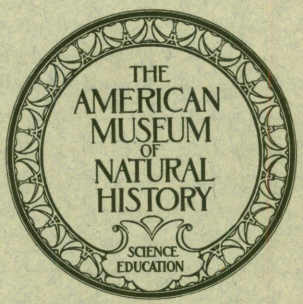
BULLETIN

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XLI, 1919



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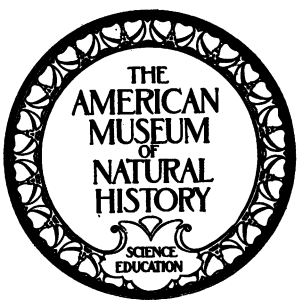

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CONTENTS OF VOLUME XLI

DATES OF PUBLICATION OF SEPARATES

The edition of separates is 300 copies, of which about 100 are mailed on the date of issue, and the others placed on sale in the Library.

Art.	I, Aug. 1, 1919.	Art.	XI, Dec. 1, 1919.
"	II, Sept. 22, 1919.	"	XII, " 3, 1919.
"	III, " 24, 1919.	"	XIII, " 5, 1919.
"	IV, " 27, 1919.	"	XIV, " 8, 1919.
"	V, " 1, 1919.	"	XV, " 10, 1919.
"	VI, " 22, 1919.	"	XVI, " 12, 1919.
"	VII, Oct. 3, 1919.	"	XVII, " 15, 1919.
"	VIII, " 5, 1919.	"	XVIII, " 29, 1919.
"	IX, Nov. 28, 1919.	"	XIX, " 30, 1919.
"	X, Oct. 2, 1919.	"	XX, " 30, 1919.

LIST OF ILLUSTRATIONS

PLATES

XXXI.—*Sabella melanostigma* var.: abdominal seta and antenna. *Parasabella fonticula:* ventral and dorsal views of head; superior thoracic, inferior, pennoned, and inferior abdominal setæ; avicular uncinus. *Parasabella midoculi:* dorsal view of anterior end; rachis with pigment-spots and pinnules; anterior end; avicular uncinus; pennoned seta.

XXXII.—*Parasabella midoculi:* thoracic and rounded setæ. *Parasabella flecata:* dorsal and ventral views of anterior end; superior thoracic; pennoned and abdominal setæ; thoracic uncinus. *Protis torquata:* ventral and dorsal view of anterior end; seta from collar fascicle; superior thoracic seta; thoracic uncinus.

XXXIII.—*Eriocheir misakiensis,* new species.

XXXIV.—*Spalax:* four views of mandible. *Rhizospalax* and *Tachyoryctes:* four views of mandible; palate from below and above, showing pits for reception of incisor roots.

XXXV–XXXVI.—Views of Daiquiri, Cuba.

XXXVII.—Skulls of West Indian mammals: *Artibeus jamaicensis; Artibeus jamaicensis parvipes* (fossil); *Nesophontes edithæ; Nesophontes micrus; Nesophontes longirostris.*

Text Figures

LIST OF NEW TAXONOMIC NAMES IN THIS VOLUME

Genera

Species and Subspecies

ERRATA

Page 211, top line, for Biblography read Bibliography.
" 367, line 16 from bottom, for *S. salinarum* read *O. salinarum*.
" 445, line 2 from top, for *F. annonæ* read *E. annonæ*.
" 468, line 6 from top, for ziphisternal read xiphisternal.
" 470, first 5 lines should follow description No. 11, p. 469.
" 477, footnote, for Siences read Sciences, closly read closely, and herpelology read herpetology,
" 565, last column of table, for *Palæsypos* read *Palæsyops*.
" 593, line 6 from bottom, for typically read atypically.

BULLETIN

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XLI, 1919

56.34, 6 (117:4)

Article I.—THE SCHRAMMEN COLLECTION OF CRETACEOUS SILICISPONGIÆ IN THE AMERICAN MUSEUM OF NATURAL HISTORY

WITH NOTES ON THE STRUCTURE, CLASSIFICATION, GEOLOGICAL AND GEOGRAPHICAL DISTRIBUTION, AND SYNONYMY OF THE SILICISPONGIÆ

BY MARJORIE O'CONNELL, PH.D.

