs run decidedly forward; it is therefore not believed to be conspecific, although it is undoubtedly congeneric. *K. duplicatus* (Kutassy, 1937, p. 69, fig. 6) has throughout development a supersutural row of nodes in addition to the subsutural one, and also forward oblique ribs. *Trypanostylus* (*Turristylus*) *waageni* Blaschke (for reference see above, species included in the genus *Kittlistylus*), possibly congeneric, has a wider pleural angle and apparently sharper and more crowded ribs.

The only other *Kittlistylus* occurring in Peru is compared below with *K. flexuosus*.

As stated, *K. flexuosus* closely resembles the group of *Rhabdocolpus subulatus*, chiefly *R.* sp. indet. 2, aff. *subulato*. The two can be distinguished by the following characters: The shell shape is more pointed in *K. flexuosus* and the apical angle markedly more acute. The early volutions are never so convex and flatten sooner. The base is shorter, as is the beak (compare figs. 28 and 36 with fig. 82 of pl. 15), which also does not point to the left. The ribs are not so prominent and are more closely set; no true "coronet" develops. The "boundary" keel, if present, is only indistinct, there is no inner revolving keel, and the revolving ornamentation of the sides is only faint and denser. Finally, the alloiostrophy of the nucleus is much more pronounced in this species than it is in *R. subulatus*.

OCCURRENCE: Occurs, with four specimens, in lot 26 only (A.M.N.H. No. 26555).

Kittlistylus alter,[1] new species

Plate 16, figures 42, 45, 46

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26521:1	*ca.* 2.9 mm.	*ca.* 60	*ca.* 54	22°
26521:2	*ca.* 4.8	*ca.* 50	*ca.* 70	24°
26521:3 (holotype)	6.20[2]	?	?	16°

The same growth trends as in *K. flexuosus* are recognizable here.

SELECTION OF TYPES: All three shells present being incomplete, the one that shows the peculiarities of whorl profile and costation best (no. 3) is designated holotype.

DESCRIPTION: Shell slender, turreted. Whorl profile first trapezoidal, then owing to the development of a subsutural ridge becoming increasingly concave. Simultaneously a narrow, almost horizontal ledge (ramp), hardly perceptible in the earlier stages, becomes more distinct. The sutures are shallowly engraved, but once the subsutural ledge is developed it makes the boundaries between the volutions stand out clearly. The base is decidedly truncate and seems to have been rather short. The columella is massive and solid; in apertural view it runs from the upper left to the lower right. The aperture, not complete in any of the shells present, seems to have been broad-rhomboidal in outline, with a subcircular lumen.

Heavy transverse ribs, about as wide as their intercostals, dominate the ornamentation. As a rule, they are straight; only on the last preserved whorl of the holotype do they become shallowly forward concave. They run in a radial or only slightly forward direction all over the lateral whorl face. In their uppermost parts they thicken considerably to form quite prominent nodes, which accentuate the subsutural ridge and occasionally tend to amalgamate in it. Regardless of size, there seem to be 16 ribs on the last volu-

[1] *Alter*, Latin, meaning the other.

[2] As preserved; total height, when complete, estimated at 10 mm. at least.

tions of all three shells. The costation of the holotype shows the following peculiarities (fig. 42): On the antepenultimate whorl the ribs assume a wedge shape, tapering all the way from the upper to the lower ends, and wedges pointing upward, occurring only at about the lower third of the whorl height, are intercalated between them. On the last preserved whorl two ribs bifurcate in their lower thirds.

In paratypes 1 and 2 as many as 10 fine denticulations per whorl, indicating the presence of a revolving striation, can be counted on the ribs. In the holotype extremely fine revolving striae can only occasionally be recognized on the subsutural ridge.

Earliest ontogenetic stages are not preserved in any of the three shells examined.

REMARKS: *Kittlistylus alter* is readily distinguished from *K. flexusous* by being wider and having a wider pleural angle. Its base is shorter and more truncate, and the peculiarities of the whorl profile and the costation are exaggerated. The subsutural ridge, though narrower, is more prominent, the ramp is more pronounced, and the lateral whorl face more clearly concave. The costation is heavier and somewhat stiffer. All these differences from the type species are believed to characterize the present species so unequivocally that naming it may be justified despite the scarcity and poor preservation of the hypodigm.

Its peculiarities also distinguish it from the congeneric species mentioned in the discussion of *K. flexuosus*.

Among forms in the Peruvian assemblage belonging to other genera *Protorcula*, new species, is somewhat similar in shell shape but can readily be distinguished by its revolving twin keels and by the lack of the heavy transverse costation found in the present form.

OCCURRENCE: In lot 26 only, three specimens (A.M.N.H. No. 26521).

CRYPTAULAX TATE

This genus was based by Tate (1869, p. 418) on *Cerithium tortile* Hébert and Eudes-Deslongchamps (1860, p. 191, pl. 6, fig. 1) and clearly defined. Their name is here provisionally retained for the type species of this genus, although according to Tate (1869, p. 419, footnote) it was a homonym when proposed by the French authors and could therefore not be validated by the transfer of the species from *Cerithium* to *Cryptaulax*, Tate's view to the contrary being not reconcilable with the Rules of Zoological Nomenclature. Hébert and Eudes-Deslongchamps, when establishing this species, figured five different specimens referred to it, but since not all of them may be conspecific under the modern circumscription of species, the original of figure 1c, believed to be most characteristic, is herewith designated holotype of the type species. As far as I could ascertain, no such selection has hitherto been made, not even by Huddleston (1889, p. 182) when dealing with this species.

Although Tate quite unequivocally designated "*Cerithium tortile*" as genotype of *Cryptaulax*, Cossmann (1906, p. 37) incorrectly selects *Cerithium scobina* Eudes-Deslongchamps (1842b, p. 196, pl. 10, figs. 49, 50) for the same purpose, though including *Cerithium tortile* in his enumeration (*ibid.*, p. 39) of species of this genus. Wenz (1940, p. 730), rather uncritical of Cossmann's statements in this case as in others, takes over Cossmann's error as to the genotype.

All the species hitherto referred to *Cryptaulax* are Jurassic in age, it is true, but the two following species are not the first of this genus recorded from the Triassic. Comparison of Kittl's (1894, pl. 10, fig. 1) illustrations of his *Promathilda bittneri* from St. Cassian with Eudes-Deslongchamps' of his *Cerithium scobina*, quoted above, leaves not the slightest doubt but that Kittl's species is a true *Cryptaulax*. *C. bittneri*, represented by a single specimen at St. Cassian, has previously been recorded from the Triassic of Peru by Jaworski (1923, p. 152, pl. 5, fig. 20). The fragment figured by that author, which might well belong to *Cryptaulax rhabdocolpoides*, lacks the aperture so that its generic affinities cannot be established with certainty. If there were any doubt as to its being a *Cryptaulax*, Jaworski's statement that *Promathilda bittneri* as conceived by him is indistinguishable from *Cerithium abcisum* Terquem and Piette, as described and figured by von Bistram (1903, p. 188, pl. 6, fig. 12) from the Liassic of the Val Solda (Lombardy), would remove it, for von Bis-

tram's form, the inner lip of which can be seen in the figure, is also a true *Cryptaulax.*

Represented by only two species, with altogether not quite 30 specimens, this genus by the standards of the present report must be considered a rather rare one. Next to *Pseudotritonium*, the presence of which is not established beyond doubt, it is the rarest among the procerithiid genera in the Peruvian material.

Cryptaulax rhabdocolpoides, new species

Plate 16, figures 48–50, 52–54, 56–59

?Promathildia Bittneri Kittl; JAWORSKI, 1923, p. 152, pl. 5, fig. 20.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26517:1	3.15 mm.	39½	50	22½°
26517:2	*ca.* 3.24	*ca.* 33½	*ca.* 56½	19°
26517:3	3.32	32½	52½	16½°
26517:4	5.88	26½	59	15°
26517:5 (syntype A)	6.12	27½	66½	15½°

The largest size attained by this species within the hypodigm is represented by syntype B, consisting of a little more than a body whorl; its height, when complete, may be estimated at a little more than 10 mm.

The table shows well the growth trends prevailing throughout the Procerithiidae, namely, decrease of W and π and increase of h.

SELECTION OF TYPES: The largest complete shell (A.M.N.H. No. 26517:5), well illustrating shell shape and ornamentation of all stages but the last, is designated syntype A, but since the mature characters, especially those of the aperture, can be studied only in the afore-mentioned body whorl (A.M.N.H. No. 26517:8), this is selected for syntype B.

DESCRIPTION: Shell turritellid, slender-conical, consisting (in syntype A) of 13 volutions, including the nuclear ones. Only the two first post-nuclear whorls are gently convex, then the whorl profile flattens and from a height of about 2 mm. on becomes slightly concave owing to the prominence of both upper and lower tubercles. At early and middle stages the whorls, though almost cylindrical in shape, attain their maximum width immediately above the suture, so that it is marked in costal section by the lower tubercles, but in maturity it shifts to the upper shoulder and is then, at least in costal section, marked by the then stronger upper tubercles. The sutures are distinctly channeled; the presence of prominent tubercles both above and beneath them makes the costal profile appear even more deeply indented. The base is inverted-conical in shape and seems to become comparatively less high and more truncate and concave with growth. In syntype A a broad and moderately deep false umbilical niche is clearly seen to accompany the thickened inner lip (fig. 49). In syntype B, on the other hand, only a faint indication of this depression is left in the shape of a shallowly engraved rift along the upper margin of the greatly expanded callosity formed by the inner lip, this callosity apparently concealing most of the depression. The columella is solid and sinuous. In the young the aperture is hardly different from that often observed in *Rhabdocolpus.* There are the same angulation at the upper end and the same shallow anterior notch at the lower. In paratype number 4 that notch can even be seen to point slightly to the left (fig. 58). Even at a middle stage, however, the inner lip is more thickened than in *Rhabdocolpus* and apparently is reflexed over the columella. This character becomes even more manifest in syntype A where it stands out boldly against the background of the mentioned false umbilical niche (fig. 49). The aperture looks quite different in syntype B. Here the inner lip has considerably expanded upward to form a callosity which covers the columella and the accompanying niche, except for the afore-mentioned narrow rift. The margin of this callosity rises gently almost to the suture, where it forms a very obtuse triangle the apex of which lies just a little beneath and a little to the left of the vertex of the upper angulation of the aperture. From that point the callosity continues as a slightly descending narrow ridge into the cavity of the body whorl, just beneath its ceiling; then it gradually vanishes. These details, illustrated in figure 53, are here described at some length, first because they show how the character of the upper part of the aperture considered diagnostic of the present genus

by its author (Tate, 1869, p. 418) develops only in maturity, and second, to stress the fact that in the present species the bridge-like callosity expanding from the inner lip does not join outright the outer wall of the body whorl as in the following species, but disappears under its ceiling.

The ornamentation of this species may still be said to be dominated by the transverse ribs, although in the latest stage observable, best represented by syntype B, they tend to dissolve into the beads formed at the crossing points with the revolving elements and are almost equaled in strength by the latter. Prior to that stage, there are from seven to nine ribs per whorl which run straight and in a radial or slightly backward direction over the lateral whorl faces. They tend to continue in line over as many as five consecutive volutions (e.g., in syntype A; fig. 56), but this tendency is not so rigidly maintained as in other species (e.g., in *C. tilarniocensis*). On the body whorl of syntype A and on the anterior half of that of paratype 4 the costae get out of line. In the latter shell this is due to a sudden increase in the density of costation, there being on that anterior half as many as six ribs, raising the total on the body whorl to 10. These ribs are also less stiff than the others, forming an extremely shallow forward concave arc and becoming slightly sinuous (fig. 57). It seems that these changes indicate a somewhat accelerated development of paratype 4 (which is even a little smaller than syntype A), for similar features are also present in syntype B, representing the latest ontogenetic stage observable (see below). At both upper and lower ends the ribs end in tubercles which are sometimes, as in paratype 1 and in syntype A (figs. 48, 49, 56) quite prominent, but less laterally compressed than they usually are in the genus *Rhabdocolpus*. Upper and lower tubercles are about equally strong up to a size of about 4 mm.; later the upper ones tend to project farther, whereas the lower ones become bullate, lending a club-like aspect to the lower parts of the ribs, as in paratype 4. Best in the same individual the ribs can be seen to end somewhat above the main revolving keel which delimits the base from the rest of the body whorl, leaving a narrow furrow between the keel and the lower tubercles. This keel slightly undulates, the crests of the waves corresponding in site to the ribs above them. This "boundary keel" is followed down the base as in most genera of this family by a second which is only slightly weaker but does not seem to undulate. The two are separated by a furrow about twice as wide as either. (For all these details of the ornamentation, see fig. 57). No more revolving keels follow on the base at the stage here dealt with, unless the faint ridge marking the outer margin of the umbilical niche of syntype A should be counted as such. There is a very fine revolving striation on the lateral faces of the later whorls, nowhere distinct enough to permit a count of the striae, but on the two or three last volutions of syntype A a median row of tubercles much weaker than both terminal ones tends to develop on the ribs, thus indicating the presence at about the middle of the whorl of a revolving element stronger than the others. This development seems to foreshadow later ones both ontogenetically and phylogenetically. The aspect of the ornamentation is considerably changed in the body whorl serving as syntype B. The costae have greatly increased in number, there being 14 on the body whorl, but equally decreased in strength and stiffness. They now run clearly forward, forming a shallow forward concave arc and here and there even assume a slightly sigmoidal course. They are strongest at the upper ends where they form prominent though rather short thorns, indistinctly split in two by a narrow revolving furrow. A fine and dense revolving striation runs across these upper tubercles and is occasionally recognizable also somewhat above and below them. Beneath that dominating top row of twin tubercles follow two distinct but fine revolving keels and after an interval considerably wider than that between them the undulant "boundary keel" which is still the strongest of the three. Below it is what was termed the second keel at an earlier stage. Here, however, it is followed by five more revolving keels which, gradually decreasing in both width and prominence, cover the space between the second keel and the columella, except where overgrown by the afore-mentioned callosity. On the sides spirally elongated beads form at the crossing

points of revolving keels and ribs, tending to dissolve both into rows of such beads and tubercles; thus the ornamentation assumes the aspect of an attractive lattice work. Only on the base fine growth striae and folds, which seem to continue the direction of the ribs, can be recognized to run radially towards the lower end of the columella. (For the details here described, see figs. 52–54.)

It is fully realized that, although certain sculptural elements can be homologized between the earlier stage and the one just described, each widely differs from the other. However, this gap is bridged by two fragments (paratypes 6 and 7) which, though poorly, represent the intervening stage.

EARLIEST ONTOGENETIC STAGES: The nucleus is preserved in several shells, best in syntype A (figs. 48, 49, 56), is pointed, inclined towards the shell axis, and to judge by the incomplete apex of paratype 4 (figs. 57, 58) alloiostrophic. All the early volutions are smooth. The first signs of costation are recognizable only on the fourth or fifth volution.

REMARKS: The Peruvian shell doubtfully included in the synonymy, lacking the aperture, is too incomplete to be identified with certainty, but its conspecificity is quite probable. It is, however, not believed to belong to the true *C. bittneri* (Kittl, 1894, p. 226, pl. 10, fig. 1) which differs from it as well as from the form here described by having lower whorls and more robust ornamentation.

The only other *Cryptaulax* dealt with in this report, *C. tilarniocensis*, is compared below.

Cryptaulax rhabdocolpoides, as indicated in its name, is still very close to the genus *Rhabdocolpus*, with which it has the shell shape and many ornamentational characters in common. In the absence of syntype B, the only individual in which the mature stage of this form can be studied, it would certainly have been considered another species of *Rhabdocolpus*. However, although it is undoubtedly transitional between that genus and *Cryptaulax*, the peculiarities of its aperture in maturity, not found in any species of *Rhabdocolpus* although some of them grow markedly larger, suggested its reference to the present genus rather than to *Rhabdocolpus*. Aside from the aperture and the distinct umbilical niche, there are also differences in ornamentation which are helpful in distinguishing this species from those of *Rhabdocolpus*. Lower tubercles appear in addition to the upper ones and at a middle stage nearly equal them in strength. The ribs do not end at the boundary keel as in so many forms of (*Paracerithium* and) *Rhabdocolpus*, but somewhat above it. In maturity the ribs tend to dissolve into the beads formed at the crossing points with the two lateral revolving keels, and five more revolving keels follow, in the lower part of the base, the two boundary keels which both genera have in common.

The close agreement in dimensions between the present form and *Rhabdocolpus* sp. indet. 1, aff. *subulato* is merely coincidental. The latter, with its subulate shell shape, strongly convex whorl profile, few tubercles, and faint revolving ornamentation, is quite different.

OCCURRENCE: In lot 26 only, where it is represented by 21 specimens, including incomplete ones and fragments (A.M.N.H. No. 26517).

Cryptaulax tilarniocensis, new species

Plate 16, figures 60–71

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26593:1	*ca.* 2.13 mm.	*ca.* 48½	*ca.* 47½	37°
26593:2	*ca.* 2.18	*ca.* 52½	*ca.* 46	35°
26593:3 (syntype A)	2.46	52	41	37°
26593:4	*ca.* 4.07	*ca.* 41	*ca.* 54	30°
26593:6 (syntype B)	3.84[1]	?	?	23½°

Syntype B and another fragment (no. 5) represent the largest size attained within the present sample, which exhibits the usual trends of W and π to decrease, and of h to increase, with growth only after a height of about 2½ mm. is surpassed; before that stage, the values are either more or less constant or even tend in the opposite direction.

SELECTION OF TYPES: The best, though not largest, complete shell (no. 3), a juvenile, is designated syntype A, and the fragment

[1] As preserved; the height, when complete, is estimated at somewhat above 6 mm.

number 6, which best represents the mature stage, particularly the characters of base and aperture, is designated syntype B.

DESCRIPTION: Above the base the conch has the shape of a heptagonal pyramid. Its edges are formed by the ribs, of which there are invariably seven and which run continuously over all volutions but the first three or four, and its sides are concave between these prominent and sharp ribs. Ten volutions can be counted in the largest complete shell present (paratype no. 4), but mature shells must have had at least two more, to judge by the fragmentary syntype B. Only the earliest whorls are convex in profile, then the intercostal profile becomes flat, whereas the costal one is dominated by two strong tubercles. Both above the upper one and beneath the lower, narrow bands sloping from the upper suture and towards the lower, respectively, can be recognized. Between these bands of consecutive whorls the sutures are deeply sunk, and they appear even deeper in costal section owing to the prominence of the tubercles flanking them. The inverted conical base becomes in this species, too, shorter and more truncate with growth. The columella is solid and at later stages rather thick. An umbilical niche is just perceptible in juveniles, for example, paratype 2 (fig. 62) and syntype A, but well developed in the incomplete mature shells paratype 5 and syntype B (figs. 66, 71). The aperture appears subcircular, although there is an angulation at its upper end and a notch at the lower in the young (paratype 1 and syntype A; figs. 61, 64). In syntype A the inner lip can be seen to be slightly reflexed, though in its lower part only, over the columella. In maturity, however, it is much more distinctly reflexed in its upper part, so as almost to touch the base above it, leaving only a narrow furrow open which connects the umbilical niche with the suture between body and preceding whorls. The reflexed inner lip itself bridges the aperture, joining the upper part of the wall of the body whorl on the opposite side and covering more (syntype B) or less (paratype 5) the posterior angulation of the aperture (figs. 71, 66). Unfortunately its lower part is not preserved in either individual so that it cannot clearly be seen how the outer lip is shaped, but it seems to recede from the spot where the extended inner lip joins the ceiling of the aperture, thus causing the profile of the body whorl to taper downward. This assumption is supported by Hébert and Eudes-Deslongchamps (1860, pl. 6, figs. 1a, 1c, 1e of their "*Cerithium tortile*") who show exactly the same bridging of the upper end of the aperture by the expansion of the reflexed inner lip as the two fragments here described.

The afore-mentioned seven transverse ribs and their tubercles dominate the ornamentation. The ribs are straight and stiff; their direction is more or less radial. They run from suture to suture, ending, on the body whorl only, at the revolving keel separating the base, as they do in many other forms of this family. The tubercles mark the points where the ribs are crossed by revolving keels. In the spiral whorls there are two main keels, the upper one immediately below the upper suture, the lower at about the lower third of the whorl height. These two produce the two tubercles dominating the whorl profile. As seen best in paratype 2 and syntype A (figs. 62–64) a third, which produces a smaller tubercle, is intercalated between these two main keels at a comparatively early stage. Below the lower one follows the keel delimiting the base from the rest of the body whorl. As a rule it is visible only on the latter. Only in syntype B does it also become visible, immediately above the suture, in the anterior third of the penultimate whorl. This third main keel carries weaker tubercles than the two others. Only in syntype B a thread-like secondary keel is seen to be intercalated between the lower of the lateral main keels and the boundary keel. Beneath the latter, follow, in both paratype 5 and syntype B, five more revolving keels all the way down to the lower end of the columella (figs. 67, 69, 71). In paratype 5 they are more or less equally strong, whereas in syntype B the second from the top stands out by greater strength and the first from the top seems even weaker than the three last. As in *C. rhabdocolpoides* so many basal keels appear only in maturity. The juveniles (e.g., paratype 2 and syntype A) carry below the boundary keel only the one "inner" keel common in this family. It would seem that the basal keel of syntype B just mentioned as stronger than the others (second below the boundary keel) is the

homologue of that "inner" keel and that the one above it has been intercalated in the course of development. In syntype B only fine growth striae, running in a shallow forward concave arc down the lateral whorl face, can be perceived in an intercostal.

EARLIEST ONTOGENETIC STAGES: The nucleus is more or less well preserved in five out of eight specimens present, best in paratypes 1 and 7 (figs. 61, 70) where it can be recognized to be alloiostrophic. In addition to the nuclear volutions, one or two postnuclear ones are smooth.

REMARKS: In contradistinction to *C. rhabdocolpoides*, which still has much in common with the genus *Rhabdocolpus*, C. *tilarniocensis* is a thoroughbred *Cryptaulax*, with all the characteristic features of this genus, namely, the pyramidal shell shape, the stiff, straight ribs, running continuously over all the whorls and forming characteristic tubercles where crossed by revolving keels, and chiefly the peculiar bridging of the upper part of the aperture by the expansion of the reflexed inner lip. It is important to note that, in this species as well as in the preceding one, the best and most important characteristic appears in maturity only. In particular, this species differs from *C. rhabdocolpoides* by greater shell width, less acute pleural angle, more angular whorl profile, stiffer ribs, which never exceed seven, are always continuous over all but the very earliest whorls, and end only at the boundary keel, and by the fact that the afore-mentioned bridge here connects the reflexed inner lip with the wall of the body whorl, whereas it disappears under its ceiling in the preceding species. From the *Cryptaulax* species first recorded from the Triassic, *C. bittneri* (Kittl) (for references, see p. 250), *C. tilarniocensis* differs also by being a more typical *Cryptaulax*, especially in its fewer and continuous ribs and their more obvious predominance over the revolving ornamentation. Also the most diagnostic generic character, the flat arch bridging the upper end of the aperture, is not visible in Kittl's figure 1 or mentioned in his description.

All the Jurassic forms of this genus, for example, those illustrated by Eudes-Deslongchamps (1842b, pl. 10, figs. 49, 50), Hébert and Eudes-Deslongchamps (1860, pl. 6, fig. 1), Hudleston (1889, pl. 11, figs. 10–15), von Bistram (1903, pl. 6, fig. 12), and Cossmann (1906, pl. 6, fig. 7; pl. 9, fig. 15), appear to be markedly more slender than *C. tilarniocensis* and as a rule to reach a considerably larger size.

OCCURRENCE: Occurs in lot 48 only, eight specimens (A.M.N.H. No. 26593).

XENOPHORIDAE

JURASSIPHORUS COSSMANN

Most surprisingly, a shell clearly referable to this peculiar and extremely rare genus, hitherto known only from the Upper Jurassic (Callovian) of France, turned up in lot 26.

This genus was based by Cossmann (1915, p. 188, pl. 7, figs. 24–26), by monotypy, on d'Orbigny's (1853, p. 306, pl. 332, figs. 1–4) interesting species "*Solarium*" *caillaudianum*, repeatedly discussed by Koken (1889, p. 439, pl. 14, fig. 9; 1896, p. 97; 1897, p. 74) for its striking resemblance to the Silurian genus *Euomphalopterus* Roemer (Koken, 1889, pl. 14, fig. 5; cf. Knight, 1941, p. 20, pl. 78, fig. 1). Koken first (1889) expressed his conviction that both were congeneric, but later (1896, 1897) considered reference of d'Orbigny's species to his Triassic genus *Viviana* which he assigned to the family Solariidae. Here, however, Cossmann's (*loc. cit.*) and Wenz' (1940, p. 905) example is followed in referring this genus to the Xenophoridae.

Jurassiphorus triadicus, new species

Plate 16, figures 30, 40, 47

DIMENSIONS

A.M.N.H. No.	H	W[1]	h	π^2
26514:1 (holotype)	4.9 mm.	155	35	110°

DESCRIPTION: Shell small, consisting of about four volutions, depressed-trochiform, gradate. Although the first whorl is missing in the holotype, a planospiral initial stage is recognizable. Since the second volution is overtopped by the third, or at least by the internal ends of the strong transverse ribs

[1] With omission of the "parachute." If it be included, W may have reached 234.

[2] Disregarding the "parachute."

of the third, the nucleus appears even slightly sunk.

Surtures and apical faces of the whorls are observable between, and on, respectively, the second and third volutions only, since the first is missing, and at a later stage both sutures and apical faces are concealed by the "parachute" expanding from the preceding whorl. Where visible, the sutures are markedly deepened and the apical faces are horizontal or only gently sloping and slightly convex. The lateral faces of the whorls, gradually emerging from concealment by the following volution from the beginning of the third whorl only, are steep, almost perpendicular, and meet the apical ones at an angle of from 100 degrees to 110 degrees in a pronounced shoulder.

The "parachute," although called a "carène très saillante" in Cossmann's (*loc. cit.*) generic diagnosis and a "peripherer, flügelartiger . . . Kiel" in Wenz' (*loc. cit.*), should be considered a character pertaining to shell shape rather than to ornamentation. It begins to appear in the second volution; in the third it already covers the apical face of the following whorl except for the shoulder; in the body whorl, it projects from the lower end of the lateral face into open space for at least the full width of the base, as measured from the umbilical edge to the periphery. It consists of markedly thin, smooth shell substance and is gently bent downward, all these features giving it a parachute-like appearance indeed. Only where its periphery is preserved, that is, at the beginning of the body whorl, can a few scallops be recognized (fig. 30), as shown in d'Orbigny's, Koken's, and Cossmann's illustrations of *J. caillaudianus*.

The base is flatly conical and gently convex; almost a third of its diameter is occupied by the wide and deep, funnel-shaped umbilicus which is bordered by a blunt ridge. In the very last part of the body whorl another ridge rises about halfway between the circumumbilical one and the periphery.

The aperture stands clearly oblique to the axis of the body whorl. Its lumen is plainly circular, but the outer margin of the rather thick peristome is irregularly polygonal, there being one corner, corresponding to the shoulder, in its upper half and three more, which mark the point of attachment of the "parachute," the midbasal ridge, and the circumumbilical ridge, in its lower half. The inner lip appears considerably thickened in its lower part, but it is not reflexed over the edge of the umbilical funnel.

ORNAMENTATION: The second volution appears to be still smooth on the whole, but there are indistinct traces of a fine costation in its last portion. On the third whorl this transverse costation attains, almost suddenly, its adult character; then it consists of 18 closely set, rather heavy ribs per whorl. They begin at or near the suture, cross, gradually increasing in strength, the apical band in a radial or even slightly prorsiradiate direction, and reach their greatest prominence on the shoulder; then they run, gradually tapering, down the lateral face of the whorl. Here their direction is perpendicular on the third volution, but somewhat oblique backward on the fourth.

On the base are 12 heavy transverse folds which run in a more or less radial direction from the umbilical edge halfway to the periphery. In about the middle section of the body whorl the inner ends of these folds are spirally elongated and amalgamate into the circumumbilical ridge. Also these folds, which are originally even, in the second half of the body whorl have both outer and inner ends raised. Thus they tend to form two concentric rows of radially elongated tubercles, one in the middle of the base, preparing, as it were, the final appearance there of the afore-mentioned ridge, the other around the umbilicus. Both tubercles of each pair are, however, still connected by a low radial ridge. In the latest stage observable, the transverse ribs tend to assume a more sigmoidal course and to continue, gradually vanishing, in the peripheral zone of the base. Furthermore, the periphery assumes, in the last quarter of the body whorl, a peculiar cockscomb-like aspect (fig. 47), with the teeth of the cockscomb corresponding as a rule to the intervals between two transverse folds.

A fine and dense growth striation can be observed all over the shell. In its upper part the growth striae follow the direction of the transverse ribs. On the upper surface of the "parachute" they run obliquely backward. On the base, they share the direction of

the transverse folds. Thus they become decidedly sigmoidal in the peripheral zone, especially near the aperture. At the very periphery of the base they form a pronounced forward convexity (fig. 47), as seen also in Koken's figure 9 and less clearly in Cossmann's figure 24, both of *J. caillaudianus*. Thus they indicate a forward direction on the lower surface of the "parachute,"[1] corresponding to the backward direction on its upper surface. The growth striae, in crossing the circumumbilical ridge, form another hook,[2] the convexity of which points backward, and then run down the wall of the umbilical funnel in a more or less radial, slightly sinuous course.

In addition to the holotype, on which this description is based, there is a little shell fragment (specimen no. 2) present which shows only a part of the shoulder of a whorl and of its lateral face.

REMARKS: In spite of this extreme scarcity of material the presence of this rare genus in the Triassic of the Andes of Central Peru was deemed remarkable enough to justify the establishment of a new species on the fairly complete holotype. The extension of the hitherto assumed stratigraphic range of the genus is alluded to in the specific name.

Our holotype is somewhat smaller than the specimen of the type species figured by Cossmann (1915), but this difference would not by itself justify specific separation. The Peruvian species differs, however, from *J. caillaudianus* in its planospiral, even slightly concave apex, its markedly less sloping "parachute," and some minor ornamentational characters, particularly on the base.

Among Triassic gastropods some species of the genus *Schizogonium* Koken (1889, p. 417; Kittl, 1891, p. 212) resemble the present form in shell shape, whorl profile, aspect of the base, and shape of the aperture, mostly so *S. serratum* (Münster), *S. scalare* (Münster), *S. subdentatum* (Münster), and *S. subcostatum* (Münster). (See Kittl, 1891, pp. 214–216, *cum synon.*, pl. 5, figs. 1–6, 10–14). However, close examination not only of the illustrations of these species in the literature, but of topotypes of *S. serratum*, *S. scalare*, and *S. subcostatum* from the Yale collections, revealed essential differences which seem to exclude congenerity. In *Schizogonium* the lower keel, the thorns of which project very far, is formed by, and part of, the whorl itself, whereas in *Jurassiphorus* the parachute appearing at the same site is formed by, and emanates from, the preceding whorl. Furthermore the sculpture is essentially different in both groups, there being no trace of the heavy transverse ribbing on the lateral whorl faces in *Schizogonium*. Finally no form of that genus seems to have so wide and deep an umbilical opening as *Jurassiphorus triadicus*. The reference by Kutassy (1937, p. 30, pl. 1, figs. 12–14) of a fragment from the Kodru-Móma Mountains of Transylvania to *Schizogonium subdentatum* and even to the genus *Schizogonium* may seriously be questioned. Kutassy's claim that the ornamentation of the base of his fragment fully supports that reference is refuted by a comparison of his figure 13 with Münster's, Laube's, and Kittl's basal views. Moreover, both Kutassy's lateral and basal views seem to indicate the presence of a "parachute." Should it really be present, it would prove that his specimen also belongs to *Jurassiphorus*, though to a species differing from the present one by the lack of any transverse costation. On the other hand, such a costation is present in the single fragment described and figured by the same author (1937, p. 31, pl. 1, fig. 15) under the designation *Schizogonium elevatum* Kittl, nov. var. *turriculata*, the apical bands of which seem also to be overgrown by a "parachute" emanating from the preceding whorl and which then would also be a *Jurassiphorus*, differing from all others by its high spire, emphasized by Kutassy. Still a third Triassic form, namely, *Onustus*[3] *gemmellaroi* Scalia (1914, p. 19, pl. 2, figs. 12, 13) from the Monte Judica group in Sicily, described by its author as having a "lembo periferico discretamente largo," seems to belong to *Jurassiphorus* but since it has a much nar-

[1] Although in French gastropod terminology "inférieur" would mean "upper," as understood in English usage, it seems that the same meaning is implied in the following words of Cossmann's (1915, p. 189) description of *J. caillaudianus:* "ils sont même plutôt un peu antécurrents sur la face plane inférieure de la carène . . ."

[2] Cossmann's (*loc. cit.*) "coude."

[3] According to Wenz (1939, p. 906) this name of Gray's is a synonym of *Xenophora*.

rower umbilicus, is certainly not conspecific with *J. triadicus*.

Within the Peruvian material here dealt with only *?Worthenia basifalcata* Körner superficially resembles the present species in the presence of strong circumumbilical folds, but the peculiar generic characters of *Jurassiphorus*, entirely missing in Körner's species, make distinction easy.

OCCURRENCE: A single specimen (holotype) and a small shell fragment in lot 26 (A.M.N.H. No. 26514).

APORRHAIDAE

? APORRHAIS DA COSTA

SUBGENUS CUPHOSOLENUS PIETTE

?Aporrhais (Cuphosolenus), new species

Plate 16, figures 51, 55

DESCRIPTION (INCLUDING DIMENSIONS): The largest fragment present (no. 1) is about half a body whorl, measuring 21 mm. in height; of this height, about 9 mm. is accounted for by the rostrum. The height of this shell, when complete, may be estimated at about 35 mm., and its width (without "fingers") at about 14 mm.

The shape of the body whorl without rostrum is biconical on the whole. Its apical face slopes at an angle of somewhat more than 60 degrees. From the upper shoulder down the whorl profile slopes somewhat more steeply, at an angle of about 70 degrees, to another shoulder which separates this lateral face from the base. The latter is obtusely conical and slightly concave and continues into the long, curved rostrum. The two shoulders are marked by the two strongest revolving keels present, the upper of which is further accentuated by heavy but blunt tubercles. The columella is solid and in its upper part rather thick. The outline of the aperture seems to have been approximately semicircular on the outside and sinuous, following the course of the columella, inside. It narrows down to the long canal which in apertural view forms a shallow arc, the convexity of which points to the left. All along this canal the inner lip is markedly thickened. The lower end of the canal seems to be invaginated in what may be a finger-like continuation of the rostrum. This continuation does not seem fully preserved, as may be inferred from the fact that another rostrum plus continuation, designated specimen number 2, although belonging to a smaller shell and not preserved to the lower end, is about one and a half times as long as that of specimen number 1. No apertural margin is preserved in the latter. Therefore no other fingers than the assumed rostral one could be preserved even if they were present.

The revolving ornamentation consists of keels and grooves. There are keels on both upper and lower shoulders the upper of which is by far the stronger, and a third, only a little weaker than the lower, somewhat above the middle of the lateral face, as bounded by the upper and lower keels. There are in addition revolving grooves varying in width and depth. Eight can be counted from the suture to the upper shoulder, four on the lateral whorl face, and 15 on the base and on the rostrum. The third from the suture, one beneath the middle keel, and the eight of the base are the widest and deepest of these furrows and can be recognized as rectangular in profile. Their slightly reënforced edges here and there simulate more revolving keels in addition to those enumerated above (fig. 51).

The transverse sculpture consists of folds and growth lamellae. The folds are blunt and broad and restricted to the lower third of the apical whorl face and to the lateral face. They culminate on the upper shoulder, where they produce spirally elongated tubercles on its revolving keel, form similar minor tubercles on the middle keel, and gradually vanish before reaching the lower one. There are five such folds to a quarter whorl. The growth lamellae, of which there are from eight to 10 to every fold, run steeply obliquely backward in the upper third of the apical whorl face, then obliquely forward as far as the upper shoulder. Beneath it they become nearly perpendicular, then turn slightly forward again. They can still be followed in the outermost zone of the base, where they keep a radial direction, then vanish. They are interrupted by the revolving furrows but produce fine beads on their edges. They are strictly straight within the revolving bands separated by these furrows.

A fragment (no. 3) of a shell much smaller than the figured one exhibits a similar whorl

profile and a similar, though badly corroded, ornamentation and may well be conspecific.

REMARKS: Although no wings or fingers are preserved except for the indication of a finger-like continuation of the rostrum, shell shape and character of ornamentation strongly suggest reference of this surprisingly modern-looking late Triassic form to Piette's (1876, pp. 5, 6) subgenus *Cuphosolenus* of the genus *Aporrhais* (see Cossmann, 1904, p. 58; Wenz, 1940, p. 917, fig. 2691). Only the fact that no finger-like apophyses could actually be observed imposes caution, as expressed by the question mark.

It should be added that the presence of a subgenus hitherto believed to appear only in the Middle Jurassic (Bathonian) in the assemblage under study is by no means more astonishing than the occurrence in the very same lot of a representative of the genus *Jurassiphorus* of which the hitherto known earliest occurrence is even later, namely, in the Callovian.

This form is so unique in the present material that no comparisons with any others are needed.

OCCURRENCE: Occurs in lot 26 only, where it is represented by three specimens (A.M.N.H. No. 27555).

ACTEONIDAE

This opisthobranch family is represented in the material under study by a rich display of manifold forms, most of which are referable to the genus *Cylindrobullina, sensu lato*, well known[1] from the Upper Triassic and Jurassic of Europe, but also including a new species which, although undoubtedly related to the others, differs so much that a separate genus, *Consobrinella*, is established for it.

Within the Acteonidae these forms belong to the subfamily named Actaeoninae by Cossmann (1895, p. 43)[2] and Cylindrobullininae by Wenz (1938, p. 48).[3]

One thousand one hundred and forty-five specimens referable to *Cylindrobullina, sensu lato*, plus 125 belonging to *Consobrinella* make a total of 1270 for this family, thus making it fifth in abundance in the assemblage under study; it is outnumbered only by the Mathildidae, Neritidae, Coelostylinidae, and Procerithiidae.

CYLINDROBULLINA VON AMMON, SENSU LATO

Under this name von Ammon (1878, p. 36) proposed a subgenus of *Acteonina* d'Orbigny, in which he included *Cylindrites elongatus* Moore, then described by von Ammon from the Rhaetian of the Alps, some forms from St. Cassian, and some Liassic species, as exemplified by *Acteonina fragilis* Dunker, later designated by Cossmann (1895, p. 62) the type species of *Cylindrobullina*. Cossmann, too, considered the latter a subgenus of *Acteonina* and included in it, in addition to *Cylindrobullina, sensu stricto*, two more sections, *Conactaeon* Meek (1863, p. 92) and *Euconactaeon* Meek (1863, p. 91).

Meanwhile Kittl (1894, pp. 241–243, pl. 11, figs. 24–31) had redescribed the St. Cassian forms, mentioned above, uniting them all in Münster's original species "*Tornatella?*" *scalaris*. In his section on the genus *Acteonina* Kittl stated that they exhibit a "callously thickened inner lip but that on the latter no distinct fold can be recognized." Since, however, von Ammon (1878, p. 35), in establishing his subgenus *Cylindrobullina*, had mentioned as its most diagnostic character "the little foldlet produced in the lower part of the columellar side by the projection of the columella, which is mostly twisted,"

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[1] If two alleged Carboniferous species are here excepted.

[2] According to the Rules, this name would indicate the family of which the type genus should be *Actaeon*, not *Actaeonina*, as was obviously Cossmann's intention. A subfamily with the latter genus as its type genus would correctly be named Actaeonininae. Similarly, Cossmann's subfamily Tornatellinae, the type genus of which he obviously considered *Tornatellaea*, should be named Tornatellaeinae, if not Acteoninae after *Acteon*, the type genus of the family. Cossmann's subfamily names Nucleopsinae and Globactaeoninae have no nomenclatorial standing, the former being taken from a "section," not from a genus, and the latter not corresponding to any name of a genus, or even to that of a subgenus or a "section."

[3] The opisthobranchs are unfortunately not included in Wenz' text book, as completed, but his division of the Acteonidae into subfamilies may be seen from the chart in the ecological section. Since Wenz strictly observed the Rules, there can be no doubt that it is his subfamily Cylindrobullininae (as distinct from the subfamily Cylindrobullinae of the Akeridae), not the Acteoninae to which both *Actaeonina* and *Cylindrobullina* should, according to him, be referred. The same probably holds for the new genus *Consobrinella* also.

Kittl hesitated to refer the St. Cassian forms to von Ammon's genus and preferred to leave them with *Acteonina*.

Thus the question arises whether to refer the present forms to *Acteonina* or to *Cylindrobullina*. However, the above-mentioned divergence between the view of both authors is seeming rather than real, as seen best by comparing the respective passages of their specific descriptions (of *C. elongata* by von Ammon, p. 33, and of *A. scalaris* by Kittl, p. 242): There von Ammon says rather cautiously that the columella (which he calls "short, visible only in the lower part of the aperture, and projecting") "seemingly forms a fold," whereas Kittl, rather less reservedly, states that "the inner lip is thickly callous, forming, at the anterior end, a hardly perceptible, weak fold." A critical evaluation of all four passages quoted, taken together, would seem to indicate that there is no real disagreement between von Ammon and Kittl with regard to the characters in question and that the latter's hesitation to apply the former's generic name to the St. Cassian species was rather over-cautious.

This impression is fully confirmed by the observations made on those Peruvian shells of the present genus of which the aperture is entirely preserved. They show an inner lip which in its lowermost part is thickened, though narrow, and somewhat projects into the aperture. In most cases it is also slightly reflexed over the umbilical niche or umbilicus, as the case may be. It may be added that, where observable, the columella can be seen to be corkscrew-shaped. All the illustrations of forms believed to belong to the present genus by von Ammon (1878, fig. 11b), Kittl (1894, pl. 11, figs. 24, 26–28, 31), and Cossmann (1895, pl. 2, fig. 1) seem to show about the same characters of the inner lip and of the lower end of the columella as reported above. These characters also agree well with the respective part of Cossmann's (1895, p. 62) generic diagnosis: " . . . columelle peu arquée, calleuse, portant un imperceptible renflement qui s'atténue en avant dans l'évasement versant de l'ouverture; bord columellaire très mince en arrière, un peu détaché en avant, limité du côté de la base par une carène qui contourne la sinuosité du bord supérieur."

It will be seen from this diagnosis that Cossmann does not mention any columellar fold, as do, though cautiously, von Ammon and Kittl. What these two authors call "a seeming" or "a hardly perceptible, weak fold" seems to be nothing more than the projection of the thickened inner lip into the aperture.

Thus the forms here dealt with are believed to fit well into *Cylindrobullina*, as proposed by von Ammon and diagnosed by Cossmann. In one respect, however, this genus is here given a wider circumscription than by Cossmann, who postulated for it a "surface lisse" and transferred the forms with revolving striation, even though he admitted (1895, p. 62) "l'analogie de leur forme extérieure," to the genus *Acteonina*, of which he made them two distinct sections, *Striactaeonina* and *Ovactaeonina* (1895, pp. 59, 60). Now there occur in the present assemblage two forms which closely resemble "*Orthostoma*" *avena* Terquem, designated the type species of *Striactaeonina* by Cossmann (*loc. cit.*), and *C. decorata* (Martin), also referred to *Striactaeonina* by that author, respectively. Both these forms show more [*C.* (*C.*) *avenoides*] or less clearly a fine revolving striation all over the shell, but such revolving ornamentation, although more pronounced in the lower part of the body whorl than elsewhere, is found in *C. peruviana* also, which by its shell shape comes clearly under Meek's subgenus *Conactaeon*, as does *C. decorata*. Therefore, the presence of revolving ornamentation is not considered sufficient as a subgeneric, let alone generic, diagnostic character; nor is the distinct transverse ornamentation occurring in two different forms of this assemblange believed to be referable to *Cylindrobullina*, *sensu lato*. Therefore, von Bistram's (1903, pp. 75, 76) example is here followed in rejecting *Striactaeonina* Cossmann, be it as a section or as a subgenus, especially since it overlaps to a considerable extent and thus interferes with von Ammon's older name *Cylindrobullina* and Meek's even older one *Conactaeon*. The forms which under Cossmann's taxonomy would have to be referred to *Striactaeonina* are here assigned to *Cylindrobullina* and within this genus in part to *Cylindrobullina*, *sensu stricto*, and in part to *Conactaeon*.

Cylindrobullina is here not used as a subgeneric name under *Acteonina*, as it was by Cossmann, but is granted generic rank, as was intended by Wenz.[1] Within this genus Meek's names *Conactaeon* and *Euconactaeon* are used as subgeneric ones; both these subgenera are well represented in our material. Their distinctive characters are dealt with below, but here it should be stressed that neither from *Cylindrobullina, sensu stricto*, nor from each other are they separated by sharp demarcation lines. For example, *C. (?C.) obesa* is somewhat transitional to *Conactaeon*. Altogether, in this group as in so many others, the boundaries not only between subgenera but of the genus itself are rather fluent. Thus the transversely ribbed species *C. (?C.) tenuicostata* and *C. (?C.) tilarniocensis* are somewhat transitional to *Consobrinella* and may sometime be given a subgeneric name of their own. Similarly, *C. (?C.) pyrulaeformis*, resembling Meek's subgenus *Trochactaeonina* in shell shape but clearly different from it, may also be considered subgenerically different from *Cylindrobullina, sensu stricto*, with which it is provisionally left in the present report.

Altogether 13 forms, 10 of which have been given specific names, are here distinguished within *Cylindrobullina, sensu lato*. In addition, some 125 specimens and fragments, mostly in lot 86, fewer in lot 48, a few each in lots 53 and 78, and a single one in lot 70, are too poorly preserved for specific determination and have therefore merely been labeled *Cylindrobullina, sensu lato*, ssp. indet. (A.M.N.H. Nos. 27646, 27646/1, 27646/2, 27646/3, 27646/4). Including these, altogether about 1150 individuals are referable to *Cylindrobullina, sensu lato*, which is thus a quite common genus in Peru, exceeded in abundance only by *Promathilda, sensu lato, Neritaria*, and *Omphaloptycha*.

Subgenus **CYLINDROBULLINA**, sensu stricto

Cylindrobullina (Cylindrobullina) vespertina,[2] new species

Plate 17, figures 1–34, 37, 38, 45, 47, 48

[1] Who otherwise would not have established a subfamily Cylindrobullininae.

[2] Latin, pertaining to *vesper*, the evening, the West.

A.M.N.H. Nos.	Dimensions H	W	h	π
	A. TYPICAL FORM			
27633:46	1.29 mm.	52	13	86°
27633/1:1	1.48	56½	11½	100°
27633:1	1.54	56½	12½	79°
27633:3	1.62	51½	14	77°
27633/1:2	1.62	55	10½	98°
27633:4	1.79	50	13½	76½°
27633/1:3	*ca.* 1.87	*ca.* 54	*ca.* 10	98°
27633:31	*ca.* 1.88	*ca.* 51	*ca.* 18	79°
27633:5	1.90	56	12	94°
27633/1:4	*ca.* 1.96	*ca.* 60	*ca.* 14½	100°
27633/1:5	1.96	57	11½	?91°
27633:19	1.96	53	11½	87°
27633:6	2.02	55½	14	81½°
27633:8	*ca.* 2.07	*ca.* 49½	*ca.* 11	79°
27633:14	*ca.* 2.07	*ca.* 58	*ca.* 13½	87°
27633:18	2.07	54	11	92°
27633:32	2.07	58	16	89°
27633/1:8	2.07	59½	13½	97°
27633:10	*ca.* 2.13	*ca.* 49½	*ca.* 14	81°
27633:11	*ca.* 2.18	*ca.* 54	*ca.* 13	86°
27633:34	2.18	51½	15½	92°
27633:35	*ca.* 2.24	*ca.* 52½	*ca.* 10	93°
27633/1:10	*ca.* 2.24	*ca.* 52½	*ca.* 12½	95°
27633/1:11	*ca.* 2.30	*ca.* 58½	*ca.* 12	99°
27633:13	*ca.* 2.30	*ca.* 58½	*ca.* 11	92°
27633:15	2.35	49	12	87°
27633:28	2.35	47½	9½	90°
27633:37	2.35	52½	14	82°
27633:17	2.41	57½	10½	92°
27633/1:16	*ca.* 2.52	*ca.* 51	*ca.* 10	95°
27633/1:17	*ca.* 2.63	*ca.* 64	*ca.* 10½	107°
27633:20	2.63	57½	13	79°
27633/1:14 (syntype A)	2.69	57	12½	97°
27633:16	*ca.* 2.69	*ca.* 58½	*ca.* 10½	83°
27633:39	*ca.* 2.69	*ca.* 53	*ca.* 14½	77°
27633:38	*ca.* 2.80	*ca.* 48	*ca.* 16	75°
27633:22	*ca.* 2.91	*ca.* 52	*ca.* 14	75½°
27633:23	*ca.* 2.97	*ca.* 51	*ca.* 14	85°
27633:24	*ca.* 3.11	*ca.* 48½	*ca.* 11½	82°
27633:25	3.16	48½	12½	76°
27633/1:19	3.24	51½	10	98°
27633/1:26	*ca.* 3.24	*ca.* 56½	*ca.* 11½	103°
27633/1:23	*ca.* 3.32	*ca.* 55	*ca.* 10	92°
27633/1:24	*ca.* 3.49	*ca.* 47½	*ca.* 10½	95°
27633:26 (syntype B)	3.64	49	17	78°
27633/5:1	*ca.* 3.65	*ca.* 57	*ca.* 11½	99°
27633:30	*ca.* 3.73	*ca.* 55½	*ca.* 12	77°
27633/1:25[3]	*ca.* 3.90	*ca.* 55½	*ca.* 8½	100°
27633/1:27	4.23	55	10	95°
27633/1:28	5.17	56	14	82°
27633:27	*ca.* 5.17	*ca.* 47½	*ca.* 14½	79°
27633/1:22	*ca.* 6.03	*ca.* 48	*ca.* 10	85°
27633/5:2	6.15	48	12	*ca.* 93°
27633/1:30[3]	6.89	56	9	99°

[3] Transitional to low-spired form.

A.M.N.H. Nos.	H	W	h	π
	B. LOW-SPIRED FORM			
27633:33	*ca.* 1.62	*ca.* 58½	*ca.* 7	128°
27633/1:32	1.68	57½	10	120°
27633:36	1.74	61½	6½	120°
27633:40	*ca.* 1.79	*ca.* 53	*ca.* 7½	108°
27633:41	1.85	57½	9	109½°
27633/1:33	1.96	54½	8½	117°
27633/1:34	*ca.* 2.02	*ca.* 61	*ca.* 8½	116°
27633/1:35[1]	2.02	64	5½	121°
27633:42	*ca.* 2.02	*ca.* 58½	*ca.* 8½	109°
27633:43	*ca.* 2.13	*ca.* 52½	*ca.* 8	112°
27633/1:36	2.24	65	10	121°
27633/1:37	*ca.* 2.30	*ca.* 63½	*ca.* 7½	120°
27633:44	*ca.* 2.30	*ca.* 63½	*ca.* 5	117°
27633/1:39	*ca.* 2.46	*ca.* 63½	*ca.* 5½	120°
27633/1:13	*ca.* 2.52	*ca.* 58	*ca.* 9	111°
27633/1:15	*ca.* 2.63	*ca.* 58½	*ca.* 10½	110°
27633/1:40	*ca.* 2.63	*ca.* 57½	*ca.* 9½	121°
27633:45	*ca.* 2.63	*ca.* 52	*ca.* 8½	105°
2733/1:18	2.91	57½	6	116°
27633/1:21	2.99	61	8½	106°
27633/1:41	*ca.* 3.14	*ca.* 59	*ca.* 7	118°
27633/1:42	*ca.* 3.32	*ca.* 57½	*ca.* 6	108°
27633/1:43	*ca.* 3.65	*ca.* 57	*ca.* 9	105°
27633/1:44	*ca.* 3.82	*ca.* 54½	*ca.* 8½	107°
27633/1:45	3.98	56	6	110°
27633/1:46	*ca.* 5.41	*ca.* 61½	*ca.* 5½	111°
27633/1:29	5.66	54½	6½	103°

The largest specimen measured (A.M.N.H. No. 27633/1:30) does not represent the greatest size attained by this species in the present assemblage; the total height of the incomplete shell A.M.N.H. No. 27633/1:31, apparently belonging to the short-spired variety, may well be estimated at 7.5 mm.

As to the mutual proportions of the several parts of the shell, two morphological forms are easily distinguishable within the present species. Those listed in B of the above table (and those of the same shell shape measured but not included in it, and many others too incomplete to be measured) differ from the majority of the individuals, dimensions for which are given in A of the table, by shorter spires and accordingly more obtuse pleural angles. In addition, they are as a rule also somewhat stouter than those referred to the typical form. Roughly, values of 10 for h and of 103 degrees for π may be considered to constitute the boundaries between both these forms, but this is rather a rule of thumb which cannot rigidly be applied without allowing for exceptions. Thus exceptionally stout individuals of the typical form, as best exemplified by specimen A.M.N.H. No. 27633/1:17, are bound to have a wider pleural angle even though they may otherwise not exhibit the shell shape characteristic of the low-spired variety. On the other hand, shells occur, such as A.M.N.H. No. 27633/1:16, with a spire as low as that of some specimens of the low-spired form but much too slender to be referable to it. Only specimens with both low spires (with h amounting to about 10 or less, down to 5) and pleural angles of 103 degrees or more (up to 128°) were referred to the low-spired form. Some specimens assigned to the typical form (e.g., A.M.N.H. Nos. 27633/1:25 and 27633/1:30) appear to be transitional to the low-spired one. Particularly with regard to the occurrence of such transitions, no formal variety or other subspecific unit is established for the low-spired form.

[1] Transitional to *C. (E.) tambosolensis.*

No definite trends seem to be derivable from the above table, except for a certain tendency of the pleural angles to decrease with size, though far from steadily, in the low-spired form. Otherwise greater and smaller widths, higher and lower spires, wider and less wide pleural angles seem to occur, in either of the two groups distinguished above, at more or less all growth stages.

SELECTION OF TYPES: Two of the best and most completely (including nucleus) preserved shells, both of medium size, A.M.N.H. Nos. 27633/1:14 and 27633:26, the former from lot 86, the latter from lot 48, are designated syntypes A and B, respectively. Considerably larger specimens are present, but not qualified in every respect for types; nor have shells referable to the low-spired variety, or unusually stout ones, or those with profiles more rounded than usual, been chosen for types. However, all these forms, which deviate from the typical form in one way or another, are amply illustrated.

DESCRIPTION: The shell consists (syntype B) of up to five whorls, including the nucleus. Its shape, as could be expected from the generic name, is essentially cylindrical, with conical annexes, corresponding to the spire on the one hand and to the base on the other. Accordingly the lateral faces of the spiral whorls drop perpendicularly to the

suture. This can of course be seen more clearly the higher the spire. A distinct, though well-rounded shoulder separates these lateral faces from the apical bands of the whorls which are narrow and horizontal, or nearly so. Specimen A.M.N.H. No. 27633/1:30 is illustrated (fig. 24) as an example of the specimens which, as to height of the spire, are somewhat transitional between the typical and the low-spired forms, whereas specimens A.M.N.H. Nos. 27633/1:36, 27633/1:21, 27633/1:42, and 27633/1:29 are figured (figs. 5–8, 32, 33, 22, 23) as characteristic representatives of the latter. A.M.N.H. No. 27633/1:29 also exhibits a slightly rounded profile of the body whorl and is thus transitional between the syntypes and such specimens (A.M.N.H. Nos. 27633/1:39, 27633:20; figs. 16, 17; 27633/1:28; figs. 25, 26) as show this character even more distinctly. Here the shoulder becomes so well rounded in the body whorl that it is hardly perceptible at the aperture. The presence, however, of individuals transitional with regard to these and other characters pleads against any taxonomic separation of these rather atypical shells with rounded profile.

Furthermore, specimens A.M.N.H. Nos. 27633/1:17 and 27633:27 (figs. 1, 2) may here be mentioned, the former as an unusually stout, the latter as an unusually slender, individual of the typical form of this species.

Only occasionally, as in syntype A (figs. 3, 4), can the body whorl be seen, at its anterior end, to be slightly constricted beneath the shoulder. However, in the much larger shell A.M.N.H. No. 27633/1:29 (fig. 23) the same (and even more pronounced) aspect is obviously caused by crushing. Downward the body whorl changes without any definite boundary into the base.

In some broken shells (e.g., A.M.N.H. No. 27633:47; fig. 9) the columella can clearly be recognized to have a corkscrew shape.

The aperture is narrow in its upper half but widens considerably in the lower. It attains its maximum width a little above the lower end, but from there the width does not decrease much downward, the anterior margin being broadly rounded. The outer lip generally runs perfectly straight from the shoulder almost all the way down to that anterior margin. The inner one also is nearly straight in its upper half and then becomes gently sigmoidal. In that lower half the inner lip is only narrowly reflexed in syntype B (fig. 11) and in most of the other specimens present, but more widely so in some other individuals (A.M.N.H. Nos. 27633/1:35,[1] 27633/1:26, 27633/1:45, and 27633/1:53; figs. 31, 30) and especially so in specimens A.M.N.H. Nos. 27633/1:27 (figs. 12, 20) and 27633/1:52. As a rule the inner lip is accompanied merely by a more or less narrow and shallow umbilical niche. Several specimens, however, including the largest measured of both the typical and the short-spired forms, exhibit an open umbilicus. It is extremely narrow in specimens A.M.N.H. No. 27633/1:29 (fig. 45) and 27633/1:50, not so narrow in specimens A.M.N.H. Nos. 27633/1:30 (fig. 34) and 27633/1:52, but considerably wider in specimens A.M.N.H. Nos. 27633/1:27 (fig. 12), mentioned above for its widely reflexed inner lip, and 27633/1:51 (fig. 48). This feature is encountered in comparatively large shells only, but seems not due to resorption, since the inner lip is well preserved even where there is an open umbilicus. Its presence certainly constitutes a character not expected in the genus and in the family, but in all others the individuals concerned agree so well with the types of the present species that their taxonomic separation is quite out of the question.

The only ornamentation observed in this species are low, rather irregular growth folds (A.M.N.H. Nos. 27633:23; fig. 24; 27633/1:28 and 27633/1:49; figs. 25, 13). In the first they run in a wide and flat, forward convex arc across most of the body whorl, whereas in the two specimens from lot 86 they assume, at least in places, a distinctly sigmoidal course, with a forward convexity in the upper third and an equally flat forward concavity in the rest of the body whorl. The same course of the growth folds is also observable, though less distinctly, in the largest measured shell (A.M.N.H. No. 27633/1:30). In only one of the many individuals of this species that were examined (A.M.N.H. No. 27633/1:42, figs. 32, 33) can a faint revolving striation be observed.

[1] This specimen deserves special mention also for its spire which is not only very low but slightly sunk within deeply engraved sutures, as is also the nucleus on top of it. It is thus somewhat transitional to *C.* (*Euconactaeon*) *tambosolensis* (see below).

EARLIEST ONTOGENETIC STAGES: The nucleus is well preserved and can be seen to be inclined towards the axis of the conch in many specimens (e.g., A.M.N.H. Nos. 27633:17 and 27633:20 and syntype A; figs. 18, 19, 16, 3, 4). In only a few, however, can its heterostrophy (or, in Wenz' terminology, alloiostrophy), which constitutes a diagnostic character of this genus as well as of the entire family Acteonidae, clearly be recognized; the embryonic whorls of syntype B and of specimens A.M.N.H. Nos. 27633:31, 27633:37, 27633/1:47, and 27633/1:48 are figured (figs. 29, 27, 37, 21, 38) as best illustrating this character.

REMARKS: Of all the forms of this genus within the Peruvian material this species seems to come closest to the type species of *Cylindrobullina, sensu stricto, C. fragilis* (Dunker) from the Liassic, as exemplified by the topotype from Halberstadt figured by Cossmann (1895, pl. 2, fig. 1), but it clearly differs in its less rounded and more gradate shell profile. Even those atypical specimens of *C. (C.) vespertina* in which the profile becomes somewhat rounded (e.g., figs. 16, 17, 22, 23, 25, 26) still show pronounced shoulders which lend a staircase outline to the spire. In *C. fragilis*, on the other hand, the profile is perfectly conical.

Cylindrobullina (Cylindrobullina) scalaris (Münster) from St. Cassian, as illustrated in Kittl (1894, pl. 11, figs. 24, 25, the originals of which Kittl states most closely resemble Münster's types), differs from *C. (C.) vespertina* in its considerably higher spire and in a torus that marks the shoulder and is followed downward by a distinct constriction of the whorl profile. This last feature tends to make the lateral faces of the spiral whorls of *C. scalaris* appear reëntrant or slightly concave. These distinctive characters are recognizable in the topotypes of Münster's species from the Yale collection at my disposal. The various tiny shells from the German Muschelkalk illustrated by Hohenstein (1913, pl. 4, figs. 24–32) under the generic designation *Actaeonina* differ by their high spires and rounded profiles even more from the Peruvian species.

By lacking a distinct revolving striation *C. (C.) vespertina* can readily be distinguished from the many Liassic and younger species referred by Cossmann to his section *Striactaeonina*, some of which are compared with the following species.

The other forms of *Cylindrobullina* dealt with in this report are compared as far as necessary in their respective discussions with *C. (C.) vespertina.*

OCCURRENCE: Very common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27633	220
86	27633/1	210
34	27633/2	1
70	27633/3	1
71	27633/4	1
78	27633/5	26
87	27633/6	1 (dobutful)
		460

If a proportionate part of the shells and fragments determined merely as *Cylindrobullina, sensu lato*, ssp. indet., be added, the total number of specimens of this species present can be estimated at about 525.

Cylindrobullina (Cylindrobullina) avenoides, new species

Plate 17, figures 35, 36, 39–42, 46, 49–51, 58, 59

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27634:1	1.46 mm.	54	17½	76°
27634:2	*ca.* 1.68	*ca.* 53½	*ca.* 16½	76°
27634:3	1.85	45½	15	75°
27634:4	*ca.* 1.90	*ca.* 50	*ca.* 17½	70°
27634:11	*ca.* 2.24	*ca.* 47½	*ca.* 20	76°
27634/3:1	*ca.* 2.24	*ca.* 42½	*ca.* 12½	59°
27634/4	*ca.* 2.24	*ca.* 45	*ca.* 20	53°
27634/1:4	*ca.* 2.35	*ca.* 52½	*ca.* 12	67°
27634:12	2.35	54½	12	63°
27634:5	*ca.* 2.58	46	13	75°
27634:6[1]	*ca.* 2.58	*ca.* 45½	*ca.* 12	84°
27634/1:5	*ca.* 2.80	*ca.* 46	*ca.* 14	64°
27634:8	*ca.* 2.99	*ca.* 44½	*ca.* 19½	71°
27634/1:1	*ca.* 3.32	*ca.* 47½	*ca.* 17½	60°
27634/1:6	*ca.* 3.82	*ca.* 45½	*ca.* 13	71°
27634/1:2[2]	*ca.* 3.90	*ca.* 40½	*ca.* 17	61°
27634:9	*ca.* 4.32	*ca.* 42½	*ca.* 14½	69°
27634:10 (syntype A)	*ca.* 4.49	*ca.* 46½	*ca.* 15	69°
27634/2:1	*ca.* 6.64	*ca.* 53½	*ca.* 13	70°
27634/1:3 (syntype B)	*ca.* 7.26[3]	*ca.* 46[3]	*ca.* 15½[3]	67°

[1] Possibly transitional to *C. (C.) vespertina.*
[2] Omitting attached parts of following whorl.
[3] Estimated.

The greatest size attained by the present species comes fairly close to that measured in *C.* (*C.*) *vespertina*. The above table includes an individual (A.M.N.H. Nos. 27634:6) with unusually wide pleural angle, which might be considered transitional to *C.* (*C.*) *vespertina*. Otherwise it exhibits a considerably narrower range of variation but it must be kept in mind that it is represented by much smaller populations. If those somewhat aberrant specimens are left out of account, W varies only between 40½ and 54½ and h only between 12 and 20. The widest range of variation, between 53 degrees and 76 degrees, is found in the pleural angles, even if the two above mentioned shells, in which they reach 84 degrees and 86 degrees, respectively, be excluded. As in other forms of this group, this wide variation of π is due to the fact that the pleural angles are affected not only by width of the conch and height of the spire but by the greater or lesser extent to which the shoulder is pronounced.

Within this wide range, a certain tendency of the pleural angles to decrease with growth is recognizable; the widest ones, 75 degrees and 76 degrees (if specimen A.M.N.H. No. 27634:6 is again left out of account), occur in four of the five smallest shells measured and only in one somewhat larger one (A.M.N.H. No. 27634:5). No other growth trends can clearly be recognized.

SELECTION OF TYPES: One of the larger characteristic individuals from lot 48 (A.M.N.H. No. 27634:10) is designated syntype A, but since the nucleus and the ornamentation are better preserved in the largest shell present (A.M.N.H. No. 27634/1:3), found in lot 86, the latter, although incomplete, is selected in addition as syntype B.

DESCRIPTION: The shell consists in the largest individual present (syntype B) of five or five and a half volutions, including the embryonic ones. It is cylindrical and slender in shape; the whorls show a pronounced though rounded shoulder and a not very narrow horizontal or slightly sloping apical band. The lateral bands of the spiral volutions are comparatively high and cylindrical. The body whorl is very gently convex and changes quite gradually into the base. In some specimens it is slightly constricted beneath the shoulder. This feature can best be seen in the apertural view of specimen A.M.N.H. No. 27634/1:1 (fig. 40) and, though only very faintly, in that of syntype A (fig. 42), but no indication of such a constriction is found in the largest shell (syntype B; figs. 58, 59). Where present, it causes an extremely shallow concavity in the course of the outer lip which otherwise runs straight and perpendicularly downward. The lower end of the aperture is broadly rounded. The inner lip is similar to that of the preceding species but since *C.* (*C.*) *avenoides* is more slender, it is here more gently sigmoidal. In its lower third it is only thinly reflexed and accompanied on its outer side by an extremely narrow umbilical niche (syntypes A and B; figs. 42, 59). In no specimen of this species has an open umbilicus been found.

In one of the smallest shells present (A.M.N.H. No. 27634:2; fig. 50) a faint transverse ornamentation, reminiscent of the costation characteristic of *C.* (*?C.*) *tenuicostata*, is observed at the end of the antepenultimate whorl. This specimen may be transitional to *C.* (*?C.*) *tenuicostata* (see below), or the ornamentation may represent growth folds developed in this one place in such a way as to simulate a delicate costation. Otherwise growth striation can only indistinctly be recognized in this species. Where observable, the growth striae or folds seem to follow about the same course as in *C.* (*C.*) *vespertina*.

Cylindrobullina (*C.*) *avenoides* is distinguished by a fine and regular revolving striation, recognizable only where preservation is favorable, best in both syntypes, in specimen A.M.N.H. No. 27634:8, and in the fragments A.M.N.H. Nos. 27634:7 and 27634:13. As a rule, it can be recognized on the body whorl only, but in specimens A.M.N.H. Nos. 27634:7 (fig. 46) and 27634:8 also on the penultimate whorl. It consists of fine, shallowly engraved striae, of which from seven to 10 can be counted per millimeter and which are separated from one another by bands from two to four times their own width. In syntype B this revolving striation gradually decreases in distinctness upward towards the shoulder.

EARLIEST ONTOGENETIC STAGES: The heterostrophy (or alloiostrophy) characteristic of this genus can best be seen in speci-

mens A.M.N.H. Nos. 27634:2 and 27634:14 (figs. 50, 49) and to a certain extent also in the apertural views (figs. 59, 36) of syntype B and of paratype A.M.N.H. No. 27634:1.

REMARKS: Within the present material this species is the best representative of the group for which Cossmann (1895, p. 59) established his "section" *Striactaeonina*. Indeed it closely resembles in shell shape the type species of this section, "*Orthostoma*" *avena* Terquem (1854, p. 260, pl. 15, fig. 8) from the Lower Liassic of Hettange (holotype refigured by Cossmann, 1895, pl. 1, fig. 22, and 1895a, pl. 16, fig. 37). This resemblance is alluded to in the specific name. However, the Peruvian species cannot be considered conspecific, since it lacks the shoulder keel and the "profond sillon spiral" found, according to Cossmann, "invariablement" beneath the keel, both characters considered by Cossmann (*loc. cit.*) diagnostic of his section and therefore implicitly of its type species. From other Liassic acteonids referable to "*Striactaeonina*" Cossmann, as described and illustrated in his monograph on Jurassic gastropods (1895a, pp. 25–32, text figs. 1–3, pl. 16, figs. 26–47, pl. 19, fig. 72),[1] the present species differs in the same way as *C.* (*C.*) *avena* and, in addition, by the absence of a shoulder keel and of a deep furrow beneath it.

From *C.* (*C.*) *vespertina*, *C.* (*C.*) *avenoides* differs in its more slender shape, higher spire, more pronounced shoulder and more distinct ramp, and chiefly in the presence of a distinct revolving striation. Some of the following forms are compared below with *C.* (*C.*) *avenoides*. *?Ramina andina* and *Coelostylina cylindrata* are compared with it above.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27634	19
86	27634/1	16
53	27634/2	5
71	27634/3	2
No. 49[2]	27634/4	1 (doubtful)
		43

[1] Four of those species are recorded also by von Bistram (1903, pp. 76–79, pl. 6, figs. 3–8) from the Liassic of the Val Solda (Lombardy).

[2] As distinct from lot 49 (see p. 4).

Even addition of a proportionate quota of the *Cylindrobullina* specimens left specifically undetermined would raise the total number of individuals for this species only to about 50.

Cylindrobullina (Cylindrobullina) aff. avenoidi Haas

Plate 17, figures 43, 44, 52, 53, 64

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27635:1	*ca.* 1.29 mm.	*ca.* 50	*ca.* 14½	*ca.* 105°
27635/1:1	*ca.* 1.79	*ca.* 50	*ca.* 12½	?110°
27635/1:4	*ca.* 1.85	*ca.* 48½	*ca.* 9	94°
27635:2	*ca.* 1.90	*ca.* 50	*ca.* 9	108°
27635/1:2	*ca.* 2.18	*ca.* 51½	*ca.* 11½	102°
27635/1:3	*ca.* 2.80	*ca.* 48	*ca.* 12	103°

The table shows only narrow ranges of variation, especially in the values of W and h.

DESCRIPTION: The few small shells comprised under the above designation are fairly close to *C.* (*C.*) *avenoides* but seem to be specifically different. The material available is, however, too poor to justify creation of a separate species.

This form has the pronounced shoulder and ramp and the slenderness of shell shape and apparently also the fine revolving striation in common with *C.* (*C.*) *avenoides*, but it differs by its markedly lower spire and accordingly much wider pleural angle. In other characters it appears to agree with *C.* (*C.*) *avenoides*.

The smallest and the largest measured specimens (A.M.N.H. Nos. 27635:1 and 27635/1:3) have been selected to illustrate the distinctive characters of the present form. Both show well its heterostrophy.

REMARKS: By having a lower spire and a wider pleural angle than the true *C.* (*C.*) *avenoides*, the present form somewhat resembles the typical form of *C.* (*C.*) *vespertina*, but it is clearly distinct in its slenderness and, particularly, in its much more pronounced shoulder and wider apical band.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27635	3
86	27635/1	4
		7

Even if one or the other of the specifically undertermined specimens of this genus should belong to this form, the total number of individuals would not reach 10.

Cylindrobullina (?Cylindrobullina) obesa, new species

Plate 17, figures 54–57, 60–63, 65, 66, 70, 71, 75, 76, 79–82, 86

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27636:1[1]	*ca.* 1.18 mm.	*ca.* 66½	*ca.* 14½	112°
27636:16	1.51	65	13½	114°
27636:3	1.74	66	7½	134°
27636/1:1	1.74	67½	15	112°
27636/1:2	*ca.* 1.79	*ca.* 72	*ca.* 9½	125°
27636/1:3	*ca.* 1.90	*ca.* 64½	*ca.* 16	101°
27636/1:4	1.90	64½	12	106°
27636:4	1.90	67½	12	118°
27636:5	*ca.* 1.96	*ca.* 70	*ca.* 6½	132°
27636/1:5	*ca.* 2.02	*ca.* 64	*ca.* 8½	124°
27636/2:6	*ca.* 2.10	*ca.* 61½	*ca.* 8	139°
27636:6	2.24	*ca.* 61	*ca.* 7½	*ca.* 125°
27637/1:6	*ca.* 2.24	*ca.* 62½	*ca.* 12½	104°
27636/1:20	*ca.* 2.30	*ca.* 63½	*ca.* 9½	108°
27636/1:21	*ca.* 2.30	*ca.* 61	*ca.* 12	105°
27636:17	*ca.* 2.30	*ca.* 60	*ca.* 12	121°
27636/1:8	*ca.* 2.46	*ca.* 57	*ca.* 11½	124°
27636/1:9	*ca.* 2.46	*ca.* 57	*ca.* 10	111°
27636/2:1	*ca.* 2.46	*ca.* 57	*ca.* 9	128°
27636/1:10	2.52	61	13½	110°
27636/1:11	*ca.* 2.52	*ca.* 64½	*ca.* 13½	111°
27636/1:16	*ca.* 2.58	*ca.* 74	*ca.* 6½	126°
27636:7	*ca.* 2.58	*ca.* 68	*ca.* 11	127°
27636/1:12	2.63	61½	13	104°
27636/1:13	*ca.* 2.63	*ca.* 66	*ca.* 10½	111°
27636/1:22	*ca.* 2.69	*ca.* 57	*ca.* 13½	112°
27636:8	*ca.* 2.69	*ca.* 65	*ca.* 9½	124°
27636:9	*ca.* 2.69	*ca.* 68½	*ca.* 10½	116°
27636/1:14	*ca.* 2.74	*ca.* 59	*ca.* 9	121°
27636/1:15	2.86	63	12	108°
27626/2:2	2.99	62½	14	143°
27636:10	*ca.* 3.02	*ca.* 65	*ca.* 13	115°
27636:11	*ca.* 3.07	*ca.* 69	*ca.* 8	121°
27636:12	*ca.* 3.07	*ca.* 73	*ca.* 9½	129°
27636/1:19	*ca.* 3.07	*ca.* 59½	*ca.* 12	104°
27636/2:3	*ca.* 3.15	*ca.* 60½	*ca.* 13	110°
27636/2:4	*ca.* 3.32	*ca.* 67½	*ca.* 6½	125°
27636/1:17	*ca.* 3.36	*ca.* 61½	*ca.* 15	104°
27636/1:23	*ca.* 3.65	*ca.* 57	*ca.* 10	110°
27636:14	*ca.* 4.43	*ca.* 61	*ca.* 14	106°
27636/2:5	*ca.* 4.8	*ca.* 59	*ca.* 10½	120°
27636/1:18 (holotype)	*ca.* 5.78	*ca.* 59½	*ca.* 16	115°

As seen from the table, the range of variation of W in this species is about the same as in *C.* (*C.*) *vespertina*, but that of h and π is markedly less wide. It is worth noting that the maximum for h and the minimum for π occur in the same individual (A.M.N.H. No. 27636/1:3), as do the maximum for W and the minimum for h (in A.M.N.H. No. 27636/1:16). The minimum value for W (57) is found in no fewer than five measured specimens, none of which shows an extraordinarily high spire or an extraordinarily low value for π. The largest measured specimen (holotype) has the maximum height of the spire (16) in common with A.M.N.H. No. 27636/1:3, which attains only about a third of the size. On the other hand, the lowest spires (h, 6½) are found in three specimens of various sizes, as are the widest pleural angles ($\pi > 130°$), with the maximum of 143 degrees encountered in the largest of the specimens concerned (A.M.N.H. No. 27636/2:2). Thus the only conclusion that can be drawn from the table is that small shells seem in general to be somewhat stouter than larger ones. In the first 10 specimens of the table W varies between 64 and 72, whereas it remains below 64 in more than two-thirds of the rest.

SELECTION OF TYPES: The largest measured specimen (A.M.N.H. No. 27636/1:18) serves best to illustrate the distinctive characters of this species, including the embryonic ones, and is therefore designated holotype.

DESCRIPTION: Six volutions, including the embryonic ones, can be counted in the holotype. Shell shape rather stout, as indicated in the specific name. Spire rather low, conical, distinctly staircase-like in profile. The shoulders of all the whorls are quite pronounced and marked by a blunt, rounded edge, but there is no keel. Their apical bands are comparatively wide and horizontal or only slightly sloping. The body whorl in particular is cylindrical on the whole, but its sides are more distinctly convex, and it tapers in its lower half more markedly downward than in *C.* (*C.*) *vespertina*, *C.* (*C.*) *avenoides*, and *C.* (*C.*) aff. *avenoidi*. In *C.* (*?C.*) *obesa* also the lateral face of the body whorl passes without any distinct boundary into the base. The fact that the body whorl tapers more decidedly downward in this species causes the base to appear slightly concave.

For the same reason, the aperture narrows slightly downward and its lower margin (unfortunately not fully preserved in the holotype, but better in specimen A.M.N.H.

[1] Omitting attached parts of following whorl.

No. 27636/1:10, fig. 61) is not quite so broadly rounded as in *C.* (*C.*) *vespertina*. The outer lip runs straight and perpendicularly, or nearly so, from the shoulder down to somewhat above the lower apertural margin. The columellar border is more strongly sigmoidal than in *C.* (*C.*) *vespertina*. In some specimens (A.M.N.H. No. 27636:8, fig. 57) it takes in its lowest part a decided turn to the left. The inner lip is only a little reflexed in the holotype (figs. 81, 82) but is more distinctly so in paratype A.M.N.H. No. 27636:9 (fig. 56). Accordingly, the umbilical niche, which as a rule is just a narrow slit, appears deeper and shows better in the latter example than in the holotype.

Specimen A.M.N.H. No. 27636:19 (figs. 70, 71) deserves special mention for its well-rounded shoulders, its unusually convex body whorl, which tapers quite decidedly downward, and for the straightness of the lower part of its columella which at the same time seems to tend somewhat to the left, though less clearly so than in specimen A.M.N.H. No. 27636:8. Thus these two specimens are somewhat transitional to *C.* (*?C.*) *pyrulaeformis*.

No other ornamentation than growth striation is recognizable. Growth striae or folds can be seen to run in a gently sigmoidal course across the body whorl in the holotype, forward convex in the upper half, forward concave in the lower. They can be followed even better in the fragment (A.M.N.H. No. 27636/1:24) of a much smaller shell (fig. 65), where they are seen to run decidedly backward across the apical band, to form a distinct hook on the shoulder, then to continue nearly straight over a little more than the upper half of the body whorl and to form, in its lower part, a marked forward concave arc.

EARLIEST ONTOGENETIC STAGES: Heterostrophy, or alloiostrophy, of the initial whorls can be recognized in a considerable number of shells, best in A.M.N.H. Nos. 27636/1:10, 27636/1:11 (figs. 61, 54), 27636/1:12, 27636/1:15, 27636/1:25 and 27636/1:26, (figs. 79, 75, 86) and in the holotype (figs. 80–82). In the last, even the two first post-nuclear volutions are still slightly inclined towards the main axis of the conch, as seen best in figure 76.

REMARKS: This species appears to be clearly intermediate between *C.* (*C.*) *vespertina* and *C.* (*Conactaeon*) *peruviana*. The shoulder is more pronounced than in the former but much less so than in the latter, forming, as it does, a blunt edge but not a sharp keel. Similarly, the apical band is wider than in the former species but less wide than in the latter. Also, the profile of the body whorl is somewhat more convex, and both the body whorl and the aperture taper more distinctly downward than in *C.* (*C.*) *vespertina*, but these features are even more pronounced in *C.* (*Conactaeon*) *peruviana*. This intermediate position between a typical *Cylindrobullina, sensu stricto*, and what is believed to be a typical *Conactaeon* renders the correct taxonomic position of this species within the genus *Cylindrobullina* somewhat difficult to determine. However, the absence of any revolving ornamentation suggests closer affinity to the former than to the latter subgenus. This species is therefore, though doubtfully, assigned to *Cylindrobullina, sensu stricto.*

The above are not the only differences that distinguish *C.* (*?C.*) *obesa* from the species mentioned, as well as from *C.* (*C.*) *avenoides* and *C.* (*C.*) aff. *avenoidi*. First, C. (*?C.*) *obesa* is characterized by stout shell shape, comparatively low and conical spire, and lack of any revolving ornamentation, this last being an additional distinctive character from *C.* (*Conactaeon*) *peruviana*.

Comparisons with *C.* (*?C.*) *pyrulaeformis*, *C.* (*Conactaeon*) cf. *decorata*, and *C.* (*Euconactaeon*) *tambosolensis* are given in the discussions of these various forms.

In the shape of the body whorl *C.* (*?C.*) *obesa* resembles to a certain extent the typical *C. scalaris* (Münster) (see Kittl, 1894, pl. 11, figs. 24, 25), but the latter species' well-developed shoulder torus, followed beneath by a slight constriction, and higher spire make distinction easy.

OCCURRENCE: Common.

LOT	A.M.N.H. NOS.	NO. OF SPECIMENS
48	27636	33
86	27636/1	100
78	27636/2	17
		150

Addition of a proportionate part of the specimens not determined specifically of *Cylindrobullina, sensu lato,* may raise the total number of individuals of this species to about 170.

Cylindrobullina (?Cylindrobullina) pyrulaeformis, new species

Plate 17, figures 67–69, 72–74, 84, 85

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27637/2:1	*ca.* 1.40 mm.	*ca.* 58	*ca.* 16	*ca.* 100°
27637/2:2	*ca.* 1.74	*ca.* 58	*ca.* 16	91°
27637/1:1	*ca.* 3.32	*ca.* 57½	*ca.* 16	87°
27637:1	*ca.* 3.40	*ca.* 57½	*ca.* 17	82°
27637/1:2	*ca.* 4.55	*ca.* 62	*ca.* 13½	106°
27637:2 (holotype)	4.90	56	12½	102°

Although this sample may be considered too small for any inferences to be drawn from it, the narrow range of variation, especially in W and h, is worth noting, as is the rather unusual tendency of h to decrease rather than to increase with growth.

SELECTION OF TYPE: The largest individual measured (A.M.N.H. No. 27637:2) appears also to be most representative of this species and is therefore designated holotype.

DESCRIPTION: Most characteristic of this species, the holotype of which consists of four volutions, is its shell shape. The body whorl is large, well rounded, and strongly convex. It tapers quite decidedly downward, gradually changing into the comparatively slender base of which the outline is distinctly concave. This shell shape, rather than being roughly cylindrical, as is the rule in the present genus, is somewhat reminiscent of that of the Tertiary and recent genus *Pyrula.* This perhaps remote resemblance suggested the specific name. The spire is moderately high. A moderately wide, slightly sloping apical band can be distinguished from the lateral face in both the body and the spiral whorls, but the shoulder separating the two is well rounded, more so than in any of the preceding species of this genus, and cannot by any means be called an edge. The lateral faces of the spiral whorls are vertical, or nearly so, and especially in the figured paratypes A.M.N.H. Nos. 27637:1 and 27637/1:2 and 27637/1:3 quite high.

As seen best in the small shell A.M.N.H. No. 27637:3 (fig. 72) in which almost all, and in the medium-sized A.M.N.H. No. 27637:1, in which the anterior half, of the body whorl is broken off, the columella is strongly corkscrew-shaped. This condition seems to account for the deep inflection of the columellar border at about half the height of the aperture. From the vertex of that inflection downward the columellar border describes a flatly sigmoidal line, turning first slightly to the right, then more decidedly to the left. This left turn simulates in incomplete shells, such as the holotype and A.M.N.H. No. 27637:1 (figs. 74, 67), the presence of an anterior canal, also pointing to the left. The columellar border in its lower part is reënforced by the inner lip which in paratypes A.M.N.H. Nos. 27637:1 and 27637/1:2 (figs. 67, 69) can clearly be recognized to be reflexed and accompanied by a narrow umbilical slit.

No ornamentation of any kind can be observed on any of the few specimens present, not even growth striae or folds. It must, however, be kept in mind that without exception their surfaces are worn.

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the embryonic whorls can be recognized in the holotype and in paratypes A.M.N.H. Nos. 27637/1:2 and 27637/1:3 (best in this last; fig. 85).

REMARKS: At first glance this form might be taken for anything but a *Cylindrobullina* or even a member of a related genus. However, the presence of a shoulder (though a thoroughly rounded one), the cylindrical aspect at least of the spiral whorls, and the alloiostrophy of the nucleus strongly suggest such a relationship, despite the rather unorthodox aspect of body whorl and aperture. If there were any doubt, it should be removed by a comparison of the holotype with paratypes A.M.N.H. Nos. 27636:8 and 27636:19 of *C. (?C.) obesa,* in both of which the aperture assumes a similar aspect. In the latter even the shape of the body whorl somewhat approaches that found in *C. (?C.) pyrulaeformis.*

The above peculiarities of the present

species make its taxonomic position within the genus *Cylindrobullina, sensu lato*, somewhat uncertain. In its large body whorl it resembles, to a certain extent, some forms of Meek's (1863, p. 91) subgenus *Trochactaeonina*, admitted by Cossmann (1895, p. 66) as a subgenus of *Actaeonina* of equal standing with *Cylindrobullina, sensu lato*, for example, *T. bigoti* Cossmann (1895, pl. 6, fig. 17; 1895a, p. 71, pl. 19, figs. 35, 36, pl. 20, fig. 35). However, since the Peruvian form lacks the columellar fold considered by Cossmann diagnostic of *Trochactaeonina*, it cannot be referred to that genus. Should more species like the present one be found, it might be worth while to establish a new subgenus of *Cylindrobullina* for them, but the material here dealt with is too scanty to justify its creation. Meanwhile the present species, as well as the following form, is tentatively and doubtfully left with *Cylindrobullina, sensu stricto.*

The peculiarities of shell shape and columella pointed out in the description distinguish *C. (?C.) pyrulaeformis* readily from all other *Cylindrobullina* forms dealt with in the present report, except the following one which is compared with it below.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	NO. OF SPECIMENS
48	27637	3
78	27637/1	3
86	27637/2	4 (doubtful juveniles)
		10

Even if some specifically undertermined *Cylindrobullina* specimens should belong to this species, the total number of individuals would not be much over 10.

Cylindrobullina (?Cylindrobullina) aff. pyrulaeformi Haas

Plate 17, figures 77, 78, 83

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27638:1	*ca.* 1.06 mm.	*ca.* 55½	*ca.* 18½	65°
27638:2	*ca.* 6.15	*ca.* 54	*ca.* 20	66°

DESCRIPTION: When these dimensions are compared with those of *C. (?C.) pyrulaeformis*, this form can be seen to have, at both sizes measured, a much less wide pleural angle and, if the largest shells of both tables are compared, also a considerably higher spire. The difference in W at both sizes and in h in the juveniles is much less marked. Despite these deviations in dimensions the close relationship between both forms is beyond any doubt.

The apical band of the body whorl is markedly wider and slopes much more distinctly, and the shoulder separating it from the rest of this whorl is considerably more distinct than in *C. (?C.) pyrulaeformis*. Otherwise this form agrees well in shape and other characters with the former. There is the same course of the columellar border and the same, here even stronger, illusion of an anterior canal pointing decidedly to the left. The reflection of the inner lip and the narrow umbilical slit which accompanies it can be seen in the larger shell (no. 2).

Except for some indistinct growth striation (fig. 83) no ornamentation can be observed in this shell. Alloiostrophy of the not too well-preserved nucleus can barely be recognized in both specimens (fig. 78).

REMARKS: The differences from *C. (?C.) pyrulaeformis* are believed to be wide enough to justify specific separation, but no new specific name is proposed for this scantily represented form.

From most of the other Acteonidae in the present assemblage it differs so widely that no further comparison is needed, except with *C. (Conactaeon)* aff. *peruvianae* and *C. (Conactaeon)* cf. *decorata* (see the discussions of these forms).

A certain resemblance in shell shape with *pyrulaeformis* are believed to be wide enough mentioned. From that form this one is readily distinguished by its quite different whorl profile and by the absence of the revolving keels (among them a particularly strong and prominent middle keel), which are found in the former.

OCCURRENCE: Occurs in lot 48 only, where it is represented by a very small juvenile and a comparatively large shell (A.M.N.H. No. 27638).

Cylindrobullina (?Cylindrobullina) tenuicostata, new species

Plate 18, figures 3–8

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27639:1	*ca.* 0.84 mm.	*ca.* 60	*ca.* 13½	?94°
27639:2	*ca.* 1.79	*ca.* 51½	*ca.* 14	72°
27639:3	*ca.* 2.02	*ca.* 53	*ca.* 14	79°
27639:4	*ca.* 2.24	*ca.* 50	*ca.* 12½	72°
27639:5	*ca.* 2.38	*ca.* 44½	*ca.* 19	71°
27639:6[1]	2.58	45½	24½	58°
27639:7 (holotype)	3.11	48	14	65°

In this table a tendency of both the width and the pleural angle to decrease with growth can clearly be recognized. With the exception of specimens numbers 5 and 6, in which it is extraordinarily high, the height of the spire shows but very little variation. Among all the named species of Acteonidae from Peru this one is the smallest.

SELECTION OF TYPE: The largest specimen present (A.M.N.H. No. 27639:7), which is also the best preserved, is designated holotype.

DESCRIPTION: Only four volutions and a half can be counted in the holotype. The shell shape is slender and cylindrical, the spire generally rather short, but unusually high in specimen number 6 (fig. 3) which can, however, only doubtfully be referred to the present species.[2] Below the shoulder all the whorls show more or less perpendicular lateral faces, but the apical ramps are only slightly pronounced and merge imperceptibly into the well-rounded shoulders. In the larger shells, for example, number 5 (the spire of which is also unusually high) and the holotype, a very slight constriction of the body whorl can just be perceived beneath the shoulder (figs. 5, 6, 8). In its lowermost part, it narrows rather rapidly into the slender, slightly concave base. Apart from the hardly perceptible constriction, the outer lip of the holotype runs straight and perpendicularly down to the lower margin of the aperture, which is broadly rounded. The columellar border is gently sigmoidal. In its lower part the thin inner lip is narrowly reflexed and accompanied by a shallow umbilical niche.

Most characteristic of this species is a delicate transverse ornamentation which can be recognized, preservation of the surface permitting, on the last and penultimate volutions of the larger shells and fragments. Only in the holotype does it extend back into the anteriormost part of the antepenultimate whorl. On the posterior half of its body whorl 12 or 13 fine ribs, separated from each other by intercostals of about the same or a slightly greater width, can be counted. They run as a rule in a shallow, forward convex arc over most of the body whorl. Only where completely preserved can they be seen to swing forward in its lowermost part, thus assuming a gently sigmoidal appearance (figs. 5, 6). Although this course is about the same as that observed in the growth striae and folds of some of the preceding species, the ornamentation here described, as indicated in the specific name, is considered a fine costation rather than a growth striation. It seems too regular and the individual ribs seem too well and too uniformly developed to pass for mere growth striation. It is true, however, that this ornamentation becomes even finer, denser, less distinct, and thus more similar to mere growth striation on the anteriormost part of the body whorl of the holotype.

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the embryonic whorls is well recognizable in several specimens, best in number 3 and in fragment number 8 (figs. 4, 7).

REMARKS: What has been considered a transverse costation rather than a growth striation gives this species a special and somewhat uncertain position within both the genus *Cylindrobullina* and its subgenus *Cylindrobillina, sensu stricto*, since their diagnosis, as formulated by Cossmann (1895, p. 62), does not allow for any transverse

[1] Conspecificity doubtful.

[2] Comparison of figures 3 and 62 of plate 18 proves how much this shell resembles some still smooth juveniles of *Consobrinella elegantula*, especially its paratype A.M.N.H. No. 27647:2, which is, however, only about two-thirds the size. Specimens of *Consobrinella elegantula* of the same size, on the other hand, differ from this shell quite markedly in the biconical shell shape, sloping apical band, and in quite distinctly exhibiting the characteristic costation of the species. A.M.N.H. No. 27639:6 from lot 48 is therefore doubtfully referred to *C. (?C.) tenuicostata* rather than to *Consobrinella elegantula*, especially since the latter is restricted to lot 86.

ornamentation other than "stries d'accroissement curvilignes, peu visibles." *C.* (*?C.*) *tenuicostata* would not conform with the last character even if the ornamentation described should be considered merely a growth striation. This species shares this "abnormality" with *C.* (*?Conactaeon*) *tilarniocensis*, described below, in which the transverse costation is much more robust (although it also degenerates on the body whorl). If the presence of such a transverse costation be considered at least a subgeneric character, a separate subgenus of *Cylindrobullina, sensu lato*, would have to be established for species like *C.* (*?C.*) *tenuicostata* and *C.* (*?Conactaeon*) *tilarniocensis*. It is felt that the material under examination would hardly justify such a procedure, at least for the time being. Therefore the present species is tentatively and provisionally left with *Cylindrobullina, sensu stricto*, as *C.* (*?Conactaeon*) *tilarniocensis* is with *Conactaeon*, since these are the respective subgenera to which they would belong without regard to their transverse ornamentation.

Of the species hitherto dealt with in this report *C.* (*C.*) *avenoides* may most require comparison with the present one. It is similarly slender but is readily distinguished by its higher and more pointed spire, more pronounced ramp and shoulder, and absence of a tranverse, and presence of a revolving, ornamentation.

Comparison of *C.* (*?C.*) *tenuicostata* with *C.* (*Conactaeon*) *peruviana*, *C.* (*?Conactaeon*) *tilarniocensis*, and *Coelostylina cylindrata* can be found in the various discussions under those species.

OCCURRENCE: Rare; represented in lot 48 by only 25 specimens, including fragments (A.M.N.H. No. 27639).

SUBGENUS CONACTAEON MEEK

Following Cossmann's (1895, pp. 43, 63) example, *Conactaeon* is here treated as a subdivision of *Cylindrobullina, sensu lato*, whereas Meek (1863, p. 92) originally created it as a subgenus of his genus *Euconactaeon*, with which *Conactaeon* is here coordinated.

As stated in Meek's (*loc. cit.*) and Cossmann's (p. 63) diagnoses, the conical shape of the body whorl (which tapers decidedly downward), the turreted spire, and the presence of a shoulder keel are distinctive of this subgenus. In one respect Cossmann's diagnosis requires emendation, if this subgenus is to accommodate the following species which are strongly believed to be referable to it (the last, *C.* (*?C.*) *tilarniocensis*, only with reservations). The surface is not always smooth, except for irregular growth folds. Instead there is a quite pronounced revolving ornamentation in *C.* (*C.*) *peruviana*, where it is best developed on the base, and a much finer one, spread all over the shell, in *C.* (*C.*) cf. *decorata*. The strong transverse folds found in *C.* (*?C.*) *tilarniocensis* also go beyond the character of ornamentation permitted by Cossmann's diagnosis for this subgenus ("surface . . . plissée par quelques accroissements irreguliers"), but that species is not a typical *Conactaeon* and may eventually be placed in a separate subgenus.

Cyllndrobullina (Conactaeon) peruviana, new species

Plate 18, figures 1, 2, 9–16, 18–22

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27640:1	*ca.* 1.12 mm.	*ca.* 60	*ca.* 10	98°
27640:2	*ca.* 1.18	*ca.* 62	*ca.* 14½	94°
27640:3	*ca.* 1.51	*ca.* 53½	*ca.* 15	82°
27640/1:1	*ca.* 1.51	*ca.* 59½	*ca.* 12½	99°
27640/1:2	*ca.* 1.62	*ca.* 58½	*ca.* 14	86°
27640/2:2	*ca.* 1.68	*ca.* 56½	*ca.* 16½	110°
27640:4	*ca.* 1.68	*ca.* 60	*ca.* 16½	90°
27640:34	*ca.* 1.68	*ca.* 53½	*ca.* 16½	102°
27640:5	1.74	50	14½	86°
27640/2:3	*ca.* 1.74	*ca.* 55	*ca.* 13	107°
27640:35	*ca.* 1.79	*ca.* 56	*ca.* 15½	92°
27640:9	*ca.* 1.85	*ca.* 63½	*ca.* 12	102°
27640/1:19	*ca.* 1.85	*ca.* 57½	*ca.* 15	90°
27540/1:20	*ca.* 1.90	*ca.* 56	*ca.* 15½	96°
27640/1:3	*ca.* 1.90	*ca.* 56	*ca.* 12½	110°
27640:8	*ca.* 1.96	*ca.* 54½	*ca.* 10	97°
27640:10	*ca.* 1.96	*ca.* 58½	*ca.* 14½	92°
27640/1:24	1.96	57	14½	105°
27640/1:4	*ca.* 1.96	*ca.* 63	*ca.* 9½	105°
27640/1:5	*ca.* 2.02	*ca.* 55½	*ca.* 14	110°
27640/1:11	*ca.* 2.02	*ca.* 60	*ca.* 9½	130°
27640:36	*ca.* 2.02	*ca.* 53	*ca.* 19½	79°
27640/1:18	*ca.* 2.02	*ca.* 54	*ca.* 18	88°
27640/1:22	2.02	55½	17½	102°
27640/1:23	*ca.* 2.13	*ca.* 58	*ca.* 16	110°
27640:38	2.18	55	13	91°
27640/1:21	2.18	54	15½	100°
27640/1:12	*ca.* 2.24	*ca.* 60	*ca.* 10	121°
27640/1:28	*ca.* 2.24	*ca.* 57½	*ca.* 17½	93°
27640/1:26	*ca.* 2.30	*ca.* 61	*ca.* 17	99°
27640/1:9	*ca.* 2.35	*ca.* 57	*ca.* 12	97°

A.M.N.H. No.	H	W	h	π
27640/1:10	*ca.* 2.35	*ca.* 55	*ca.* 14½	103°
27640:11	2.35	55	14½	90°
27640:17	*ca.* 2.35	*ca.* 52½	*ca.* 9½	107°
27640/1:7	*ca.* 2.35	*ca.* 55	*ca.* 14	*ca.* 94°
27640:12	2.46	57	9	102°
27640/1:29	2.52	54½	18	92°
27640/1:15	*ca.* 2.52	*ca.* 55½	*ca.* 13½	112°
27640:13	2.58	*ca.* 54½	*ca.* 11	104°
27640:16	2.58	52	15	93°
27640:18	*ca.* 2.58	*ca.* 48	*ca.* 11	*ca.* 95°
27640/1:13	*ca.* 2.58	*ca.* 58½	*ca.* 11	113°
27640/1:31	*ca.* 2.69	*?ca.* 62½	*ca.* 16½	109°
27640:14	2.69	56	10½	101°
27640:20	*ca.* 2.69	*ca.* 57½	*ca.* 12½	107°
27640:15	*ca.* 2.74	*ca.* 54	*ca.* 16½	93°
27640/1:30	*ca.* 2.74	*ca.* 55	*ca.* 16½	101°
27640:33	*ca.* 2.80	*ca.* 60	*ca.* 14	99°
27640:30	*ca.* 2.80	*ca.* 56	*ca.* 16	88°
27640:21	2.86	51	15½	96°
27640/1:32 (syntype A)	2.86	53	17½	89°
27640/2:4	*ca.* 3.24	*ca.* 55	*ca.* 15½	108°
27640/1:16	*ca.* 3.32	*ca.* 55	*ca.* 11½	112°
27640:22	*ca.* 3.32	*ca.* 51	*ca.* 11	96°
27640:23	*ca.* 3.40	*ca.* 50	*ca.* 13½	87°
27640:31	*ca.* 3.65	*ca.* 59	*ca.* 12½	80°
27640:32	*ca.* 3.73	*ca.* 55½	*ca.* 9	94°
27640:33	*ca.* 3.73	*ca.* 53½	*ca.* 11	82°
27640:25	*ca.* 3.82	*ca.* 54½[1]	*ca.* 10	109°
27640:27	*ca.* 3.82	*ca.* 54½	*ca.* 11	96°
27640:26	*ca.* 4.15	*ca.* 52	*ca.* 12	92°
27640:28	*ca.* 4.23	*ca.* 49	*ca.* 17½	82°
27640:29 (syntype B)	5.04	51	14½	89°
27640:37	*ca.* 5.78	*ca.* 58½	*ca.* 10½	116°

The largest specimen (A.M.N.H. No. 27640:37) attains exactly the same size as the largest measured *C.* (*?C.*) *obesa*. A fragment (A.M.N.H. No. 27640:41), however, may indicate a somewhat greater size, which would not be far below the maximum sizes reached by *C.* (*C.*) *vespertina* and *C.* (*C.*) *avenoides*.

The range of variation in dimensions closely approaches that observed in *C.* (*C.*) *vespertina*, except for h, in which it is markedly narrower. It is true that widths close to the maximum of 63½ do not occur among the larger shells, but otherwise no growth trends can be recognized. It is interesting in this respect to compare the dimensions given in the above table for the five specimens of the total height of 2.02 mm. One (A.M.N.H. No. 27640:36) exhibits the maximum for h (19½) and also the minimum for π (79°). Of the others two approach it rather closely in height of the spire. In a third the height of the spire is markedly lower, while in the fourth (A.M.N.H. No. 27640/1:11), in which the pleural angle attains the maximum (130°), it is very close to the minimum of 9, measured in specimens A.M.N.H. Nos. 27640:12 and 27640:32. With the exception of one of these specimens in which W attains 60, the widths vary in the four others only within a narrow range (53–55½). The pleural angles vary, as is to be expected, inversely to the heights of the spire.

[1] Crushed.

SELECTION OF TYPES: A medium-sized specimen (A.M.N.H. No. 27640/1:32) from lot 86 and the best preserved among the largest ones (A.M.N.H. No. 27640:29) from lot 48 are designated syntypes A and B, respectively.

DESCRIPTION: Five volutions and a half, including the embryonic ones, are present in the largest complete shell (syntype B). Both body whorl and spire are conical in shape, but since the spire attains only from about one-tenth to about one-fourth of the height of the body whorl, it might be misleading to call the shell biconical, a term believed better suited to the shell shape of *Consobrinella elegantula* (see pl. 18, figs. 62–78). Most characteristic of this species is the staircase profile of the spire, with a sharp, at later stages somewhat projecting, shoulder edge separating the rather wide, horizontal or only slightly sloping apical bands of its whorls from their strictly perpendicular (exceptionally, as in paratype A.M.N.H. No. 27640:28; fig. 18, even overhanging) lateral faces. The uppermost third of the body whorl is cylindrical also, but in its lower two-thirds it tapers markedly downward, thus assuming its characteristic slender-conical shape. In some specimens the shoulder edge is marked by a keel which appears sometimes at a very early stage, for instance in paratype A.M.N.H. No. 27640/1:19 at a total height of only 1.85 mm. (fig. 16). There it is comparatively thick, but in the somewhat larger paratype A.M.N.H. No. 27640/1:7 (fig. 9) it is finer and sharper, as it is also in syntype B, particularly so in its penultimate whorl (figs. 1, 10). Where it is well developed, this shoulder keel is accompanied beneath by a distinct groove, obviously homologous

with the "profond sillon spiral" recorded by Cossmann (1895, p. 59) as a diagnostic feature of his section *Striactaeonina*. This groove is more pronounced in the penultimate volution of syntype B than in its body whorl, where it assumes the form of a slight constriction, also observable in paratype A.M.N.H. No. 27640:28 (figs. 1, 10, 18, 19). Only in certain places can some minute beads, caused by the crossing of growth folds, be recognized on the shoulder keels of the penultimate whorls of syntype B (figs. 1, 10) and syntype A (fig. 12). This observation is important, because it proves the presence of a character considered diagnostic of *Conactaeon* by Cossmann (1895, p. 63, "carène crénelée") and well seen in Eudes-Deslongchamps' (1842a, pl. 10, figs. 10–14) protographs, though less distinctly in Cossmann's own illustrations (1895, pl. 2, figs. 5, 6; 1895a, pl. 17, figs. 17, 18) of the type species, *C. cadomensis*. In a single incomplete shell (A.M.N.H. No. 27640:39; fig. 27) two more revolving keels follow at about equal distances below the shoulder keel on the upper half of the body whorl. Of these, the upper is only somewhat, the lower considerably, weaker than that on the shoulder.

Following the shape of the body whorl the aperture also tapers downward more markedly than in the various species referred above to *Cylindrobullina, sensu stricto*, and its lower margin is less broadly rounded. The outer lip runs not straight, but in a continuous shallow arc all the way from the shoulder to the lower end of the aperture. In its upper part this arc follows a nearly perpendicular direction. The columellar border is gently sigmoidal, but assumes an almost perpendicular direction in its lowermost part, where it is somewhat thickened by the clearly reflexed inner lip. The latter is accompanied by a distinct and rather deep umbilical niche (syntypes A and B and paratype A.M.N.H. No. 27640:28; figs. 12, 10, 19). In only one shell (A.M.N.H. No. 27640/1:10; fig. 29) is this niche seen to continue into a narrowly open umbilicus. In some specimens (A.M.N.H. Nos. 27640:14, 27640:17, 27640:21, and 27640:23) the collumella seems to be more decidedly corkscrew-shaped than in most, thus producing in apertural view the same illusion of a canal pointing to the left as mentioned for two shells of *C. (?C.) obesa* and some of *C. (?C.) pyrulaeformis*. This phenomenon is illustrated in figures 2 and 15.

In addition to the shoulder keel (triplicated in the single specimen mentioned above) the revolving ornamentation comprises lirae, separated by shallow furrows from one-third to one-half as wide.[1] This ornamentation can be recognized only at later growth stages on the body whorl, rarely, as in syntype B, also on the penultimate whorl. It is developed best on the base and loses strength and distinctness as it goes upward. In the upper part of the body whorls and on the penultimate whorl of syntype B it becomes so faint as to be hardly perceptible. Syntype B and paratype A.M.N.H. No. 27640:28 show this ornamentation best (figs. 1, 18). In the latter individual the lirae seem to be somewhat narrower and more crowded at the bottom of the base than they are in the lower third of the body whorl. Beyond that zone they practically disappear in this particular shell. There seems to be some variation in the density of this ornamentation. In that paratype and in syntype B about eight lirae can be counted to 1 mm., but only about six in paratype A.M.N.H. No. 27640:37, where they are markedly wider.

In the penultimate whorl of syntype B growth folds that produce beads on the shoulder keel can be seen indistinctly. They run backward over the apical band, then form a hook on the shoulder, and continue in a slightly forward oblique direction nearly straight across the lateral whorl face (fig. 1). Furthermore indistinct growth striae and folds are faintly recognizable in the small juvenile A.M.N.H. No. 27640/1:27 and in syntype A.

EARLIEST ONTOGENETIC STAGES: Heterostrophy of the nucleus is observable in many individuals (e.g., paratypes A.M.N.H. Nos. 27640:16, 27640:40, 27640/1:10, 27640/1:28, 27640/1:19, 27640/1:34, 27640/1:35, and syntype A). The five best examples of this phenomenon are illustrated in figures 13, 16, 20–22, and 28.

[1] These furrows could also be characterized as striae, separated by bands from two to three times as wide.

REMARKS: This species is considered the most characteristic representative of *Conactaeon* in the assemblage under study, as it clearly exhibits all the distinctive characters of this subgenus. It is not nearly so slender as the genotype, *C. cadomensis* (Eudes-Deslongchamps, 1842a, p. 147, pl. 10, figs. 10–14; Cossmann, 1895, pl. 2, figs. 5, 6; 1895a, p. 60, *cum synon.*, pl. 17, figs. 17, 18), and the spire is much lower. From a contemporary of *C. cadomensis*, *C. brachyteles* Cossmann (1895a, p. 61, pl. 17, figs. 50–52), our species differs much less in both respects.

These subgeneric characters, particularly the more conical shape of the body whorl, which tapers decidedly downward, as does the aperture, the pronounced staircase profile of the spire, with sharp shoulder edges or keels, and the comparatively wide, horizontal or nearly horizontal apical bands of the whorls distinguish *C.* (*Conactaeon*) *peruviana* from the forms referred in this report to *Cylindrobullina, sensu stricto*, even from *C.* (*?C.*) *obesa*, which is somewhat transitional to *Conactaeon* but is much stouter than *C. C.* (*Conactaeon*) *peruviana*. *C.* (*C.*) *avenoides*, which is also rather slender, differs from the present species chiefly in its narrower apical bands, more rounded shoulders, cylindrical shape of body whorl, and the character of its revolving ornamentation which is more delicate and more evenly spread over the body whorl.

Cylindrobullina (*Conactaeon*) *peruviana* is compared with *C.* (*Conactaeon*) aff. *peruvianae*, *C.* (*Conactaeon*) cf. *decorata*, and *C.* (*?Conactaeon*) *tilarniocensis* in the discussions of these three forms.

Cylindrobullina scalaris (Münster) (for references, see p. 256), though referred to *Cylindrobullina, sensu stricto*, by Cossmann (1895, p. 63), still has some features in common with the subgenus *Conactaeon*, namely, the staircase profile of the spire, the pronounced shoulder accentuated by a keel, which is sometimes (Kittl, 1894, pl. 11, fig. 29) beaded, and the conical rather than cylindrical shape of the body whorl. This keel is not sharp as in typical forms of *Conactaeon*, but in Kittl's (1894, p. 242) words, "round and inflated," more like a torus. The present species can, furthermore, readily be distinguished from Münster's by its shorter spire, wider apical bands, and revolving ornamentation. No trace of such ornamentation can be seen in *C. scalaris*, even in Laube's (1868, pl. 23, figs. 6–8) excellent, greatly enlarged drawings.

OCCURRENCE: Common.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27640	115
86	27640/1	125
78	27640/2	8
26	27640/3	3
76	27640/4	1 (doubtful)
		252

Addition of a proportionate part of the individuals of *Cylindrobullina, sensu lato*, left specifically undetermined might increase the total of 252 to about 280.

Cylindrobullina (Conactaeon) aff. peruvianae Haas

Plate 18, figures 25, 26

DESCRIPTION (INCLUDING DIMENSIONS): The fragment here dealt with separately, as preserved, is about 3.7 mm. high and about 2.65 mm. wide. It consists of a high and slender, conical spire, which comprises about six volutions, and of a fragment of a body whorl. If the latter were entirely preserved, the total height might well reach about 5 mm. Omitting that preserved part of the body whorl, the pleural angle of the spire amounts to 83 degrees, and the result can be estimated as about the same if the measurement is taken from the shoulder of the body whorl up. However, if measured from that of the antepenultimate volution up, π amounts to only 71 degrees. These measurements indicate a slightly concave outline of the spire on the whole, which with its height constitutes one of the characters distinguishing this form from the preceding species to such an extent as to exclude conspecificity. Furthermore the apical bands are narrower, and the shoulder edges somewhat less pronounced in the earlier whorls. The penultimate whorl and what is preserved of the body whorl exhibit as wide apical bands and as pronounced shoulders as syntype B of *C.* (*Conactaeon*) *peruviana*, so that there can be no serious doubt as to the close relationship between these forms. How-

ever, the shoulder keel observable in the preserved part of the body whorl points in the fragment here described upward rather than outward, as it does in the preceding species, thus causing a distinct though shallow concavity of the apical band. What can be seen of the lower part, base, and aperture of the antepenultimate whorl agrees well with syntype A of *C.* (*Conactaeon*) *peruviana* which is of about the same size.

Some indications of growth striae can be recognized, best on the shoulder keel of the preserved part of the body whorl which they cross in a backward oblique direction. After crossing it, they form a hook, to continue steeply obliquely forward on the lateral face of that whorl.

The alloiostrophy of the embryonic whorls common in this genus can also be observed fairly well in this specimen.

REMARKS: In its high spire this species resembles *C.* (*?C.*) aff. *pyrulaeformi* (pl. 17, figs. 77, 78, 83), but the shoulders even of its spiral volutions are much more pronounced and not rounded, and the apical bands are more distinct and horizontal. These differences are much more obvious in the body whorls. The body whorl of *C.* (*?C.*) aff. *pyrulaeformi* exhibits a decidedly sloping apical band and a well-rounded shoulder, whereas the apical band is horizontal and gently concave and the shoulder is pronounced and accentuated by a keel in the present form.

Of all the various forms referred in this report to *Cylindrobullina, sensu lato, C.* (*Conacteaon*) aff. *peruvianae* shows the greatest similarity to *Trachynerita porrecta* (see above and pl. 11, figs. 27, 28, 31), especially in the profiles of the spiral whorls and of the upper part of the body whorl. There is even the same concavity of the apical band of the body whorl in both. However, the general shapes are quite different, the spire is much more obtuse, and the body whorl is much stouter in *T. porrecta.* Both forms differ also in apertural characters and quite widely in size, the single specimen of *T. porrecta* reaching almost nine times the reconstructed size of the shell here dealt with.

OCCURRENCE: A single incomplete shell (A.M.N.H. No. 27641) in lot 51, in which it is the only acteonid. [A few individuals referred to *C.* (*C.*) *vespertina* were found in lot 53, only a little over one-quarter of a kilometer to the west.]

Cylindrobullina (Conactaeon) cf. decorata (Martin)

Plate 18, figures 17, 23, 24, 30, 31, 38, 39

Cf.:

Orthostoma decoratum, Mart.; MARTIN, 1859, p. 71, pl. 1, figs. 11, 12.

Orth. decorata, Mart. (*sub Striactaeonina*); COSSMANN, 1895, p. 60.

Striactaeonina decorata Mart.; COSSMANN, 1895a, p. 28, *cum synon.*, pl. 16, figs. 42–45, pl. 19, fig. 72.

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
26442/2:1	*ca.* 1.62 mm.	*ca.* 55	*ca.* 17	86°
27642/2:2	*ca.* 1.79	*ca.* 56	*ca.* 14	92°
27642/1:1	*ca.* 2.18	*ca.* 51½	*ca.* 18	81°
27642/1:2	*ca.* 3.73	*ca.* 58	*ca.* 18	93°
27642	*ca.* 3.73[1]	*ca.* 53½[1]	*ca.* 19[1]	81°

Within the above small sample h and π vary comparatively little and W even less.

DESCRIPTION: Although otherwise closely related, this form differs from *C.* (*Conactaeon*) *peruviana* in, on the average, higher spires and accordingly less wide pleural angles and chiefly in the wider and decidedly sloping apical bands of its whorls. In the next to the largest shell (A.M.N.H. No. 27642/1:2; figs. 30, 31) the apical band of the body whorl is concave. The shoulder keel, which is like that of *C.* (*Conactaeon*) *peruviana*, is already indicated in the penultimate, and well developed in the last, whorl of the next to the smallest measured specimen (A.M.N.H. No. 27642/2:2; figs 23, 24), i.e., at an ontogenetic stage at which it is only exceptionally present in that species (specimen A.M.N.H. No. 27640/1:19, see p. 270, pl. 18, fig. 16). It shows rather poorly in the next to the largest shell present (A.M.N.H. No. 27642/1:2; figs. 30, 31), but very well in the largest (A.M.N.H. No. 27642; figs. 38, 39), where the constriction of the body whorl beneath the keel is also well seen, whereas it is just indicated in A.M.N.H. No. 27642/1:2. Base and aperture are about the same as in *C.* (*Conactaeon*) *peruviana*, except that the columellar border appears swollen in specimens A.M.N.H. Nos. 27642/2:2 and 27642/

[1] Estimated.

1:2. The latter shows also a thickly reflexed inner lip.

Five and a half or six volutions can be counted in the largest and best preserved though incomplete shell (A.M.N.H. No. 27642).

Only in this specimen can a revolving striation be perceived on the lateral faces of both penultimate and body whorls (figs. 38, 39). It is rather fine and dense, with the intervals between the engraved striae only from one and a half to two times as wide as the striae themselves.

Traces of growth striae are observable here and there, best in specimen A.M.N.H. No. 27642/2:2, where they appear to run back over the apical band and to continue in a gently sigmoidal course all over the lateral face of the body whorl (figs. 23, 24).

EARLIEST ONTOGENETIC STAGES: The smallest measured individual (A.M.N.H. No. 27642/2:1) exhibits well the alloiostrophy of the nucleus (fig. 17).

REMARKS: The resemblance, particularly of the largest specimen present (A.M.N.H. No. 27642), to *Orthostoma decoratum* Martin from the lowermost Liassic (Hettangian) of the Côte d'Or (France) is striking indeed. Were it not for the much finer and denser striation of our specimen, as compared with that shown in Martin's protograph, the Peruvian form would have to be considered conspecific with the French one, and the specimen just mentioned the Peruvian hypotype of Martin's species. It is believed that the lack of full agreement in this particular case is indicated by "cf." better than by "aff.," since the present form is probably more closely related to *C.* (*Conactaeon*) *peruviana*, with which it is associated in lots 48 and 86 and from which it would seem just to branch off, than it is to the probably younger French species, whose striking similarity may well be due to some intrageneric, or intrasubgeneric, convergence. Taxonomic usage does not permit separation of forms that nearly or entirely agree morphologically, even though there may be good reason to suspect that they are not related so closely as they appear to be.

As to its taxonomic position within *Cylindrobullina, sensu lato, Orthostoma decoratum* is referred by Cossmann (*loc. cit.* in synon.) to his "section" *Striactaeonina*, but since that is not accepted in this report, the present form is here referred to *Conactaeon* on the strength of its conical body whorl, the pronounced, keeled shoulders, and the wide, flat apical bands of its whorls. Its close relationship to *C.* (*Conactaeon*) *peruviana* would exclude any other subgeneric assignment.

Other forms in the Peruvian material that require comparison are *C.* (*C.*) *avenoides*, which is readily distinguished by its more cylindrical shell shape, horizontal or less sloping apical bands, and rounded, unkeeled shoulders, and *C.* (*?C.*) aff. *pyrulaeformi*. The latter form has the comparatively high spire and in maturity the wide and sloping apical band of the body whorl in common with *C.* (*Conactaeon*) cf. *decorata* but differs most obviously by its well-rounded shoulders and lack of any shoulder keel, and of any constriction beneath it, even at nearly twice the size of the largest individual of the present form.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
71	27642	1
86	27642/1	3
48	27642/2	3
Total		7

The single specimen in lot 71 is the largest and best preserved.

Cylindrobullina (?Conactaeon) tilarniocensis,[1] new species

Plate 18, figures 32–37, 44, 45, 48

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27643:1	*ca.* 1.62 mm.	*ca.* 48½	*ca.* 17	84°
27643:2	*ca.* 2.02	*ca.* 53	*ca.* 25	78°
27643:3	*ca.* 2.07	*ca.* 54	*ca.* 21½	70°
27643:4	*ca.* 2.24	*ca.* 55	*ca.* 21½	81°
27643:5	*ca.* 2.52	*ca.* 52	*ca.* 15½	90°
27643:6	*ca.* 2.69	*ca.* 55	*ca.* 21	79°
27643:7	*ca.* 2.86	*ca.* 49	*ca.* 20½	82°
27643:8	*ca.* 3.65	*ca.* 54½	*ca.* 20½	76°
27643:9 (holotype)	5.29	47½	23½	57°

[1] Named after the village of Tilarnioc in the vicinity of which lot 48 was collected.

The above table shows clear, though not quite steady, trends. In general, W and π tend to decrease, and h tends to increase, with growth. The largest measured shell (no. 9) attains the minima of both W and π, but the maximum height of the spire is not associated with them, as could be expected, but is found in the next to the smallest measured specimen (no. 2). Similarly, the minimum of h is not encountered at the top but in the middle of the table, namely, in specimen number 5, which accordingly also exhibits the widest pleural angle. The width increases during the early growth stages and begins to decrease only at a medium size.

SELECTION OF TYPE: The largest shell present (A.M.N.H. No. 27643:9) is also the best preserved and the most characteristic and is therefore chosen as holotype.

DESCRIPTION: This holotype consists of six and a half volutions, including the incompletely preserved embryonic ones. The shell shape is that of this subgenus, with the body whorl tapering downward; however, it does not become conical to the same extent as in *C. (Conactaeon) peruviana*, which is a more typical *Conactaeon* than the present species. The latter resembles in shell shape *C. (Conactaeon)* cf. *decorata* more closely; this holds true for the body whorl as well as for the whorls of the comparatively high spire. All these volutions are characterized by a pronounced shoulder which separates the perpendicular (or exceptionally, as in the penultimate whorl of the holotype, even slightly overhanging) lateral face from the apical one, which is moderately wide and in some individuals, as in paratype number 6 and in the holotype, slightly concave and tends to slope more and more with growth (see holotype; figs. 34, 35). In some specimens, especially in numbers 1 and 5 (figs. 44, 45), however, the apical band remains strictly horizontal even at a stage when it slopes quite distinctly in the holotype, possibly owing to retarded development but in specimen number 5 partly to crushing. The shoulder is even more accentuated by the fact that the transverse ribs are strongest and highest and tend to form nodes there. Only where these nodes stand out considerably above the adjacent sections of the ribs and are closely set, as on the body whorl of paratype number 6 (fig. 32), do they coalesce into a beaded keel. There is no clear furrow beneath that keel, but in this shell as well as in paratype number 8 (figs. 36, 37) and in the holotype, i.e., in three of the four largest individuals present, the body whorl can be recognized to be somewhat constricted beneath the shoulder.

The aperture can best be studied in paratype number 6 and in the holotype (figs. 33, 35). Its outer lip follows in its uppermost part the slope of the apical band. Then it runs, if the slight constriction beneath the shoulder be disregarded, perpendicularly downward, but in the lower third of the aperture it turns into a gentle arc. The lower margin is moderately wide and rounded. The columellar border describes a gently sigmoidal curve, in the lower half of which the inner lip can be seen as thinly reflexed and accompanied by an extremly narrow umbilical slit.

This species exhibits, among all those of *Cylindrobullina, sensu lato*, in the present material, the most pronounced, sometimes even robust transverse ornamentation. Here, as in *C. (?C.) tenuicostata*, the question arises as to the correct term for the elements of this transverse ornamentation. They follow the same course as the growth striae and folds, and they degenerate on the anterior half of the body whorl of the holotype and on all that of paratype number 6 (figs. 32–35), into what cannot be designated otherwise than as a growth striation. However, as long as they are pronounced, well-defined, and regular, as they are on the posterior half of the body whorl and on the two preceding volutions of the holotype, they should, it is believed, be called ribs rather than growth folds. Eight can be counted on the posterior half of the body whorl of the holotype, and about the same density of the costation prevails in its penultimate whorl and in the distinctly ribbed paratypes numbers 8 and 5 (figs. 36, 37, 45), but in paratype number 6, where the costation degenerates at a much earlier stage than in the holotype, the growth lamellae into which it dissolves are markedly more closely set (figs. 32, 33). These ribs are broadest and most prominent on the shoulder where they tend to form heavy nodes and whence they decrease in both characters

downward. Even where they are best developed in the upper half of the body whorl, as they are in the posterior part of that of the holotype, only one or the other remains visible in the lower half. The growth striae and folds into which the costae later dissolve can be followed down the base, almost as far as the umbilical slit (fig. 35). Thanks to them, the full course of the elements of the transverse ornamentation can be reconstructed. They seem to run obliquely backward over the apical bands, which appear mostly smooth even where ribs are best developed on the shoulders and beneath. On the shoulder they describe hooks which in paratype number 6 form the fine tubercles coalescing into the keel mentioned above. Then they run in a gently sigmoidal curve down the lateral face of the body whorl, with a shallow forward convexity above and an even shallower forward concavity below, and eventually on the base turn in a well-rounded arc backward towards its center.

In paratype number 6 only a very delicate revolving ornamentation is recognizable which produces an extremely fine crenulation, or imbrication, of the ribs or growth striae (figs. 32, 33).

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the initial volutions can be observed in paratypes numbers 1, 2, and 5 (figs. 44, 48, 45).

REMARKS: The comparatively high, distinctly turreted spire and the nearly conical body whorl bring this species into closer affinity to *Conactaeon* than to any other subgenus of *Cylindrobullina*. The same is true for the nodes which the transverse ribs tend to form on the shoulder and which, in some specimens at least, coalesce into a beaded keel; they are undoubtedly homologous to those on the shoulder keel of *Conactaeon cadomensis*, the type species (cf. above, p. 271). Because of the distinct costation in this species, which makes it definitely transitional to the new genus *Consobrinella*, the species can only tentatively be referred to *Conactaeon*, as *Cylindrobullina* (*?Cylindrobullina*) *tenuicostata* was to *Cylindrobullina*, *sensu stricto*. As pointed out above, a separate subgenus of *Cylindrobullina* may eventually be necessary to accommodate forms with such pronounced transverse ornamentation.

Within the subgenus *Conactaeon*, as represented in the Peruvian material, the present species resembles *C.* (*Conactaeon*) cf. *decorata* most closely. Both forms agree in shell shape, especially in the comparatively high spires and the sloping apical bands, but the preceding one lacks the transverse ornamentation characteristic of this species. *C.* (*Conactaeon*) *peruviana* differs from it, in addition, by the lower spire, wide, horizontal apical bands, and the more pronouncedly conical shape of the body whorl.

From the only other Peruvian *Cylindrobullina* with a transverse ornamentation, *C.* (*?C.*) *tenuicostata*, this form is readily distinguished by its higher spire, pronounced shoulder, body whorl, which tapers more distinctly downward, less broadly rounded aperture, and most of all by its much more robust costation.

Finally, of all the *Cylindrobullina* species here discussed, *C.* (*?Conactaeon*) *tilarniocensis* approaches *Consobrinella elegantula* most closely and is compared with it below.

OCCURRENCE: Rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
48	27643	12
76	27643/1	1
Total		13

SUBGENUS **EUCONACTAEON** MEEK

This was proposed as a genus by Meek (1863, p. 91) but is here used as a subgenus of *Cylindrobullina*. Thus *Euconactaeon* and *Conactaeon* are here coordinated as subgenera, as they are as sections by Cossmann (1895, p. 43).

Both authors gave diagnoses of *Euconactaeon*, but whereas Meek (*loc. cit.*) postulates, "Spire wanting, its place being occupied by a cavity," Cossmann (1895, p. 64) modifies this character to "spire plane, ou même excavée. . . . " The latter, wider conception is here followed. Thus *C.* (*E.*) *tambosolensis*, the top of which is plane but can hardly be called concave, as well as *C.* (*E.*) *ninacacana* of which the spire is definitely sunk, can both be accommodated in this subgenus. By the study of the Peruvian material also that part of Cossmann's diagnosis is verified that mentions a "nucléus un peu saillant"; as a matter of fact, the embryonic whorls form a

tiny cone both on plane and concave upper surfaces.

It should be added that Cossmann's (*loc. cit.*) designation of *Conus concavus* Eudes-Deslongchamps (1842a, p. 149, pl. 10, figs. 15–22) as the type species is invalid, since Meek (1863, p. 92) 32 years earlier had selected *Conus caumontii* Eudes-Deslongchamps (1849, p. 165, pl. 18, fig. 7). It is irrelevant under the Rules that *Conus concavus* Eudes-Deslongchamps was established first and that it could be considered more characteristic of the subgenus.

Cylindrobullina (Euconactaeon) tambosolensis,[1] new species

Plate 18, figures 40–43, 46, 47, 49–52, 59–61

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27644/1:1	*ca.* 1.29 mm.	*ca.* 63	*ca.* 4½[2]	141°
27644/1:2	*ca.* 1.34	*ca.* 60½	*ca.* 4[2]	142°
27644:1	*ca.* 1.40	*ca.* 60	*ca.* 12	135°
27644/1:3	*ca.* 1.57	*ca.* 60½	[3]	>180°
27644:2	*ca.* 1.68	*ca.* 63½	*ca.* 4½[2]	146°
27644:6	*ca.* 1.79	*ca.* 76½	[3]	156°
27644:3	*ca.* 1.85	*ca.* 63½	*ca.* 12	136°
27644:4	*ca.* 1.85	*ca.* 69½	*ca.* 3	>180°
27644/1:4	*ca.* 1.90	*ca.* 59	*ca.* 3[2]	>180°
27644/1:5	*ca.* 1.90	*ca.* 70½	[3]	>180°
27644/2:1	*ca.* 1.96	*ca.* 63	*ca.* 5½[2]	145°
27644/1:6	*ca.* 2.02	*ca.* 66½	*ca.* 3[2]	145°
27644:5 (syntype A)	2.02	66½	6[2]	141°
27644:7	*ca.* 2.24	*ca.* 75	*ca.* 6[2]	>180°
27644:8	*ca.* 2.52	*ca.* 66½	*ca.* 9[2]	161°
27644:9	*ca.* 2.52	*ca.* 66½	*ca.* 2[2]	155°
27644:10	*ca.* 2.58	*ca.* 69½	*ca.* 4½[2]	170°
27644:11	*ca.* 2.69	*ca.* 64½	*ca.* 2[2]	*ca.* 180°
27644:12	*ca.* 2.80	*ca.* 58	*ca.* 9	146°
27644:13	*ca.* 2.86	*ca.* 56	*ca.* 8	137°
27644/1:7	*ca.* 2.91	*ca.* 53	[3]	>180°
27644:14	3.82	57½	2	165°
27644:15 (syntype B)	3.90	66	[3]	163°

The flatness or even concavity of the top of the conch, or at least of its peripheral zone, and the consequent necessity of measuring the height of the spire from the bottom of the apical concavity up render a correct evaluation of growth trends in this species particularly difficult. From the table it would seem that the ontogeny follows no clear-cut rules as to proportions.

SELECTION OF TYPES: The characteristic juvenile A.M.N.H. No. 27644:5 and the largest shell present, A.M.N.H. No. 27644:15 are chosen as syntypes A and B, respectively, the former for clearly exhibiting the embryonic characters.

DESCRIPTION: Four and a half or five volutions, including the nuclear ones, can be counted in the largest shell examined (syntype B).

The shell shape of this species is characterized by a flat or slightly concave top, with the embryonic and sometimes the first postembryonic whorls projecting above the plane or slight concavity formed by the apical bands of the following volutions, which are horizontal or slightly inclined towards the center. Accordingly, the highest values for h are found among the smaller individuals. The apical bands of the later whorls are separated from each other by deeply engraved sutures which reënforce the impression of a sunk spire, or even create it where there is no real concavity. As a further characteristic of this form a trend (not recognizable in the above table) to grow faster in width than in other dimensions should be noted, which causes some shells, for example, A.M.N.H. Nos. 27644:7, 27644:8, and 27644:15 (syntype B), to assume an elliptical rather than circular shape in apical view (figs. 43, 41, 52).

The body whorl (which means practically the shell as a whole) is bounded at its upper end by a pronounced but not sharp shoulder which carries no keel. In none of the examples examined has a constriction of the body whorl been observed. It is decidedly conical and tapers sharply downward. The base is distinctly concave. Accordingly, the aperture, comparatively narrow from the outset, also tapers markedly towards its somewhat pointed, almost canal-like lower end (both syntypes and paratype A.M.N.H. No. 27644/1:7; figs. 50, 61, 47). Its outer lip describes a regular, gently convex arc, the columellar border a sigmoidal curve. In its lower half the latter is thickened by the reflexed inner lip which in syntype B seems to form a callosity reaching up half the height of the aperture. In this specimen a narrow umbilical slit is just indicated; it can be seen more clearly in paratype A.M.N.H. No. 27644/2:1.

[1] Named for the village of Tambo del Sol, in the vicinity of which lot 78 was collected.

[2] Height of tip of nucleus above apical plane or concavity.

[3] Nucleus not preserved.

Paratype A.M.N.H. No. 27644/1:7 is illustrated in figures 46, 47, and 51 as an unusually slender shell and for exhibiting a definitely concave top.

Except for an extremely fine revolving striation, indistinctly perceptible in paratype A.M.N.H. No. 27644:7 (fig. 42), no ornamentation of any kind can be observed in the present species.

EARLIEST ONTOGENETIC STAGES: Alloiostrophy of the initial whorls is clearly shown in a considerable number of specimens, best in syntype A and in paratype A.M.N.H. No. 27644:8 (figs. 49, 50, 40).

REMARKS: The characters pointed out above, especially the truncate or even concave apical surface of the shell, refer this species beyond any doubt to the subgenus *Euconactaeon*, as defined by Cossmann. It differs, however, from the typical representatives of this subgenus from the Liassic of France, *E. concavus* (Eudes-Deslongchamps), incorrectly selected as genotype by Cossmann (1895, p. 64, pl. 2, figs. 7, 8; 1895a, p. 63, pl. 18, figs. 11–17), *E. maubertensis* (Terquem and Piette; Cossmann, 1895a, p. 62, text fig. 9), and *E. caumontii* (Eudes-Deslongchamps; Cossmann, 1895a, p. 64, pl. 18, figs. 23–25), the true genotype, not only in its much smaller size but in the shape of the aperture, which is bounded by a flatly convex outer margin and a sigmoidal inner one, whereas both run straight and parallel in the French species. These two differences may indicate a higher degree of divergence from *Cylindrobullina, sensu stricto*, and of specialization for the French forms.

The characters described, chiefly the flat or even concave top of the shell, distinguish this species readily from all other Acteonidae described so far in this report, not excepting the low-spired form of *C. (C.) vespertina*, specimens of which approach some individuals of *C. (E.) tambosolensis* in various dimensions. In *C. (C.) vespertina* the spire is always convex, even though it may be very low, whereas it is invariably plane or even concave in the present species, if the nuclear whorls are not considered.

Cylindrobullina (E.) tambosolensis is compared with *C. (E.) ninacacana*, the only other species of the subgenus occurring in Peru, in the discussion of that form.

OCCURRENCE: Not so rare.

LOT	A.M.N.H. Nos.	No. OF SPECIMENS
78	27644	28
48	27644/1	14
86	27644/2	2
Total		44

Even if a few of the specifically undetermined shells should belong to this species, the total number of specimens would not increase very much.

Cylindrobullina (Euconactaeon) ninacacana,[1] new species

Plate 18, figures 53–58

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27645:1	*ca.* 6.15 mm.	70	[2]	>180°
27645:2 (holotype)	*ca.* 10.58[3]	57	[2]	>180°

The total height of the holotype far exceeds that of any other Peruvian species of *Cylindrobullina, sensu lato*. It attains twice the maximum measured in *vespertina* and *avenoides*, more than two and a half times that of *obesa, peruviana*, and *tilarniocensis*, three times that of *pyrulaeformis*, almost four times that of *tambosolensis* and cf. *decorata*, and nearly five times that of *tenuicostata*. This size attained by the holotype is nothing unusual in this species, for of five more specimens two (nos. 3 and 4) are fragments of shells of nearly the same size. Thus exactly half of the individuals present prove this species to be by far the largest *Cylindrobullina, sensu lato*, in the Peruvian assemblage.

SELECTION OF TYPE: The larger of the two more or less complete specimens available (A.M.N.H. No. 27645:2) is designated the holotype.

DESCRIPTION: The holotype consists of from two to two and a half embryonic volutions and of from four to four and a half post-embryonic ones. The former rise as a

[1] Named after the village of Ninacaca in the vicinity of which lot 86 was collected.

[2] Top concave.

[3] Total height, including preserved parts of last whorl, 14.76 mm.

tiny, slightly oblique cone from the saucer-shaped concavity formed by the apical bands of the latter. These apical bands slope more or less decidedly towards the center and are separated from each other by deeply engraved sutures. They are gently concave and their peripheral portions are bent up in hat-brim fashion and reënforced by the strong, rounded shoulder keel which shows on the apical as well as the lateral faces. The latter are deeply constricted immediately beneath the keel, but this constriction is not so well defined as to be called a furrow. Beneath it the profile of the body whorl swells again, although not to the maximum width marked by that keel, then tapers rather rapidly downward to the pointed-triangular lower end of the aperture. The sides of this inverted cone are, however, not straight, as they are in the typical Liassic representatives of this subgenus, but distinctly convex.

The base is gently concave, the columella corkscrew-shaped. The outer lip forms a rather flat arc, and the columellar border is gently sigmoidal. Still both margins of the aperture look as if they ran nearly parallel, thus approaching the condition characteristic of the subgenotype and of closely allied Liassic species (for references see above). Thus the aperture assumes with growth (compare fig. 56 with fig. 58) more of the aspect of a rather narrow slit which tapers only moderately towards its canal-like, narrow, lower end. In the holotype the inner lip can be seen to be widely reflexed, surrounding a tube-like umbilical niche, and to join the wall of the body whorl only at about half its height, where it spreads over it as a rather wide though not well-defined callosity.

The unusual thinness of the test of this species should be noted as a distinctive character. Faint indications of growth striae in paratype number 1, where they follow a rursiradiate course on the apical face of the body whorl and a flatly sigmoidal one on its lateral face, and of an extremely fine revolving striation on the reflexed inner lip of the holotype are the only observable traces of ornamentation.

EARLIEST ONTOGENETIC STAGES: The initial whorls are more or less well preserved in all specimens present (apparently owing to their comparative safety in the apical concavity), best in the holotype where they can clearly be recognized as alloiostrophic (fig. 54).

REMARKS: Only *C. (E.) tambosolensis* need be compared with this species. The latter differs not only by greater size but by a decidedly concave apical face, strong, rounded shoulder keel, and pronounced constriction of the body whorl beneath it.

The last two characters and the gentle convexity of the lateral faces serve to distinguish *C. (E.) ninacana* from the typical Liassic *Euconactaeon* species of France which it otherwise approaches in the shape of the aperture. However, except for *E. maubertensis*, which is much smaller (H, 2.8 mm.), the French forms grow more than twice as large as this one.

OCCURRENCE: Rare; two specimens and four characteristic fragments in lot 86 (A.M.N.H. No. 27645).

CONSOBRINELLA,[1] NEW GENUS

A considerable number of small shells, all referable to one species, differ so radically from all other Acteonidae here dealt with under *Cylindrobullina, sensu lato*, and even from all other known acteonid genera, that a new genus is here proposed to include them.

GENERIC DIAGNOSIS: Very small acteonids of biconical shell shape, with high, turreted spires, pronounced shoulders, moderately wide, sloping, apical whorl faces, and slightly overhanging lateral faces. Body whorl tapering all the way from the shoulder down. Sutural gradient ("Nahtanstieg") somewhat steeper than in *Cylindrobullina*. Aperture obliquely subelliptical, with the shoulder producing the only pronounced corner in its outline, tapering downward, with the lower end narrowly rounded but neither pointed nor canal-like. Base gently concave. Inner lip thinly reflexed and accompanied by a narrow and shallow umbilical niche. Ornamentation consists of rather closely set, not very prominent, transverse ribs (which may be nothing but reënforced growth lamellae). They are indistinct on the apical bands, where they seem to run obliquely backward, culminate on the shoulder, where they occasionally

[1] Latin, meaning the little cousin, that is, of *Cylindrobullina*.

tend to form inconspicuous tubercles, then run in a gently sinuous course all over the lateral whorl face and gradually vanish on reaching the base. A hardly perceptible imbrication or crenulation of these ribs seems to be caused by an extremely fine revolving striation.

Embryonic whorls alloiostrophic.

TYPE SPECIES (BY MONOTYPY): *Consobrinella elegantula*, new species.

Since the above diagnosis is based on the type species only, it is of course subject to modification as soon as more species of this genus should become known.

DISCUSSION: Although, among the species referred above to *Cylindrobullina, sensu lato, C. (?Conactaeon) tilarniocensis* approaches this genus in both shell shape and sculpture and is clearly transitional between it and *Cylindrobullina*, the biconical shell shape, high spire, and decided tapering of the whorl profile from the shoulder down are characters so distinctive as to make generic separation imperative. However, the present genus is believed to have evolved from forms like *C. (?Conactaeon) tilarniocensis* only a short time, geologically speaking, before the deposition of the beds from which lot 86 was collected.

Nor can the form here dealt with be accommodated in any other of the generic or subgeneric groups of the Acteonidae, as reviewed by Cossmann (1895, pp. 43–77, pls. 1–3). It is true that there exist forms with similarly high spires, for example, the type species of *Actaeonina, sensu stricto, A. acuta* d'Orbigny from the Upper Jurassic of France (Cossmann, 1895, p. 58, pl. 2, fig. 4), but the entirely different profiles of the shell on the whole, the outline of which is practically unbroken, as well as of the several whorls, and the lack of any transverse or other ornamentation exclude congenerity. Thus creation of this new genus seems to be justified.

Since it is connected by transitions with, and seems to stem from, certain forms referable to *Cylindrobullina, sensu lato*, it is, within the family Acteonidae, referred to the same subfamily, the Cylindrobullininae Wenz.

Since the close relationship of this genus to the Acteonidae is established, it may suffice to mention its similarity in shell shape to certain Purpurinidae, especially to some forms of the genus *Angularia*, for example, *A. pleurotomaria* (Münster) and *A. subpleurotomaria* (Münster) (Kittl, 1894, pp. 63–65, pl. 6; figs. 6–9), or *A. multinodosa* Kutassy (1937, p. 58, pl. 2, figs. 39–41) and *A. plicata* Kutassy (1937, p. 59, pl. 2, figs. 42–45). This resemblance results chiefly from the similarity in whorl profile, caused by the slope of the apical bands in both genera, and accordingly in the external outline of the aperture. Otherwise, *Consobrinella* is quite different from *Angularia;* it is smaller in size and more slender, has a higher spire, and its ribs follow an entirely different course.

Consobrinella elegantula, new species

Plate 18, figures 62–78

DIMENSIONS

A.M.N.H. Nos.	H	W	h	π
27647:1	*ca.* 1.4 mm.	*ca.* 50	*ca.* 24	44°
27647:2	*ca.* 1.68	*ca.* 46½	*ca.* 23½	43°
27647:3	1.74	51½	19½	50°
27647:4	*ca.* 1.74	*ca.* 48½	*ca.* 26	41°
27647:6	*ca.* 1.9	*ca.* 50	*ca.* 26½	45°
27647:7	*ca.* 2.02	*ca.* 47	*ca.* 25	46°
27647:8	2.07	43	24½	43½°
27647:9	*ca.* 2.18	*ca.* 48½	*ca.* 28	51°
27647:10	*ca.* 2.24	*ca.* 40	*ca.* 22½	46°
27647:11	*ca.* 2.24	*ca.* 47½	*ca.* 27½	42°
27647:19	*ca.* 2.3	*ca.* 49	*ca.* 22	49°
27647:22	*ca.* 2.3	*ca.* 45	*ca.* 27	50°
27647:12	*ca.* 2.35	*ca.* 50	*ca.* 26	55°
27647:15	*ca.* 2.35	*ca.* 47½	*ca.* 24	60°
27647:14	*ca.* 2.46	*ca.* 45½	*ca.* 29½	42°
27647:16	*ca.* 2.46	*ca.* 48	*ca.* 27½	53°
27647:20	2.46	45½	22½	55°
27647:17	2.52	46½	26½	56°
27647:23	*ca.* 2.58	*ca.* 41½	*ca.* 28½	45°
27647:29	*ca.* 2.58	*ca.* 52	*ca.* 26	56°
27647:24	*ca.* 2.63	*ca.* 40½	*ca.* 22½	53°
27647:25	2.69	48	27	55°
27647:26	*ca.* 2.8	*ca.* 44	*ca.* 25	49°
27647:34	2.82	47	29½	52°
27647:31	2.91	42½	27	51°
27647:28	2.97	47	24½	65°
27647:35	*ca.* 3.07	*ca.* 44½	*ca.* 30	46°
27647:32	*ca.* 3.15	*ca.* 46	*ca.* 26½	58°
27647:33	*ca.* 3.32	*ca.* 50	*ca.* 25	52°
27647:38[1]	*ca.* 3.4	*ca.* 49	*ca.* 33	54°
27647:36	*ca.* 3.49	*ca.* 43	*ca.* 28½	50°
27647:41	*ca.* 3.65	*ca.* 45½	*ca.* 32	53°
27647:42 (holotype)	*ca.* 3.82	*ca.* 42½	*ca.* 32½	44°
27647:40	3.90	40½	30	40°
27647:43	*ca.* 3.9	*ca.* 44½	*ca.* 30	51°
27647:44	*ca.* 4.4	*ca.* 44½	*ca.* 30	*ca.* 40°

[1] Crippled.

No fragment has been found that would indicate a greater size than that reached by the largest measured specimen (no. 14); thus, this species may safely be stated not to reach, within the present material, a total height of 4½ mm.

One trend can clearly be derived from the table; the relative height of the spire tends to increase with growth. Whereas at earlier stages h is as a rule only half of W or less, it rises to two-thirds of W or more in adults. Accordingly, the maximum and near-maximum for h (33 and 32½) are found in specimens measuring about 3.4 and 3.8 mm. in total height (no. 28 and the holotype, respectively), but its minimum (19½) in one of the smallest juveniles measured. The width, on the other hand, varies throughout development within about the same range of between 40 and 50, exceptionally (specimen no. 29) 52. If a single, unusually stout shell (no. 28), in which π reaches 65 degrees, is excepted, the pleural angle varies between 40 and 60 degrees. It is true that the minimum of 40 degrees is reached in the largest shell measured (no. 44) and in one of the two which come closest to it in size (no. 40), but similarly acute pleural angles are also found in quite small juveniles, for example, number 4, whereas the most obtuse angles occur in two specimens measuring about 3 mm. (no. 28) and about 2⅓ mm. (no. 15), respectively, that is, at medium sizes. This seems surprising but is accounted for by the fact that the pleural angle in this form as in many others depends not only on the width of the conch and the height of the spire, but also largely on the extent to which the shoulder projects, a farther-projecting shoulder making for a more obtuse pleural angle. Thus quite frequently of two specimens of about the same size the one with the greater width or with the shorter spire may have a more acute angle, although the opposite result should be expected were it not for the influence of the shoulder.

SELECTION OF TYPE: Among several characteristic specimens one of the largest (A.M.N.H. No. 27645:42) is selected as the holotype.

DESCRIPTION: In addition to the characters distinctive of the genus this species shows the following:

About six and a half volutions, including the embryonic ones, are present in the holotype. The earlier whorls are gently convex, but with the ever more pronounced development of the shoulder the whorl profile becomes more and more angular, and the lateral whorl face tends to overhang. Simultaneously, the apical band increases in width and becomes slightly concave. This change occurs in some specimens (paratype 3; fig. 67) at an earlier ontogenetic stage than in others (holotype; figs. 74, 75). Only in paratypes 41 and 43 are the body whorls slightly constricted beneath the shoulder (figs. 72, 73, 76, 77). An altogether characteristic shell profile (paratype 33) is illustrated in figure 63. The gradient of the sutures, somewhat steeper than in *Cylindrobullina*, is seen best in paratype 41 (figs. 72, 73).

The thinly reflexed inner lip and the accompanying narrow umbilical niche, which continues upward almost to the height of the ceiling of the aperture, are clearly visible in paratype 8 and in the holotype (figs. 66, 75), but the lower end of the aperture is not entirely preserved in the latter. It can be seen better in paratype 43 (fig. 77), where it is narrowly rounded and could be termed a wide anterior notch but by no means a canal.

The initial volutions are smooth. Then a rather indistinct transverse ornamentation sets in, but it deserves (in the holotype and in paratype no. 48) the designation "costation" only from about the middle of the antepenultimate whorl. As is indicated in the generic diagnosis, these ribs could be called pronounced growth folds or reënforced growth lamellae, but as in *Cylindrobullina (?C.) tenuicostata* and *C. (?Conactaeon) tilarniocensis* their regularity and uniformity make it preferable to speak of a costation. Their course is that of the growth striae, as in those species of *Cylindrobullina, sensu lato.* As far as they can be recognized on the apical band (body whorls of the holotype and of paratype number 41; figs. 72, 73), they run obliquely backward. In crossing the shoulder they form hooks which here and there tend to develop into rather inconspicuous tubercles; these hooks are seen best in paratype 41 (figs. 72, 73). Then the ribs run in a more or less shallow, forward convex arc over the lateral face of the body whorl and gradually

vanish on the base where they assume a radial direction. In contradistinction to the two afore-mentioned species of *Cylindrobullina, sensu lato,* with a similar ornamentation, this costation seems not to degenerate on the body whorl of the holotype, of which the surface is the best preserved. (Here it might be inserted that the surfaces of even the best shells from lot 86 are always somewhat iced, as it were, and can never compare in clearness of ornamentational details with good specimens from lot 48.) These ribs are always wide, though not prominent. They are as wide, or up to twice as wide, as the furrow-like intervals between them. This condition makes the costation appear rather dense. With about 25 costae present on the body whorls of the holotype and of paratype number 43, the density of the costation is about the same as in *Cylindrobullina (?C.) tenuicostata* but one and one-half that of *C. (?Conactaeon) tilarniocensis.* Only under favorable conditions of preservation can an extremely fine revolving striation be recognized which produces similarly fine beads on the ribs; in the holotype about 20 can be counted to a millimeter.

EARLIEST ONTOGENETIC STAGES: With embryonic volutions at least partly preserved in a considerable number of specimens, their alloiostrophy is best observable in the holotype and in paratypes numbers, 3, 8, 13, 17, 45, and 46 (figs. 74, 67, 66, 69, 70, 71, 78).

REMARKS: For a comparison with *Cylindrobullina* and other acteonid genera, see the discussion of the genus.

Only two *Cylindrobullina* species with more or less similar transverse ornamentation require specific comparison: *C. (?C.) tenuicostata* has more delicate costae than *C. elegantula* and differs even more in shell shape and profile, namely, by its comparatively short spire, rounded shoulders, and rather narrow, not so well-defined apical bands. In *C. (?Conactaeon) tilarniocensis,* the costation is more robust than in *C. elegantula* and the spire is not so high and the apical bands are not so wide. Both species compared differ, furthermore, from *C. elegantula* in the aperture, which is more broadly rounded at the lower ends, and by the degeneration of the transverse ornamentation on the anterior parts of the body whorls to a mere growth striation.

Of species belonging to other families, *Coelostylina cylindrata* is compared above.

Finally, *C. elegantula* is readily distinguished from *?Ramina andina,* which it somewhat resembles in shell shape, by its decidedly angular shell profile, by the presence of a pronounced shoulder, by the flatter gradient of its sutures, and by its characteristic transverse ornamentation.

OCCURRENCE: In lot 86 only, where it is fairly common (125 specimens) (A.M.N.H. No. 27647).

CONCLUSIONS

SURVEY OF THE FAUNA

Composition of the Fauna

Chart 1 lists the families, subfamilies, genera, subgenera, and species, shows the distribution of the last over the 37 lots, and indicates the degree of abundance of the species for every lot in which they occur, as well as their over-all abundance.

The gastropod material includes 26 families, 62 genera, and 181 species—a total of 16,456 specimens. About 90 could not be determined even generically. Thus the over-all total number of specimens is about 16,500.

In addition to the families, chart 1 lists six subfamilies of which only four (Loxonematinae, Zygopleurinae, Naticopsinae, and Neritopsinae) serve the purpose of subdivision of the respective families (Loxonematidae and Neritopsidae). The other two (Hesperocirrinae and Neritinae) within the scope of the present study are coextensive with their respective families (Cirridae and Neritidae).

Similarly seven subgenera (*Asperilla*, *Eosolariella*, *Eocalliostoma*, *Boutillieria*, *Polygyrina*, *Tyrsoecus*, *sensu stricto*, and *Cuphosolenus*) uniquely represent their respective genera (*Platyacra*, *Solariella*, *Calliostoma*, *Homalopoma*, *Loxonema*, *Tyrsoecus*, and *Aporrhais*). Eleven others (*Katosira*, *Kittliconcha*, *Allostrophia*, *Anoptychia*, and *Allocosmia* of *Zygopleura; Promathilda*, *sensu stricto*, *Teretrina*, and *Clathrobaculus* of *Promathilda;* and *Cylindrobullina*, *sensu stricto*, *Conactaeon*, and *Euconactaeon* of *Cylindrobullina*) serve to subdivide their genera, rich in both species and individuals. To obtain a more complete estimate of the taxonomic units immediately above the species level than is shown merely by a list of the 62 genera, the seven subgenera coextensive with their genera should not be counted. Among the 11 subgenera used as subdivisions of their respective genera, the first in each genus should also not be counted. Then eight subgenera remain to be counted, raising the total number of supraspecific units, as herein understood, from 62 to 70. It should be pointed out that under the disguise of existing generic or subgeneric names preceded by a query, other such supraspecific units are hidden in the descriptive part of this report. Thus most of the species listed under *Ptychomphalina*, one listed under *Omphaloptycha* (*?O. cacuana*), one listed under *Trachynerita* (*?T. evoluta*), and one listed under *Promathilda* (*Clathrobaculus*), i.e., *P.* (*?C.*) *gracillima*, may be subgenerically, if not generically, different from the typical representatives of these genera, or subgenera. The group consisting of *Guidonia parvula* and *G. bifasciata* may eventually be granted subgeneric rank within the genus *Guidonia*. Even two such as yet unnamed subgenera seem to be present within the genus *Cylindrobullina;* one, represented by *C. pyruliformis*, has provisionally been left with *Cylindrobullina, sensu stricto;* the other, consisting of *C. tenuicostata* and *C. tilarniocensis* and obviously transitional to the new genus *Consobrinella*, has provisionally been divided between the subgenera *Cylindrobullina, sensu stricto*, and *Conactaeon*. In all these cases I have refrained from proposing new subgeneric, or even generic, names because the material available was not deemed sufficient. From a statistical angle, however, these cases represent seven, though invisible, supraspecific units in addition to the 70 arrived at above.

Chart 1 is here supplemented by tables 1 to 3. Subfamilies and subgenera are not included in tables 1 and 2 for the sake of simplicity.

In table 3, all species above "rare" are listed in order of abundance, thus indicating the index gastropods most common in the late Triassic of Peru. If finer specific differences, of a degree that a field geologist might be inclined to neglect, be disregarded, and closely related species (such as the three of the subgenus *Teretrina* that rank first, second, and fourth, the three of the genus *Neritaria* that rank fifth, sixth, and eighth, the two of the genus *Omphaloptycha* that rank third and twelfth, and the two of the genus *Cylindrobullina, sensu lato*, that rank seventh and fifteenth) be united in characteristic species

groups, the same sequence of these groups with regard to their importance as index fossils is obtained as in table 2 for the genera by total number of individuals.

The following is a tabulation of species by degrees of abundance:

Degrees of Abundance	No. of Species
er	39
vr	53
r	38
nr	17
fc	8
c	19
vc	2
ec	5
Total	181

From this tabulation it follows that very rare species, represented by from two to five individuals, are most common and that extremely rare ones, represented by one individual only, and rare ones, with from six to 25 individuals each, are about equally common. From "r" on, the curve declines, though not steadily, there being more common species than not so rare ones and far more than fairly common ones, and more than twice as many extremely common species than very common ones. It must, however, be kept in mind that a different selection of brackets might have smoothed the unevennesses of the curve corresponding to the above tabulation. Altogether the results seem to agree quite well with those deduced mathematically by Preston (1948).

Representativeness of the Material

The question may arise whether the material examined, with all its richness, can be considered truly representative of the gastropod fauna which inhabited the sea covering what is now central Peru in late Triassic times. For a correct answer to this question it may be well to consult the last tabulation; it lists altogether 39 extremely rare species, represented by only one specimen each, and 53 very rare ones, represented by not more than five specimens each. Table 2 shows as many as 10 genera represented by only one individual each, nine represented by two individuals each, and four represented by three, and the same number of genera represented by four individuals each. As seen in table 1, there is even a family with only one individual, and there are three with only two individuals, one with only three, and one with only five specimens. Such rarity certainly does not reflect natural conditions but is obviously due to accidents of preservation and collecting. Many more such "rare"

CHART 1

The fossil localities are separated into the Cerro de Pasco and Tilarnioc regions, the former subdivided into Jenks' western and eastern facies. Within both these facies the lots are arranged mainly in stratigraphic groups, with those from the "*Myophoria*" limestones farthest on the left and those from the bituminous limestones following to the right. Within Jenks' eastern facies, there follow, furthermore, lots 24 and 26 from near Huachon, then the lots from the light limestones, namely, lot 76 from an isolated mound, 4½ kilometers southeast of Vico, and the lots from the Shelby-Ninacaca-Tambo del Sol area, i.e., 73, 69–71, 78, and 86. Farthest to the right is lot 48, from 4 kilometers east of Tilarnioc. Within these stratigraphic groups, the individual lots are given in approximately geographic sequence.

Symbols for degree of abundance: er, extremely rare (1 specimen); vr, very rare (2–5 specimens); r, rare (6–25 specimens); nr, not so rare (26–75 specimens); fc, fairly common (76–150 specimens); c, common (151–500 specimens); vc, very common (501–1000 specimens); ec, extremely common (more than 1000 specimens).

Symbols for correlation: =, same species as one listed at left of table; cf, comparable species; aff, related species; sim, similar species; ?, doubtful conspecificity. =, ?, and aff are used analogously for subgenera and genera.

Genera, subgenera, and species of other faunas are referred to as they are here understood, regardless of the names applied by the respective authors.

No attempt is made to list every previously known occurrence of species, subgenera, and genera. Only faunas particularly important for correlation are included. In the case of subgenera and genera the correlation is further restricted to those that are more or less rare and have limited stratigraphic ranges.

For the geographic location of lots, see map 1, facing page 4.

TABLE 1

FAMILIES LISTED BY ABUNDANCE OF GENERA, SPECIES, AND INDIVIDUALS

Family	No. of Genera	Family	No. of Species	Family	No. of Individuals[a]
Coelostylinidae	8	Procerithiidae	25	Mathildidae	5808
Procerithiidae	6	Loxonematidae	19	Neritidae	2832
Pleurotomariidae	5	Coelostylinidae	18	Coelostylinidae	1852
Trochidae	5	Mathildidae	16	Procerithiidae	1816
Euomphalidae	4	Pleurotomariidae	15	Acteonidae	1268
Platyacridae	3	Acteonidae	14	Trochonematidae	1050
Loxonematidae	3	Trochidae	11	Loxonematidae	966
Neritidae	3	Neritidae	11	Trochidae	317
Cirridae	2	Cirridae	9	Cirridae	230
Turbinidae	2	Euomphalidae	6	Pseudomelaniidae	75
Pseudomelaniidae	2	Trochonematidae	6	Lacunidae	45
Spirostylidae	2	Platyacridae	4	Paraturbinidae	39
Neritopsidae	2	Turbinidae	4	Pleurotomariidae	37
Purpurinidae	2	Anomphalidae	3	Amberleyidae	26
Acteonidae	2	Paraturbinidae	3	Anomphalidae	18
Murchisoniidae	1	Spirostylidae	3	Turbinidae	18
Acmaeidae	1	Pseudomelaniidae	2	Neritopsidae	18
Trochonematidae	1	Neritopsidae	2	Platyacridae	10
Anomphalidae	1	Purpurinidae	2	Euomphalidae	8
Paraturbinidae	1	Vermetidae	2	Spirostylidae	8
Amberleyidae	1	Murchisoniidae	1	Purpurinidae	5
Lacunidae	1	Acmaeidae	1	Aporrhaidae	3
Mathildidae	1	Amberleyidae	1	Acmaeidae	2
Vermetidae	1	Lacunidae	1	Vermetidae	2
Xenophoridae	1	Xenophoridae	1	Xenophoridae	2
Aporrhaidae	1	Aporrhaidae	1	Murchisoniidae	1
Total	62	Total	181	Total	16,456

[a] In many cases the total number of individuals has been only approximately computed.

species and even genera and one or the other "rare" family may well be assumed to have been present in the living assemblage we are trying to reconstruct, but they just did not succeed in being preserved in the fossil record. These considerations lead to a decidedly negative answer to the above question. In general, such an answer is the more warranted the smaller the material examined.

In this connection it is quite interesting to compare the present material with that published by Cox (1949), including altogether only 26 gastropod specimens. They are referable to seven genera, as compared to 62 dealt with in the present report. Of our three most common genera (*Promathilda, sensu lato, Neritaria,* and *Omphaloptycha;* see table 2), *Neritaria* is not at all represented in Cox' material, and the two others are by only one individual each. Moreover neither of these belongs to the leading index fossils of this fauna [*Promathilda* (*Teretrina*) *bolinoides* and *Omphaloptycha jaworskii*, respectively]. Other genera than *Neritaria*, which are very, or even extremely, common in the Jenks Collection but entirely missing in Cox' material are, in order of their abundance in the former, *Cylindrobullina, sensu lato, Guidonia, Zygopleura, sensu lato,* and *Protofusus.* On the other hand, three genera rare, or even very rare, in our material (*Brochidium, Calliostoma,* and *Homalopoma*) are represented in Cox' also by one or two individuals each, but *Chartroniella,* of which not more than 39 specimens are counted in the Jenks Collection, is represented there by as many as 17. This may indicate that the collectors whose specimens were studied by Cox hap-

TABLE 2

GENERA LISTED BY ABUNDANCE OF SPECIES AND INDIVIDUALS

Genus	No. of Species	Genus	No. of Individuals[a]
Promathilda, sensu lato[b]	16	*Promathilda, sensu lato*[b]	5808
Zygopleura, sensu lato[c]	14	*Neritaria*	2820
Cylindrobullina, sensu lato[d]	13	*Omphaloptycha*	1800
Protofusus	8	*Cylindrobullina, sensu lato*[d]	1143
Neritaria	7	*Guidonia*	1050
Hesperocirrus	6	*Zygopleura, sensu lato*[c]	951
Guidonia	6	*Protofusus*	920
Omphaloptycha	6	*Rhabdocolpus*	456
Paracerithium	6	*Paracerithium*	400
Rhabdocolpus	6	*Solariella, sensu lato*	270
Sisenna	5	*Hesperocirrus*	202
Coelostylina	5	*Consobrinella*	125
?Worthenia	4	*?Ramina*	73
Ptychomphalina	4	*Heterospira*	45
Solarioconulus	4	*Chartroniella*	39
Brochidium	3	*Solarioconulus*	32
Sororcula	3	*Cryptaulux*	29
Anomphalus	3	*Sorocula*	28
Chartroniella	3	*Eucyclus*	26
Solariella, sensu lato	3	*Coelostylina*	24
Tyrsoecus, sensu lato	3	*Anomphalus*	18
Trachynerita	3	*Pustulifer*	18
?Hyperacanthus, Calliostoma, sensu lato, Eucycloscala, Homalopoma, sensu lato, Loxonema, sensu lato, Pustulifer, Spirostylus, ?Vermicularia, Kittlistylus, Cryptaulax	2 each	*Neritopsis*	17
		?Worthenia	16
		Ptychomphalina, Eucycloscala, Trachynerita	11 each
		Calliostoma, sensu lato, Tyrsoecus, sensu lato	9 each
Pareuryalox, Pleurotomaria, Trypanocochlea, Euomphalus, Phymatifer, Discohelix, Platyacra, sensu lato, ?Lepidotrochus, Acmaea, Eucyclus, Callotrochus, Amphitrochus, ?Oonia, ?Ramina, ?Gigantogonia, Undularia, Toxoconcha, Protorcula, ?Glyptochrysalis, Euthystylus, ?Marmolatella, Neritopsis, Oncochilus, Heterospira, Andangularia, Pseudoscalites, ?Pseudotritonium, Jurassiphorus, Aporrhais, sensu lato, Consobrinella	1 each	*Homalopoma, sensu lato, Spirostylus, Kittlistylus*	7 each
		Sisenna, ?Hyperacanthus, Loxonema, sensu lato	6 each
		Brochidium, Callotrochus, Toxoconcha, ?Pseudotritonium	4 each
		Pareuryalox, Platyacra, sensu lato, Andangularia, Aporrhais, sensu lato	3 each
		Euomphalus, Acmaea, Amphitrochus, ?Oonia, Undularia, ?Glyptochrysalis, Pseudoscalites, ?Vermicularia, Jurassiphorus	2 each
		Pleurotomaria, Trypanocochlea, Phymatifer, Discohelix, ?Lepidotrochus, ?Gigantogonia, Protorcula, Euthystylus, ?Marmolatella, Oncochilus	1 each

[a] In many cases the total number of individuals has been only approximately computed.
[b] Represented by the three subgenera *Promathilda, sensu stricto, Teretrina*, and *Clathrobaculus*.
[c] Represented by the five subgenera *Katosira, Kittliconcha, Allostrophia, Anoptychia*, and *Allocosmia*.
[d] Represented by the three subgenera *Cylindrobullina, sensu stricto, Conactaeon*, and *Euconactaeon*.

TABLE 3

SPECIES WITH MORE THAN 25 SPECIMENS, LISTED IN ORDER OF ABUNDANCE[a]

	Total Number of Specimens		Total Number of Specimens
Extremely common		*Paracerithium vixstriatum*	160
Promathilda (Teretrina) bolinoides	2830	*Guidonia planetecta*	150+
Promathilda (Teretrina) intermedia	1370	Fairly common	
Omphaloptycha jaworskii	1300	*Protofusus pyramidalis*	146
Promathilda (Teretrina) obtusa	1170	*Paracerithium turritellare*	130
Neritaria obliqua	1000+	*Consobrinella elegantula*	125
Very common		*Protofusus peruvianus*	110
Neritaria dicosmoides	800	*Protofusus transitorius*	108
Cylindrobullina (Cylindrobullina) vespertina	525	*?Omphaloptycha cacuana*	92
		Guidonia intermedia	90
Common		*Neritaria distincta*	90
Neritaria hologyroides	500	Not so rare	
Guidonia parvula	400	*?Ramina andina*	73
Rhabdocolpus praeco	376	*Promathilda (Promathilda) alia*	70
Protofusus delicatulus	359	*Paracerithium porrectum*	68
Omphaloptycha speciosa	350	*Promathilda (Clathrobaculus) terebraeformis*	66
Zygopleura (Anoptychia) tambosolensis	320	*Hesperocirrus triasicus*	60
Neritaria ninacacana	285	*Solariella (Eosolariella) brevispira*	53
Cylindrobullina (Conactaeon) peruviana	280	*Cylindrobullina (Cylindrobullina) avenoides*	50
Promathilda (Promathilda) subnodosoides	225	*Cylindrobullina (Euconacetaeon) tambosolensis*	50
Zygopleura (Kittliconcha) dissimilis	200+	*Heterospira simulatrix*	45
Zygopleura (Kittliconcha) peruviana	200	*Hesperocirrus modestus*	44
Guidonia peruviana	200	*Hesperocirrus robusteornatus*	41
Solariella (Eosolariella) pusilla	198	*Omphaloptycha jenksi*	40
Protofusus gracilis	195	*Promathilda (Clathrobaculus) tilarniocensis*	35
Zygopleura (Anoptychia) tilarniocensis	190	*Paracerithium tambosolense*	35
Guidonia bifasciata	175	*Chartroniella pacifica*	32
Cylindrobullina (?Cylindrobullina) obesa	170	*Eucyclus denticulatus*	26

[a] The total number of specimens is in many cases only approximate, especially where it was estimated by adding a proportionate part of specifically undetermined congeneric specimens to those referred with certainty to the species.

pened to hit chiefly the bituminous limestones with *Chartroniella* (see pp. 80–84). In any event, the above comparison seems to show how misleading too small a sample can be in an estimate of the composition of a fauna.

REVIEW OF FAMILIES AND GENERA; THEIR GEOGRAPHIC AND STRATIGRAPHIC RANGES AND PHYLOGENY

The family dealt with first in the section on Systematics, the Pleurotomariidae, seems to include some of the forms of a more ancient character in the present assemblage, among them those questionably referred to *Worthenia*, including two first described by Körner from the Nevado de Acrotambo, and to *Ptychomphalina*. The new genus *Pareuryalox* may have descended from the closely related *Euryalox* which ranges from the Anisian stage up into the Norian. However, all the genera of this family are too scantily represented to permit any further paleontologic or

phylogenetic inferences. They occur scattered over the various groups of the eastern facies in the Cerro de Pasco region, with only the single *Pleurotomaria* found in the western lot 16A, and also in lot 26 near Huachon and in lot 48 near Tilarnoic. While *?Worthenia* favors the bituminous limestones and lot 26, with only a single juvenile shell in lot 48, *Sisenna* in turn occurs in lot 86, and in another lot (69) of the light limestones, but is represented also in lot 45 and doubtfully in lot 48. The new genus *Pareuryalox* occurs in the bituminous limestones (lots 29 and 97), and *Ptychomphalina* also in a lot (57) referred to them, but less rarely in lots 26 and 48, and extremely rarely in lot 86.

The single murchisoniid, from lot 48 near Tilarnioc, belongs to the rare genus *Trypanocochlea*, hitherto known only from the Carnian Hallstatt limestones.

The Euomphalidae, another family reaching far back into the Paleozoic, are also very scantily represented. Some of its members, referred to the genera *Euomphalus* and *Phymatifer*, may be considered archaic types, whereas the genus *Brochidium* is restricted to the Triassic and early Jurassic. Among the euomphalids of this material, this genus is represented by the largest, though still very small, number of individuals, but its only species hitherto known from Peru, *B. spinosum* Körner, recorded also by Cox, has not been encountered in the present material. Wherever euomphalids occur within the present assemblage, i.e., in lots 31, 57, 26, and 76, they are associated with the brachiopod genus *Spondylospira*. They are entirely missing in the "*Myophoria*" limestones as well as in the light limestones.

It seems open to doubt if the three genera, each represented by a few specimens or by one specimen only, that, following Koken's and Wenz' systematics, are united in the family Platyacridae [*Platyacra* (*Asperilla*), *Lepidotrochus*, and *Hyperacanthus*] are indeed so closely related to one another. The type species of the subgenus *Asperilla* and that of the genus *Lepidotrochus* and of the genus *Hyperacanthus* all occur in the Middle or Upper Triassic, but *Asperilla* and *Hyperacanthus* survive in the Jurassic. Within the present material, *Platyacra* (*Asperilla*) is restricted to lot 26 and *?Lepidotrochus* to lot 48, whereas *?Hyperacanthus* occurs in lots 71 and 86.

The Cirridae are quite abundantly represented by a new subfamily, the Hesperocirrinae, characterized within the family by planospiral or even concave nuclei. If the principle of recapitulation can be trusted even to a limited extent, these nuclei may suggest derivation of the Hesperiocirrinae (and through them of the Cirridae on the whole?) from Paleozoic to Middle Triassic Euomphalidae or Omphalocirridae. The Hesperocirrinae include the two new genera *Hesperocirrus* and *Sororcula*, the former much more abundant in both species and individuals than the latter. As noted above, their occurrences are, with a single doubtful exception, mutually exclusive, *Hesperocirrus* being restricted to the light limestones, while *Sororcula* favors lots 26 and 48 but occurs also in the bituminous limestones (lots 29, 33, 53, 57, 67) where it is mostly associated with *Chartroniella*. Thus *Sororcula* would seem to appear somewhat earlier than *Hesperocirrus*. From the phylogenetic angle these two genera offer an interesting example of divergence at an early ontogenetic stage (Haas, 1948). Whereas in *Sororcula* the first postembryonic whorl projects only a little, or hardly at all, beyond the nucleus, thus initiating and determining the slender conical shell shape and practically unbroken profile of this genus, the second embryonic whorl projects markedly beyond the first and the first postembryonic one projects even more decidedly beyond the nucleus in *Hesperocirrus*. Thus in the latter genus the shell profile starts in the embryonic stage to become deeply indented and more or less broadly triangular. Should the above assumption that *Hesperocirrus* originated from *Sororcula* prove correct, an initially slight change occurring in the genes controlling the growth of the shell at the earliest post-embryonic (if not at a late embryonic) stage might be responsible for the divergence of *Hesperocirrus* from *Sororcula*, causing a morphologic difference wide enough for them to be considered independent though closely related genera.

The Acmaeidae are represented in lot 86 by only one shell and one fragment which are doubtfully referred to the genus *Acmaea*. They do not offer much interest paleonto-

logically, since the material available is scarce, or stratigraphically, since the genus ranges all the way from Triassic to Recent.

The following family, the Trochonematidae, is also represented by only one genus, but this genus (*Guidonia*) is the first among the five most abundant of the present fauna that is dealt with in this summary. (For the vicissitudes of the history of the generic name, see pp. 56 ff.) Here we are interested in this genus for its wealth in species, among which two quasi-subgeneric groups seem to be distinguishable. Those comprised in the first of these groups, *peruviana-planetecta-intermedia*, constitute an excellent morphologic series, while those comprised in the second group, *parvula-bifasciata*, seem phylogenetically to offer another example of early divergence, here on the species level. Because the stratigraphic range of *Guidonia* extends only from the Norian to the Liassic, this genus is bound to play an important part in the dating of the fauna. It is concentrated in lot 86 and is not so rare in lot 70, another lot of the light limestones, but it is rare in lot 26 and represented only by a single small shell in lot 48. A few poor specimens in the western lot 16A, tentatively referred to the bituminous limestones, can only with reservation be referred to this genus.

The Anomphalidae are another very ancient family in this assemblage; of the three species of *Anomphalus* present one occurs in the St. Cassian fauna and one seems closely related to another St. Cassian species. This genus is rare in lot 86 and very rare in lot 48; in addition, a single shell has been found in the bituminous limestones (lot 33). However, it has not much to offer beyond the distinction and description of its three species.

The next family is the Paraturbinidae, of which the only genus present, *Chartroniella*, previously recorded from Peru by Jaworski and Cox, is one of the most interesting. Phylogenetically the Peruvian late Triassic species of this genus might connect its alleged St. Cassian member, *Turbo subcarinatus*, with its Jurassic representatives, among them the type species, *C. digoniata*, of Liassic age. Stratigraphically this genus, though not abundant, provides the most characteristic gastropod of the dark bituminous limestones of the Cerro de Pasco region and occurs also in lot 26 and, in a single specimen, in the light limestones (lot 69).

The Amberleyidae are also represented by one genus only, *Eucyclus*, one of the genera present with a more modern aspect. Its only Peruvian species, *E. denticulatus*, occurring almost exclusively[1] in lot 48, is one of the most fascinating in this assemblage, owing to its extremely rich ornamentation and to the fact that it resembles some Liassic species of this genus much more closely than its Carnian and Norian representatives from the Hallstatt limesones.

The Trochidae, although ranking only eighth in abundance among the families present, display, with five genera and altogether 11 species, a rich diversity of forms. Of its five supraspecific groups only the new subgenus *Eosolariella* of *Solariella* is common; it is concentrated in lot 48 and, to a lesser extent, in the light limestones; a single shell only has been found in lot 33 from the bituminous limestones. *Solarioconulus* is not so rare; it occurs only in lots 86 and 48. *Callotrochus* has been found in the "*Myophoria*"-bearing lot 53 as well as in lot 86. *Amphitrochus* occurs only in lot 26, where *Eocalliostoma* also is concentrated, but a single specimen of *Eocalliostoma*, referred to another species, is present in lot 86. The latter subgenus has previously been recorded from Peru by Körner and in an interesting new species by Cox. *Solarioconulus* is known only from St. Cassian and *Callotrochus* only from the Norian, whereas *Amphitrochus* is an essentially Jurassic genus with probably a few early species in the Carnian and Norian. Of all these groups *Eosolariella* is the most useful in dating the assemblage under study.

The next family, the Turbinidae, is represented in our material by one of the oldest genera (*Eucycloscala*) and by one of a much younger character (*Homalopoma*). Both are rare. *Eucycloscala* occurs in three lots from the bituminous limestones and in lot 26, with a single doubtful, extremely small juvenile found in lot 78 also, while *Homalopoma* is least rare in the bituminous limestones (no. 49), but also represented by one or two individuals each in lots 26, 86, and 48. The species referable to *Eucycloscala* are

[1] A single fragment has been identified in lot 51 from the bituminous limestones.

strongly reminiscent of St. Cassian species, and *Homalopoma*, except for a single fragment belonging to a new species, is represented by a well-known St. Cassian species, *H. subcinctum*, twice before (by Körner and Cox) recorded from the Triassic of Peru. This species has, within *Homalopoma*, been referred to the subgenus *Boutillieria*.

The Pseudomelaniidae are represented by only two extremely small shells of the genus *Oonia*, doubtfully referred to a St. Cassian species, in lot 26 and by another interesting species, which probably belongs to the rare genus *Ramina*, restricted to the Upper Triassic; this species is concentrated in lot 78.

The Loxonematidae are one of the most important families present; they rank seventh in abundance. Within this family the subfamily Loxonematinae is only poorly represented by the subgenus *Polygyrina* of *Loxonema*. Only in lot 26 can a few small specimens be referred with certainty to two forms of this subgenus. Isolated occurrences of the first of these forms in three other lots remain doubtful. The subfamily Zygopleurinae, on the other hand, is abundantly represented by five subgenera of the genus *Zygopleura* and by the genus *Tyrsoecus*. The latter is concentrated in, and for all practical purposes restricted to, lot 37 of the "*Myophoria*" limestones of the western facies, with only one doubtful specimen occurring in another western lot (no. 16A) which, however, carries *Spondylospira* and is therefore tentatively referred to the bituminous limestones. Of the subgenera of *Zygopleura*, *sensu lato*, *Allostrophia* and *Allocosmia* are represented by a single individual each, one in the "*Myophoria*" limestones (lot 19), the other in the bituminous limestones (lot 38). *Katosira* is not quite so rare, but with one exception [*Z.* (*K.*) cf. *beneckei*] is represented only by small and poor individuals. This subgenus occurs in the bituminous limestones (lots 15, 29, 31, 33, 34, 57) and in lot 26. It is interesting to note that other Zygopleurinae are absent from most of these lots; only in lot 26 *Katosira* is associated with a single *Anoptychia*, and in lot 33 with a doubtful one. The only two common subgenera of *Zygopleura* (*Kittliconcha* and *Anoptychia*) are, with the exception of a few in part doubtful individuals in the bituminous lots 87, 31, and 33, concentrated in the light limestones and in lot 48. Both common species of *Anoptychia* and one of the two common species of *Kittliconcha* definitely favor, within those lots, lot 78, as do *?Ramina* and the two undoubted *Trachynerita* species. Although both the Loxonematidae and the Zygopleurinae range back into the Ordovician, all five of the subgenera of *Zygopleura* mentioned above appear (with doubtful exceptions) only in the Triassic, four of them only in the Carnian. *Kittliconcha*, in particular, has hitherto been recorded only from St. Cassian and from northwestern Argentina. The only other genus of the Zygopleurinae present, *Tyrsoecus*, also appears in the Carnian.

The next family, the Coelostylinidae, occupies, in table 1, the first place as to number of genera, and the third in both number of species and total individuals. However, of its eight genera only *Omphaloptycha* is extremely common, *Coelostylina* and *Pustulifer* are rare, *Undularia*, *Toxoconcha*, and *?Glyptochrysalis* very rare, and *?Gigantogonia* and *Protorcula* extremely rare. The most common of all these genera, which has yielded one of the leading index fossils of the assemblage, *O. jaworskii* (previously identified as *O. rhenana* Koken by Jaworski), is concentrated in the light limestones of the Shelby-Ninacaca-Tambo del Sol area, where it is most abundant in lot 86, the richest of them, and in lot 48 near Tilarnioc, but three small specimens from lot 26 have also been referred to this genus, as has an extremely small shell in lot 91, one of Jenks' western facies. On the other hand, a somewhat aberrant species of doubtful congenerity, *?O. cacuana*, is fairly common in that lot, tentatively referred to the bituminous limestones. It might be considered as its index fossil; it is doubtfully represented by one specimen each in two other western lots of the same group (87 and 35). The three named species distinguished within the typical *Omphaloptychae*, *O. jaworskii*, *O. jenksi*, and *O. speciosa*, constitute another of the interesting morphological series encountered in the present assemblage. The genus *Coelostylina* is represented by the largest number of individuals in lot 26 but occurs also in lots 91 and 37 of the western facies, in the bituminous limestones (lot 33), in the light limestones

(lots 71, 86), and in lot 48. *Pustulifer* is concentrated in the "*Myophoria*" limestones (lot 37 of the western, and lots 3, 21, and 40 of the eastern, facies) but has been found also in the bituminous limestones (lot 97) and in lot 76. *?Gigantogonia* is restricted to the "*Myophoria*"-bearing lot 40, and *Protorcula* to lot 26. *Undularia* is present in the latter lot and possibly also in lot 76. *Toxoconcha* also occurs in lot 26 and in addition in the bituminous limestones (lot 56 and perhaps lot 67). *?Glyptochrysalis* has been found in lots 26 and 48. It is worth noting that no coelostylinid genus other than *Omphaloptycha* and *Coelostylina* is present in the light limestones. All the rare genera present, namely, *Gigantogonia*, *Undularia*, *Pustulifer*, *Toxoconcha*, *Protorcula*, and *Glyptochrysalis*, appear in the Middle Triassic and all except *Pustulifer* and *Protorcula* are even restricted to the Middle and/or Upper Triassic, but the stratigraphic ranges of *Coelostylina* and *Omphaloptycha* are too wide to make these genera valuable for correlation.

The Spirostylidae are represented by two genera only, *Spirostylus* and *Euthystylus*, both of which appear first in the St. Cassian beds. The former has also been recorded by Bonarelli from northwestern Argentina. *Spirostylus* is well represented, by a named species, in lot 48, with a single not conspecific individual also in lot 26, whereas only a single specimen of *Euthystylus* occurs in the latter lot.

Of the Neritopsidae two genera are present, one, the Middle to Upper Triassic *Marmolatella*, in only one doubtful specimen in the "*Myophoria*" limestones (lot 2); the other, *Neritopsis* is represented by some fine shells of a St. Cassian species in lot 86, but only by a small fragment in lot 26 and doubtfully by an extremely poor and small shell in the western lot 87.

The Neritidae, on the other hand, rank second in abundance among the families present and are represented by three genera with altogether 11 species. Of the genera *Neritaria*, the over-all stratigraphic range of which extends from the Permian to the late Triassic, is the most important and by far the most abundant. Among all genera present, only *Promathilda, sensu lato*, exceeds it in total number of individuals. *Neritaria* is represented by seven species. Among these, *obliqua*, *dicosmoides*, *hologyroides*, and *ninacacana* constitute another of the morphologic series recognizable in the material under study, with *N. distincta* differing more from them than they do from one another. From the angle of speciation it is interesting to note that every one of the species mentioned has a pattern of color markings of its own, which in some individuals yields to that of a closely related species, or the patterns of related species combine in various ways. It seems that speciation, or rather its genetic base, is here achieved with regard to shell shape and other characters but is not so firmly established with regard to patterns of color markings. Phylogenetically, this would call for the inference that here, too, divergence between the several species concerned took place, geologically speaking, only recently. *Neritaria* is concentrated in lot 86 and to a lesser extent in lots 70, 71, and 48 and occurs also in lot 78, all of these lots except 48 being from the light limestones. Furthermore it is represented by only a single specimen in lot 26. However, a few individuals each of this genus were found also in lot 3 from the "*Myophoria*" limestones and in lot 87, and a single one occurred in lot 15, the last two lots of the western facies being tentatively referred to the bituminous limestones. The genus *Trachynerita*, with only 11 specimens, is rare, especially if compared with *Neritaria*. Whereas two of its species (*tambosolensis* and *porrecta*) are essentially restricted to lot 78 of the light limestones, with a single shell fragment present in lot 26, the third, *evoluta*, previously recorded from Peru by Jaworski and here only doubtfully referred to this genus, occurs chiefly in lots 2, 3, and 40 of the "*Myophoria*" limestones, with doubtful fragments attributed to a single shell in lot 34, which is referred to the bituminous limestones. This genus, first described from the Ladinian Esino limestones, ranges from Anisian to Bathonian, whereas the third of the genera of this family present, *Oncochilus*, appearing in the Carnian, survived well into the Cretaceous. In our material it is represented by a single well-preserved shell in lot 70. As is shown above in the section on Systematics, the twin teeth on the inner lip, considered a distinctive character of this

genus, can also be found, though not so strongly developed, in several Peruvian *Neritaria* species. Phylogenetically this suggests derivation of *Oncochilus* from *Neritaria*, if not suppression of the former as an independent genus.

The Lacunidae are represented by the rare genus *Heterospira*, hitherto known only from the Carnian, solely in lot 71, where the only species, *H. simulatrix*, is not so rare.

Two genera of the family Purpurinidae were found in the material under examination, but both are only scantily represented. *Andangularia* is a new genus split off from *Angularia* (often misnamed *Pseudoscalites* in literature). It has hitherto been known only from Suta in northern Peru, whence it has been described by Jaworski. It is abundant in Kummel's collection from that locality, but represented in the material under examination only by one specimen each in lots 96 and 24 and by a doubtful fragment in lot 34. Thus it may well be considered a genus characteristic of the bituminous limestones. The close resemblance of this genus to *Rhabdocolpus*, originally recorded from the Middle Jurassic, is of phylogenetic interest. Only thorough examination of more material will tell if this resemblance is a case of convergence or justifies derivation of *Rhabdocolpus* from *Andangularia* and thus of a branch of the Procerithiidae from the Purpurinidae. The other genus of this family, the true *Pseudoscalites*, hitherto known only from the St. Cassian beds, is restricted to lot 26 where it occurs in two specimens only.

The next family, the Mathildidae, with about 5800 individuals or more than a third of all gastropods examined, is by far the most abundant, although all its members can be referred to one genus, *Promathilda, sensu lato*. Of its three subgenera, *Promathilda, sensu stricto*, is concentrated in the out-of-the-way lot 48, with only one species, *P.* (*P.*) *alia*, somewhat more abundant in lot 86 than in the former. Of the two other species, one (*P. subnodosoides*) closely resembles a St. Cassian species, and the other, very rare, is believed to be closely related to *P. perarmata*, also from St. Cassian. The overwhelming majority of the approximately 5500 specimens of *Promathilda* from Peru are referable to the subgenus *Teretrina*. It is concentrated in the lots from the light limestones, mostly in lot 86. Only the very rare *P.* (*T.*) *aculeata* and a single individual of another species, which is otherwise restricted to lot 48, occur in lot 26. Only a few individuals, one belonging to *P.* (*T.*) *aculeata*, a few belonging to *P.* (*T.*) *eucycloides*, and some specifically undetermined, were found in the bituminous limestones, namely, in lots 38, 51, and 87, respectively. One more each, identified merely as *Promathilda, sensu lato*, sp. indet., came from lots 45 and 53 of the same group. Of the nine species of this subgenus, four (*bolinoides, intermedia, obtusa*, and *eucycloides*) constitute the fourth, the largest, and the most remarkable of the morphologic groups studied within the present material. *P.* (*T.*) *eucycloides* owes its name to a remarkable similarity in shell shape with the genus *Eucyclus*, but this similarity is believed to be due rather to convergence than relationship. The last species is probably the same as the only true *Promathilda* that has previously been recorded from Peru, viz., by Cox under the generic designation *Eucyclus*. Two other species referred to the subgenus *Teretrina*, distinguished by the predominance of the middle keel, constitute another group within it. The third and rarest subgenus of *Promathilda*, *Clathrobaculus*, is represented by three species. Of these one occurs in lot 48, with a single specimen in lot 86; one, unnamed, only in lot 31 of the bituminous limestones; and the third, "multilirate," which may represent another, unnamed subgenus, is restricted to lot 26. Of the three subgenera distinguished within this large genus, the forms of *Promathilda, sensu stricto*, may be said to exhibit the closest resemblance to Upper Triassic, viz., St. Cassian, species. Those of *Teretrina* resemble Liassic species as closely as late Triassic ones, whereas those of *Clathrobaculus* display the younger aspect of this essentially Liassic subgenus.

The Vermetidae, represented by one specimen each in lots 26 and 48, both doubtfully referred to the genus *Vermicularia*, are here mentioned merely for the sake of completeness.

However, the following family, the Procerithiidae, with six genera and altogether

25 species, is one of the most diversified in the Peruvian material, although it ranks only fourth in number of individuals. With the exception of a single *Protofusus* in lot 91 and a single *Rhabdocolpus* in lot 87 (both these lots referred to the bituminous limestones of the western facies) this whole family, undoubtedly the least ancient among the large groups of this fauna, is restricted to the lots from the light limestones and lots 48 and 26. Of its genera, *Protofusus* is the most common. It is most abundant in lot 48, a little less so in lot 86, much less so in lot 78, and represented only by a few, somewhat aberrant specimens in lot 26. *Paracerithium*, a primarily Liassic genus, on the other hand, is best represented in lot 86, not so rare in lots 70 and 78, but rather rare in lots 71 and 48, and entirely missing in lot 26. *Pseudotritonium*, the rarest genus of all, occurs in the last lot and, in a single specimen, in lot 48. Within the genus *Rhabdocolpus*, first recorded from the Middle Jurassic, two groups can clearly be distinguished, one of subulate forms restricted to lot 26, and the other, much more abundant, with *R. praeco* as the leading species. This second group is common only in lot 48, but surprisingly rare in lot 86. It is entirely missing in lot 26 but represented, in addition to a doubtful single shell in lot 76 believed to belong to the light limestones, by two fragments in lot 57 and by the afore-mentioned single shell in lot 87, both bituminous limestone lots. The rare genus *Kittlistylus* is represented by two species in lot 26 only, and *Cryptaulax*, another primarily Liassic genus, by one species each in lots 26 and 48.

This family would seem to lend itself best to phylogenetic investigation, since for the first time a large material of Triassic age has been studied that may reveal something of the roots of this lineage, hitherto believed to appear only in the Jurassic. However, too many gaps remain in our knowledge of the early beginnings of this family to permit us to decide which of the above genera appeared earlier. For instance, were it not for the single *Paracerithium* illustrated quite recently by Leonardi and Fiscon (1948, pl. 2, fig. 8), though under an erroneous generic designation, from the St. Cassian beds near Cortina d'Ampezzo, no previous indubitable evidence of the occurrence of that genus in the Triassic (see above, p. 225) would exist, and *Protofusus*, hitherto recorded only from the "Horizonte calcáreo-dolomítico" of northwestern Argentina, would have to be considered the older genus. For the latter (the dating of which is most controversial) is here considered as of late Triassic age, whereas the earliest previously known certain occurrences of *Paracerithium* are Liassic. The above-mentioned publication of 1948 adds, however, *Paracerithium* to the three other genera of the Procerithiidae, *Pseudotritonium*, *Kittlistylus*, and *Cryptaulax*, which have been previously known from the St. Cassian beds of early Carnian age. Thus, as far as the records now available go, all four may be considered to have appeared earlier than *Protofusus* and *Rhabdocolpus*, for that matter, even if the tentative assumption of the presence of the latter in the "Horizonte calcáreo-dolomítico" should be corroborated. Still, both these genera may appear at any time in beds older than the "Horizonte calcáreo-dolimítico," or its dating may have to be moved earlier in time. Thus in an attempt at constructing a family tree of the Procerithiidae, no genus can with any certainty be considered the ancestor of any other, and there is therefore no way of knowing the phylogenetic direction (whether from ancestor to descendant or vice versa) of the interesting transitions observable between the several genera.

In the transition from *Protofusus*, treated first within this family in the present report, to the next genus, *Paracerithium*, for instance, the following morphological changes can be observed. There gradually develop a distinct subsutural ledge and a pronounced peripheral shoulder, the latter accentuated by revolving twin keels at which the transverse ribs end abruptly, whereas in typical *Protofusus* forms they continue more or less distinctly into the base. These developments change the whorl profile from a more or less rounded one, as predominant in *Protofusus*, to the more angular one of *Paracerithium*. Simultaneously, the pronounced beak housing the canal, which projects beyond the outline of the conch in *Protofusus*, gives way to a much shorter, hardly projecting anterior notch, and the revolving ornamentation of

the lateral whorl faces, only faint in *Protofusus*, becomes quite distinct. However, a revolving ornamentation as distinct as that occurring in *Paracerithium* can also be recognized in the early stages of some *Protofusus* species and the revolving peripheral keels in those of almost all of them. Here, however, both these characters disappear in maturity. *Protofusus* as a descendant of *Paracerithium* would be an excellent example of palingenesis, as the opposite phylogenetic relation would have to be interpreted in a cenogenetic (proterogenetic) sense.

It must be emphasized that one *Protofusus* species (*P. transitorius*) exhibits even in maturity all the characters otherwise distinctive of *Paracerithium*, namely, the pronounced subsutural ledge, peripheral shoulder, less convex lateral whorl face, sharp rather than thick ribs, and distinct revolving striation, with one important exception. It has the projecting beak diagnostic of the genus *Protofusus* and has therefore been left with that genus despite the presence of all the paracerithoid features enumerated. This species from a phylogenetic angle is the more interesting since it also shows a close approach to the genus *Rhabdocolpus*, but the latter differs from it, as it does from the genus *Paracerithium*, by flatter lateral whorl faces, absence of a subsutural ledge, stiffer and straighter ribs, on the upper ends of which the tubercles of the "coronet" develop, and an even more pronounced revolving ornamentation.[1]

Thus the changes leading from *Paracerithium* to *Rhabdocolpus* to a certain extent seem to continue the direction of those marking the transition from *Protofusus* to *Paracerithium*. This suggests a series in which the whorl profile changes first from rounded to angular, then by gradual disappearance of the subsutural ledge from angular to flat, in which the base gradually decreases in height and the beak gradually disappears, and in which the transverse costation becomes ever sharper and straighter and eventually develops the crowning tubercles so characteristic of *Rhabdocolpus*. In that series the revolving keels separating the base from the upper part of the body whorl would seem to appear at the adolescent stage, but to vanish in maturity in *Protofusus* and to come to full display only in *Paracerithium* and even more clearly in *Rhabdocolpus*. It should be emphasized that while *Rhabdocolpus* on the strength of its morphological characters could be considered the most highly specialized and thus the youngest of these three genera, there is no way of deciding whether to derive *Paracerithium* from *Protofusus* or the latter from the former. Nor can any decision be ventured as to whether the three genera should phylogenetically be connected by a straight line or two independent such lines be drawn from the ancestral genus (which *Rhabdocolpus* is *not* considered) to the two others. Be that as it may, a form like *Protofusus transitorius* may come fairly close to the picture we must draw of the ancestral form of all these three genera.

Even the position of *Rhabdocolpus* in any such tentative family tree remains uncertain, there existing also a possibility of its derivation from *Andangularia* (see above, p. 292).

Kittlistylus and *Cryptaulax* are two more rather highly specialized genera. Both show a certain affinity to *Rhabdocolpus*, but here again it would be extremely difficult at the present state of our knowledge to suggest which of these genera to derive from which. *Cryptaulax* in particular seems to represent such a high degree of specialization that it might be tempting to derive it from *Rhabdocolpus*, but there is no sufficient stratigraphic justification for such a procedure, since, should our belief that *Promathilda bittneri* Kittl is actually a *Cryptaulax* prove correct, the latter genus would have appeared earlier than *Rhabdocolpus*, even if the latter should, as we assume, already have occurred in the "Horizonte calcáreo-dolomítico" of northwestern Argentina. However, *Cryptaulax* might also have evolved from some Mathildidae, to the most common Triassic representative of which *Promathilda, sensu lato*, it comes fairly close. In that case it would have to be transferred from the Procerithiidae, to which it is referred by both Cossmann and Wenz, to the Mathildidae.

The following two families, the Xeno-

[1] *Protofusus pyramidalis* also shows a flattening of the lateral whorl faces and a straightening of the ribs, both characters causing a similar though somewhat less close approach to the genus *Rhabdocolpus*.

phoridae and Aporrhaidae, are undoubtedly the most surprisingly modern in our material. Both are restricted to lot 26, the most puzzling of all the lots, where they are scantily but unequivocally represented by one species each of the genera *Jurassiphorus* and *?Aporrhais* (*Cuphosolenus*). The former genus, however, seems to have been previously recorded from the Carnian, under the names *Schizogonium* and *Onustus*, by Kutassy (Bihar Mountains of Hungary) and Scalia (Monte Judica of Sicily), respectively.

The last, and only opisthobranch, family, the Acteonidae, ranks fifth in abundance. Its 14 species are referred to two genera only, *Cylindrobullina, sensu lato*, and *Consobrinella*, the former subdivided for purposes of this report into three subgenera (*Cylindrobullina, sensu stricto, Conactaeon*, and *Euconactaeon*). On the whole, this family is concentrated in lot 48 and in the lots from the light limestones, mostly in lot 86, and is only sporadically represented in lot 26 and in the bituminous limestone lots 34, 51, 53, 87, and no. 49. This holds true for *Cylindrobullina, sensu stricto*, which is most abundant in lots 48 and 86, much less so in lot 78, but very rare in lots 71 and 53, and represented by single specimens only in lots 70, 87, 34, and no. 49. It is worth noting that the Peruvian species of this subgenus resemble Liassic ones more closely than Upper Triassic ones. This is especially true of *C. (C.) avenoides*, which closely resembles *C. (C.) avena*, the type species of Cossmann's subgenus *Striactaeonina* (here not accepted). *C. (?C.) obesa* and *C. (?C.) pyrulaeformis*, two species that might be considered subgenerically different from the typical *Cylindrobullina, sensu stricto*, are restricted to lots 48, 86, and 78. The Peruvian members of the subgenus *Conactaeon* also are more reminiscent of Liassic than Triassic species. One form, *C. (Conactaeon)* cf. *decorata*, is even closely comparable to a species from the Liassic of France. This subgenus also is concentrated in lots 48, 86, and 78, with only a few specimens in lot 26 and single individuals in lots 76 and 51. *C. (?Conataeon) tilarniocensis* and *C. (C.) tenuicostata*, both apparently belonging to a group transitional to the new genus *Consobrinella*, are restricted to lot 48 [except for a single shell of *C. (?Conactaeon) tilarniocensis* in lot 76]. Of the two species referred to the subgenus *Euconactaeon*, one, *C. (E.) tambosolensis*, is not so rare in lot 78 but rare in lot 48 and very rare in lot 86, and the other, *C. (E.) ninacacana*, is restricted to the last lot. The same is true of the new acteonid genus *Consobrinella* which is connected with *Cylindrobullina* by transitional forms such as *C. (?Conactaeon) tilarniocensis*.

Groups of Faunules and Some Individual Faunules

Three groups distinguishable

From the above review of families and genera and more concisely from chart 1 it can be seen that each of the three lithologic groups distinguished among the fossil-bearing lots of the Cerro de Pasco region in Part 1 ("*Myophoria*" limestones, bituminous limestones, and light limestones) has its characteristic gastropod fauna.

1. The "*Myophoria*" limestones, to which lots, 2, 3, 19, 21, and 40 of the eastern facies and tentatively lot 37 of the western facies are referred, are characterized in both facies by the genus *Pustulifer*,[1] also in the eastern facies by the genus *Tyrsoecus*,[2] and in the eastern facies by a single *?Gigantogonia* and by *?Trachynerita evoluta*.[3] As indicated in the name, these limstones contain "*Myophoria*" but not a single *Spondylospira*.

2. Distinctive of the faunules of the bituminous limestones, to which no. 49 and lots 51, 53, 22, 56, 57, 96, 97, 33, 34, 42, 29, 45, 31, 38, and 67 of the eastern facies and tentatively lots 15, 16A, 35, 87, and 91 of the western facies are referred, are the following gastropods: the pleurotomariid genera *?Worthenia* and *Pareuryalox*, the euomphalid genus *Phymatifer*, and most of all the genera *Sororcula* and *Chartroniella;* among the Loxonematidae the subgenera *Polygyrina*[4] of *Loxonema* and *Katosira*, *Allostrophia* and *?Allocosmia* of *Zygopleura;* the genera *Toxoconcha, Andangularia*, and the two turbinid

[1] However, two specimens of this genus were found in lot 76, referred to the light limestones, and one was also found in the bituminous lot 97.

[2] Doubtfully represented also in lot 16A, tentatively referred to the bituminous limestones.

[3] Fragments of a single doubtful shell of this species were found in the bituminous lot 34.

[4] A doubtful single specimen also in lot 86.

genera *Eucycloscala* and *Homalpoma*[1]; finally, the somewhat aberrant *?Omphaloptycha cacuana*, the last occurring in the western facies only.

Some of these lots contain "*Myophoria*," but more contain *Spondylospira*.[2] It would seem that the *Spondylospira* beds, repeatedly dealt with by Jenks (1951, pp. 205 ff.) can be identified more or less with these bituminous limestones. It must, however, be admitted that *Spondylospira* is not restricted to the lots listed in chart 1 as from the bituminous limestones; it occurs in lots 24, 26, 76, and 73 as well. Of these, lot 24 yielded only a single gastropod, *Andangularia* aff. *perarmatae*, which occurs elsewhere only in lot 96 and doubtfully in lot 34. Since both are undoubtedly bituminous limestone lots, lot 24 also must be included in these. It has been listed in chart 1 with lot 26 merely owing to the fact that both are from practically the same site ("2 kilometers north of a pass on the Huachon railroad"), though not necessarily from the same horizon. The peculiar faunistic character of lot 26 is discussed under the next heading. Lots 76 and 73 are the westernmost marginal lots of the light limestones and those with the fewest and poorest gastropods.

3. With the exception of lots 76 and 73, neither *Spondylospira* nor "*Myophoria*" occurs in the lots referred to the light limestones, all from the Shelby-Ninacaca-Tambo del Sol area. These lots do bear, however, the richest gastropod assemblage of the Cerro de Pasco region (see Jenks, 1951, p. 208). Within it, the genera *Promathilda, sensu lato*, and *Neritaria*, the undoubted *Omphaloptychae*, the genera *Cylindrobullina, sensu lato*, and *Guidonia*, the subgenera *Kittliconcha* and *Anoptychia* of *Zygopleura*, the procerithiids *Protofusus* and *Paracerithium*, the trochids *Solariella* and *Solarioconulus*, the cirrid *Hesperocirrus*, the new acteonid genus *Consobrinella*, the pseudomelaniid *?Ramina*, *Anomphalus*, and among the Pleurotomariidae *Sisenna* are dominant or at least remarkable. All these genera are entirely missing or only scantily represented in the "*Myophoria*" and the bituminous limestones.

Although the faunules concerned, i.e., in addition to the marginal lots 76 and 73, lots 69 to 71, 78 and 86, are here comprised in one group, certain differences among them in both abundance and faunal composition should not be overlooked. In abundance lot 86 ranks first; it has yielded close to 10,000 gastropods and thus accounts for about 60 per cent of all those comprised in the present study. Lot 78, though much less rich, also has yielded some common species and lot 70 two not so rare ones, but "rare" is the highest degree of abundance found in lot 70 and "very rare" in lots 69, 76, and 73, the last having yielded only one species. Faunistically there are differences, inasmuch as among these lots *Acmaea, Solarioconulus, Calliostoma, Callotrochus, Promathilda, sensu stricto*, and *Consobrinella* are represented in lot 86 only, and some other genera are restricted as follows: *?Hyperacanthus* to lots 86 and 71, *?Ramina* to lots 78 and 76, *Euomphalus* and *Undularia* to lot 76, the undoubted *Trachyneritae* (*T. tambosolensis* and *T. porrecta*) to lot 78, *Heterospira* to lot 71, and *Oncochilus* to lot 70. Most interestingly in this respect, one of the two common species of *Kittliconcha* and both common species of *Anoptychia*, as well as the only *?Ramina* species, are common or at least not so rare in lot 78 but are much less abundant in other lots.

LOTS 26 AND 48

As can be seen from chart 1, these two faunules require special discussion not only because their localities are more (lot 48) or less (lot 26) remote from the Cerro de Pasco area proper but because of their faunal composition.

Disregarding, for the time being, the many genera restricted to, or concentrated in, lot 26, this lot includes *Spondylospira* and some gastropod genera and subgenera characteristic of the bituminous limestones, such as *?Worthenia, Sororcula, Chartroniella, Eucycloscala, Katosira, Toxoconcha, Clathrobaculus*, and the peculiar species *Promathilda* (*Teretrina*) *aculeata*, which occurs elsewhere only in the bituminous limestone lot 38. On the

[1] Represented by only two specimens, not conspecific, also in lot 86.

[2] The best specimens of this brachiopod genus were found in lots 14A, 16A, 29, 31, 38, 54, and 75; of these, only 16A, 29, 31, and 38 also contain gastropods. Other faunules of the bituminous limestones in which gastropods are associated with *Spondylospira* are those of lots 35, 56, 57, 97, and 33.

other hand, genera and subgenera characteristic of the light limestones, such as *Guidonia*, *Anoptychia*, *Omphaloptycha*, *Neritopsis*, *Neritaria*, *Trachynerita*, *Protofusus*, and *Conactaeon*, are also represented, though in most cases only scantily, in lot 26 which furthermore includes the two most surprisingly modern gastropod genera present, namely, *Jurassiphorus* and *?Aporrhais*. What makes this lot most conspicuous is its wealth in very rare and extremely rare genera. Of altogether 23 genera restricted to one lot, 10 (*Discohelix*, *Platyacra*, *?Amphitrochus*, *?Oonia*, *Protorcula*, *Euthystylus*, *Pseudoscalites*, *Kittlistylus*, *Jurassiphorus*, and *?Aporrhais*) occur in lot 26, as do seven out of 13 genera and subgenera restricted to two lots each (*?Glyptochrysalis*, *Spirostylus*, *?Vermicularia*, *?Pseudotritonium*, *Cryptaulax*, also in lot 48; *Calliostoma*, also in lot 86; and *Undularia*, also in lot 76). Of the genera restricted to two lots each, *Calliostoma* and *Pseudotritonium* are concentrated in lot 26, as are, of genera and subgenera occurring in more than two lots, *Polygyrina*, *Coelostylina*, *Toxoconcha*, and *Clathrobaculus*, and, of such species, *Sororcula gracilis*. Thus this lot is truly the "cabinet of curios" within the present material.

Lot 48 faunistically resembles in several respects lot 26, but there are also marked differences. Neither "*Myophoria*" nor *Spondylospira* is present. Still, lot 48 has the characteristic genus *Sororcula* in common with the faunules of the bituminous limestones, and one of its two named species, *S. costata*, is even concentrated here. In addition, this lot shares a few species (*?Worthenia basifalcata*, *?Ptychomphalina* sp. indet. 1, and *Homalopoma subcinctum*) with those faunules. Its faunal affinities with lot 26 are even much closer. Of altogether 13 genera restricted to two lots each, five (*?Glyptochrysalis*, *Spirostylus*, *?Vermicularia*, *?Pseudotritonium*, and *Cryptaulax*) occur in lots 26 and 48 only. The genus *Spirostylus*, concentrated in lot 48, has a single specimen in lot 26 also, and these two lots have furthermore the following species in common: *Ptychomphalina* cf. *protei* (the only undoubted representative of the genus in our material), *Sororcula gracilis* and *S. costata*, *Guidonia planetecta*, *Homalopoma subcinctum*, *Coelostylina cylindrata*, *Promathilda* (*Teretrina*) *tilarniocensis*, *Protofusus* aff. *pyramidali*, and *Cylindrobullina* (*Conactaeon*) *peruviana*. Like lot 26, lot 48 also has a monopoly on certain genera, though on much fewer. Only two (*Trypanocochlea* and *?Lepidotrochus*) were found solely in lot 48, but two more that are concentrated in this lot at such a degree that only a single fragment occurs elsewhere might here be added, namely, the important genera *Eucyclus* and *Spirostylus*. *Eucyclus* is not so rare, *Spirostylus* is rare, in the lot under discussion, each with a single specimen also in lots 51 and 26, respectively. *Eucyclus* is in addition remarkable for being represented by a single species of definitely Liassic character. However, lot 48 differs considerably from lot 26 in that it has its closest faunistic affinities with the light limestone lots, mostly with lot 86, the richest. Only a single specimen of the genus *Guidonia*, which is concentrated in lot 86 and to a lesser extent in lot 70, was found in lot 48; it is remarkable that it belongs to a species represented also in lot 26. However, all the other genera and subgenera which dominate the faunal character of the light limestones (*Solariella*, *Solarioconulus*, *Kittliconcha*, *Anoptychia*, *Omphaloptycha*, *Neritaria*, *Promathilda*, *sensu stricto*, *Teretrina*, *Clathrobaculus*, *Protofusus*, *Paracerithium*, *Rhabdocolpus*, *Cylindrobullina*, *sensu stricto*, *Conactaeon*, and *Euconactaeon*) are more or less abundantly present also in lot 48. Among them *Neritaria* is comparatively poorly represented, but allowance must be made for the fact (see table below) that lot 48 cannot compare in overall abundance of individuals with lot 86 and thus cannot boast of similarly large populations in any group. On the other hand, *Promathilda*, *sensu stricto*, and the group of *Rhabdocolpus praeco*[1] are markedly concentrated in lot 48. The latter group is definitely Liassic in character.

STATISTICAL COMPARISON OF LOTS 26, 48, AND 86

These three lots, the most important and most interesting in the material, can be compared statistically as follows:

[1] The other group of this genus, that of *R. subulatus*, is restricted to lot 26.

	Lot 26	Lot 48	Lot 86
Supraspecific units[1]	39	32	29
Species	56	66	78
Species by degree of abundance[2]			
er	26	11	18
vr	22	18	16
r	8	17	14
nr	—	6	9
fc	—	8	7
c	—	6	7
vc	—	—	2
ec	—	—	5

This tabulation clearly shows that the number of supraspecific units decreases while that of species rises from lot 26 to lot 48 to lot 86. Even more drastically do the species increase in abundance. Thus lot 26 by having many genera, or subgenera, but on the average few species to the genus, or subgenus, and even more strikingly fewer individuals to the species, once more justifies the designation "cabinet of curios."

PALEOECOLOGICAL CONSIDERATIONS

Environment

From the survey of the habitats of marine gastropod families and genera given by Wenz (1938, pp. 34, 35) all the faunules present would seem to have lived in the neritic zone. It is believed that most of the shells were entombed at or near the places where they lived, but some exotic guests like the only xenophorid *Jurassiphorus* or the body whorl of a comparatively large aporrhaid may well have been washed in from adjacent zones. Within the neritic zone, the gastropods of the faunules of the light limestones, or at least the small ones among them, may have lived in seaweed thickets, as was assumed for the classical St. Cassian fauna for the first time by Theodor Fuchs (1871; see also Shimer, 1908, p. 476; Diener, 1925, pp. 17, 18; Ellenberger, 1947, p. 313). Should this assumption be valid for the mollusk faunules of our light limestones, it would place their habitats in Wenz' (*loc. cit.*) zone with *Laminaria* or that with *Nullipora* [=*Lithothamnium*] and corallines. It is puzzling, however, that no algal structures whatever were found in the sediments that yielded these faunules, although at least some of the algae concerned are certainly susceptible to fossilization.

Size Problems

As is to be expected in material of the abundance and variety of the present one, wide differences in size can be recognized within it. Thus the genus *Pustulifer* may have attained a total height of 120 mm. or more, and a considerably greater size can be assumed for the shell doubtfully referred to *Gigantogonia*, of which a single whorl is preserved. On the other hand, some genera, such as *Eosolariella* and *Eocalliostoma*, and most of the Acteonidae,[3] are extremely small, never exceeding 5 mm. or at the most 7½ mm. in total height. Other genera (*Sororcula*, *Tyrsoecus*, *Neritaria*, *Promathilda*) reach sizes of about 20 mm., still others (*Hesperocirrus*, *Anoptychia*, *Omphaloptycha*, *?Marmolatella*, and the true *Trachyneritae*), between 35 and 45 mm., and *Chartroniella pacifica* and *?Trachynerita evoluta* grow more than 50 mm. high, thus being about intermediate between the largest and the smallest forms.

A close connection exists between sizes attained and groups of lots (see chart 1). The largest forms, *Pustulifer* and *?Gigantogonia*, and two forms that come closest to them in size (*?Trachynerita evoluta* and *?Marmolatella*) occur exclusively, or almost (see p. 295, footnotes 1 and 3), in the faunules of the "*Myophoria*" limestones, and the genus *Tyrsoecus*, also restricted to this group, is not very small by the standards of this report. Of the genera most characteristic of the faunules of the bituminous limestones, *Sororcula* and *Chartroniella*, the former reaches about the same size as *Tyrsoecus*, but the latter a comparatively large size, though by no means the sizes of *Pustulifer* or *?Gigantogonia*. The single cast doubtfully referred to the subgenus *Allocosmia* of *Zygopleura* indi-

[1] Genera without subgenera or represented by only one subgenus, and the several subgenera of a genus.

[2] For significance of symbols, see chart 1.

[3] With the single exception of *Cylindrobullina* (*Euconactaeon*) *ninacacana* which reaches a total height of about 15 mm.

cates an even greater size than that reached by the largest shell of *Chartroniella*. On the other hand, some small (*Andangularia*) and very small (*Polygyrina*, *Katosira*) forms also occur in this group of lots. Altogether it may be said to be in size of gastropods intermediate between the "*Myophoria*" and the light limestones. In the faunules of the latter, small or even very small shells constitute the overwhelming majority among the gastropods. Only a single large genus, *Trachynerita*, is present, and only a few specimens each in other genera attain medium (*Hesperocirrus*, *Anoptychia*, *Omphaloptycha*) or not so small sizes (*Neritaria*, *Promathilda*). As far as gastropod sizes are concerned, lots 26 and 48 come closest to the faunules of the light limestones. The largest *Omphaloptycha* present, in lot 48, and the body whorl of an *?Aporrhais* (*Cuphosolenus*), in lot 26, both of a total height estimated at about 35 mm., look like giants within their respective faunules. The only *Trypanocochlea* present, the total height of which may have reached 30 mm. or more, also appears very large when compared with its associates in lot 48.

As to size, a similar relation seems to exist between the gastropod faunules of the light limestones and those of the "*Myophoria*" limestones as exists, within the Triassic gastropod faunas of the southern Alps, between the faunule of St. Cassian and that of the Esino limestones. However, as stated above (p. 9), the average gastropod size of the St. Cassian fauna (which is often but apparently incorrectly considered a dwarf fauna) is considerably greater than that of our light limestone faunules.

Most although not all gastropods from the light limestones and lots 26 and 48 are very small or even extremely small. However, in some faunules a few shells several times as large as the average of the species are intermixed with these very small or extremely small shells, but they are always comparatively very rare. This permits no other inference than that they are full grown, and that all the others are juveniles.[1] This interpretation is strongly supported by the fact that the larger a population, the better is the chance to encounter such large individuals. If species that are rather large, such as the two in lot 78 referred without reservation to *Trachynerita*, be excepted, it is only in the common or, more likely, in the very common or extremely common species of the most abundant genera (*Promathilda*, *sensu lato*, *Neritaria*, and *Omphaloptycha*) and to a lesser extent of *Zygopleura* (*Anoptychia*) and *Protofusus* that such unusually large individuals, interpreted above as adults, are encountered. Only in similarly abundant genera (*Cylindrobullina*, *sensu lato*, *Solariella*, and *Consobrinella*) may the absence of such "oversized" specimens prove that the species did not reach sizes larger than those represented. For the many species that are rare, very rare, or extremely rare the same inference would be only a wild guess. Where such unusually large individuals are present, their frequency may be estimated at perhaps one in 50, or even one in 100, of the total number of individuals present, even if the many fragments of such individuals in abundant species be taken into account. This ratio is statistically corroborated. Wherever such specimens appear at the bottom of the tables of dimensions or in the paragraphs added to them, the maximum sizes are approached in leaps and bounds, as distinct from the steady increase in size recognizable in earlier parts of the table.

These considerations cogently lead to the conclusion that the faunules under discussion do not represent true dwarf faunas. The same result was obtained for the St. Cassian fauna as early as 1871 by Fuchs who convincingly stated that its very wealth of forms excludes such an interpretation.[2] The same holds true for the rich assemblages of our light limestones.

This result dispenses with further discussion of the problem of dwarf faunas as such, recently dealt with by Boni (1940), Beets (1943, p. 240–242), Casanova (1948), and most intensively by Boni (1942), and (at a

[1] Here it must be admitted that in the course of the descriptive work, extending over many years, the terms "juvenile" and "adult" or "full grown" have not always been used as they should be in the light of the above interpretation. In many cases what has been termed "adult" or "full grown" should more correctly have been designated as the largest sizes (or latest stages) represented in the material examined.

[2] For a review of the various interpretations of this fauna, see Boni (1942, pp. 238–239.)

symposium held in April, 1948, by the Society of Economic Paleontologists and Mineralogists) by Lalicker (1948), Cloud (1948), Kummel (1948), and Scott (1948).

To explain the relative rarity of full-grown individuals. three approaches can be tried. One is based on the habitat of the living animals, another on their death rates as distributed between different age groups, and the third on the fate of the empty shells after the animals' death.

1. Fuchs (1871) observed in the port of Messina, Sicily, that the thickets of algae teemed with small organisms seeking food and shelter. By this observation he was led to assume for the St. Cassian fauna, "that a dense forest of algae is bound to be, in addition to the world of small inhabitants peculiar to it, also a welcome refuge for the flocking fry [of the young] of the most diversified animals, while it is, conversely, difficult for large animals to intrude into the thicket, where they would at once get entangled in the algal tomentum and inhibited in their movements." To Fuchs this is a quite satisfactory explanation of "the great rarity of larger animals in the St. Cassian sediments and of the abundance of various juveniles." This explanation, accepted by Shimer (1908, p. 476) and Diener (1925, p. 18), may well be applicable to our case. What few full-grown individuals are found in these faunules may have intruded into the algal thicket despite the inadvisability of doing so and perished there, or their shells may have been washed in into the sediment.

2. As recently shown by Deevey (1947), juvenile mortality is heavy in most wild animals. Therefore far more small empty shells may be expected to be produced by nature than larger ones.

3. It seems furthermore that small shells have a better chance to remain entire and preserved than larger ones. Whatever detrimental agents are at work will affect tiny shells like those that constitute the majority of the populations in the light limestone faunules less than larger ones. It is true that Menard and Boucot's (1951) recent experiments on terebratuloid brachiopod shells prove that, other conditions being equal, smaller shells[1] are more readily moved by water currents than larger ones. This fact need, however, not prove destructive for the smaller ones, for their very ability to give way sooner might diminish resistance and thus protect them from being destroyed in their original place. On the other hand, sphericity, as shown by the same investigation, retards the beginning of the movement of empty shells by flowing water and might thus accelerate their being entombed in the sediment. This factor should favor juvenile shells which, even in turitellid forms, deviate less from a spherical shape than their elders. In any event the present material excellently proves the beneficial effect of sphericity on preservation in that the percentage of complete or almost complete specimens is highest in those genera of which the shape of the shell is most nearly spherical, especially *Neritaria* and *Solariella*. Even when moved by water, such forms will roll smoothly and offer fewer points of attack to whatever destructive forces come into play than forms of slender conical shell shape such as *Promathilda* or larger individuals of that shape.

Finally, although the lots under discussion were certainly deposited too far off shore for them to be interpreted as wind rows, some size-sorting influences similar to those effecting wind rows might be at work at the bottom of the sea in the neritic zone and might accumulate small shells in certain spots, thus adding to the size-sorting effect of the environment (above, paragraph 1).

Similar size-sorting influences, of environment during the lifetime of the animals or of such nature as acted on the empty shells after their death, must also be responsible for some remarkable size differences within the same species between individual lots. In this respect it is especially the faunule of lot 48 in which certain species reach only a markedly smaller size than in other lots. Thus in this lot *Zyglopleura* (*Kittliconcha*) *peruviana*, *Z.* (*K.*) *dissimilis*, and *Protofusus peruvianus* remain much smaller than in lot 78, and *P. transitorius* remains much smaller than in lot 86. These size differences, too, are believed to indicate ontogenetic differences.

[1] With the exception of those extremely small ones, not reaching 1 mm. in their greatest dimension, that are held by the friction of the water's boundary layer (*ibid.*, p. 145). Some of our smallest juveniles may have benefited by this exception.

?Ecospecies in Lot 26

Lot 26 is peculiar, as in various other ways, in having certain genera represented in its faunule by subulate species or by species more subulate than the congeneric species of other faunules. This holds true for *Promathilda* (*Teretrina*) *aculeata*,[1] as compared to *P.* (*T.*) *bolinoides* of the light limestone faunules, especially lot 86, and of lot 48; for *Rhabdocolpus subulatus* and two closely related species, as compared to *R. praeco* and its close allies, *R. rursicostatus* and *R. emaciatus*, all of which are concentrated in, or even restricted to, lot 48; and for *Cryptaulax rhabdocolpoides*, as compared to *C. tilarniocensis* of lot 48. In addition, lot 26 includes the needle-shaped *Kittlistylus flexuosus*. The assumption is suggested, although it cannot be substantiated in any way, that the subulate shell shape of these species might have been controlled by environmental conditions. If so, they can be considered ecospecies.

STRATIGRAPHIC CONCLUSIONS

Stratigraphy of Lots

The character of the faunules and previous geological observations in the field contribute to the establishment of the stratigraphic sequence of three horizons, each represented by one of the three groups of lots distinguished above (pp. 295, 296).

In regard to the character of the faunules, *Pustulifer* (a typically Carnian genus) and *Gigantogonia* (known hitherto only from the Ladinian) are more ancient in character than *Chartroniella*, originally recorded from the Liassic. *Pustulifer* and *Gigantogonia* characterize the "*Myophoria*" limestones; *Chartroniella* characterizes the bituminous limestones.[2] The assumption thus suggested that the bituminous limestones with *Spondylospira* overlie the "*Myophoria*" limestones is fully confirmed by Boit's (1949, pp. 2, 12) observation that the dark bituminous limestones overlie the Norian ones with "*Myophoria*," as well as by Jenks' (1951, pp. 207–211), that *Spondylospira* occurs only in the upper beds of the Pucará group. According to Jenks, the top of the *Spondylospira* zone is about 1500 feet below the top of that group in the eastern facies, where it attains a total thickness of about 9500 feet, and about 1320 feet below that top in the western facies, where the over-all thickness of the group is reduced to about 2000 feet. In the eastern facies, where the sequence may be assumed to be more or less complete, *Spondylospira* appears in a zone about 1300 feet thick, from about 6700 to about 8000 feet from the bottom, or roughly in the sixth one-seventh from below of the total thickness.

Paleontological evidence similar to that drawn on above for the superposition of the bituminous limestones over the "*Myophoria*" limestones is provided by the faunules of the light limestones. Their rich display of forms of the essentially Jurassic family Procerithiidae, the abundant representation of *Guidonia*, which ranges from the Norian up to the Liassic, and of *Eosolariella*, a subgenus characteristic of the Rhaetian, and the presence of *Cylindrobullina* species of a Liassic rather than Triassic character make these faunules appear somewhat younger than those of the bituminous limestones. This assumption again is corroborated by Jenks' (1951, p. 208) assertion that the "prolific faunal zone [of the light limestones], especially rich in gastropods" is "high in the section" of the Pucará group. Thus, the following descending sequence of the three horizons corresponding to our groups of lots appears fairly safely established:

Light limestones
Bituminous limestones
"*Myophoria*" limestones

Lots 26 and 48, however, are not so easy to place in this sequence. Lot 48, which Jenks (letter, dated Rochester, March 11, 1948) stated "can in no way be tied into my study," agrees in faunal composition best with the light limestones. It includes forms of a similarly young (Liassic or even Middle Jurassic) character, especially *Eucyclus denticulatus* and the group of *Rhabdocol-*

[1] Represented by a single, comparatively large fragment also in lot 38.

[2] Of which the other index gastropod, *Sororcula*, is a new genus.

pus praeco. On the other hand, it has also close faunal affinities with lot 26 and to a certain extent with the bituminous limestones. In particular it has the characteristic genus *Sororcula* in common with the latter, and both its species in common with the former. Thus lot 48 may roughly be correlated with the light limestones, but it must be assumed to reach somewhat farther down in the stratigraphic column.

Even more difficult is the case of lot 26. Its closest faunistic affinities seem to connect it with the bituminous limestones, but it has also a considerable number of genera and subgenera in common with the light limestones and most surprisingly includes two genera [*Jurassiphorus* and *?Aporrhais* (*Cuphosolenus*)] the type species of which occur in the Middle and Upper Jurassic, respectively. It would seem, however, at least with regard to the first of these two genera, that only such well-preserved specimens as make recognition of the true generic affinities easy have been encountered in our material, thanks to chemical preparation, for the first time in late Triassic strata. As mentioned above, forms from the Carnian of Hungary and Sicily, though referred by their respective authors to other genera, are also believed to belong to *Jurassiphorus*. The situation may be similar in the case of *?Aporrhais* (*Cuphosolenus*).

At any rate, the curious faunal mixture represented by lot 26, with the fact that before preparation it consisted of only a few small, contiguous pieces of rock and can thus represent only a very small thickness of beds, seems to permit no other explanation than that we must be dealing here with a case of stratigraphic condensation (Heim, 1934; Schaub, 1948). Should this assumption be correct, lot 26 may represent the stratigraphic equivalent of both bituminous and light limestones. Taking into account the assumed Carnian occurrences of *Jurassiphorus*, it is, however, not felt that the presence of that genus, or that of *?Aporrhais* (*Cuphosolenus*) for that matter, requires extension of the stratigraphic range of this lot beyond that of the light limestones.

Clues for Correlation

Forms recorded in this report have been referred without reservation to the following previously known species:

Worthenia rhombifera Körner and *W. basifalcata* Körner, both from the Nevado de Acrotambo, northern Peru; our specimens so identified occur in lots of the bituminous limestones and in lot 26.

Hesperocirrus triasicus Cox from close to Lulicocha, near south shore of lake, central Peru; our specimens occur almost exclusively in lot 86 of the light limestones.

Chartroniella pacifica (Jaworski) from the "Uliachin conglomerate" near Cerro de Pasco and from near La Cima, 3 kilometers east of Lake Lulicocha, both localities in central Peru; our specimens occur in eight lots of the bituminous limestones and in lot 26.

Chartroniella wortheniaeformis Cox from 2 miles southwest of Hacienda Huanca, central Peru; our specimens occur in one or two lots of the bituminous limestones and in lot 26.

Homalopoma (*Boutillieria*) *subcinctum* (d'Orbigny) from the Nevado de Acrotambo, northern Peru, from 2 miles southwest of Hacienda Huanca, central Peru, and from St. Cassian in the southern Alps and other contemporary European faunas; most of our specimens occur in no. 49 of the bituminous limestones and one each occurs in lots 26, 48, and 86.

Trachynerita evoluta Jaworski from the *Myophoria* limestones of Uliachin; our specimens also occur in three lots of the "*Myophoria*" limestones (with a single doubtful one in a lot of the bituminous limestones).

Omphaloptycha "rhenana Koken" (=*O. jaworskii* Haas) from the Nevado de Acrotambo, northern Peru, and from the Junin boulders, central Peru; our specimens are extremely common in the light limestones, with a single one in lot 26. *Pseudomelania münsteri* Wissmann from St. Cassian is possibly also conspecific.

Tyrosecus (*Tyrosecus*) *andinus* Bonarelli from Carbajal, northwestern Argentina; our specimens occur in lot 37 of the "*Myophoria*" limestones only.

Anomphalus helicoides (Münster), *Neritopsis decussata* (Münster), and *Kittlistylus flexuosus* (Münster) from St. Cassian; in the present material the first and second

species occur, solely or mostly, in lot 86 of the light limestones, the third occurs only in lot 26.

The species provisionally designated *Andangularia* aff. *subarmatae* (Jaworski), present in lots 24, 96, and perhaps also 34 of the bituminous limestones, is represented in Kummel's collections from Suta, northern Peru, and closely related to Jaworski's species from the same locality.

Furthermore, a specimen from lot 86 might be conspecific with *Calliostoma* (*Eocalliostoma*) *körneri* (=Körner's "*Trochus* (*Tectus*)? n. sp. ind.") from the Nevado de Acrotambo. Our *Promathilda* (*Teretrina*) *eucycloides*, occurring chiefly in lot 86 and perhaps in lot 73, both of the light limestones, but very rarely also in the bituminous lot 51 may be conspecific with *Eucyclus tricarinatus* Cox (*non* Martin) from 1¼ miles south of Carhuamayo, central Peru. Our *Cryptaulax rhabdocolpoides* from lot 26 may be conspecific with Jaworski's "*Promathilda bittneri*" from the *Myophoria* limestones of Huairas, northern Peru. A form occurring in lot 48 and possibly also in lot 86 may be conspecific with *Solarioconulus nudus* (Münster) and one occurring in lot 26 only with *Oonia subtortilis* (Münster), both of these species from St. Cassian.

Most of our forms to which an existing specific name has been applied with a "cf." also are comparable to St. Cassian forms, namely, *Ptychomphalina* cf. *protei* (Laube), occurring in lot 48 and extremely rarely in lot 26; *Eucycloscala* cf. *baltzeri* (Klipstein), also occurring in lot 26; *Zygopleura* (*Katosira*) cf. *beneckei* Kittl, occurring in lots 34 and 15 of the bituminous limestones and in lot 26; and *Coelostylina* cf. *medea* Kittl, occurring in lots 86 and 26. The last-named species also occurs in the Marmolata limestones of the southern Alps. The same beds have yielded *Undularia disputata* Kittl, to which a form occurring in lot 26 and possibly also in lot 76 of the light limestones is closely comparable. Finally, an acteonid occurring in both lots 48 and 86, with a single specimen in another lot (71) of the light limestones, is compared to *Cylindrobullina* (*Conactaeon*) *decorata* (Martin) from the Liassic of France-

TABLE 4

CORRELATION BY RARE AND SHORT-LIVED SUBGENERA AND GENERA

Genus or Subgenus	Previously Known Occurrences	This Report: Lots[a]
Sisenna	Carnian and Norian Hallstatt limestones	69 (lls), 86 (lls); 45 (bls)
Trypanocochlea	Carnian Hallstatt limestones	48
Eosolariella	"Grenzdolomit," Monte Nota	lls, 48; 33 (bls)
Solarioconulus	St. Cassian	86 (lls); 48
Eocalliostoma	Peru (Körner and Cox)	26; 86 (lls)
Kittliconcha	Carbajal (Argentina), St. Cassian	78 (lls), ?86 (lls), 48
Allostrophia	St. Cassian	19 (Mls)
Undularia	Marmolata and Esino limestones	26, ?76 (lls)
Toxoconcha	Marmolata and Esino limestones, St. Cassian	26; 56 (bls), ?67 (bls)
Spirostylus	Tres Croces (Argentina), St. Cassian	48; 26
Euthystylus	Marmolata and Esino limestones, St. Cassian	26
Marmolatella	Marmolata limestones	2 (Mls)
Trachynerita[b]	Marmolata and Esino limestones	78 (lls)
Heterospira	Carnian Hallstatt limestones, St. Cassian	71 (lls)
Pseudoscalites	St. Cassian	26
Protofusus	Carbajal (Argentina)	lls; 26, 91 (Mls)
Paracerithium	St. Cassian fauna of Cortina d'Ampezzo, Liassic of France	lls; ?26
Conactaeon	Liassic of France	lls; 26, 51 (bls)
Euconactaeon	Liassic of France	lls

[a] *Abbreviations:* bls, bituminous limestones; lls, light limestones; Mls, "*Myophoria*" limestones. Minor occurrences are listed after the semicolon.

[b] For *?Trachynerita evoluta*, see among previously known species (p. 302).

A few more forms in our material are considered to be related ("aff.") to known species, namely, one form each from lots 45 and 16A of the bituminous limestones to *Sisenna excelsior* Koken and *Pleurotomaria haueri* Hörnes, respectively, the former recorded from the Carnian Hallstatt limestones, the latter from the Norian ones, and two more forms, one from lots 26 and 48, the other from lot 48, to two St. Cassian species, *Glyptochrysalis anthophylloides* (Klipstein) and *Promathilda* (*Promathilda*) *perarmata* (Münster), respectively.

A certain similarity[1] between species here established and species previously described from other faunas has, in the cases of *Promathilda* (*Promathilda*) *subnodosoides*, *P.* (*Teretrina*) *bolinoides*, and *Cylindrobullina* (*Cylindrobullina*) *avenoides*, been indicated by appending the suffix "*oides*" to the trivial names of the previously known species, i.e., *Promathilda* (*Promathilda*) *subnodosa* (Münster) and *P.* (*Teretrina*) *bolina* (Münster), both from St. Cassian, and *Cylindrobullina* (*Cylindrobullina*) *avena* (Terquem) from the Liassic of France. Of our own species, the first occurs only in lot 48, the second in the light limestones (most abundantly in lot 86), and the third in lots 71 and 86 of the light limestones, in lot 48, and also in lot 53 and doubtfully in no. 49 of the bituminous limestones.

In tables 4 and 5 subgenera and genera are used for purposes of correlation only if more or less rare and of limited stratigraphic range.

Finally, the new genus *Pareuryalox*, occurring in lots 29 and 97 of the bituminous limestones, is believed to be closely related to *Euryalox* of the Carnian and Norian Hallstatt limestones.

By way of appendix to this section, a certain faunal relationship between the present material and one collected by Newell in 1948 near Lewiston, Idaho, may be mentioned. The latter has the two rare genera *Sororcula* and *Kittlistylus*, perhaps even one species each of both these genera, in common with the bituminous limestones and lot 26, respectively, of central Peru.[2]

TABLE 5

FORMS FROM PERU OF DOUBTFUL GENERIC REFERENCE

Genus or Subgenus	Previously Known Occurrences	This Report: Lots[a]
Lepidotrochus	Carnian and Norian Hallstatt limestones	48
Hyperacanthus	Norian Hallstatt limestones	71 (lls), 86 (lls)
Ramina	Marmolata limestones, St. Cassian	78 (lls); 76 (lls)
Gigantogonia	Esino limestones	40 (Mls)
Pseudotritonium	St. Cassian	26; 48

[a] *Abbreviations:* lls, light limestones; Mls, "*Myophoria*" limestones. Minor occurrences are listed after the semicolon.

AGES ASSUMED FOR THREE GROUPS OF LOTS AND FOR LOTS 26 AND 48

1. As stated in Part 1 of this report, not a single ammonite was found among the several tens of thousands of specimens of the Jenks Collection. Nor has it yet been possible anywhere to establish contact between the light limestones or the stratigraphically closely connected lot 48 and the undoubtedly Liassic beds, the fauna of which has been described by Tilmann (1917), although such early Liassic beds crop out at San Blas,[3] only about 36 kilometers south-southeast from Ninacaca, as do somewhat younger beds near Oroja, only about 24 kilometers south of Tilarnioc, the village near which lot 48 was collected.

In the total absence of ammonites and without the possibility of tying the un-

[1] Indicated in chart 1 by the symbol "sim."

[2] The presence of the genera *Jurassiphorus* and *?Aporrhais* (*Cuphosolenus*) in our lot 26 is paralleled in the material from Idaho by that of a perfectly preserved specimen of the Jurassic genus *Lamelliphorus*.

[3] A large number of specimens of *Vermiceras stübeli* Tilmann collected at San Blas by John H. Moses has been given by Jenks to the American Museum of Natural History (lot 92 of the Jenks Collection).

doubtedly Liassic beds of central Peru to the various beds of the Pucará group that yielded the present material, the gastropods, in connection with previously used index fossils (the pelecypod genera *Entomonotis* and "*Myophoria*" and the brachiopod genus *Spondylospira*), must be depended on for correlation and age determination.

In the latter respect, the utmost caution is warranted. Let us assume, for the sake of argument, that a single *Jurassiphorus* or *?Aporrhais* (*Cuphosolenus*) might have been found near Huachon (in lot 26), or a single *Paracerithium* somewhere in the Shelby-Ninacaca-Tambo del Sol area (in the light limestones), or a single *Eucyclus denticulatus* near Tilarnioc (in lot 48). Then no one could justly have questioned the age determination of the respective beds, or perhaps of all of the Pucará group, as Middle Jurassic in the first case or as Liassic in the two others.[1]

It would seem that Jaworski (1923) and Körner (1937) attached in a somewhat similar way too much importance to single forms, often only scantily represented in their materials, which they identified with, or considered closely related to, species from other continents and based their correlation and dating on such conspecificity or relationship.

Correlation of their faunules and Cox' with ours is found (below) to be not so difficult. On the other hand, the conspecificity, comparability, or affinity of so many of our species, subgenera, or genera with those of the St. Cassian fauna, and of others with those from the Marmolata, Esino, and Carnian Hallstatt limestones, cannot be relied on for purposes of age determination. As far as the St. Cassian fauna is concerned, the above fact is to a certain extent indubitably due to its extraordinary wealth and to its excellent and complete study by Kittl and his predecessors. This applies analogously, though at a lesser degree, to the three other faunas mentioned above. Once it comes to dating, all these affinities are certainly compensated for by the decidedly Liassic character of other elements of our faunules such as *Chartroniella*, *Eucyclus denticulatus*, most of the Procerithiidae, especially the group of *Rhabdocolpus praeco*, and most of the Acteonidae. To a somewhat lesser extent, the abundance in the light limestones of the genus *Guidonia*, which ranges from the Norian up into the Liassic, also argues a younger than St. Cassian age of these beds.[2]

It is strongly felt that only careful weighing of the evidence in favor of both an older and a younger age can lead in a case like the present to a dating that has some chance to stand.

2. As stated above, *Pustulifer* is the most characteristic gastropod genus of the "*Myophoria*" limestones, occurring in both Jenks' western (lot 37) and eastern facies (lots 3, 21, 40). In addition, the only western lot referred to these limestones (lot 37) yielded the genus *Tyrsoecus*, which occurs nowhere else in our material, and a doubtful *Gigantogonia* fragment was found in lot 40. In the Alps of Europe *Gigantogonia* is Ladinian as is *Marmolatella*, doubtfully represented in our assemblage. The type species of the other two are Carnian. However, the presence of the Norian pelecypod genus *Entomonotis* at Mina San Gregoria (lot 6),[3] at the extreme base of the Pucará group, excludes an earlier than Norian dating even of this oldest of our three horizons.

The somewhat special position occupied by lot 37, the only western one of this horizon, owing to the presence of the genus *Tyrsoecus*, not found anywhere else in Peru, is not believed to be of time-stratigraphic significance, for according to Jenks (1951, p. 209) no beds older than the *Entomonotis* horizon of Mina San Gregorio can be expected in the western facies. The restriction of *Tyrsoecus* to lot 37 may, however, indicate a difference in facies which in turn may suggest that the places of deposition of lot 37 and of the eastern lots of the "*Myophoria*"

[1] The occurrence of *Paracerithium* in the St. Cassian beds of Cortina d'Ampezzo is asserted for the first time in this report.

[2] For many decades there has been a controversy as to whether to assign a Ladinian or a Carnian age to the famous St. Cassian beds. Von Arthaber (1905, pp. 272, 273, 277 ff., 295, 296) includes them in the Ladinian stage, as do Pia (1930, table, p. 97, pp. 98, 99; see also Pia, 1937, p. 87) and Wenz throughout his handbook. Diener (1926, *passim*) and J. P. Smith (1914, table facing p. 4) assign them an early Carnian age; the same age is assumed for them in the present report.

[3] In addition to lot 6, which contains no gastropods and is therefore mentioned nowhere else in this report, the eastern bituminous limestone lot 97 may, according to Norman D. Newell, also include *Entomonotis*.

limestones (2, 3, 19, 21, 40) were originally farther apart than the places where these fossil lots were found are today in this structurally strongly disturbed area.

3. The bituminous limestones are faunistically characterized by *Spondylospira*, *Chartroniella*, and *Sororcula*. The last genus, as a new one, cannot be of any help in dating. *Chartroniella*, originally described from the Liassic and ranging up to the uppermost Jurassic, is believed to have an early representative (*Turbo subcarinatus* Münster) in the Carnian of St. Cassian. In other alpine localities the genus *Toxoconcha*, represented in our bituminous limestones, occurs in the Ladinian, and *Pleurotomaria haueri*, to which a species in the western bituminous lot 16A is related, in the Norian.

In the bituminous limestones also, some of the western lots show a peculiarity in composition of gastropod fauna, inasmuch as *?Omphaloptycha cacuana*, a species believed to deviate in subgeneric if not generic characters from the true *Omphaloptychae*, is fairly common in lot 91 and perhaps also occurs, though extremely rarely, in the adjacent lots 87 and 35, but nowhere else. The situation here is believed to be similar to that pointed out above for *Tyrsoecus* in the "*Myophoria*" limestones and to indicate a difference in facies rather than in age, with the same possible implication as above.

There are no reliable clues for dating these bituminous limestones in terms of geologic stages. Since they are undubitably younger than the Norian "*Myophoria*" limestones but older than the Rhaetian light limestones, their age is here assumed to be late Norian or early Rhaetian.

4. The light limestones exhibit faunistically a mixture of Carnian (St. Cassian, Hallstatt limestones) and even a few Ladinian forms on the one hand, and of decidedly Liassic forms on the other. Some genera of the Procerithiidae and some of the acteonids of the genus *Cylindrobullina* must be counted among the latter forms. The procerithiid genus most common in Peru (*Protofusus*) has hitherto been known from northwestern Argentina only. *Paracerithium* and *Rhabdocolpus*[1] are considered typically Liassic genera in Europe, but a Marmolata species (*Purpuroidea subcerithiformis* Kittl) recorded by Kutassy (1937, p. 73, pl. 2, figs. 84, 85) also from the Norian of the Kodru-Moma Mountains of Hungary, is referred, doubtfully by Cossmann (1906, p. 46), but without reservation by Kutassy (*loc. cit.*), to *Paracerithium*, and a single specimen safely referable to this genus has quite recently been found in the St. Cassian beds of Cortina d'Ampezzo. Two genera, *Solariella* (*Eosolariella*) and *Guidonia*, occupy a somewhat intermediate position between these extremes and seem to suggest a Rhaetian age. If the procedure of weighing evidence against evidence and relying on a combination of data rather than on single species that two beds have in common for determining correlation is here followed, a Rhaetian age is strongly supported by the remarkable faunal analogy between the light limestones and the Rhaetian (von Arthaber, 1905, p. 363) "Grenzdolomit" of the Monte Nota, near Lake Garda in the southern Alps. In both assemblages we find *Neritaria* in great abundance,[2] associated with both *Guidonia* and the subgenus *Eosolariella* of *Solariella*, which occurs nowhere else; nor is this threefold association found anywhere else.

A further argument against extending the stratigraphic range of the light limestones beyond the upper boundary of the Rhaetian is that they contain neither the ammonites of the Lower Liassic fauna described by Tilmann from outcrops rather near to our area nor any other of its elements.[3]

5. As indicated above, lot 26 shares many forms (including their index genera) with the bituminous limestones and some with the light limestones. In addition, the genera *Rhabdocolpus* and *Cryptaulax*, both Liassic in style, occur here. On the other hand, most of the genera and species correlated in chart

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[1] This genus, it is true, is concentrated in lots 26 and 48 and occurs only very rarely in the light limestones proper.

[2] According to von Ammon (1893, p. 193) the gastropod assemblage of the Monte Nota could be called a "Neritarienbank" (*Neritaria* bed).

[3] Tilmann's two "*Spiriferina*" species, which Vokes and Haas (1944, p. 284) believe to belong to *Spondylospira*, occur in Middle Liassic beds. It is worth noting that one of these localities is given as Ninacaca. Within the Jenks Collection, *Spondylospira* is restricted to the bituminous limestones, to lot 26, and to the marginal lots 73 and 76 of the light limestones.

1 with those of the Ladinian Marmolata and Esino limestones are found in lot 26. Time-stratigraphically, it must be considered the equivalent of both bituminous and light limestones, that is, late Norian (or early Rhaetian) plus Rhaetian. For the reasons given (p. 306), no extension of this stratigraphic range beyond the upper boundary of the Rhaetian stage is believed to be required by the presence of forms of so modern an aspect as *Jurassiphorus triadicus* and *?Aporrhais* (*Cuphosolenus*), new species.

6. Lot 48 also has some forms (including the important genus *Sororcula*) in common with the bituminous limestones, not a few with lot 26, and far more with the light limestones. The typical representatives of *Rhabdocolpus*, those comprised in the group of *R. praeco*, very rare in both bituminous and light limestones, are concentrated in lot 48 which includes two other species of decidedly Liassic style, *Eucyclus denticulatus* and *Cryptaulax tilarniocensis*. Lot 48 is therefore also believed to be Rhaetian in age, but it seems to include at least the upper part of the horizon of the bituminous limestones. This result does not quite agree with that of Harrison (1943, p. 7) who refers the limestones of the Oroja-Tilarnioc area from which lot 48 was collected to his Upper Calcareous Series which he considers "Middle Lias, probably with some Upper Lias" in age, and who so represents them on his map (*ibid.*, pl. 6).

The results reached in this section can be condensed in a tabulation.

Rhaetian	Pucará group	Light limestones	Lot 26	Lot 48
Early Rhaetian or Late Norian		Bituminous limestones		
Norian		"*Myophoria*" limestones		

Earlier Appearance of Some Gastropod Groups in Peru

Should the dating of the light limestones as Rhaetian be correct, it would raise the problem of how to explain the appearance of a considerable number of gastropod genera, hitherto considered by European standards to appear only in the Liassic, at this earlier stage in the Peruvian Andes. Even if the isolated occurrences of *Paracerithium* and *Cryptaulax* in the St. Cassian fauna (pp. 225, 247) and the presence of *Eucyclus* species, which are, however, less Liassic in character, in the Hallstatt limestones be taken into account, this problem still remains, for in no Triassic deposit of Europe, nor in any other previously known Triassic deposit do those genera appear in such abundance and diversification. I know of no other answer to this problem but that these groups must have dispersed from the sea of the South Andean geosyncline and reached the European seas by one stage later of the geologic scale. The situation may be similar with regard to the even more surprising occurrence of the genera *Jurassiphorus* and *?Aporrhais* (*Cuphosolenus*), hitherto believed to appear in the Middle Jurassic only, in lot 26. However, the first of these genera is likely to have appeared as early as in the Carnian of Europe (p. 295).

The above answer to the first problem at once raises a second: How can this "premature" appearance of "young" forms be reconciled with the occurrence of a considerable number of more ancient ones, of early Carnian or even Ladinian character, in beds considered Norian or even Rhaetian? Could they in turn have originated in the Alpine geosyncline, dispersed from there, and reached the Andean region only later? At first sight it cannot be seen why dispersion should not work in opposite directions at the same geologic period, but it is realized that paleogeographic knowledge would have to be far more advanced than it actually is to answer the last question without hesitation in the affirmative. On the other hand, earlier Triassic gastropod faunas from this part of the globe are not known, so that we do not know when those Ladinian and Carnian types actually reached South America. They may have appeared here at about the same stage as in the Alps but survived longer.

Correlation with Other Faunas from Peru, Argentina, and Idaho

PERU

1. The limestones from Suta in northern Peru, considered Norian by Jaworski (1923, pp. 173, 179), have just one species in common with our bituminous limestones. The late Norian or early Rhaetian age assumed for the latter is not inconsistent with Jaworski's dating. Since, on the other hand, these limestones are rich in ammonites, a revision of the latter might, after a safe correlation between both regions, be helpful in a more precise determination of the age of the bituminous limestones and consequently of the underlying and overlying beds.

2. The limestones from the summit of the Nevado de Acrotambo, also in northern Peru, have yielded two *Spondylospira* species, two *?Worthenia* species, and *Homalopoma subcinctum*, all of which also occur in our bituminous limestones. They are therefore contemporary, that is, late Norian or early Rhaetian but not "Cassian-Raibl," i.e., Carnian, in age, as assumed by Körner (1937).[1] If there were any doubt about this correlation, it should be dispelled by H. Kinzl's report (*in* Körner, 1937, p. 149) that "a bituminous odor appears even at a light strike [with the hammer against these limestones]."

3. The conspecificity of Jaworski's "*Promathildia Bitterni*" from the *Myophoria* limestone of Huairas in northern Peru, considered Norian by him (1923, p. 180), with *Cryptaulax rhabdocolpoides* in our lot 26 is not certain, but a Norian age may be assumed for the oldest part of the series of beds condensed in lot 26.

4. Jaworski's *Myophoria* limestone from Uliachin, considered probably Carnian by him (1923, p. 181), contains *?Trachynerita evoluta*, a species characteristic of our "*Myophoria*" limestones, and must therefore be considered Norian. There is thus no reason to consider these limestones with "*Myophoria*" older than those from Huairas, as does Jaworski.

5. His boulder from Uliachin, considered by him Norian and contemporary with the limestones from Huairas, on the strength of the presence of *Chartroniella pacifica* can readily be correlated with our bituminous limestones. Its age is thus late Norian or early Rhaetian.

6. Jaworski's boulder from Junin, considered by him Carnian rather than Ladinian in age, contains *Omphaloptycha jaworskii*, one of the leading index fossils of our light limestones, and is therefore Rhaetian in age.

The last three paragraphs fully justify Jaworski's differentiation between those three occurrences.

7. Of the gastropods described by Cox (1949) the two *Chartroniella* species, *Calliostoma* (*Eocalliostoma*) *interruptum*, and *Homalopoma "cimana"* occur in our bituminous limestones and are therefore to be dated late Norian or early Rhaetian. "*Eucyclus tricarinatus*" and *Omphaloptycha lissonii*, on the other hand, are possibly identical with two species from our light limestones [*Promathilda* (*Teretrina*) *eucycloides* and *Omphaloptycha speciosa*, respectively] and must be considered Rhaetian. Thus Cox' (1949) first "conclusion that the age of the . . . fossils . . . must be very high in the Triassic" is fully corroborated, but not the second, that it is "most probably Norian." In any case, although Cox did not differentiate, as did Jaworski, between several horizons and although some of his gastropod identifications disagree with mine, he arrived at an essentially correct age determination.

8. The same holds true at an even higher degree for Boit (1949) who from his own geological observations and partly from Cox' paleontologic results clearly deduces the presence of Rhaetian beds overlying the Norian ones. His Rhaetian beds seem, however, to be equivalent to our bituminous limestones, not to our light limestones which he did not recognize as such.

[1] Thus the correlation by Vokes and Haas (1944, p. 283) of Körner's beds from the Nevado de Acrotambo with the *Spondylospira*-bearing beds from the Cerro de Pasco region is proved to have been correct. On the other hand, Boit (1949, p. 6) justly disapproved of our taking Körner's age determination of his fauna for granted. Cox (*in* Harrison, 1943, p. 7) also accepted Körner's age determination, but he was thereby led to a conclusion opposite to ours, namely, that the Norian Cerro de Pasco fossils must be younger than the Acrotambo faunule. In 1949 (p. 15), however, Cox considered both contemporary.

NORTHWESTERN ARGENTINA

The geologic age of the "Horizonte calcáreo-dolomítico"[1] of the Argentinian provinces of Salta and Jujuy has been highly controversial for more than three decades. Bonarelli (1921, p. 74) reached the conclusion that it is Triassic to Liassic, possibly extending into early Middle Jurassic. Cossmann (1925a) did not pronounce an age determination, but from the passages of his paper quoted by Bonarelli (1927, p. 113) it is clear that Cossmann tacitly assigned a late Triassic age to Bonarelli's gastropods from this horizon. In 1927 (p. 114) Bonarelli considered a Triassic, most probably Upper Triassic, age of all the fossils described by him, all of which are from the lower part of the "Horizonte calcáreo-dolomítico," to be safely established.

Frenguelli (1937, pp. 335, 336) declared this horizon to be a complex of shallow-water lacustrine sediments and its gastropods to be fresh-water gastropods, which he referred to the Melaniidae (Thiaridae according to Wenz, 1939, p. 684) and to the genus *Potamides*. In his Résumé (1937, p. 557) Frenguelli placed Bonarelli's "Horizonte calcáreo-dolomítico" in the upper part of his "Upper System," considered by him "Upper Jurassic-Cretaceous, perhaps plainly Cretaceous," thus clearly assigning a Cretaceous age to that horizon. These views of Frenguelli's were strongly endorsed by Schlagintweit (1941)[2] who (*ibid.*, p. 351) bluntly states the age of the "Horizonte calcáreo-dolomítico," correlated by him with the limestones of Miraflores, Bolivia, to be latest Cretaceous.

The opposite extreme is represented by Picard's (1948) view. Questioning Schlagintweit's above correlation, Picard infers from the finding, at Tres Cruces, of a pelecypod named *Kidodia picardi* by Frenguelli a "doubtless" Permian age of the " 'Calcáreo-dolomítico' *sensu lato* (comprenant le conglomérat de base, le Calcáreo-dolomítico, et les Marnes multicolores)."

Bonarelli, on the other hand, kept defending the marine character and the older than Cretaceous age of the beds under discussion to the very end of his long life (Bonarelli, 1945, 1950, 1950a). Of the fossils of interest for the present investigation he (1950, p. 13) considered those from "Carbajal" late Triassic, and those from Tres Cruces (*ibid.*, p. 14) probably Rhaetian, in age. In his very last paper on this subject (1950a, p. 22) he reassumed the results of his previous work to the effect that the known fossils of the "Horizonte calcáreo-dolomítico" (lower part of the preandine and subandine Mesozoic series of northern Argentina and Bolivia) cover the chronologic range from Upper Triassic to Lower Jurassic, including all of the Liassic.

It is fully realized that to enter into the complex of difficult geological and stratigraphic problems involved in the study of the "Horizonte calcáreo-dolomítico" would far exceed the scope of the present investigation. This much, however, may here be said:

1. Frenguelli and his followers have not been able to produce sufficient paleontologic evidence to support the fresh-water character and the Cretaceous age of that horizon.

2. The fossils from "Carbajal" (see Bonarelli, 1927, p. 52) have the genus *Tyrsoecus*, and even its species *T. andinus*, in common with the "*Myophoria*" limestones, and the genus *Protofusus* in common with both the bituminous and the light limestones of central Peru; the latter genus has not hitherto been recorded from anywhere else. The genus *Spirostylus* (including *Heligmostylus*, here not recognized as a separate genus) occurs at St. Cassian, in the limestones of Bonarelli's locality Tres Cruces, and in central Peru in lot 48 and extremely rarely in lot 26. The limestones from Tres Cruces may thus also be correlated with our bituminous and light limestones.

3. Hence it follows that on the strength of these faunal affinities Bonarelli's assemblages from "Carbajal" and Tres Cruces may be considered approximately contemporary with those dealt with in this report and therefore of Norian to Rhaetian age. To

[1] Sometimes named "Formacion petrolifera."

[2] His attempt (*ibid.*, p. 337) at depreciation of Cossmann's age determination by contending that Cossman passed away before terminating the restudy of Bonarelli's gastropods is decidedly refuted by M. Doello-Jurado's "Note de la Direction du Musée," preceding Cossmann's (1925a) paper, for this note states that Cossmann completed the study and returned the specimens "quelques mois avant son regrettable décès."

judge by the conclusions reached above for the Peruvian ones, the stratigraphic range of the "Horizonte calcáreo-dolomítico" need not even be extended into the Liassic, as Bonarelli was inclined to do in his last papers.

IDAHO

Since the gastropod fauna from near Lewiston, Idaho, mentioned above (p. 304), has not yet been properly studied, utmost caution is imperative in attempting to learn its geologic age. However, the fact that it has two genera as rare as *Sororcula* and *Kittlistylus*, and perhaps even species of these genera, in common with the bituminous limestones of central Peru suggests contemporaneity, that is, a Norian to Rhaetian age.

PALEOGEOGRAPHIC REMARKS

The faunal affinities, pointed out in the preceding section, between our gastropod assemblages on the one hand and those of the Alps of Europe (especially St. Cassian), of Idaho, and of northwestern Argentina on the other suggest connections between the respective neritic seas along the borders of continents existing in the late Triassic. Those between northwestern Argentina and central Peru are the least surprising, despite the distance of more than 1000 kilometers between them. Within the Northern Hemisphere, affinities between European and American faunas of approximately the same age have long been known from various geologic periods. In the present case, however, the European faunas are from the Northern Hemisphere, but the Peruvian fauna is from the Southern. This situation as well as the affinities between the fauna from Peru and that from Idaho poses the question of whether or not neritic forms could spread across the Equator—if the Equator is assumed to have crossed the Andean geosyncline in late Triassic times.

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PLATES 1–18

All specimens shown in the following plates are from the Cerro de Pasco and Tilarnioc regions of central Peru, with the exception of the specimen illustrated in figures 33–35 of plate 11. In the explanations of plates that follow only the American Museum of Natural History catalogue numbers are given. The corresponding lot numbers can be found in the paragraphs on occurrence at the end of the descriptions of the respective species, and by them the precise locality can be located on map 1.

PLATE 1

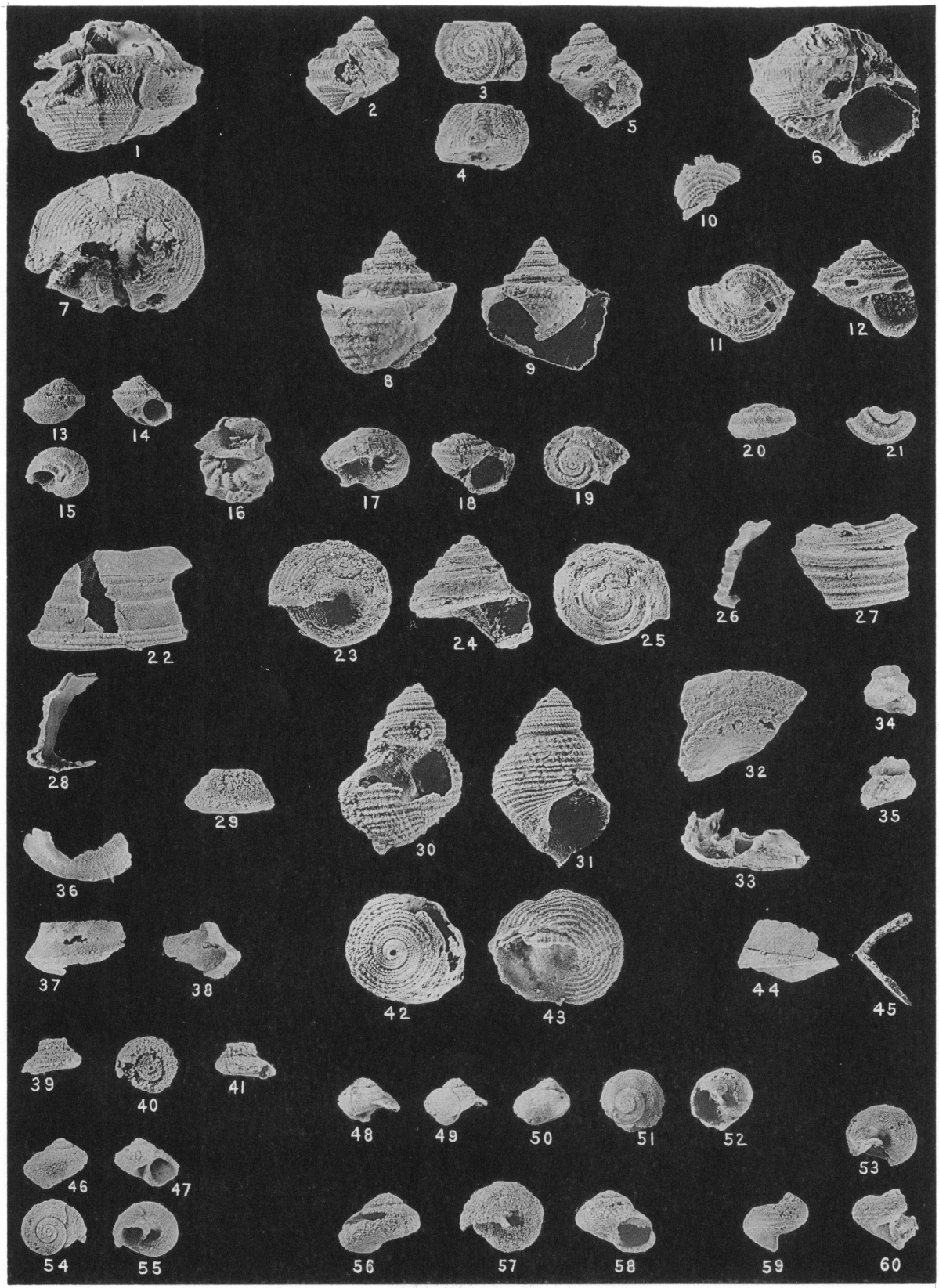
PLEUROTOMARIIDAE: *?Worthenia, Sisenna, Pareuryalox, Ptychomphalina*

?Worthenia rhombifera Körner: 1–7
1, 6, 7. A.M.N.H. No. 26508:2, ×3.
2–5. A.M.N.H. No. 26508:1, × *ca.* 4.2.[1]
?W., new species 2: 8, 9
8, 9. A.M.N.H. No. 26529:1; 8, × *ca.* 2 1/4; 9, ×2.
?W., new species 1:10–12
10. A.M.N.H. No. 26511/1:1, ×3.
11, 12. A.M.N.H. No. 26511, ×2.
?W. basifalcata Körner: 13–21
13–15. A.M.N.H. No. 26513/1, ×3.
16. A.M.N.H. No. 26513:2, ×3.
17–19. A.M.N.H. No. 26513:1, ×2.
20, 21. A.M.N.H. No. 26513:3, ×5
Sisenna, new species 2: 22, 28
22, 28. A.M.N.H. No. 27536, ×3.
S., new species 1: 23–25
23–25. A.M.N.H. No. 26504, ×3/2.
S., new species 3: 26–27
26–27. A.M.N.H. No. 27537, ×3.

[1] The odd scales (× *ca.* 1.2, *ca.* 2 1/4, *ca.* 3.3, *ca.* 4.2, *ca.* 5.2, *ca.* 6.1) occurring in plates 1–7 are due to the fact, discovered only after the photographs were taken, that the magnifying device of the camera had been tampered with.

?S., sp. indet.: 32, 33
32, 33. A.M.N.H. No. 26542, ×2.
S. aff. *excelsiori* Koken: 34, 35
34, 35. A.M.N.H. No. 27699, ×5.
Pareuryalox perornata Haas: 30, 31, 42, 43
30, 31, 42, 43. Holotype, A.M.N.H. No. 26506/1, ×2.
Ptychomphalina cf. *protei* ([Münster] Laube): 29, 36–38, 44, 45
29. A.M.N.H. No. 27697/1, ×3.
36–38. A.M.N.H. No. 27697:2, ×3; 37 to show whorl profile.
44, 45. A.M.N.H. No. 27697:3, ×3/2.
?P. sp. indet. 2: 39–41
39–41. A.M.N.H. No. 27540, ×5.
?P. discoidea Haas: 46, 47, 54–58
46, 47, 54, 55. Holotype, A.M.N.H. No. 27693, ×5.
56–58. Paratype A.M.N.H. No. 27693/1, ×5.
?P. sp. indet. 1: 48–53, 59, 60
48–52. A.M.N.H. No. 27694, ×5; 48 to show slit band in posteriormost part of last whorl and anteriormost part of penultimate; 49 to show sinus produced by slit band in transverse furrow.
53, 59, 60. A.M.N.H. No. 27694/1:1, ×3.

The Pleurotomariidae are continued on plate 2.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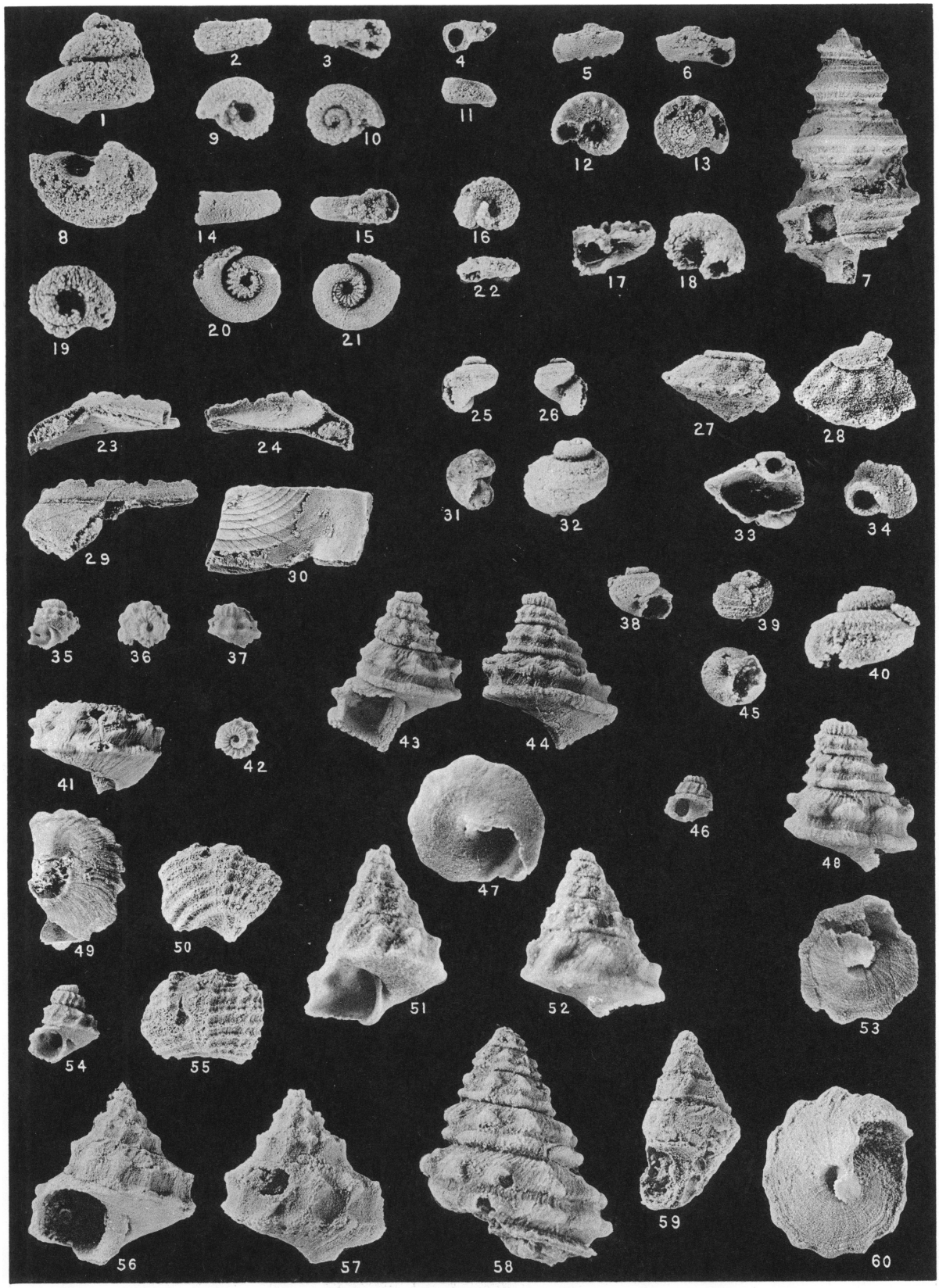
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PLATE 2

PLEUROTOMARIIDAE (*continued*): *Pleurotomaria*
MURCHISONIIDAE: *Trypanocochlea*
EUOMPHALIDAE: *Euomphalus, Phymatifer, Discohelix, Brochidium*
PLATYACRIDAE: *?Platyacra* (*Asperilla*), *?Lepidotrochus, ?Hyperacanthus*
CIRRIDAE (HESPEROCIRRINAE): *Hesperocirrus*

Pleurotomaria ex aff. *P. haueri* Hörnes: 1, 8
1, 8. A.M.N.H. No. 27698, ×3.
Trypanocochlea, new species: 7
7. A.M.N.H. No. 26505, × *ca.* 2 1/4.
Euomphalus, new species: 2, 3, 9, 10
2, 3, 9, 10. A.M.N.H. No. 27542, ×8.
Phymatifer peruvianus Haas: 5, 6, 12, 13
5, 6, 12, 13. Holotype, A.M.N.H. No. 27543, ×5.
Discohelix sp.: 4, 11
4, 11. A.M.N.H. No. 27544, ×2.
Brochidium vareasense Haas: 14, 15, 19–21
14, 15, 20, 21. Holotype, A.M.N.H. No. 27545, ×5.
19. Apical view of A.M.N.H. No. 27545/1, ×8, to show protoconch.
B. sp. indet. 1: 17, 18
17, 18. A.M.N.H. No. 27546, ×8.
B. sp. indet. 2: 16, 22
16, 22. A.M.N.H. No. 27547, ×3.
?Platyacra (*Asperilla*) sp. indet.: 27, 28, 33, 34
27, 28, 33. Fragment, A.M.N.H. No. 26541:1, ×5; 27, from outside; 28, with apex tilted towards camera; 33, from inside.
34. Fragment, A.M.N.H. No. 26541:3, basal view showing umbilicus, ×5.
?Lepidotrochus sp. indet.: 23, 24, 29, 30
23, 24, 29, 30. A.M.N.H. No. 27535, ×3/2; 23, 24, fractures at posterior and anterior ends; 29, fragment from outside; 30, basal view.
?Hyperacanthus juvenile form 1: 25, 26, 31, 32
25, 26, 31, 32. A.M.N.H. No. 27688; 25, 26, 31, ×5; 32, ×8; 31 unwhitened to show, in both larger specimen and small one sticking in its aperture, dark dots believed to be points of attachment of spines; 32, with apex slightly tilted towards camera to show nucleus.
?H. juvenile form 2: 38–40, 45
38–40, 45. A.M.N.H. No. 27689:2; 38, 39, 45, ×5; 40, ×8, to show nucleus.
Hesperocirrus robusteornatus Haas: 35–37, 41, 43, 44, 47–49, 51–53, 58
35–37. A.M.N.H. No. 26533:1, ×4.
41, 49. Syntype B, A.M.N.H. No. 26533:7, ×3/2.
43, 44. Syntype A, A.M.N.H. No. 26533:4, ×4.
47, 51, 52. A.M.N.H. No. 26533:6, ×4.
48, 53. A.M.N.H. No. 26533:5, ×4.
58. Syntype C, A.M.N.H. No. 26533/1, with apex tilted slightly away from camera, to show continuation of growth striae below periphery, ×2.
Hesperocirrus striatus Haas: 42, 46, 54, 56, 57, 60
42, 46. Syntype A, A.M.N.H. No. 26536:1, ×4.
54. A.M.N.H. No. 26536:2, ×4.
56, 57, 60. Syntype B, A.M.N.H. No. 26536:4, ×3.
Hesperocirrus, new species: 50, 55, 59
50, 55. Basal and lateral views of whorl fragment, A.M.N.H. No. 26535:3, ×2.
59. A.M.N.H. No. 26535:1, ×2.

The Cirridae (Hesperocirrinae) and *Hesperocirrus* are continued on plate 3.

PLATE 3

CIRRIDAE (HESPEROCIRRINAE): *Hesperocirrus (continued)*, *Sororcula*

Hesperocirrus triasicus (Cox): 1–15, 19–22, 25–27

1. A.M.N.H. No. 26534:6, ×4, to show first appearance of middle keel.

2–5. A.M.N.H. No. 26534:4, ×4.

6. A.M.N.H. No. 26534:7, ×4, to show first appearance of middle keel.

7, 8, 10, 11. A.M.N.H. No. 26534:2, ×4.

9. A.M.N.H. No. 26534:5, ×4.

12, 20. A.M.N.H. No. 26534:10, ×3/2.

13–15. A.M.N.H. No. 26534:8, ×3/2.

19. A.M.N.H. No. 26534:9, ×3/2.

21, 25, 26. A.M.N.H. No. 26534:12, ×1; apex tilted towards camera in 25 to show septum closing nuclear scar.

22, 27. A.M.N.H. No. 26534:11, ×3/2.

H. modestus Haas: 16–18, 23, 24, 29, 37–39

16–18. Syntype A, A.M.N.H. No. 26537:1, ×4.

23, 24, 29. Syntype C, A.M.N.H. No. 26537:5, ×2.

37–39. Syntype B, A.M.N.H. No. 26537:4, ×3.

Sororcula gracilis Haas: 28, 30, 31, 35, 36, 42–46

28, 43, 45. A.M.N.H. No. 26539:5, ×5; note revolving striation on base and sides and thread-like keel, stronger than the others, at about half the height of lateral face of body whorl.

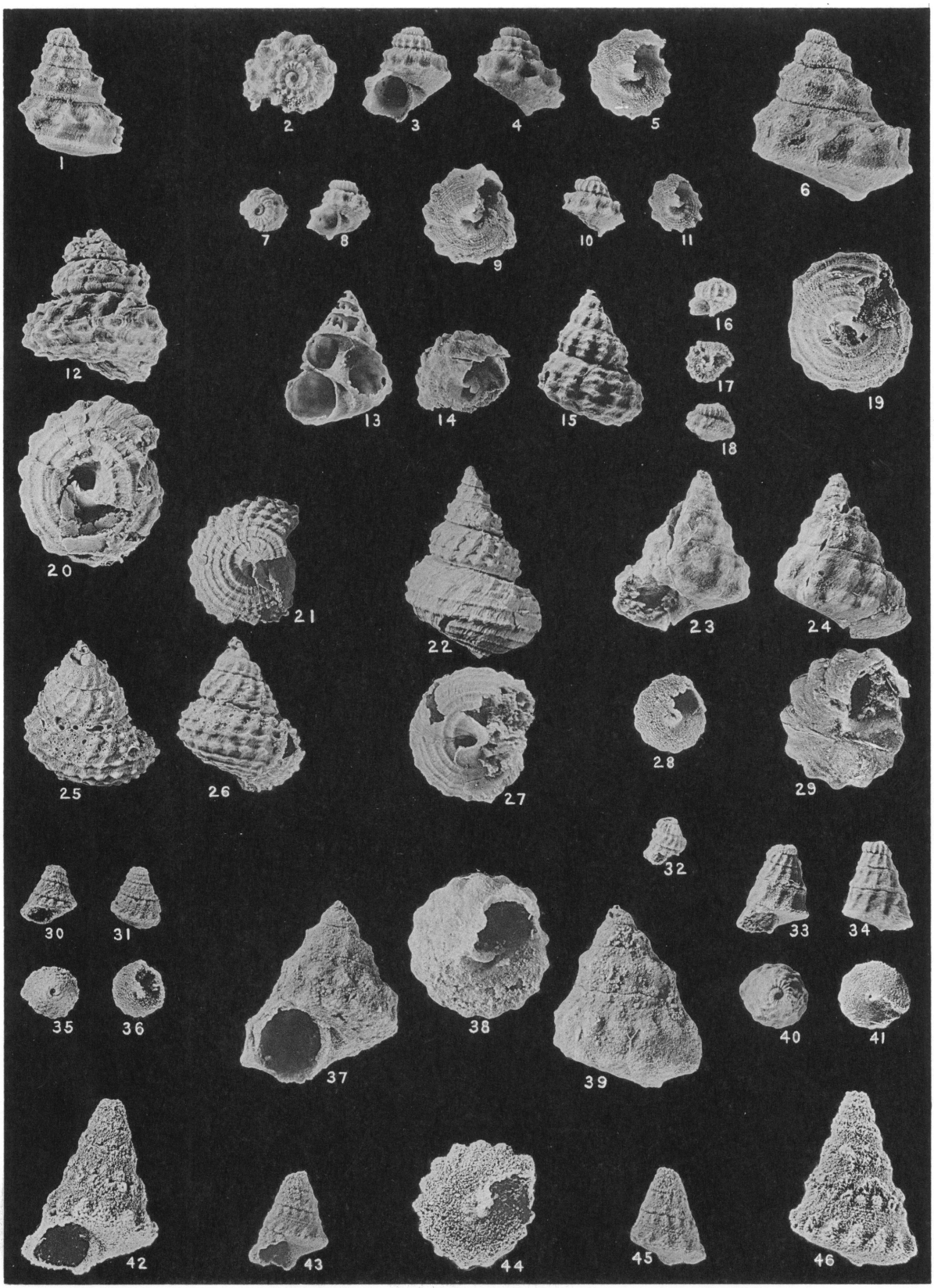
30, 31, 35, 36. Syntype A, A.M.N.H. No. 26539:3, ×5; apex tilted towards camera in 31 to show nucleus.

42, 44, 46. Syntype B, A.M.N.H. No. 26539/2, ×5.

S. costata Haas: 32–34, 40, 41

32. A.M.N.H. No. 26540/1, ×5; note inclination of nucleus.

33, 34, 40, 41. Holotype, A.M.N.H. No. 26540:3, ×5.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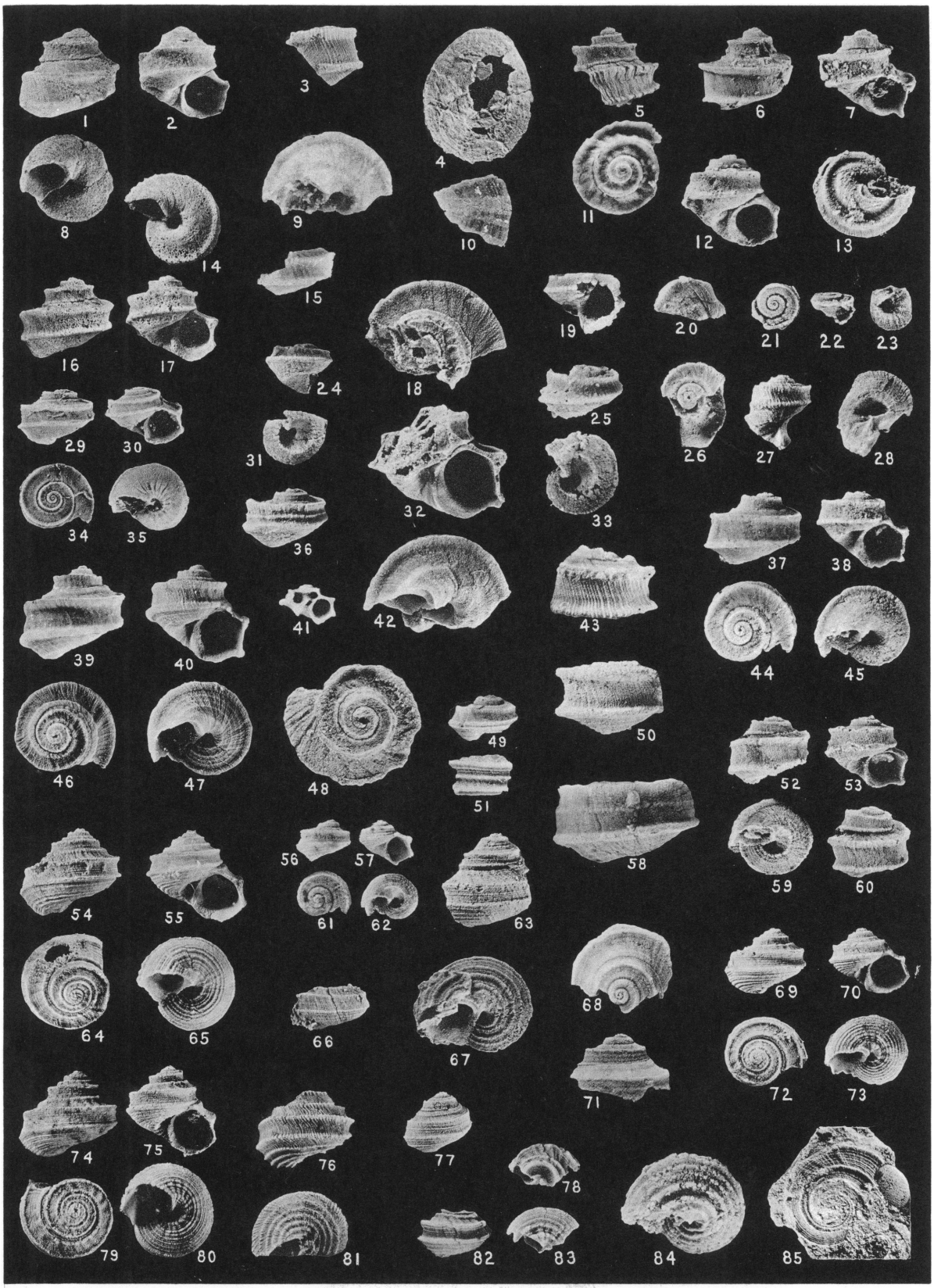
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PLATE 4

ACMAEIDAE: *?Acmaea*
TROCHONEMATIDAE: *Guidonia*

?Acmaea sp. indet.: 4, 10
4. A.M.N.H. No. 27551:1, ×1.
10. A.M.N.H. No. 27551:2, ×2.

Guidonia peruviana Haas: 1–3, 5–9, 11–18, 20, 32, 42
1, 2, 8. Syntype A, A.M.N.H. No. 26500:1, ×2.
3. Syntype B, A.M.N.H. No. 26500:29, ×3.
5, 11. A.M.N.H. No. 26500:2, ×2; 5 to illustrate "pseudolunulae."
6, 7, 13. A.M.N.H. No. 26500:9, ×3.
9. A.M.N.H. No. 26500:16, ×3, to show revolving ridge on base.
12. A.M.N.H. No. 26500:11, ×2.
14, 16, 17. A.M.N.H. No. 26500/1:2, ×3.
15. A.M.N.H. No. 26500:18, ×3.
18, 32, 42. A.M.N.H. No. 26500/1:3, ×3.
20. A.M.N.H. No. 26500:30, ×3, to show growth folds on base.

Guidonia planetecta Haas: 19, 21–31, 33–35, 37, 38, 44, 45
19, 25, 33. Syntype B, A.M.N.H. No. 27091/1:3, ×3.
21–23. Juvenile, A.M.N.H. No. 27091/3:1, ×4.
24, 31. A.M.N.H. No. 27091/2, ×4.
26–28. A.M.N.H. No. 27091:14, ×3.
29, 30, 34, 35. Syntype A, A.M.N.H. No. 27091:8, ×3.
37, 38, 44, 45. Syntype C, A.M.N.H. No. 27091:9, ×3.

Guidonia intermedia Haas: 36, 39–41, 43, 46–48, 50, 52, 53, 58–60
36, 58. Specimens with middle keel, A.M.N.H. Nos. 27092:15 and 27092:12, ×4.
39, 40, 46, 47. Syntype B, A.M.N.H. No. 27092:9, ×3.
41. Juvenile in natural cross section, A.M.N.H. No. 27092:3, ×3.
43. A.M.N.H. No. 27092:11, ×4; with 48 and 50, to show growth striae.
48. A.M.N.H. No. 27092:10, ×3.
50. A.M.N.H. No. 27092:13, ×4.
52, 53, 59, 60. Syntype A, A.M.N.H. No. 27092/1:2, ×3.

G. parvula Haas: 49, 51, 54–57, 61–75, 79, 80
49. Specimen with lower main keel developed as twin keel, A.M.N.H. No. 26501:46, ×4.
51. Specimen with middle keel, A.M.N.H. No. 26501:52, ×3.
54, 55, 64, 65. Syntype B, A.M.N.H. No. 26501:1, ×3.
56, 57, 61, 62. Syntype A, juvenile, A.M.N.H. No. 26501:6, ×5.
63, 66. Fragments showing growth striae, A.M.N.H. Nos. 26501:49 and 26501:43, ×3.
67. Specimen with only three, but extraordinarily strong, revolving keels on base, A.M.N.H. No. 26501:39, ×3.
68, 71. Fragment, A.M.N.H. No. 26501:37, ×5, to show early ontogeny.
69, 70, 72, 73. Medium-sized shell, A.M.N.H. No. 26501:30, ×3.
74, 75, 79, 80. Syntype C, A.M.N.H. No. 26501:2, ×3.

G. bifasciata Haas: 76–78, 81–85.
76, 81. Syntype C, A.M.N.H. No. 26502:21, ×4; note excellently developed growth lamellae.
77. Specimen with outstanding revolving threads on lateral and apical bands, A.M.N.H. No. 26502:25, ×3.
78, 82, 83. A.M.N.H. No. 26502:18, ×3, to show details of revolving ornamentation.
84. Specimen with revolving keel next to circumumbilical ridge outstanding among the others, A.M.N.H. No. 26502:13, ×3.
85. A.M.N.H. No. 26502:20, ×3, to show revolving ornamentation of apical whorl faces.

The Trochonematidae, *Guidonia*, and *G. bifasciata* are continued on plate 5.

PLATE 5

TROCHONEMATIDAE: *Guidonia (continued)*
ANOMPHALIDAE: *Anomphalus*
PARATURBINIDAE: *Chartroniella*
AMBERLEYIDAE: *Eucyclus*

Guidonia bifasciata Haas (*continued*): 1–3, 7, 8, 14, 15, 21, 22

1–3, 14, 15. Syntype A, A.M.N.H. No. 26502:1, ×5; 3 to show growth lamellae.

7, 8, 21, 22. Syntype B, A.M.N.H. No. 26502:5, ×4.

Anomphalus helicoides (Münster): 4–6, 9, 10, 13, 16, 17

4, 5. A.M.N.H. No. 27548:4, ×8.

6, 13. A.M.N.H. No. 27548:5, ×8.

9, 10, 16, 17. A.M.N.H. No. 27548:2, ×8.

A. biconcavus Haas: 11, 12, 18–20

11, 12, 18, 19. Holotype, A.M.N.H. No. 27549:1, ×8.

20. A.M.N.H. No. 27549:3, ×8.

A. amorphus Haas: 23–30

23, 24, 27, 28. Holotype, A.M.N.H. No. 27550:3, ×5.

25, 26, 29, 30. Paratype A.M.N.H. No. 27550:1, ×5.

Chartroniella pacifica (Jaworski): 31–41, 45–47, 54

31, 36, 40, 54. Fragments, A.M.N.H. Nos. 26530/3:1, × *ca.* 5.2, 26530/4:1, × *ca.* 2 1/4, 26530/4:2, × *ca.* 2 1/4, 26530/8:6, × *ca.* 3.3, respectively; all to show details of ornamentation.

32, 33. A.M.N.H. No. 26530:1, × *ca.* 2 1/4.

34. A.M.N.H. No. 26530:3, × *ca.* 2 1/4, to show corkscrew-shaped, hollow columella.

35, 37–39. A.M.N.H. No. 26530/1:1; 35, 37, 38, × *ca.* 1.2; 39, ×1; 38, body whorl without uppermost part, in apertural view, with apex tilted slightly away from camera to show details of ornamentation.

41. A.M.N.H. No. 26530/8:2, × *ca.* 1.2.

45–47. A.M.N.H. No. 26530/8:3, × *ca.* 1.2.

C. wortheniaeformis (Cox): 42–44, 48, 55

42, 48, 55. A.M.N.H. No. 26531:1, × *ca.* 1.2.

43. A.M.N.H. No. 26531/1, × *ca.* 3.3, to show shell profile.

44. Apical view of incomplete specimen, A.M.N.H. No. 26531/2:1, × *ca.* 3.3.

Eucyclus denticulatus Haas: 49–53, 56–61

49, 50. Paratype A.M.N.H. No. 26515:10, ×5, to show teeth of upper main keel; fragment tilted in 50 to give better profile view of these teeth.

51, 57. Syntype B, A.M.N.H. No. 26515:5, 51, apical view, × *ca.* 5.2; 57, ×8.

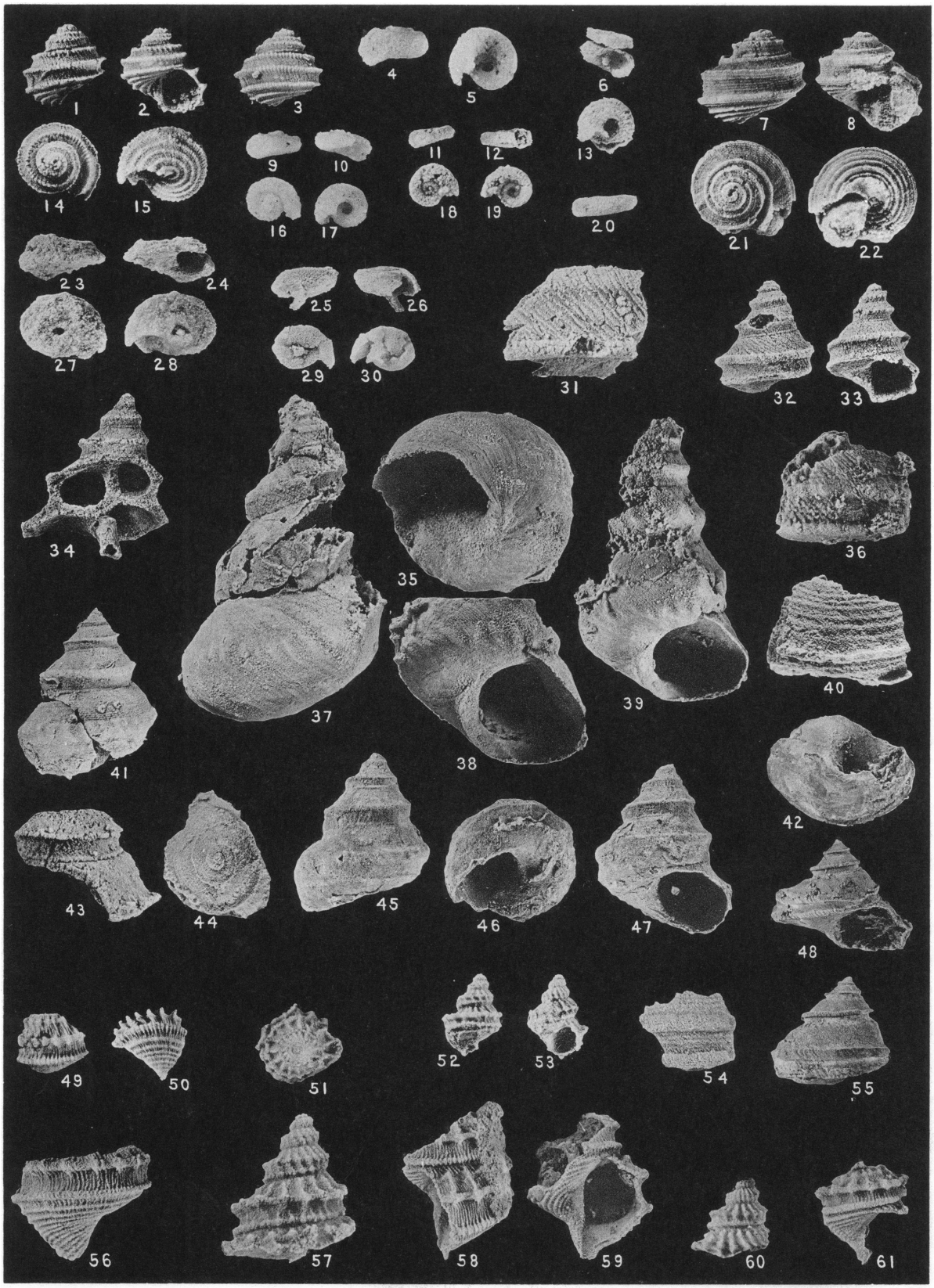
52, 53. Syntype A, A.M.N.H. No. 26515:1, ×5.

56. Syntype D, A.M.N.H. No. 26515:4, × *ca.* 5.2.

58, 59. Syntype C, A.M.N.H. No. 26515:3, × *ca.* 5.2.

60. Paratype A.M.N.H. No. 26515:2, ×5.

61. Paratype A.M.N.H. No. 26515:11, × *ca.* 5.2.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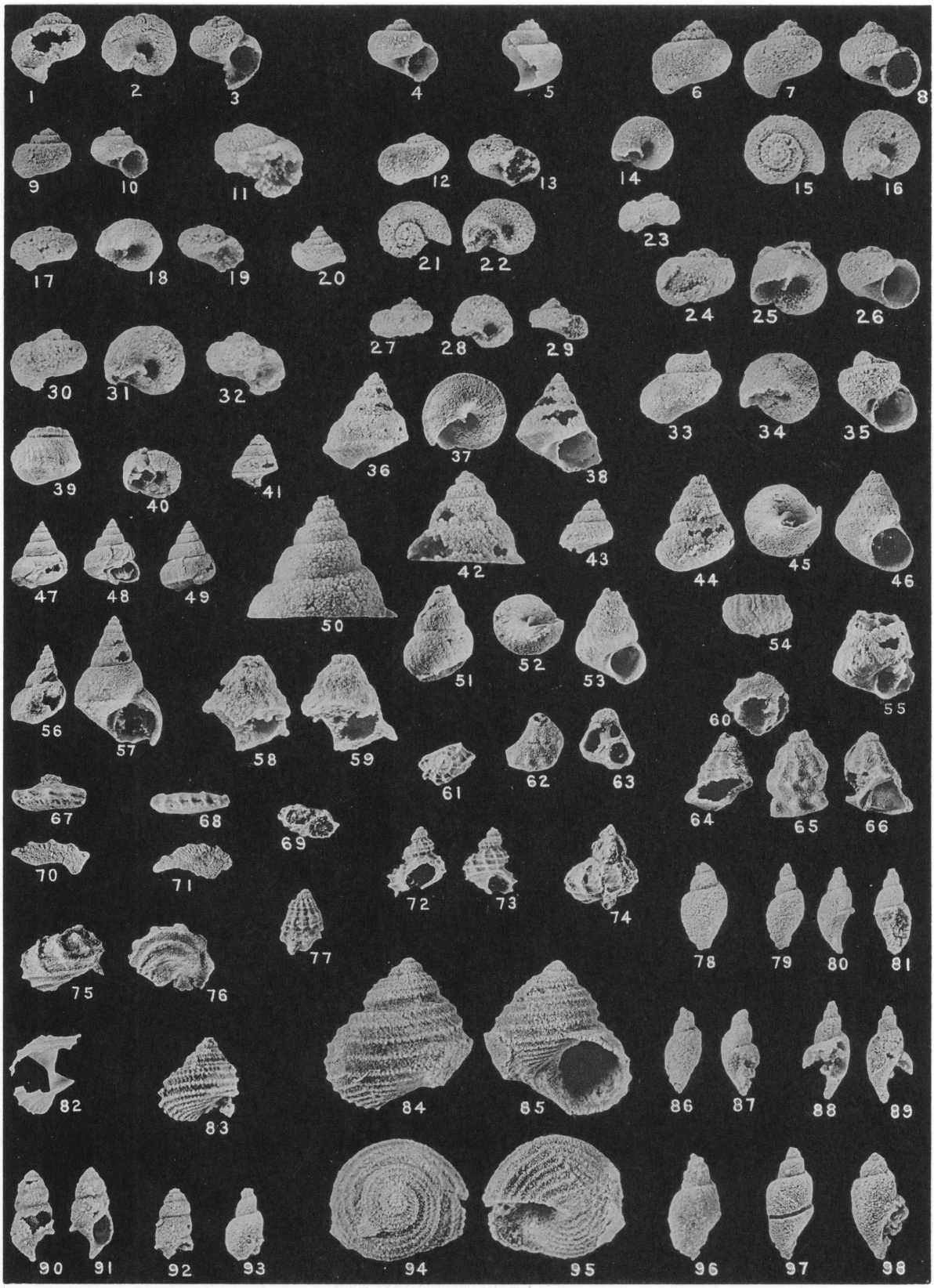
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PLATE 6

TROCHIDAE: *Solariella* (*Eosolariella*), *Solarioconulus*, *Callotrochus*, *Calliostoma* (*Eocalliostoma*), *Amphitrochus*
TURBINIDAE: *Eucycloscala*, *Homalopoma* (*Boutillieria*)
PSEUDOMELANIIDAE: *?Oonia*, *?Ramina*

Solariella (*Eosolariella*) *pusilla* Haas: 1–10, 14–16
1–3. Largest paratype, A.M.N.H. No. 27690/3:10, ×5.
4. Specimen with wide pleural angle, A.M.N.H. No. 27690:18, ×8.
5. A.M.N.H. No. 27690:22, ×8, to show eccentric site of nucleus.
6–8, 15, 16. Holotype, A.M.N.H. No. 27690:23, ×8; 6 to show growth striation on body whorl.
9, 10. Juvenile, A.M.N.H. No. 27690:9, ×8; note growth striae in 9.
14. Basal view of juvenile, A.M.N.H. No. 27690:12, ×8.

S. (*E.*) *brevispira* Haas: 11–13, 17–19, 21, 22, 24–26
11. A.M.N.H. No. 27691/3:10, specimen transitional to *S.* (*E.*) *pusilla*, ×8.
12, 13, 21, 22. A.M.N.H. No. 27691, ×8.
17–19. A.M.N.H. No. 27691/4:3, ×8.
24–26. Holotype, A.M.N.H. No. 27691/1:5, ×8.

S. (*E.*) *distincta* Haas: 23, 27–32
23. A.M.N.H. No. 27692/1:3, ×8, to show early ontogeny.
27–29. Syntype A, A.M.N.H. No. 27692/1:2, ×8.
30–32. Syntype B, A.M.N.H. No. 27692:5, ×8.

Solarioconulus ?nudus (Münster): 20, 33–35
20. Incomplete juvenile, A.M.N.H. No. 27528:1, ×5.
33–35. A.M.N.H. No. 27528:2, ×5.

S. elegans Haas: 36–39, 41, 42
36–38, 42. Holotype, A.M.N.H. No. 27529:5; 36–38, ×3; 42, close-up of upper part of spire to show nucleus, ×5.
39. Shell fragment, A.M.N.H. No. 27529:7, ×3, to show growth striation.
41. Incomplete juvenile, A.M.N.H. No. 27529:1, ×3; note widely reflexed inner lip.

S. ninacacanus Haas: 40, 43–50, 54, 55
40, 47–50. Syntype A, A.M.N.H. No. 27530:4; 40, 47–49, ×2; 50, ×8, close-up of upper part of spire to show nucleus.
43. A.M.N.H. No. 27530:2, ×5, to show inclination and eccentricity of nucleus.
44–46. Syntype B, A.M.N.H. No. 27530:5, ×2.
54. Shell fragment, A.M.N.H. No. 27530:8, ×3, to show growth striation.
55. Incomplete shell, A.M.N.H. No. 27530:11, ×3, to show tubercles on peripheral shoulder.

S. infrequens Haas: 51–53, 56, 57
51–53. Syntype B, A.M.N.H. No. 27531:3, ×2; note coarse growth folds.
56, 57. Syntype A, A.M.N.H. No. 27531:1; 56, ×3; 57, ×5, to show nucleus.

Callotrochus sp. indet.: 58, 59
58, 59. A.M.N.H. No. 27532:2, ×5; note blunt folds in 58.

Calliostoma (*Eocalliostoma*) *concavum* Haas: 60, 62–66
60, 64–66. Holotype, A.M.N.H. No. 26518:3, ×5; 65 to show subsutural and supersutural tubercles better than in 64 or 66.
62, 63. Juvenile, A.M.N.H. No. 26518:1, ×5.

Amphitrochus sp. indet.: 67, 68, 70, 71
67, 70. Fragment, A.M.N.H. No. 27533:1, side and basal views, ×3.
68, 71. Fragment, A.M.N.H. No. 27533:2, side and basal views, ×3.

Eucycloscala pascoensis Haas: 61, 69, 72–76
61, 72, 73. Holotype, A.M.N.H. No. 26510:2, ×3; 61 is apical view.
69. Fragment, A.M.N.H. No. 26510/1:3, apertural view, ×3.
74. A.M.N.H. No. 26510/1:1, ×3.
75, 76. Largest shell, A.M.N.H. No. 26510/2, ×3.

E. cf. *baltzeri* (Kittl): 77
77. A.M.N.H. No. 26512, ×3.

Homalopoma (*Boutillieria*) *subcinctum* (d'Orbigny): 83–85, 94, 95
83. Juvenile, A.M.N.H. No. 26543/1, ×5.
84, 85, 94, 95. A.M.N.H. No. 26543/2:2, × *ca.* 5.2.

H. (*B.*), new species: 82
82. Fragment, A.M.N.H. No. 27129, ×2.

?Oonia ?subtortilis (Münster): 90–92
90, 91. A.M.N.H. No. 27196:1, ×5.
92. A.M.N.H. No. 27196:2, ×5.

?Ramina andina Haas: 78–81, 86–89, 93, 96–98
78. An unusually stout shell, A.M.N.H. No. 27679:21, ×5.
79–81. Syntype A, A.M.N.H. No. 27679:8, ×5; note circumumbilical ridge and shallow groove on left in 80.
86, 87. Syntype B, A.M.N.H. No. 27679:19, ×5; note umbilical depression in 87.
88, 89. Unusually high-spired shell, A.M.N.H. No. 27679:22, ×5; note nucleus in 89.
93. A.M.N.H. No. 27679:27, ×5; note traces of revolving striation on penultimate and last whorls.
96. A.M.N.H. No. 27679:11, ×8, to show nucleus.
97. A.M.N.H. No. 27679:23, ×5; note revolving striation on base.
98. A.M.N.H. No. 27679:26, ×5, to show growth striation.

PLATE 7

LOXONEMATIDAE (LOXONEMATINAE): *Loxonema* (*Polygyrina*); (ZYGOPLEURINAE): *Zygopleura* (*Katosira, Kittliconcha, Allostrophia, Anoptychia, ?Allocosmia*), *Tyrsoecus* (*Tyrsoecus*)
COELOSTYLINIDAE: *Coelostylina*

Loxonema (*Polygyrina*) sp. indet. 1: 6
6. A.M.N.H. No. 26571:1, ×5; note nucleus and inclined spire.

L. (*P.*) sp. indet. 2: 7
7. A.M.N.H. No. 26572, ×3; note inclined nucleus.

Zygopleura (*Katosira*) sp. indet. 1: 1–5
1, 2. A.M.N.H. No. 26573:1, ×5
3. A.M.N.H. No. 26573:2, ×5.
4, 5. A.M.N.H. No. 26573/1, ×5.

Z. (*K.*) sp. indet. 2: 8–11
8. A.M.N.H. No. 26574/1, ×5; note nucleus.
9. Juvenile, A.M.N.H. No. 26574/2, ×8.
10, 11. A.M.N.H. No. 26574, ×3.

Z. (*K.*) cf. *beneckei* Kittl: 12
12. A.M.N.H. No. 26575, ×2.

Zygopleura (*Kittliconcha*) *peruviana* Haas: 13–25
13, 25. A.M.N.H. No. 26556:20, × *ca.* 4.2; note beaded ribs.
14, 15. Very early stage, A.M.N.H. No. 26556/1:2, ×10.
16, 17. Juvenile, A.M.N.H. No. 26556:21, × *ca.* 5.2.
18–20. Holotype, A.M.N.H. No. 26556:18; 18, ×2; 19, 20, × *ca.* 2 1/4.
21. A.M.N.H. No. 26556:14, × *ca.* 4.2.
22. A.M.N.H. No. 26556:23, × *ca.* 6.1.
23. A.M.N.H. No. 26556:22, × *ca.* 4.2.
24. A.M.N.H. No. 26556:24, × *ca.* 2 1/4; note contrast between distinctly costate penultimate whorl and smooth body whorl.

Z. (*K.*) *dissimilis* Haas: 26–35
26, 27. Juvenile, A.M.N.H. No. 26557/1:8; 26, ×8; 27, *ca.* 5.2; note nucleus in 26.
28. A.M.N.H. No. 26557:30, × *ca.* 5.2, to show inner lip and course of outstanding single rib.
29–31. Holotype, A.M.N.H. No. 26557:22; 29, ×2; 30, 31, × *ca.* 2 1/4.
32. A.M.N.H. No. 26557:29, ×*ca.* 3.3; note costation extending over three consecutive whorls.
33. A.M.N.H. No. 26557:25, × *ca.* 3.3.
34. A.M.N.H. No. 26557:28, × *ca.* 3.3.
Note outstanding single ribs in 33, 34.
35. A.M.N.H. No. 26557:27, × *ca.* 5.2, to show inclination of nucleus.

Z. (*Allostrophia*) sp. indet.: 36
36. A.M.N.H. No. 26563, × 2.

Z. (*Anoptychia*) *tambosolensis* Haas: 37–43, 53, 54
37. A.M.N.H. No. 26559:17, × *ca.* 2 1/4.
38. A.M.N.H. No. 26559:20, × *ca.* 4.2, to show growth folds on body whorl.
39. A.M.N.H. No. 26559:21, × *ca.* 5.2, to show faint revolving striation.
40, 41. Syntype A, A.M.N.H. No. 26559:16, × *ca.* 3.3.
42. A.M.N.H. No. 26559:19, × *ca.* 5.2, to show fold-like ribs on fifth whorl from apex.
43. A.M.N.H. No. 26559:22, ×8, note nucleus.
53, 54. Syntype B, A.M.N.H. No. 26559:18, × *ca.* 2 1/4; note faint growth folds on body whorl in 53.

Z. (*A.*) *tilarniocensis* Haas: 44–50, 55, 56
44–46. Holotype, A.M.N.H. No. 26560/1:2; 44, ×2; 45, 46, × *ca.* 1.2; note revolving ornamentation of base in 44 and false canal in 46.
47, 48. Medium-sized shell, A.M.N.H. No. 26560:10, × *ca.* 3.3; note umbilical niche nearly filled by callosity of inner lip in 48.
49. Juvenile, A.M.N.H. No. 26560/1:1, × *ca.* 4.2; note narrow umbilical niche.
50. A.M.N.H. No. 26560:13, × *ca.* 4.2; note nucleus and single growth stria on body whorl.
55. Fragment, A.M.N.H. No. 26560:17, × *ca.* 3.3, to show corkscrew shape of columella.
56. Juvenile, A.M.N.H. No. 26560:19, × *ca.* 5.2, to show costation of early whorls.

Z. (*A.*) *ninacacana* Haas: 51, 52, 57–61, 65–70
51, 52, 61. Holotype, A.M.N.H. No. 26561:3; 51, 52, ×2; 61, close-up of nucleus, × *ca.* 4.2.
57, 58. A.M.N.H. No. 26561/1:2, × *ca.* 5.2.
59, 60. Smallest juvenile, A.M.N.H. No. 26561:7, × *ca.* 5.2; note narrow umbilicus.
65. A.M.N.H. No. 26561:2, × *ca.* 4.2.
66. A.M.N.H. No. 26561:4, ×2.
67, 68. Juvenile, A.M.N.H. No. 26561:1, × *ca.* 5.2.
69, 70. A.M.N.H. No. 26561:8, × *ca.* 5.2.
Note in comparison of 59, 58, 68, and 70 that umbilical niche becomes narrower with growth.

?Z. (*A.*) sp. indet. 1: 64, 71
64. A.M.N.H. No. 26564/1:2, ×2; note peripheral shoulder and revolving ornamentation.
71. A.M.N.H. No. 26564:1, ×1.

Tyrsoecus (*Tyrsoecus*) *andinus* Bonarelli: 74–78
74. A.M.N.H. No. 26568:3, ×3/2.
75, 76. A.M.N.H. No. 26568:1, ×2; note revolving ornamentation.
77. A.M.N.H. No. 26568:2, ×2.
78. A.M.N.H. No. 26568:4, ×3/2.

T. (*T.*) *obtusus* Haas: 72, 73, 81–83.
72, 73, 81. Syntype A, A.M.N.H. No. 26569:2, ×2; note revolving ornamentation in 72 and 73 and growth lamellae in 81.
82. A.M.N.H. No. 26569:4, ×3/2.
83. Syntype B, A.M.N.H. No. 26569:3, ×3/2, to show mature shell profile.
Note tubercles in 74, 77, 82, 83.

Coelostylina cylindrata Haas: 79, 80, 88–91, 99, 100
79, 80. Syntype A, A.M.N.H. No. 27678:4, ×5.
88–90. A.M.N.H. No. 27678:3, ×5; 89 to show thickened and reflexed inner lip.
91. A.M.N.H. No. 27678/2:2, ×5, to show faint growth striation.
99, 100. Syntype B, A.M.N.H. No. 27678/1; 99, ×5; 100, ×8; note nucleus in 100.

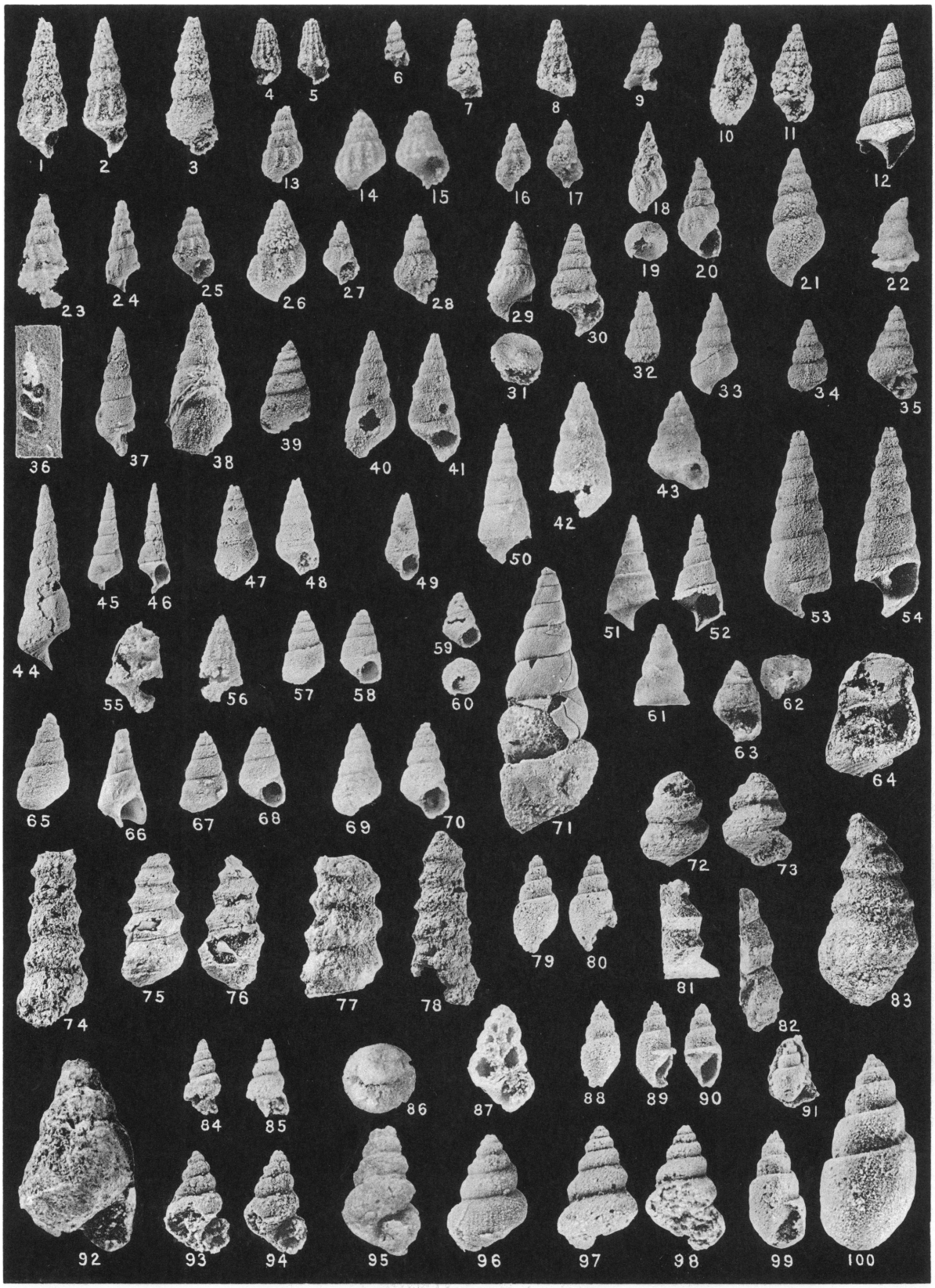
C. sp. indet. 1: 84, 85
84, 85. A.M.N.H. No. 26570, ×5; note umbilical niche in 85.

C. inexspectata Haas: 86, 87, 93–98.
86, 95. A.M.N.H. No. 26548/1:2, ×5.
87. A.M.N.H. No. 26548/1:1, ×5.
93, 94. Syntype A, A.M.N.H. No. 26548:2, ×5; note reflexed inner lip and columella in 93.
96. Syntype C, A.M.N.H. No. 26548/1:3, ×5; note growth striation.
97, 98. Syntype B, A.M.N.H. No. 26548:3, ×5.

C. cf. *medea* Kittl: 62, 63
62, 63. A.M.N.H. No. 26549, ×5; note open umbilicus in 62.

C. sp. indet. 2: 92.
92. A.M.N.H. No. 26550, ×3.

The Coelostylinidae are continued on plate 8.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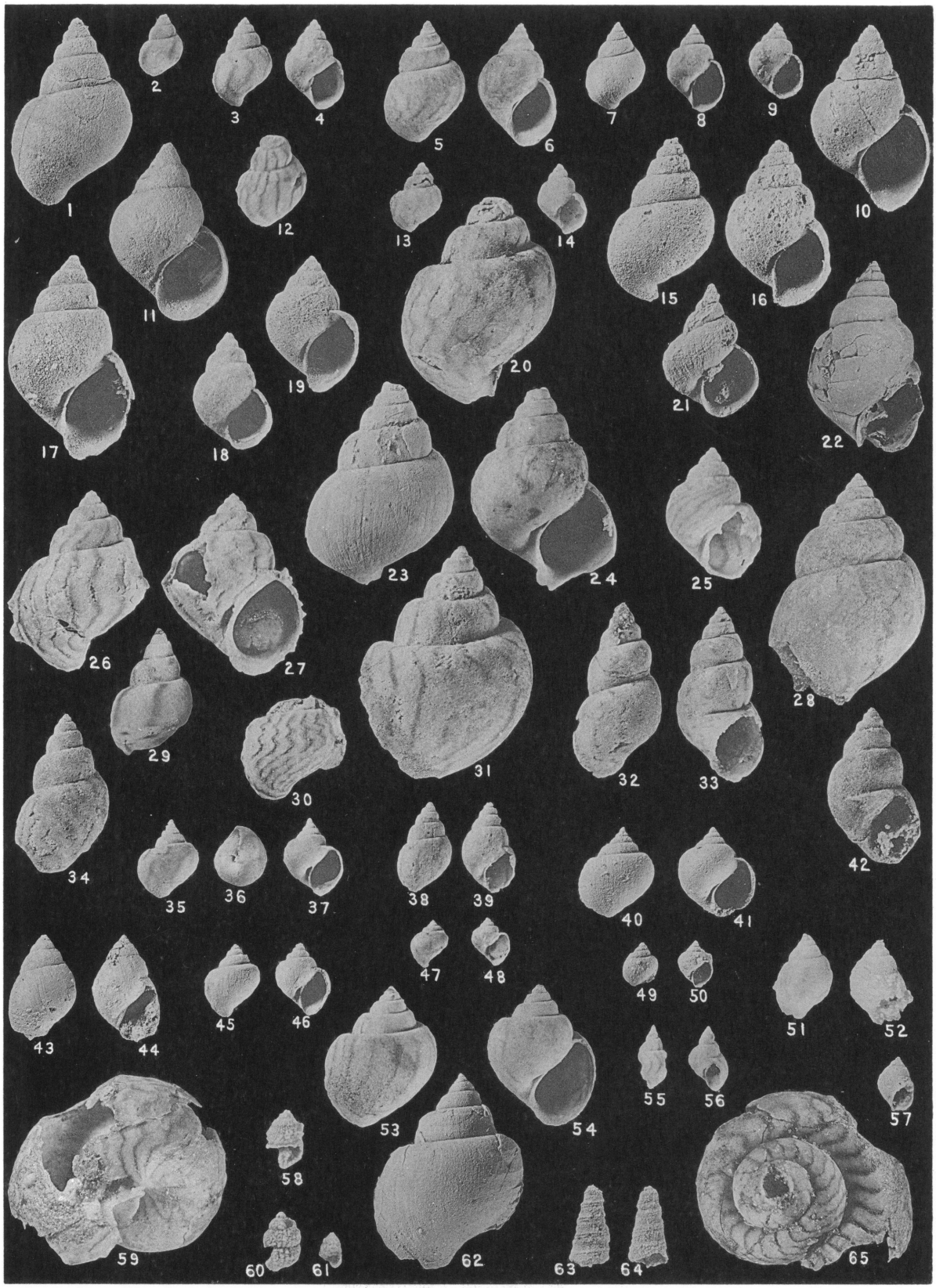
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PLATE 8

COELOSTYLINIDAE (*continued*): *Omphaloptycha, Protorcula, ?Glyptochrysalis*

Omphaloptycha jaworskii Haas: 1–28, 31

1, 10. A.M.N.H. No. 26522:14, ×2; 10 shows anterior notch better than 6, apertural view of holotype.

2. A.M.N.H. No. 26522:47, ×2; note wide spacing of color markings.

3, 4. A.M.N.H. No. 26522:2, ×2.

5, 6. Holotype, A.M.N.H. No. 26522:5, ×2; bottom of aperture in 6 not quite complete.

7, 8. A.M.N.H. No. 26522:1, ×2.

9. A.M.N.H. No. 26522/5:1, specimen transitional to *O. speciosa*, ×2.

11. A.M.N.H. No. 26522:16, ×2, to show bundles of growth striae.

12. Specimen with closely set color markings, A.M.N.H. No. 26522:67, ×2.

13, 14. A.M.N.H. No. 26522:61, specimen transitional to *O. speciosa*, ×5/2.

15, 16. A.M.N.H. No. 26522/2:5, specimen most closely approaching *O. jenksi*, ×2.

17, 18. A.M.N.H. Nos. 26522:28 and 26522:27, respectively, transitional to *O. jenksi*, ×2.

19. A.M.N.H. No. 26522:66, transitional to *O. speciosa*, ×2.

20. A.M.N.H. No. 26522:24, 2; note zigzagging color markings.

21. A.M.N.H. No. 26522:69, specimen with extraordinarily steep gradient of sutures, ×2.

22. Largest paratype, A.M.N.H. No. 26522/1:11, ×1.

23. A.M.N.H. No. 26522:32, ×2, whitened, to show growth striation.

24. A.M.N.H. No. 26522:32, ×2, unwhitened, to show color markings.

25. A.M.N.H. No. 26522:6, ×2; note color markings.

26, 27. A.M.N.H. No. 26522/2:6, transitional to *O. speciosa*, ×2; note color markings.

28. A.M.N.H. No. 26522/1:12, ×3/2; note sudden change in pattern of color markings.

31. A.M.N.H. No. 26522:25, ×2, to show color markings.

O. jenksi Haas: 29, 32–34, 38, 39, 42

29. A.M.N.H. No. 26523/1:2, ×2; note wide spacing of color markings.

32, 33. Specimen with particularly low aperture and body whorl, A.M.N.H. No. 26523:3, ×2.

34, 42. Syntype B, A.M.N.H. No. 26523:4, ×2.

38, 39. Syntype A, A.M.N.H. No. 26523:2, ×2.

O. speciosa Haas: 30, 35–37, 40, 41, 45–50, 53, 54, 59, 62, 65

30. A.M.N.H. No. 26524:16 (conspecificity not certain), ×2, to show zigzagging color markings.

35–37. A.M.N.H. No. 26524/1:2, ×2.

40, 41. Most characteristic shell from lot 86, A.M.N.H. No. 26524:1, ×2.

45, 46. A.M.N.H. No. 26524/1:4 (less gibbous than A.M.N.H. No. 26524:1), ×2.

47, 48. Juvenile, A.M.N.H. No. 26524/1:3, ×2.

49, 50. One of smallest juveniles measured, A.M.N.H. No. 26524/1:10, ×3.

53, 54. Holotype, A.M.N.H. No. 26524/1:1, ×2.

59, 65. Largest paratype, A.M.N.H. No. 26524:13, ×2, to show color markings on apical whorl faces and on base.

62. A.M.N.H. No. 26524:11, ×2; note fineness of growth striation and five "revolving keels."

O., new species: 55, 56

55, 56. A.M.N.H. No. 26525:1, ×2; note color markings.

?O. cacuana Haas: 43, 44, 51, 52, 57

43, 44. Syntype A, A.M.N.H. No. 26545:8, ×2; note growth striation in both and thickened inner lip in 44.

51, 52. Syntype B, A.M.N.H. No. 26545:2, ×5; note inclined nucleus.

57. A.M.N.H. No. 26545:6, ×2, to show reflexed inner lip and umbilical niche.

Protorcula, new species: 63, 64

63, 64. A.M.N.H. No. 26520, ×5.

?Glyptochrysalis ex aff. *G. anthophylloidis* (Klipstein): 58, 60, 61

58. A.M.N.H. No. 26519/1, ×8; note details of ornamentation and inclined nucleus.

60, 61. A.M.N.H. No. 26519; 60, ×8; 61, ×5.

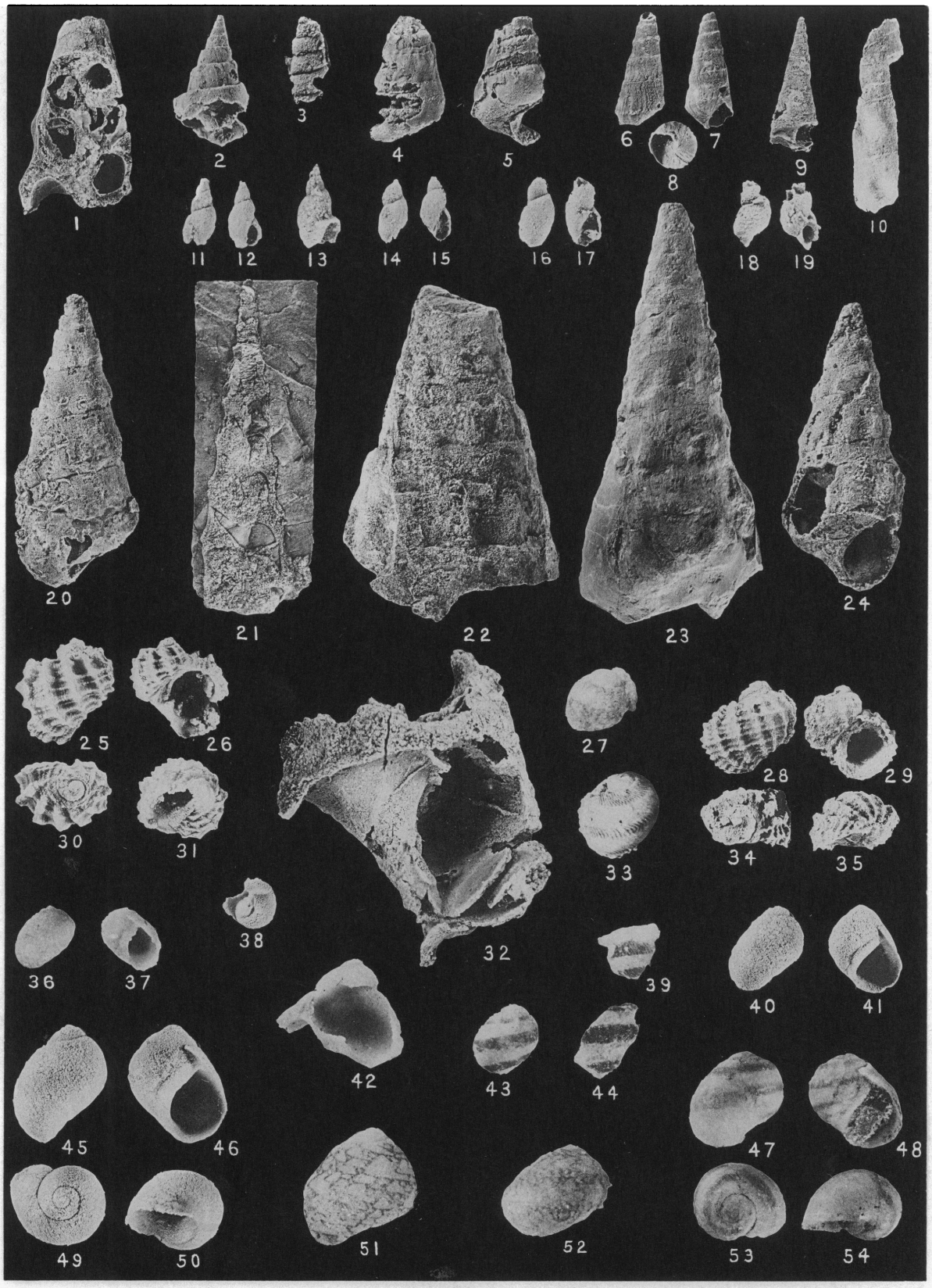
The Coelostylinidae are continued on plate 9.

PLATE 9

COELOSTYLINIDAE (*continued*): *Gigantogonia, Undularia, Pustulifer, Toxochoncha*
SPIROSTYLIDAE: *Spirostylus, Euthystylus*
NERITOPSIDAE (NERITOPSINAE): *Neritopsis*
NERITIDAE: *Neritaria*

Gigantogonia sp.: 32
32. A.M.N.H. No. 26547, ×1.
Undularia cf. *disputata* Kittl: 2
2. A.M.N.H. No. 26551, ×2.
Pustulifer peruvianus Haas: 20–24
20, 24. Holotype, A.M.N.H. No. 26552, ×1.
21. A.M.N.H. No. 26552/3:2, ×3/4, shown as embedded in slab of rock.
22, 23. Paratypes A.M.N.H. Nos. 26552/3:1 and 26552/2:1, respectively, ×3/4; note tubercles.
P. sp. indet.: 1, 4, 5, 10
1, 10. A.M.N.H. No. 26553:2, ×1; note tubercles in 10.
4, 5. A.M.N.H. No. 26553:1, ×1; note tubercles in 4.
Toxoconcha gracilis Haas: 6–9
6–8. Syntype A, A.M.N.H. No. 26554:1, ×1.
9. Syntype B, A.M.N.H. No. 26554/1, ×1.
Spirostylus peruvianus Haas: 11–17
11, 12. Syntype A, A.M.N.H. No. 27680:2, ×5.
13. A.M.N.H. No. 27680:6, ×8.
14, 15. Syntype B, A.M.N.H. No. 27680:3, ×5.
16, 17. A.M.N.H. No. 27680:4, ×5.
Note projecting inner lip and narrow but deep umbilical slit in 15, faint growth striation in 14 and 16, and alloiostrophy in 12–15.
S. sp. indet.: 18, 19
18, 19. A.M.N.H. No. 27681, ×5; note faint revolving striation.
Euthystylus sp. indet.: 3
3. A.M.N.H. No. 26546, ×5.
Neritopsis decussata (Münster): 25, 26, 28–31, 34, 35
25, 26, 30, 31. A.M.N.H. No. 26507:2, ×4.
28, 29, 34, 35. A.M.N.H. No. 26507:1, ×2.
Neritaria obliqua Haas: 27, 36–38, 40–42, 45, 46, 49–52
27, 52. A.M.N.H. Nos. 27179:96 and 27179:92, respectively, ×5, to show variation in pattern of color markings.
36, 37. Juvenile, A.M.N.H. No. 27179:8, ×5; note that small prominences on inner lip are sand grains, not teeth.
38. Paratype A.M.N.H. No. 27179:94, basal view, ×3, to show knob-shaped callosity.
40, 41. Characteristic shell, A.M.N.H. No. 27179:85, ×3.
42. A.M.N.H. No. 27179:95, ×5, to show resorption of inner walls.
45, 46, 49, 50. Syntype A, A.M.N.H. No. 27179:90, ×3; note growth striation in 45, 46, and 49.
51. Syntype B, A.M.N.H. No. 27179:93, ×5, to show pattern of color markings most common in the species.
N. dicosmoides Haas: 33, 39, 43, 44, 47, 48, 53, 54
33, 39, 43, 44. A.M.N.H. Nos. 27180:115–27180:118, respectively, ×3, to show variation in pattern of color markings; note that blank bands are sunk between solid colored ones in 44.
47, 48, 53, 54. Holotype, A.M.N.H. No. 27180:98, ×3; note color markings characteristic of the species, growth striae, and, in 48, reflexed lower part of inner lip.

The Neritidae, *Neritaria*, and *N. dicosmoides* are continued on plate 10.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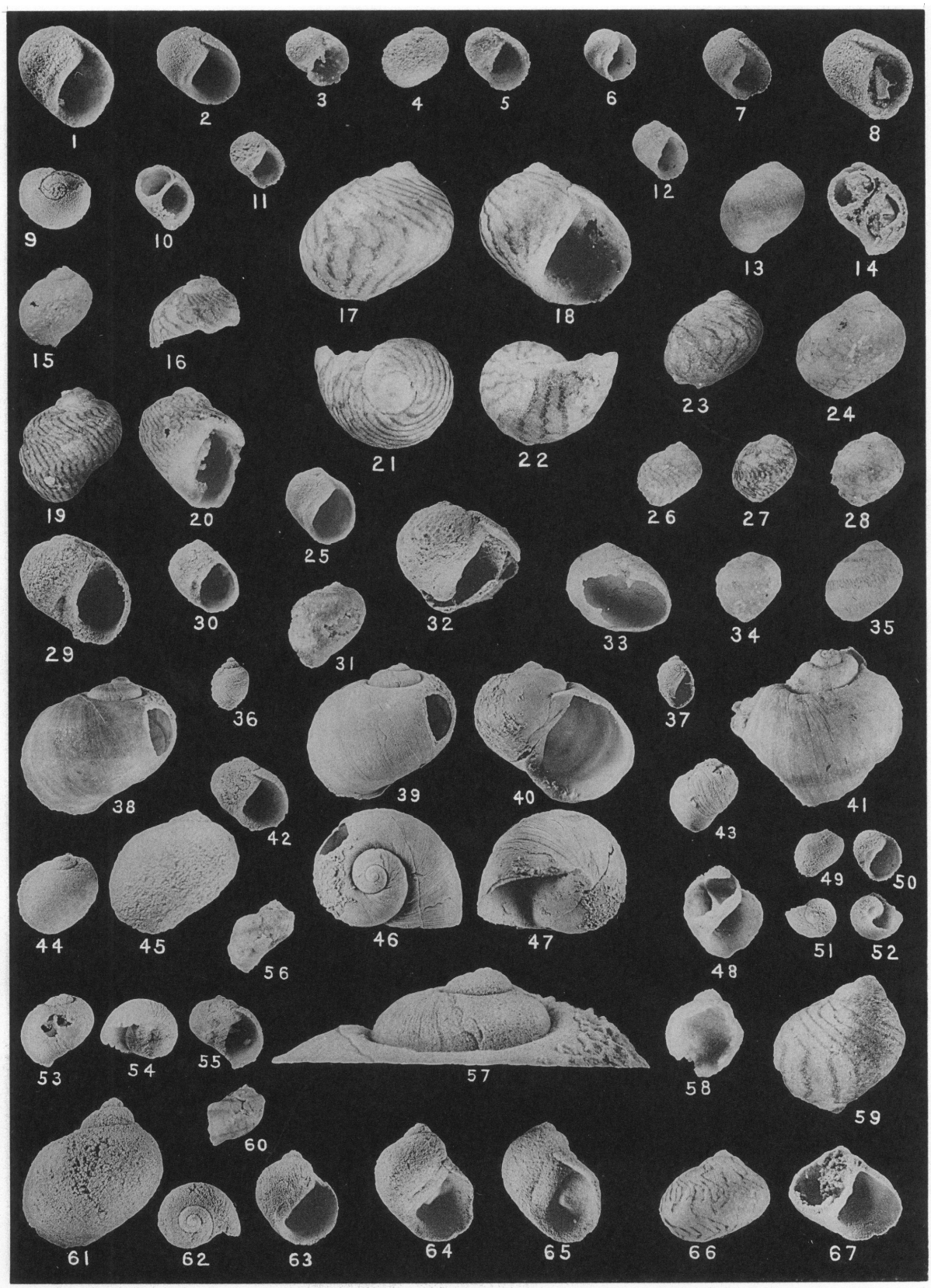
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PLATE 10

NERITIDAE: *Neritaria* (*continued*)

Neritaria dicosmoides Haas (continued): 1–7, 9, 29, 32

1. A.M.N.H. No. 27180:49, ×5, to show circumumbilical edge.
2. A.M.N.H. No. 27180:84, ×3, to show circumumbilical edge.
3. A.M.N.H. No. 27180:108, ×5, to show reflexed inner lip.
4, 5. Juvenile, A.M.N.H. No. 27180:14, ×5.
6, 7. A.M.N.H. Nos. 27180:6 and 27180:24, respectively, ×5, to show indications of twin teeth on inner lip, 6 tilted with apex away from camera.
9. A.M.N.H. No. 27180:76, apical view, ×3, to show elliptical outline.
29. A.M.N.H. No. 27180:110, ×3, to show deep umbilical niche.
32. A.M.N.H. No. 27180/2:2, ×2, to show pitted surface.

N. hologyroides Haas: 8, 10–28, 30, 33, 35

8. A.M.N.H. No. 27181/1:1, ×5, to show indication of twin teeth on inner lip.
10, 33. A.M.N.H. Nos. 27181:97 and 27181:98, respectively, ×3, to show partial and almost total resorption of inner walls.
11. A.M.N.H. No. 27181/2:1, ×5, to show reflexed inner lip, heavy callosity, and groove encircling it.
12. A.M.N.H. No. 27181:15, ×5, to show single tooth on inner lip.
13, 14. A.M.N.H. No. 27181:82, ×3; note color markings in 13.
15. Juvenile, A.M.N.H. No. 27181:93, ×8, to show early ontogeny.
16, 23, 24, 26–28, 35. A.M.N.H. Nos. 27181:100, 27181:56, 27181:91, 27181:49, 27181:96, 27181:67, and 27181:80, respectively; 16, 23, 26, and 35, ×3; 24, 27, and 28, ×5. All are to show variation in pattern of color markings.
17, 18, 21, 22. Holotype, A.M.N.H. No. 27181:59, ×3.
19, 20. A.M.N.H. No. 27181:55, ×3, to show color markings and, in 20, deep excavation of lower part of callosity.
25, A.M.N.H. No. 27181:60, ×3, to show deep umbilical niche.
30. A.M.N.H. No. 27181:51, ×3, to show swelling on callosity.

N. ninacacana Haas: 31, 34, 38–42, 44–47, 49–55, 57

31, 34, 41. A.M.N.H. Nos. 27182:46, 27182:42, and 27182:45, respectively; 31, 34, ×5; 41, ×3. All are to show variation in site and width of color bands and, in 41, growth striation and deepened sutures.
38–40, 46, 47, 57. Syntype B, A.M.N.H. No. 27182:41; 38–40, 46, 47, ×3/2, 38 unwhitened to show color bands; 57, close-up of spire to show early ontogeny, ×5.
42, 44, 45. Juvenile, A.M.N.H. No. 27182:33, 42, 44, ×5; 45, ×8; 44 and 45 to show early ontogeny.
49–52. Syntype A, A.M.N.H. No. 27182:15, ×5; note swelling on callosity and adjacent pit in 50 and 52 and faint indication of twin teeth on inner lip in 50.
53–55. A.M.N.H. No. 27182:38, ×3; note swelling on callosity and adjacent pit in 54 and 55 and sharp corner at lower left of aperture and reflexed inner lip in 55.

N. distincta Haas: 43, 48, 56, 58–67

43. A.M.N.H. No. 27183/2:3, ×3, to show growth folds.
48, 58. A.M.N.H. Nos. 27183:34 and 27183:35, respectively; 48, ×3; 58, ×5; to show partial and total resorption of inner walls.
56, 60. A.M.N.H. Nos. 27183:32 and 27183:31, respectively, ×3, to show color bands.
59. A.M.N.H. No. 27183:26, ×5, to show different color markings.
61–63. Syntype A, A.M.N.H. No. 27183:21; 61, ×5, to show early ontogeny; 62, 63, ×3.
64. A.M.N.H. No. 27183:22, ×3; note umbilical niche.
65. A.M.N.H. No. 27183:23, ×3, to show callosity and adjacent groove and what is believed to be mold of reverse face of an operculum.
66, 67. A.M.N.H. No. 27183:28, ×3; 66 to show color markings and growth striation and 67 to show shell profile and indication of twin teeth on inner lip.

N. aff. *distinctae* Haas: 36, 37

36, 37. A.M.N.H. No. 27184, ×3.

The Neritidae, *Neritaria*, and *N. distincta* are continued on plate 11.

PLATE 11

NERITIDAE: *Neritaria (continued)*, *Trachynerita*, *Oncochilus*
LACUNIDAE: *Heterospira*
PURPURINIDAE: *Andangularia*, *Pseudoscalites*

Neritaria distincta Haas (*continued*): 1–6, 9, 12

1, 12. A.M.N.H. No. 27183/1:5; 1, ×3/2, to show narrow color bands; 12, ×5, to show course of growth striae, especially near suture.

2–4. Syntype B. A.M.N.H. No. 27183/2:6, ×3; note growth striation.

5. A.M.N.H. No. 27183:14, ×5, to show swelling on callosity.

6. A.M.N.H. No. 27183/1:7, ×3, to show color band wider than bands in 1.

9. A.M.N.H. No. 27183/1:3, ×2, to show deep excavation of callosity.

Trachynerita tambosolensis Haas: 18, 19, 24

18, 19, 24. Holotype, A.M.N.H. No. 27189, ×1.

T. porrecta Haas: 27, 28, 31

27, 28, 31. Holotype, A.M.N.H. No. 27190, ×1.

?T. evoluta Jaworski: 10, 17, 20, 26, 29

10, A.M.N.H. No. 27193/1:1, ×1, shown embedded in slab of rock.

17, 20. A.M.N.H. No. 27193:1, ×1.

26. A.M.N.H. No. 27193/2:2, ×1, with spire tilted away from camera to show callosity and shape of aperture.

29. A.M.N.H. No. 27193/2:1, ×1, to show shell shape.

Oncochilus peruvianus Haas: 7, 8, 11

7, 8, 11. Holotype, A.M.N.H. No. 27187, ×3; note twin teeth in 8.

Heterospira simulatrix Haas: 13–16

13, 15, 16. Holotype, A.M.N.H. No. 26527:1, ×2; note well-developed growth striation.

14. Largest specimen present, base incomplete, A.M.N.H. No. 26527:4, ×2.

Andangularia aff. *subarmatae* (Jaworski): 21–23, 25, 33–35

21, 22. A.M.N.H. No. 27682; 21, ×5; 22, ×8, to show nucleus.

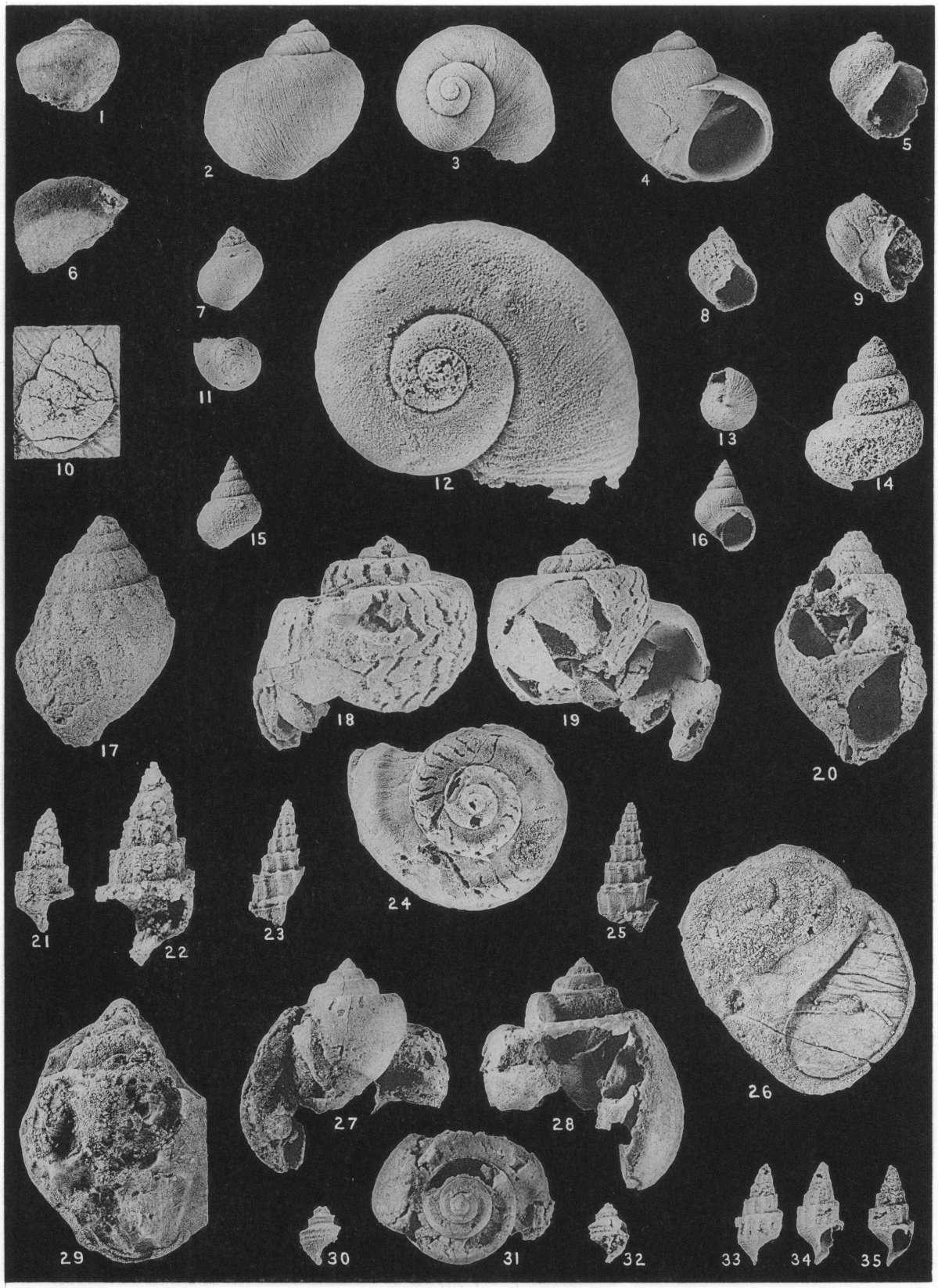
23, 25. A.M.N.H. No. 27682/1, ×3; note strong shoulder tubercles and minor keel running beneath shoulder keel carrying inconspicuous tubercles.

33–35. Specimen from Suta, coll. B. Kummel, ×3; note one minor keel beneath shoulder keel and two beneath peripheral shoulder in 33 and canal and reflexed inner lip in 34 and 35.

Pseudoscalites, new species: 30, 32

30, 32. A.M.N.H. No. 27683:1, ×5; note two revolving keels beneath shoulder keel in 30.

The Purpurinidae, *Pseudoscalites*, and *P.*, new species, are continued on plate 12.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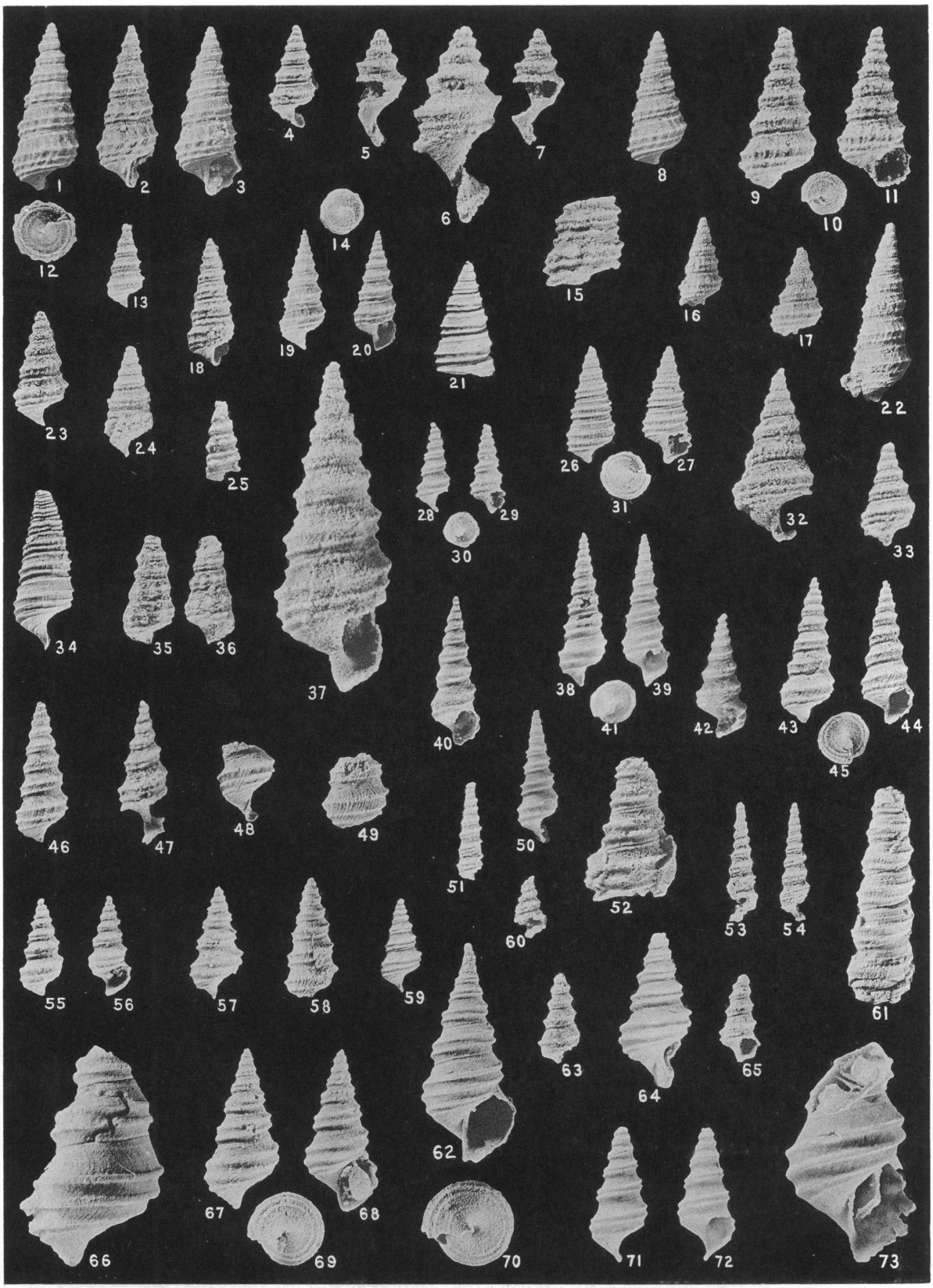
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PLATE 12

PURPURINIDAE: *Pseudoscalites* (*continued*)
MATHILDIDAE: *Promathilda* (*Promathilda, Teretrina*)

Pseudoscalites, new species (*continued*): 5–7

5–7. A.M.N.H. No. 27683:2; 5, 7, ×5; 6, ×8; in 6 note canal, reflexed inner lip, deep umbilical niche, two minor keels beneath shoulder keel, faint growth striae that produce beads on shoulder keel, and alloiostrophic nucleus.

Promathilda (*Promathilda*) *subnodosoides* Haas: 1–4, 8–16, 18–20, 22, 23, 37

1–3, 12. Syntype C, A.M.N.H. No. 27155:44, ×3; 2 to show reflexed inner lip.

4. A.M.N.H. No. 27155:38, ×3; individual growth striae recognizable.

8. A.M.N.H. No. 27155:4, ×3.

9–11. Syntype A, juvenile, A.M.N.H. No. 27155:22; 9, 11, ×8, to show alloiostrophy of nucleus; 10, ×5.

13, 16. Juveniles, A.M.N.H. Nos. 27155:16 and 27155:17, respectively, ×5, to show first appearance of beads on keels.

14, 19, 20, 37. Syntype B, A.M.N.H. No. 27155:52; 14, 19, 20, ×3; 37, ×8, to show alloiostrophic nucleus; note also reflexed inner lip in 20 and 37.

15. Fragment, A.M.N.H. No. 27155:45, ×5, to show strength and sharpness of tubercles.

18. A.M.N.H. No. 27155:40, ×3, to show three faint revolving ridges on base.

22, 23. A.M.N.H. Nos. 27155:46 and 27155:31, respectively, to show details of ornamentation; 22, ×3; 23, ×5.

P. (*P.*) *alia* Haas: 17, 21, 24, 26, 27, 31–34

17. Stout juvenile, A.M.N.H. No. 27156/1:10, ×5.

21. Fragment, A.M.N.H. No. 27156:9, ×3/2; note subsutural keel.

24, 32. A.M.N.H. Nos. 27156/1:3 and 27156/1:13, respectively, ×8, to show alloiostrophic nuclei.

26, 27, 31. Holotype, A.M.N.H. No. 27156:4, ×3; note revolving ridges on base.

33. Juvenile, A.M.N.H. No. 27156/1:2, ×8, to show early stages of ornamentation.

34. A.M.N.H. No. 27156:8, ×2; note details of ornamentation, particularly four revolving ridges on base.

P. (*P.*) aff. *perarmatae* (Münster): 25, 35, 36

25. A.M.N.H. No. 27157:1, ×5.

35, 36. A.M.N.H. No. 27157:2, ×5; note details of ornamentation.

Promathilda (*Teretrina*) *bolinoides* Haas: 28–30, 38–50, 52

28–30. Syntype A, Juvenile, A.M.N.H. No. 27158:38, ×5; note alloiostrophic nucleus in 28 and 29.

38, 39, 41. Syntype C, A.M.N.H. No. 27158:11, ×3; note fine supersutural and subsutural keels in 38 and 39 and alloiostrophic nucleus in 38.

40. A.M.N.H. No. 27158:10, ×3.

42, 47. A.M.N.H. Nos. 27158/1:15 and 27158/1:14, respectively, ×8, to show alloiostrophic nuclei.

43–45. Syntype B, A.M.N.H. No. 27158/1:44, ×3; note growth striation.

46. A.M.N.H. No. 27158/1:47, ×3, to show growth striation.

48. Fragment, A.M.N.H. No. 27158/1:46, ×3, to show reflexed inner lip, revolving lirae on base, and growth striation.

49. Fragment, A.M.N.H. No. 27158/1:7, ×5, to show growth striae and beads they produce on keels.

50. A.M.N.H. No. 27158:49, ×3; note alloiostrophic nucleus.

52. Fragment, A.M.N.H. No. 27158:70, ×5, to show supersutural and subsutural keels.

P. (*T.*) *aculeata* Haas: 51, 53, 54, 61

51. A.M.N.H. No. 27166:1, ×5; note alloiostrophic nucleus.

53, 54. Holotype, A.M.N.H. No. 27166:2, ×3.

61. Fragment, A.M.N.H. No. 27166/1, ×3, to show details of ornamentation.

P. (*T.*) *intermedia* Haas: 55–60, 62, 66–70, 73

55, 56. Syntype A, juvenile, A.M.N.H. No. 27159/1:31, ×5; note alloiostrophic nucleus.

57. A.M.N.H. No. 27159:20, ×3.

58. Fragment, A.M.N.H. No. 27159:41, ×3, to show growth striation.

59. Juvenile, A.M.N.H. No. 27159:28, ×5, to show early appearance of supersutural keels.

60. Juvenile, A.M.N.H. No. 27159/1:3, ×8, to show alloiostrophic nucleus.

62, 70. Syntype C, A.M.N.H. No. 27159:27, ×2; note reflexed inner lip in 62 and narrow umbilicus and revolving lirae on base in 62 and 70.

66, 73. Fragment, A.M.N.H. No. 27159:32, ×3; note reflexed inner lip and deep umbilical niche in 73 and fine growth striation in 66 and 73.

67–69. Syntype B, A.M.N.H. No. 27159:26, ×3.

P. (*T.*) sp.: 63, 65

63, 65. A.M.N.H. No. 27163, ×2.

P. (*T.*) *obtusa* Haas: 64, 71, 72

64. A.M.N.H. No. 27160:4, ×5, to show umbilical niche.

71, 72. Juvenile, A.M.N.H. No. 27160:35, ×5.

The Mathildidae, *Promathilda* (*Teretrina*), and *P.* (*T.*) *obtusa* are continued on plate 13.

PLATE 13

MATHILDIDAE: *Promathilda* (*Teretrina*) (*continued*), *Promathilda* (*Clathrobaculus*)
VERMITIDAE: *?Vermicularia*

Promathilda (*Teretrina*) *obtusa* Haas (*continued*): 1–9, 11–18, 26

1, 9. Syntype B, A.M.N.H. No. 27160:42, ×5.
2–4. Syntype A, A.M.N.H. No. 27160:61, ×5.
5, 6. A.M.N.H. No. 27160:69, ×5.
7, 8. A.M.N.H. No. 27160:71, ×5.
11. A.M.N.H. No. 27160:58, ×3/2.
12. Fragment, A.M.N.H. No. 27160:77, ×2.
13. Natural cross section, A.M.N.H. No. 27160:72, ×3.
14. A.M.N.H. No. 27160:78, ×2.
15. Syntype C, A.M.N.H. No. 27160:60, ×2, to show growth striation.
16. A.M.N.H. No. 27160:73, ×3, to show two innermost revolving lirae of base.
17. Incomplete juvenile, A.M.N.H. No. 27160:76, ×8.
18. Natural cross section, A.M.N.H. No. 27160:70, ×2; note anterior notch, reflexed inner lip, and narrow umbilicus.
26. Fragment, A.M.N.H. No. 27160:75, ×3, to show growth lamellae.

Note alloiostrophic nuclei in 1–3, 5–8, 11, and 17.

P. (*T.*) *eucycloides* Haas: 10, 19–21, 27, 29

10. A.M.N.H. No. 27161/1:4, ×5, to show growth striation on body whorl.
19, 20, 27. Syntype B, A.M.N.H. No. 27161:6, ×3; note deep umbilical niche in 27.
21, 29. Syntype A, A.M.N.H. No. 27161:4. 21, ×5; 29, ×8, to show alloiostrophic nucleus.

P. (*T.*) *tilarniocensis* Haas: 22–25, 28, 31, 41

22, 23. A.M.N.H. No. 27162:12, ×3; note growth striae.
24, 25, 31. Holotype, A.M.N.H. No. 27162:10, ×5; note two innermost revolving lirae of base in 24 and 31 and growth striae in 24 and 25.
28. A.M.N.H. No. 27162:15, ×5, to show alloiostrophic nucleus.
41. Largest paratype, A.M.N.H. No. 27162:16, ×3.

P. (*T.*) *terebraeformis* Haas: 30, 32–40, 42, 53

30. Fragment, A.M.N.H. No. 27164/1:8, ×5; note subsutural ridges.
32. A.M.N.H. No. 27164:14, ×5, to show alloiostrophy.
33. A.M.N.H. No. 27164:16, ×3.
34. Syntype B, A.M.N.H. No. 27164:13, ×5.
35, 36. A.M.N.H. No. 27164:15, ×5; note disappearance of lower lateral keel on penultimate whorl.
37, 38. Syntype A, A.M.N.H. No. 27164:11, ×5; note alloiostrophic nucleus.
39. A.M.N.H. No. 27164/1:7, ×2.
40. A.M.N.H. No. 27164/1:6, ×2.
42, 53. Syntype C, A.M.N.H. No. 27164/1:4, ×5; note reflexed inner lip, umbilical niche, revolving swelling on base, and growth striation in 42.

P. (*Clathrobaculus*) *subulata* Haas: 43–52, 59, 69

43–45. Syntype A, A.M.N.H. No. 27167:7, ×5.
46–48. Syntype B, A.M.N.H. No. 27167:10, ×5; note nodes on keels.
49, 50. A.M.N.H. No. 27167:9, ×5; note beads on keels in 49.
51, 52. A.M.N.H. No. 27167:11, ×5; note subsutural keels and, in 52, corkscrew-shaped columella.
59, 69. A.M.N.H. No. 27167:8; 59, ×5; 69, ×8; both to show alloiostrophic nucleus.

?P. (*C.*), new species: 54, 60

54, 60. A.M.N.H. No. 27168; 54, ×3; 60, ×5; note revolving striation and alloiostrophic nucleus.

P. (*?C.*) *gracillima* Haas: 55–58, 64, 65

55, 56. Syntype A, A.M.N.H. No. 27165:3, ×5.
57. Fragment, A.M.N.H. No. 27165:8, ×5, to show aperture.
58. A.M.N.H. No. 27165:1, ×8.
64. A.M.N.H. No. 27165:6, ×8.
65. Syntype B, A.M.N.H. No. 27165:5, ×5; note revolving ornamentation.

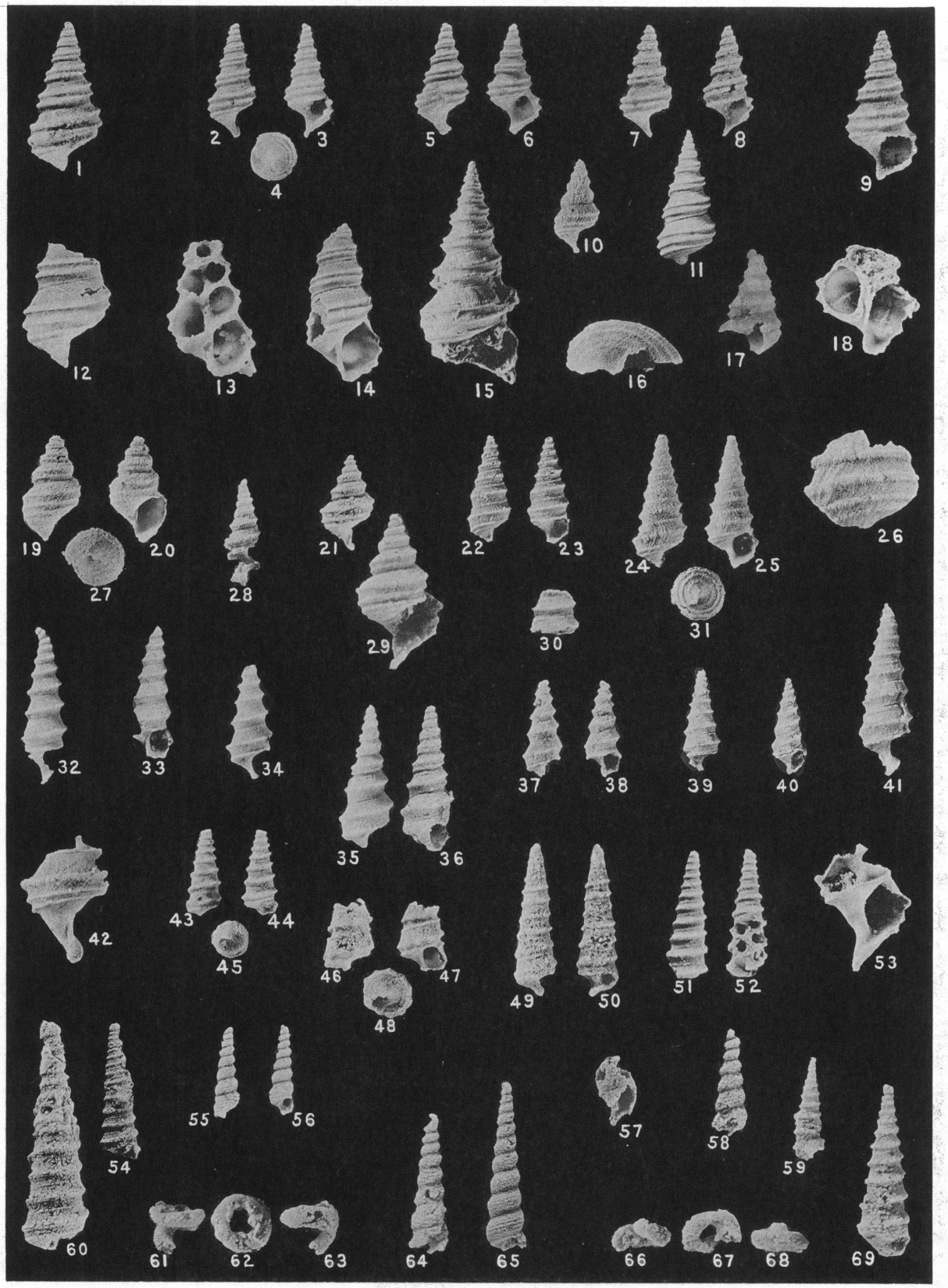
Note alloiostrophic nuclei in 55, 56, and 58 and broken heterostrophic nucleus in 64.

?Vermicularia sp. indet. 1: 61–63

61–63. A.M.N.H. No. 27553; 61, 63, side views; 62, apical view; ×8.

?V. sp. indet. 2: 66–68

66–68. A.M.N.H. No. 27554; 66, front view; 67, basal view; 68, rear view; ×8.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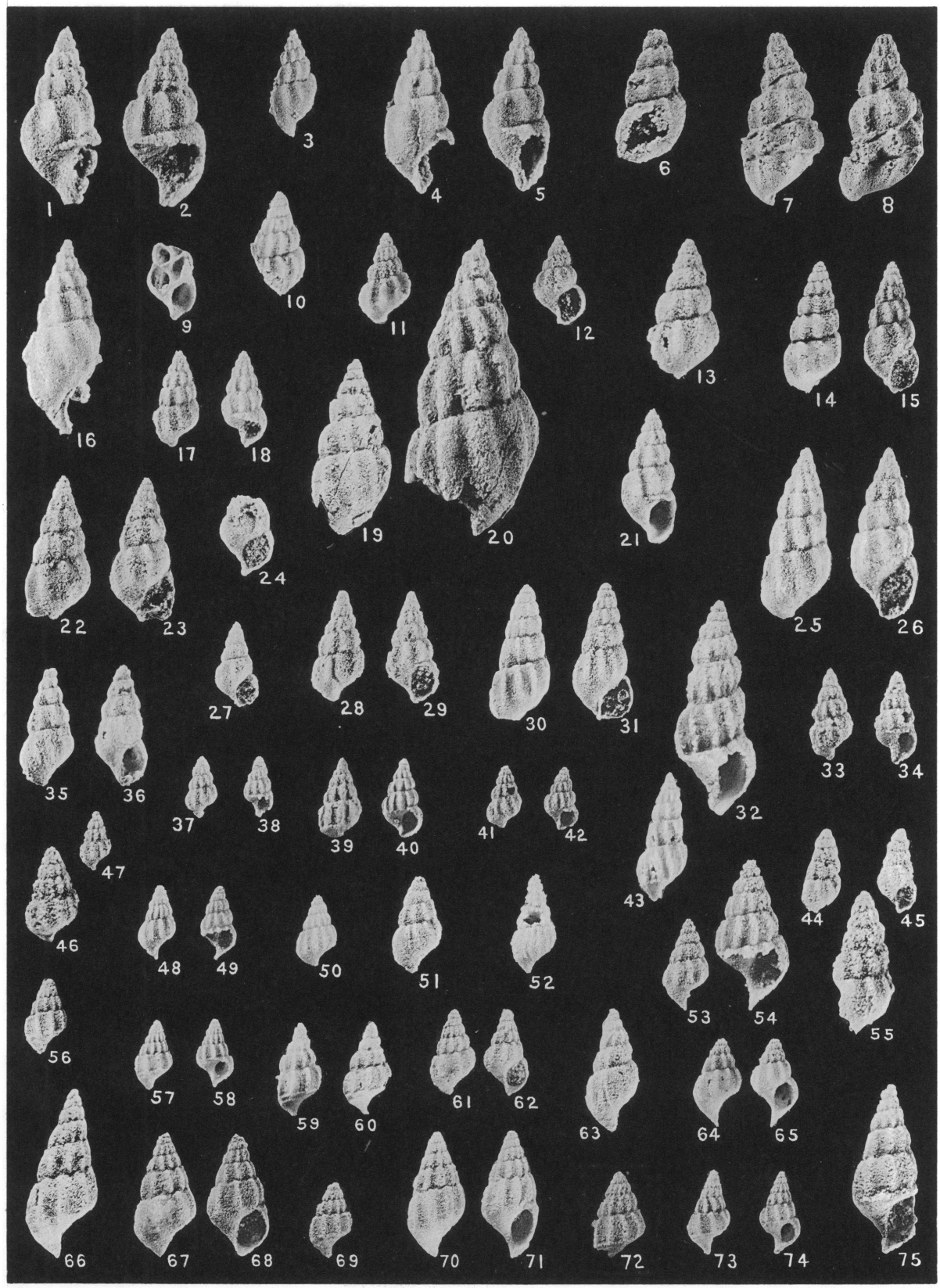
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PLATE 14

PROCERITHIIDAE: *Protofusus*

Protofusus peruvianus Haas: 1–8, 10–12, 16, 19, 20

1–3. Syntype B, A.M.N.H. No. 26584:2; 1, 2, ×5; 3, ×2; 1 to show reflexed inner lip.

4, 5. Syntype C, A.M.N.H. No. 26584:3, ×3; note reflexed inner lip and faint revolving striation in 4.

6. A.M.N.H. No. 26584:6, ×3; note minute denticulations produced by revolving striation on ribs.

7, 8. A.M.N.H. No. 26584/1:29, ×3; note lower end of umbilical furrow and ribs continuing into base in 7.

10. A.M.N.H. No. 26584/1:31, ×5; note heavy and dense costation, faint revolving striation, and inclined nucleus.

11, 12. Syntype A, juvenile, A.M.N.H. No. 26584/1:10, ×5.

16. Largest paratype, A.M.N.H. No. 26584:4, ×3; note furrow accompanying inner lip and continuity of ribs across three last whorls.

19, 20. A.M.N.H. No. 26584:5; 19, ×3; 20, ×5, note alloiostrophic nucleus.

Protofusus gracilis Haas: 9, 13–15, 17, 18, 21–29

9. Broken juvenile, A.M.N.H. No. 26587:1, ×5, to show shell profile, corkscrew-shaped columella, and reflexed inner lip.

13, 27. Juvenile, A.M.N.H. No. 26587:4; 13, ×8, to show inclined nucleus; 27, ×5.

14, 15. Syntype B, A.M.N.H. No. 26587:8, ×5; note faint revolving striation in 14 and indication of umbilical niche in 15.

17, 18. Juvenile, A.M.N.H. No. 26587/1:5, ×5.

21. A.M.N.H. No. 26587:27, ×5; note alloiostrophic nucleus.

22, 23. A.M.N.H. No. 26587:11, ×5; note ribs continuing into base and, in 22, fine revolving striation on body whorl.

24. Fragment, A.M.N.H. No. 26587:31, ×5, to show shape of aperture.

25, 26. Syntype C, A.M.N.H. No. 26587:12, ×5; in 25 note continuity of ribs over two consecutive whorls and their continuation into base.

28, 29. Syntype A, A.M.N.H. No. 26587:6, ×5; note slightly reflexed inner lip in 29.

P. delicatulus Haas: 30–52, 55, 63

30, 31. A.M.N.H. No. 26588/1:18, ×5, bottom of aperture missing; note alloiostrophic nucleus, especially in 30.

32, 43. Syntype C, A.M.N.H. No. 26588:30; 32, ×8, to show alloiostrophy; 43, ×5.

33, 34. Syntype B, A.M.N.H. No. 26588:20, ×5; note thickened and reflexed inner lip in 34.

35, 36. A.M.N.H. No. 26588:28, ×5.

37, 38. Juvenile, A.M.N.H. No. 26588:2, ×5.

39, 40. Syntype A, A.M.N.H. No. 26588:19, ×5; note reflexed inner lip in 40.

41, 42. Juvenile, A.M.N.H. No. 26588:6, ×5.

44, 45, 55. A.M.N.H. No. 26588/1:12; 44, 45, ×5; note reflexed inner lip in 45; 55, ×8, to show alloiostrophy.

46, 47. Juvenile, A.M.N.H. No. 26588:5; 46, ×8, to show alloiostrophy; 47, ×5.

48, 49. Medium-sized shell, A.M.N.H. No. 26588/1:8, ×5.

50. Somewhat stouter shell than that in 48 and 49, A.M.N.H. No. 26588/1:1, ×5.

51, 52, 63. A.M.N.H. Nos. 26588/1:16, 26588:23, and 26588/1:17, respectively, ×5; note fading of costation on body whorls.

P. pyramidalis Haas: 53, 54, 56–62, 64–75

53, 54. Syntype B, A.M.N.H. No. 26588:32; 53, ×5; 54, ×8, to show nucleus.

56, 69, 72. Juveniles, A.M.N.H. Nos. 26585:8, 26585:11, and 26585:1, respectively; 56, 69, ×5; 72, ×8; note faint revolving striation.

57, 58, Syntype A, A.M.N.H. No. 26585:5, ×5.

59, 60. A.M.N.H. No. 26585:16, ×5.

61, 62. Medium-sized shell, A.M.N.H. No. 26585:14, ×5.

64, 65. Short-spired specimen, A.M.N.H. No. 26588:18, ×5.

66, 75. Largest paratype, A.M.N.H. No. 26588:28, ×5; note alloiostrophic nucleus and, in 66, continuation of ribs into base.

67, 68. A.M.N.H. No. 26588:26, ×5.

70, 71. Syntype C, A.M.N.H. No. 26588:24, ×5.

73, 74. A.M.N.H. No. 26585:34, ×5.

Note twin keels on peripheral shoulders in 56–60, 72, and 73.

The Procerithiidae, *Protofusus*, and *P. pyramidalis* are continued on plate 15.

PLATE 15

PROCERITHIIDAE: *Protofusus* (*continued*), *Paracerithium*, *?Pseudotritonium*, *Rhabdocolpus*

Protofusus pyramidalis Haas (*continued*): 5, 6, 15

5, 6, 15. A.M.N.H. No. 26585:35; 5, 6, ×5; 15, ×8; note, especially in 15, faint revolving striation and alloiostrophic nucleus.

P. sp. indet.: 1, 10

1, 10. A.M.N.H. No. 26589, ×5; note in 1 beads on ribs caused by revolving striation.

P. aff. *pyramidali* Haas: 2, 3, 11, 12

2, 3. A.M.N.H. No. 26586:1, ×5.

11, 12. Juvenile, A.M.N.H. No. 26586/2, ×5. Note faint revolving striation in all four.

P. transitorius Haas: 4, 7–9, 13, 14, 16–24, 28, 29

4. Fragment, A.M.N.H. No. 26582/1:1, ×5; note beads at crossing points.

7, 16. Syntype C, A.M.N.H. No. 26582/1:8; 7, ×3; 16, ×5, to show alloiostrophic nucleus.

8, 9. Syntype A, A.M.N.H. No. 26582:22, ×8.

13, 14. Juvenile, A.M.N.H. No. 26582:1, ×5.

17. A.M.N.H. No. 26582/1:10, ×3.

18, 19. Syntype B, A.M.N.H. No. 26582/1:4; 18, ×8, to show nucleus; 19, ×5.

20, 21. High-spired juvenile, A.M.N.H. No. 26582/1:2, ×5.

22. A.M.N.H. No. 26582:26, ×5; note dense revolving ornamentation.

23, 24. A.M.N.H. No. 26582/1:7, ×5; note alloiostrophic nucleus, especially in 23.

28, 29. A.M.N.H. No. 26582/1:6, ×3.

P. aff. *transitorio* Haas: 26, 27, 30, 31

26, 27. A.M.N.H. No. 26583: 2, ×5.

30, 31. A.M.N.H. No. 26583:1, ×5.

Paracerithium tambosolense Haas: 25, 33–39

25. A.M.N.H. No. 26576/1:3, ×5, to show three basal keels.

33, 34. Syntype A, A.M.N.H. No. 26576/1:2, ×3.

35. Fragment, A.M.N.H. No. 26576:7, ×3.

36, 37. Syntype B, A.M.N.H. No. 26576:6, ×5.

38, 39. A.M.N.H. No. 26576:4, ×5; note sharp tubercles on ribs.

Note revolving ornamentation, especially on base, in 33–39.

P. turritellare Haas: 32, 40–47

32. A.M.N.H. No. 26577:14, ×5, to show radial growth striae.

40, 41. Syntype B, A.M.N.H. No. 26577:8, ×3.

42. A.M.N.H. No. 26577:9, transitional to *P. tambosolense*, ×3; note shoulder tubercles.

43, 44. A.M.N.H. No. 26577:13, ×3; 43 tilted with apex towards camera to show revolving ornamentation and crescent-shaped intercostals; note anterior notch and basal keels in 44.

45. Syntype A, A.M.N.H. No. 26577:10, ×3.

46, 47. Juvenile, A.M.N.H. No. 26577:4; 46, ×3; 47, ×5, to show nucleus.

P. porrectum Haas: 48–53, 56

48, 49. Syntype B, A.M.N.H. No. 26578/2:1, ×2; note slight shoulder tubercles.

50, 51. Syntype A, A.M.N.H. No. 26578:3, ×2.

52, 53. Juvenile, A.M.N.H. No. 26578/3:1, ×5; note revolving ornamentation and nucleus.

56. Incomplete spire, A.M.N.H. No. 26578/2:2, ×2.

P. aff. *porrecto* Haas: 54, 55

54, 55. Fragment, A.M.N.H. No. 26579, ×2.

P. vixstriatum Haas: 57–64, 69, 70, 73–75

57, 58. Unusually stout, medium-sized shell, A.M.N.H. No. 26580/1:3, ×5.

59, 60. Medium-sized shell, A.M.N.H. No. 26580/1:15, ×5.

61, 62. Juvenile, A.M.N.H. No. 26580/1:1, ×5.

63, 64. Syntype A, A.M.N.H. No. 26580:7; 63, ×3; 64, ×5, to show crescent-shaped intercostals.

69, 70. Syntype N, A.M.N.H. No. 26580/1:7, ×5.

73–75. Fragment, A.M.N.H. No. 26580/1:17, ×3; note pronounced upper shoulder in 73, slightly reflexed inner lip and accompanying furrow in 74, and outer and inner basal keels and radial growth striae of base in 75.

P. aff. *vixstriato* Haas: 65, 66, 71, 72

65, 66. A.M.N.H. No. 26581:2, ×3; note faint revolving striation in 65.

71, 72. A.M.N.H. No. 26581:1, ×3.

Note twin keels on peripheral shoulders in 65, 69, 71 and alloiostrophic nuclei in 64, 65, 70, 71.

?Pseudotritonium sp. indet.: 67, 68, 78, 79

67, 68. A.M.N.H. No. 26516, ×5.

78. A.M.N.H. No. 26516/1:1, ×5; note costation and faint revolving striation.

79. A.M.N.H. No. 26516/1:2, ×8, to show alloiostrophic nucleus.

Rhabdocolpus subulatus Haas: 76, 77, 80, 81, 85–88

76, 77. Juvenile, A.M.N.H. No. 26590:2, ×5.

80. Fragment, A.M.N.H. No. 26590:7, ×8, to show two revolving keels on base.

81. A.M.N.H. No. 26590:3, ×5.

85, 86. Syntype A, A.M.N.H. No. 26590:4; 85, ×3; 86, ×5.

87, 88. Syntype B, A.M.N.H. No. 26590:5, ×3.

Note flat lateral face of body whorl in 86, faint revolving striation in 76, 77, 81, and 85–87, shoulder tubercles and inclined nucleus in 86, 87.

R. sp. indet. 1, aff. *subulato* Haas: 89–91

89. A.M.N.H. No. 26591:2, ×5; note shape of aperture.

90. A.M.N.H. No. 26591:1, ×5, to show costation of earlier whorls.

91. A.M.N.H. No. 26591:3, ×3; note shoulder tubercles on preserved part of last whorl.

R. sp. indet. 2, aff. *subulato* Haas: 82–84

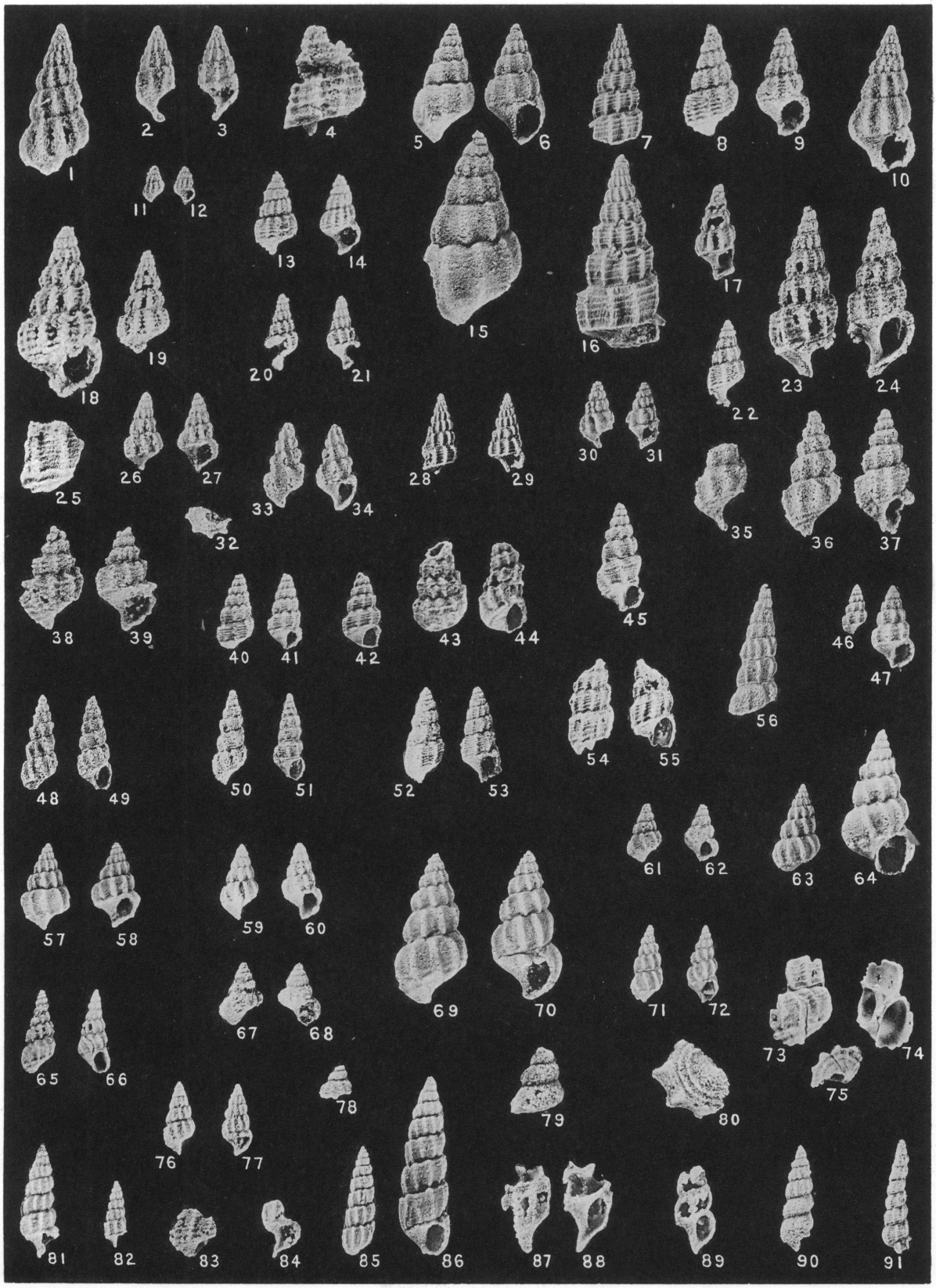
82. A.M.N.H. No. 26592:1, ×3; note shoulder tubercles.

83. Fragment, A.M.N.H. No. 26592:4, ×5.

84. Fragment, A.M.N.H. No. 26592:5, ×5; to show shape of aperture and anterior canal.

Note revolving ornamentation in 82, 83, 90, 91.

The Procerithiidae and *Rhabdocolpus* are continued on plate 16.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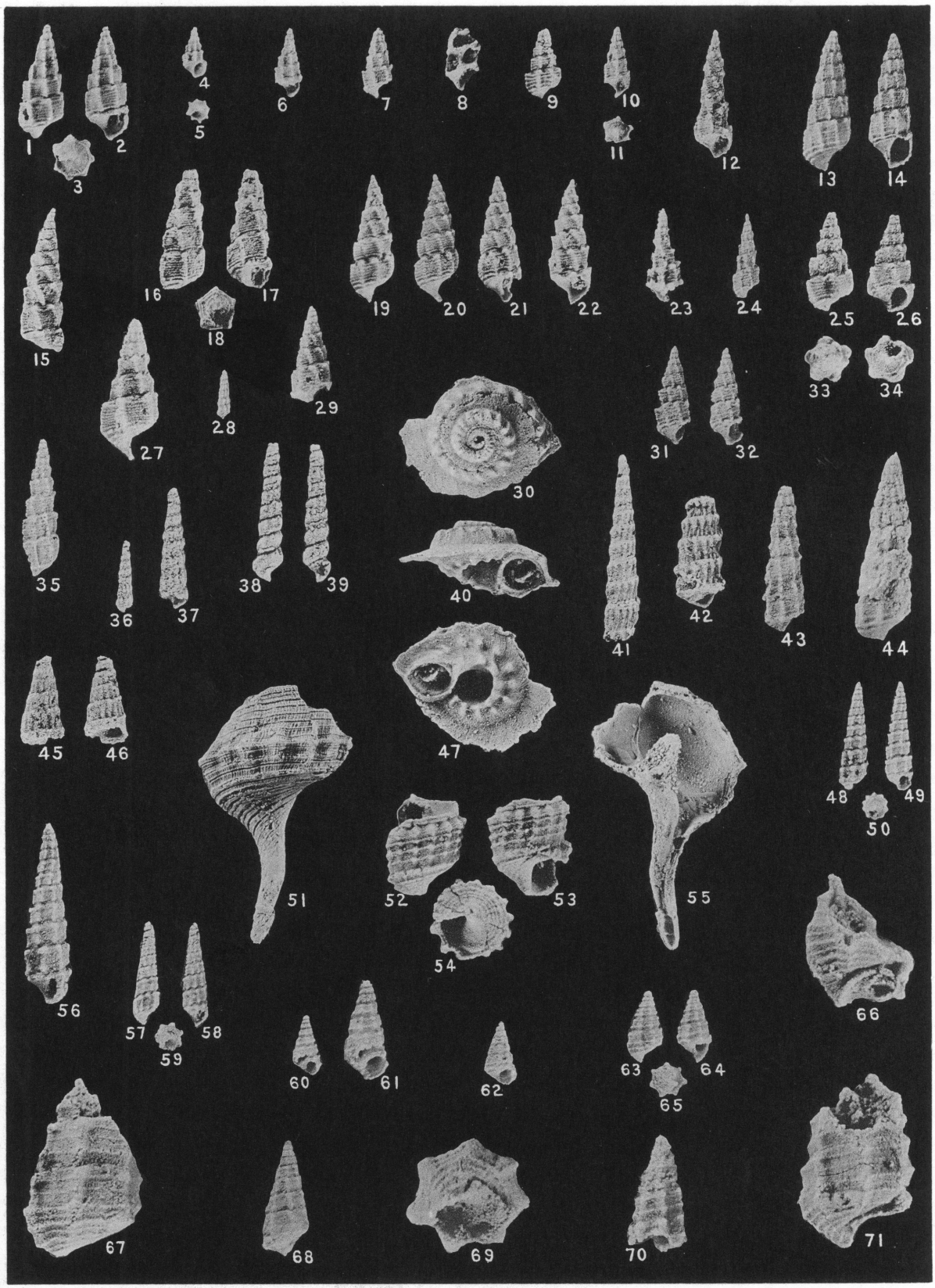
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PLATE 16

PROCERITHIIDAE: *Rhabdocolpus (continued)*, *Kittlistylus*, *Cryptaulax*
XENOPHORIDAE: *Jurassiphorus*
APORRHAIDAE: *?Aporrhais (Cuphosolenus)*

Rhabdocolpus praeco Haas: 1–11, 13, 14, 27

1–3. Syntype B, A.M.N.H. No. 26594:34, ×3.

4, 5. Syntype A, juvenile, A.M.N.H. No. 26594:10, ×3.

6, 7. Specimens with spine-like shoulder tubercles, A.M.N.H. Nos. 26594:39 and 26594:43, respectively, ×3.

8. Natural section, A.M.N.H. No. 26594:42, ×3; note corkscrew shape of columella.

9. Sturdy juvenile, A.M.N.H. No. 26594:44, ×5; note particularly distinct revolving ornamentation.

10, 11. A.M.N.H. No. 26594:17, ×3; note wide, deeply concave intercostals, denticulations of ribs produced by revolving threads, and garland shape of uppermost threads.

13, 14. Syntype C, A.M.N.H. No. 26594/1:2, ×3.

27. Shell with widely separated ribs, A.M.N.H. No. 26594:25, ×5.

R. rursicostatus Haas: 12, 15–23, 25, 26, 33, 34

12. A.M.N.H. No. 26595:7, ×3.

15. A.M.N.H. No. 26595:8, ×3.

16–18. Syntype C, A.M.N.H. No. 26595:9, ×3; note density of revolving ornamentation.

19–22. Syntype B, A.M.N.H. No. 26595:6, ×3; 20 to show revolving ornamentation, 21 to show reflexed inner lip and accompanying furrow.

23. A.M.N.H. No. 26595:10, ×3; note strong, sharp spines on right.

25, 26, 33, 34. Syntype A, juvenile, A.M.N.H. No. 26595:1, ×5; note density of revolving ornamentation.

R. emaciatus Haas: 24, 29, 31, 32, 35, 43, 44

24. A.M.N.H. No. 26597:2, ×3; note slender, high spire and short shoulder spines.

29. A.M.N.H. No. 26597:1, ×5.

31, 32. Syntype A, A.M.N.H. No. 26597:3, ×3; note shoulder tubercles.

35. Syntype B, A.M.N.H. No. 26597:7, ×3; note ribs continuing across upper ramp and revolving thread on latter.

43. A.M.N.H. No. 26597:8, ×3; note continuity of ribs over five whorls.

44. A.M.N.H. No. 26597:4, ×5.

Note alloiostrophic nuclei in 1, 2, 13, 14, 19, 22, 27, 29, and 44.

Kittlistylus flexuosus (Münster): 28, 36–39, 41

28. Juvenile, A.M.N.H. No. 26555:1, ×3; note tubercles on ribs.

36, 37. A.M.N.H. No. 26555:2; 36, ×3; 37, ×5.

38, 39. A.M.N.H. No. 26555:3, ×3; note strong tubercle in 39.

41. Largest specimen present, A.M.N.H. No. 26555:4, ×3; note revolving striation on upper portions of ribs.

Note alloiostrophic nuclei in 28, 36, and 37.

K. alter Haas: 42, 45, 46

42. Holotype, A.M.N.H. No. 26521:3, ×3.

45, 46. A.M.N.H. No. 26521:2, ×3.

Note fine denticulation of ribs in all three.

Cryptaulax rhabdocolpoides Haas: 48–50, 52–54, 56–59

48–50, 56. Syntype A, A.M.N.H. No. 26517:5; 48–50, ×3; 56, ×5, to show alloiostrophy.

52–54. Syntype B, A.M.N.H. No. 26517:8, ×5; note callosity formed by reflexed inner lip in 53 and 54.

57–59. A.M.N.H. No. 26517:4, ×3; note alloiostrophy in 57 and 58.

C. tilarniocensis Haas: 60–71

60, 61. A.M.N.H. No. 26593:1; 60, ×5; 61, ×8.

62. A.M.N.H. No. 26593:2, ×5; note umbilical niche and, on the right, middle tubercles on two last whorls.

63–65. Syntype A, A.M.N.H. No. 26593:3, ×5; note middle tubercles in 63 and 64.

66. Fragment, A.M.N.H. No. 26593: 5, ×8, to show ceiling of aperture.

67, 69, 71. Syntype B, A.M.N.H. No. 26593:6, ×8, to show details of ornamentation.

68. Largest complete shell, A.M.N.H. No. 26593:4, ×5.

70. Fragment, A.M.N.H. No. 26593:7, ×8.

Note nuclei in 61–63 and 68 and especially alloiostrophy of nucleus in 70.

Jurassiphorus triadicus Haas: 30, 40, 47

30, 40, 47. Holotype, A.M.N.H. No. 26514:1, ×3; note course of growth striae, particularly in 47.

?Aporrhais (Cuphosolenus), new species: 51, 55

51, 55. A.M.N.H. No. 27655:1, ×2; note details of ornamentation in 51.

PLATE 17

ACTEONIDAE: *Cylindrobullina* (*Cylindrobullina*)

Cylindrobullina (*Cylindrobullina*) *vespertina* Haas: 1–34, 37, 38, 45, 47, 48

1, 2. Unusually slender shell, A.M.N.H. No. 27633:27, ×5.

3, 4. Syntype A, A.M.N.H. No. 27633/1:14, ×5.

5–8. Examples of short-spired variety; 5, 6, A.M.N.H. No. 27633/1:36, ×5; 7, 8, A.M.N.H. No. 27633/1:21, ×5.

9. A.M.N.H. No. 27633:47, ×5, to show corkscrew shape of columella.

10, 11, 29. Syntype B, A.M.N.H. No. 27633:26; 10, 11, ×5; 29, ×8; note reflexed inner lip in 11.

12, 20. A.M.N.H. No. 27633/1:27, ×5; note open-umbilicus entirely covered in 12, partly covered in 20, by widely reflexed inner lip.

13. A.M.N.H. No. 27633/1:49, ×5, to show sigmoidal growth fold.

14, 15. Juvenile, A.M.N.H. No.27633:34, ×5.

16, 17. Shell with rounded profile, A.M.N.H. No. 27633:20, ×5.

18, 19. A.M.N.H. No. 27633:17, ×5.

21. A.M.N.H. No. 27633/1:47, ×8.

22, 23, 45. Short-spired shell with slightly rounded profile, A.M.N.H. No. 27633/1:29; 22, 23, ×3; 45, ×5, to show open umbilicus.

24, 34. Shell with medium high spire, A.M.N.H. No. 27633/1:30, ×5; note open umbilicus in 34.

25, 26. Shell with rounded profile, A.M.N.H. No. 27633/1:28, ×3.

27, 28. Juvenile, A.M.N.H. No. 27633:31, ×5.

30. A.M.N.H. No. 27633/1:53, ×5, to show widely reflexed inner lip.

31. A.M.N.H. No. 27633/1:45, to show reflexed inner lip and umbilical niche.

32, 33. A.M.N.H. No. 27633/1:42, belonging to short-spired variety, ×5; note faint revolving striation.

37. A.M.N.H. No. 27633:37, ×8.

38. A.M.N.H. No. 27633/1:48, ×8.

47. A.M.N.H. No. 27633:23, ×5, to show growth folds.

48. A.M.N.H. No. 27633/1:51, ×5, to show wide open umbilicus.

Note alloiostrophic or inclined nuclei in 3, 4, 16, 18, 19, 21, 27, 29, 37, and 38.

C. (*C.*) *avenoides* Haas: 35, 36, 39–42, 46, 49–51, 58, 59

35, 36. Juvenile, A.M.N.H. No. 27634:1, ×8.

39, 40. A.M.N.H. No. 27634/1:1, ×5; note slight constriction of body whorl on right in 40.

41, 42. Syntype A, A.M.N.H. No. 27634:10, ×5; note revolving striation in 41 and extremely narrow umbilical niche in 42.

46. A.M.N.H. No. 27634:7, ×8, to show revolving striation on last two whorls.

49. A.M.N.H. No. 27634:14, ×8.

50, 51. Incomplete juvenile, A.M.N.H. No. 27634:2, ×8; note faint costation on antepenultimate whorl in 50.

58, 59. Syntype B, A.M.N.H. No. 27634/1:3, ×3; note upper end of narrow umbilical niche in 59.

Note alloiostrophic nuclei in 36 and 59 and most distinctly in 49 and 50.

C. (*C.*) aff. *avenoidi* Haas: 43, 44, 52, 53, 64

43, 44, 64. A.M.N.H. No. 27635/1:3; 43, 44, ×5; 64, ×8.

52, 53. Juvenile, A.M.N.H. No. 27635:1, ×8.

Note alloiostrophic nuclei in all five, particularly in 64.

C. (*?C.*) *obesa* Haas: 54–57, 60–63, 65, 66, 70, 71, 75, 76, 79–82, 86

54. A.M.N.H. No. 27636/1:11, ×8.

55, 56. Characteristic medium-sized shell, A.M.N.H. No. 27636:9, ×5; note reflexed inner lip and narrow but deep umbilical niche in 56.

57. Medium-sized shell, A.M.N.H. No. 27636:8, ×5; note left twist of columella at its lower end.

60, 61. Medium-sized shell, A.M.N.H. No. 27636/1:10, ×5.

62, 63. Juvenile, A.M.N.H. No. 27636:16, ×8.

65. A.M.N.H. No. 27636/1:24, ×5, to show course of growth striae.

66. Unusually slender shell, A.M.N.H. No. 27636/1:23, ×5.

70. 71. A.M.N.H. No. 27636:19, transitional to *C.* (*?C.*) *pyrulaeformis*, ×5.

75, 79, 86. A.M.N.H. Nos. 27636/1:25, 27636/1:15, and 27636/1:26, respectively, ×8.

76, 80–82. Holotype, A.M.N.H. No. 27636/1:18; 76, close-up of spire, ×8; 80–82, ×3; note reflexed inner lip and narrow umbilical niche in 81 and 82.

Note alloiostrophic nuclei in 57 and 71 and more distinctly in 54, 61, 75, 76, 79, and 86.

C. (*?C.*) *pyrulaeformis* Haas: 67–69, 72–74, 84, 85

67. Slender, medium-sized shell, A.M.N.H. No. 27637:1, ×3; note "canal" pointing to left.

68, 69. Medium-sized shell, A.M.N.H. No. 27637/1:2, ×3; note reflexed inner lip in 69.

72. A.M.N.H. No. 27637:3, ×8, to show corkscrew shape of columella.

73, 74. Holotype, A.M.N.H. No. 27637:2, ×3.

84, 85. A.M.N.H. No. 27637/1:3; 84, ×3; 85, ×5.

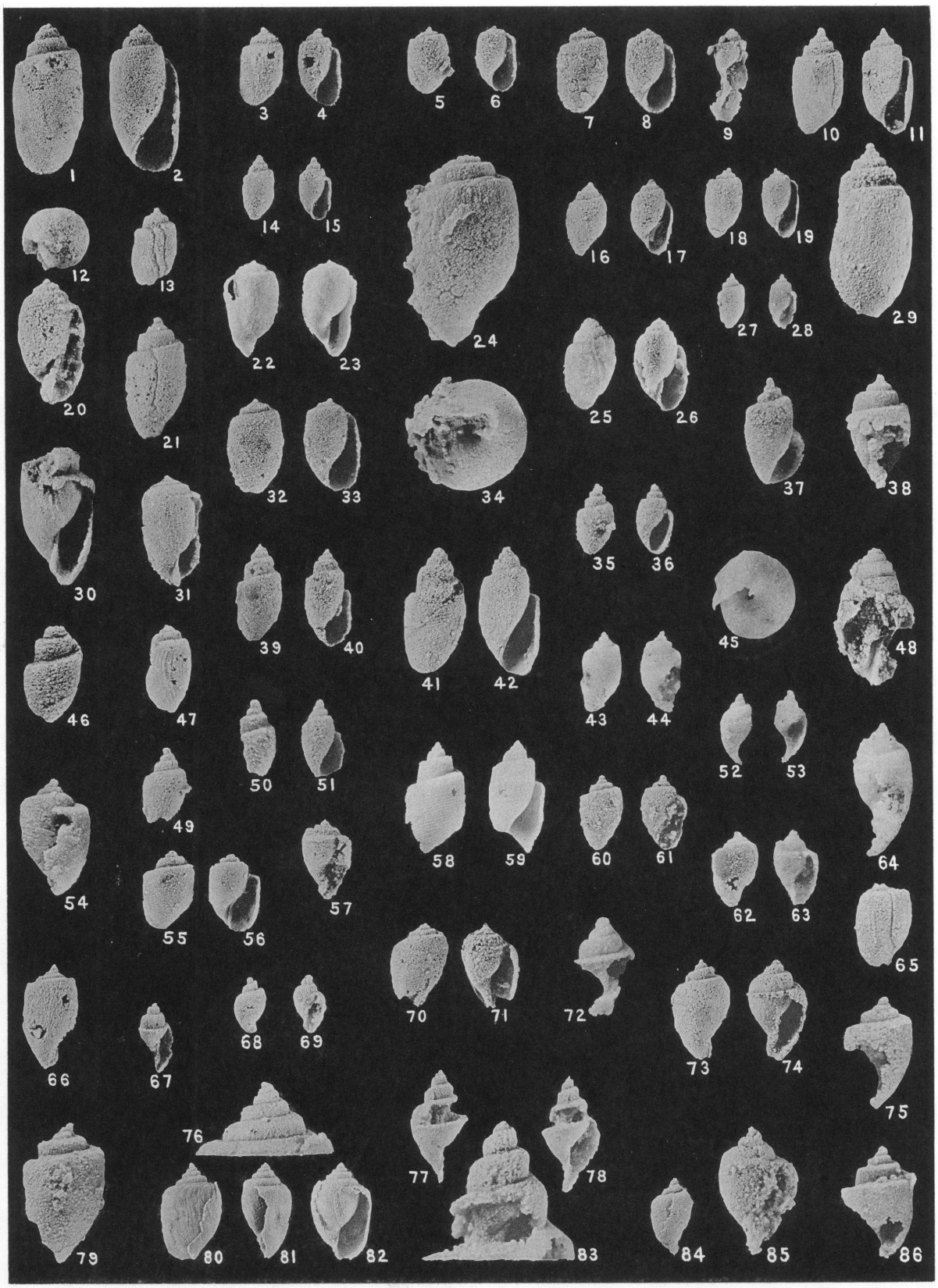
Note alloiostrophic nuclei in 68, 69, and 84 and most distinctly in 85.

C. (*?C.*) aff. *pyrulaeformi* Haas: 77, 78, 83

77, 78, 83. A.M.N.H. No. 27638:2; 77, 78, ×3; 83, close-up of spire, ×8.

Note alloiostrophic nucleus, reflexed inner lip, and narrow umbilical slit in 78 and growth striae in 83.

The Acteonidae and *Cylindrobullina* are continued on plate 18.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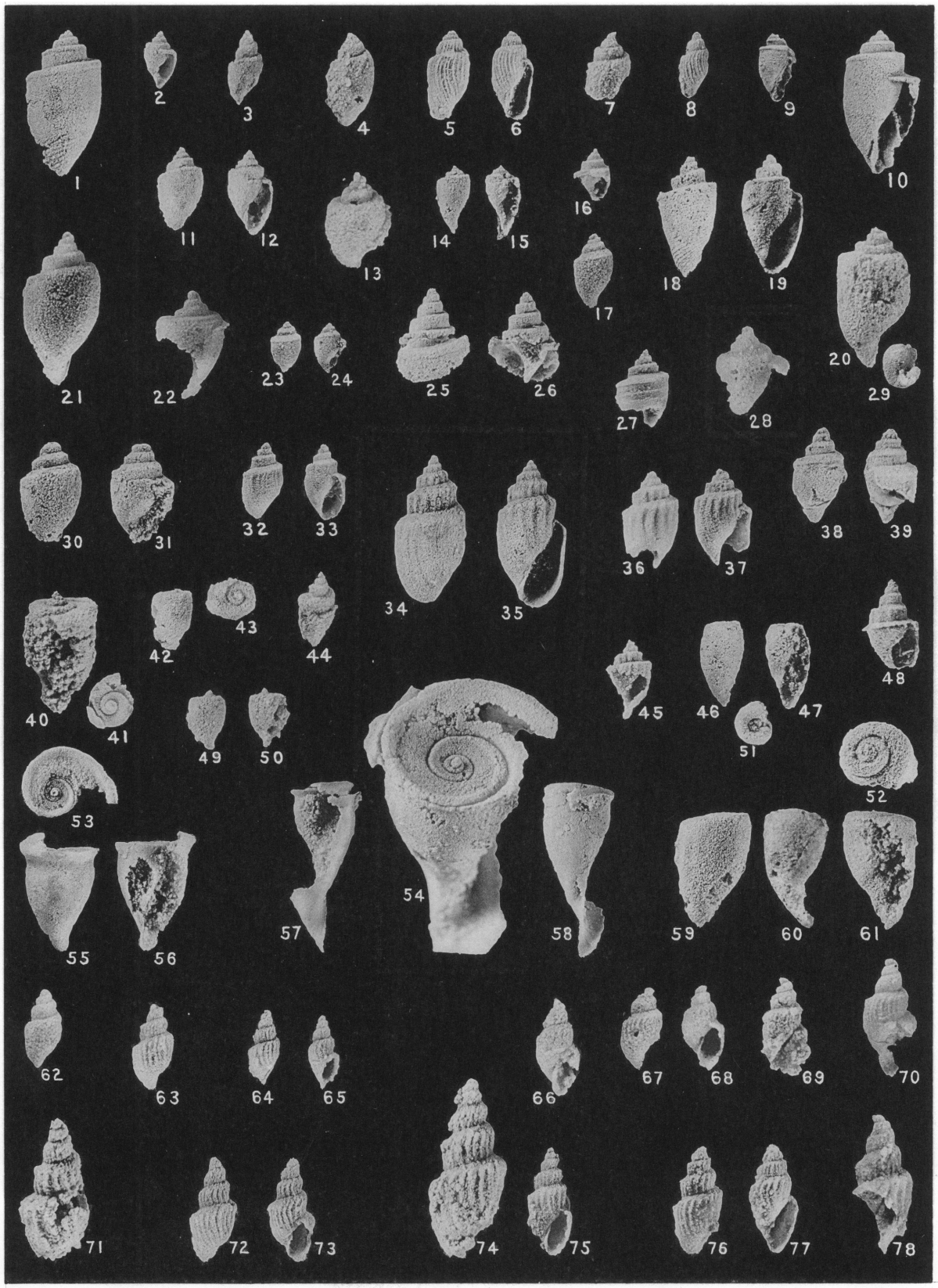
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PLATE 18

ACTEONIDAE: *Cylindrobullina* (*?Cylindrobullina, continued, Conactaeon, Euconactaeon*), *Consobrinella*

Cylindrobullina (*?Cylindrobullina*) *tenuicostata* Haas: 3–8

3. High-spired specimen of doubtful conspecificity, A.M.N.H. No. 27639:6, ×5.
4. A.M.N.H. No. 27639:3, ×8.
5, 6. Holotype, A.M.N.H. No. 27639:7, ×5; in 6 note shallow umbilical niche.
7. A.M.N.H. No. 27639:8, ×8.
8. A.M.N.H. No. 27639:5, ×5.

Note alloiostrophic nuclei in 5, 6, most distinctly in 4, 7, and slight constriction of body whorls in 6, 8.

C. (*Conactaeon*) *peruviana* Haas: 1, 2, 9–16, 18–22, 27–29

1, 10. Syntype B, A.M.N.H. No. 27640:29, ×5; note pronounced shoulder keels in 10 and revolving striation of base in 1.
2. Juvenile, A.M.N.H. No. 27640/1:21, ×5; note "canal" pointing to left.
9. Juvenile, A.M.N.H. No. 27640/1:7, ×5; note sharpness of shoulder keel.

Note reflexed inner lip in 6, 9, 10.

11, 12. Syntype A, A.M.N.H. No. 27640/1:32, ×5; note minute beads produced on shoulder keel by growth striae in 12.
13. A.M.N.H. No. 27640/1:35, ×10.
14, 15. Slender juvenile, A.M.N.H. No. 27640:17, ×5; note "canal" pointing to left in 15.
16. A.M.N.H. No. 27640/1:19, ×5; note pronounced shoulder keels.
18, 19. A.M.N.H. No. 27640:28, ×5; note overhanging lateral face of penultimate whorl and revolving striation in 18 and slight constriction of body whorl in 18 and 19.
20, 29. A.M.N.H. No. 27640/1:10; 20, ×10; 29, ×5, to show narrow open umbilicus.
21, 22, 28. A.M.N.H. Nos. 27640:16, 27640:40, and 27640/1:34, respectively, ×10.
27. A.M.N.H. No. 27640:39, ×5, to show two more revolving keels beneath shoulder keel.

Note alloiostrophic nuclei in 2, 10, 11, 14, 19, 27, most distinctly in 13, 16, 20–22, 28.

C. (*Conactaeon*) aff. *peruvianae* Haas: 25, 26

25, 26. A.M.N.H. No. 27641, ×5; note faint growth striae, producing minute beads on shoulder, and slight concavity of apical face.

C. (*Conactaeon*) cf. *decorata* (Martin): 17, 23, 24, 30, 31, 38, 39

17. Juvenile, A.M.N.H. No. 27642/2:1, ×8, to show alloiostrophic nucleus.
23, 24. Juvenile, A.M.N.H. No. 27642/2:2, ×5; note sloping apical faces, pronounced shoulder keels, and swollen columellar border.
30, 31. A.M.N.H. No. 27642/1:2, ×5; note concavity of apical band of body whorl and, in 31, thickly reflexed inner lip.
38, 39. A.M.N.H. No. 27642, ×5; note constriction of body whorl beneath shoulder keel.

C. (*?Conactaeon*) *tilarniocensis* Haas: 32–37, 44, 45, 48

32, 33. A.M.N.H. No. 27643: 6, ×5; note slightly concave apical bands, slight constriction of body whorl beneath shoulder keel, fine transverse ribs or growth striae, on which crossing revolving striae produce minute beads, and in 33 thinly reflexed inner lip.
34, 35. Holotype, A.M.N.H. No. 27643:9, ×5.
36, 37. A.M.N.H. No. 27643:8, ×5.
44. A.M.N.H. No. 27643:1, ×8.
45. A.M.N.H. No. 27643:5, ×5.
48. A.M.N.H. No. 27643:2, ×8.

Note alloiostrophic nuclei in all, most distinctly in 44, 45, and 48.

Cylindrobullina (*Euconactaeon*) *tambosolensis* Haas: 40–43, 46, 47, 49–52, 59–61

40, 41. A.M.N.H. No. 27644:8; 40, ×8; 41, ×5.
42, 43. A.M.N.H. No. 27644:7, ×5.
41, 43 to show elliptical outline.
46, 47, 51. Slender shell, A.M.N.H. No. 27644/1:7, ×5; note concave top in 51.
49, 50. Syntype A, juvenile, A.M.N.H. No. 27644:5, ×5.
52, 59–61. Syntype B, A.M.N.H. No. 27644:15, ×5; note deeply engraved sutures in 52 and reflexed inner lip in 61.

Note alloiostrophy of nuclei in 40, 49, 50; they just show above tops in 42, 59, 61.

C. (*E.*) *ninacacana* Haas: 53–58

53, 55, 66. A.M.N.H. No. 27645:1, ×3; note elliptical outline in 53 and constriction of body whorl beneath shoulder in 55 and 56.
54, 57, 58. Holotype, A.M.N.H. No. 27645:2; 54, ×5; 57, 58, ×2; note concave top from which conical alloiostrophic nucleus rises in 54, and reflexed inner lip and tube-like umbilical niche in 58.

Consobrinella elegantula Haas: 62–78

62. Smooth juvenile, A.M.N.H. No. 27647:2, ×8.
63. A.M.N.H. No. 27647:33, ×5; note profile.
64, 65. Juvenile, A.M.N.H. No. 27647:23, ×5.
66. Medium-sized shell, A.M.N.H. No. 27647:8, ×8; note reflexed inner lip.
67, 68. Juvenile, A.M.N.H. No. 27647:3, ×8.
69, 70, 71, 78. A.M.N.H. Nos. 27647:13, 27647:17, 27647:45, and 27647:46, respectively, ×8.
72, 73. A.M.N.H. No. 27647:41, ×5; note hooks formed by ribs on shoulder.
74, 75. Holotype, A.M.N.H. No. 27647:42; 74 ×8; 75, ×5; note concave apical band of body whorl and minute beads on some ribs.
76, 77. A.M.N.H. No. 27647:43, ×5; note anterior notch of aperture or "beak," respectively, and in 76 slightly overhanging lateral face of penultimate whorl.

Note alloiostrophic nuclei in 66, 67, 74, 76, 77, most distinctly in 69–71, 78, and slight constriction of body whorl beneath shoulder in 72, 73, 76.