PLATES I TO XIV

PREFACE

The following paper was written primarily as a series of notes on the kinds of types in the Schrammen Collection of Silicispongiæ in The American Museum of Natural History, these notes now forming Chapter IV. It seemed advisable for many reasons to include an account of the historic development of the science of palæospongiology, and a description of the morphological characteristics of the Silicispongiæ, which constitute Chapters I and II. Since Schrammen's material came from many localities in Germany, and from successive horizons in the Upper Cretaceous, it appeared to me that a general summary of the stratigraphy of the Cretaceous sponge-bearing horizons of Europe would be of service to the student especially since stratigraphic texts contain little information about sponge localities, while writers on sponges have not given much heed to broad stratigraphic correlations. This summary is given in Chapter III.

I was able to write the first three chapters in time made available to me under the Sarah Berliner Research Fellowship for Women, which I held for the year 1917-1918. These chapters constitute the preliminary work on my research problem which deals with the habitat of the Silicispongiæ.

The arrangement of the Schrammen Collection was undertaken at the suggestion of Associate Curator Chester A. Reeds, who, throughout the work, placed every facility at my disposal for its speedy completion and himself gave much time to the preparation of the plates and the reading of the manuscript. To Curator E. O. Hovey my thanks are due for careful attention to the manuscript, after his return from the Arctic, and for numerous helpful suggestions.

American Museum of Natural History,
November, 1918.

TABLE OF CONTENTS

INTRODUCTION

The Schrammen collection of sponges comprises 222 species,[1] distributed in 116 genera, and numbers 800 specimens. It was acquired by The American Museum of Natural History by purchase in 1914 from Doctor Anton Schrammen of the Roemer Museum at Hildesheim, Hanover, Germany. The material is a part of that used by Schrammen in his Monograph on the Silicispongiæ of Northwest Germany, few of the specimens being the actual primary or proterotypes but nearly all of them coming from the type localities and forming a portion of the original series upon which the new species erected by that author are based. The specimens thus constitute tangible illustrations for the Monograph and many of them are superior to the illustrated forms. In this collection, the student may find an almost complete zoological representation of this interesting and all too little-known group of fossils.

All of the specimens belong to that group of sponges generally classed by palæontologists as Silicispongiæ. This term, in its earliest form, Silicea, dates back more than fifty years in the history of classification of the sponges, having been given by Bowerbank in 1864 to distinguish the forms with siliceous skeletal elements from those having calcareous elements. The designation, however, is unsatisfactory, as all later workers on the sponges have realized, for many of the Calcispongiæ have their skeletal elements or spicules secondarily silicified, while the spicules in the Silicispongiæ are calcified at times (Hinde, 1886). Since the students of fossil sponges have long recognized that the mineral condition in which the sponges are found is no clue to their genetic relationships, and since the real basis of classification has been the form of skeletal element, it would seem advisable to drop terms which were introduced at a time when the true structure of sponges was almost unknown and to adopt in nomenclature what has virtually been adopted in practice, namely, a morphological not a chemical basis for classification. Zoologists, working upon recent sponges, have taken the lead in this more scientific mode of designation, but palæontologists, following the classification erected by Zittel, still continue to divide fossil sponges into Calcispongiæ and Silicispongiæ, according to the calcareous or siliceous nature of the spicules, though the right is always

[1]This number includes one variety and three mutations. The total of 800 does not include 300 specimens purchased in 1903 most of which are not types or cannot be determined because of insufficient labeling by Schrammen.

reserved of excluding calcareous sponges from the first class and siliceous ones from the second class if the form of skeletal element indicates a structural relation which does not agree with the mineralogical preservation. Thus, Zittel concludes his general statements on classification with the following remark: " . . . the distinction between siliceous and calcareous sponges in the fossil state depends entirely upon morphological characters, and not at all upon the chemical composition of the preserved parts" (Zittel, 1910, p. 47; 1913, p. 50). This is Zittel's last opinion, and yet he proceeded to divide the sponges into Calcispongiæ and Silicispongiæ and, since he was undoubtedly the greatest specialist on fossil sponges, no palæontologist has thought of departing from the classification which he not so much founded as perpetuated by setting upon it the seal of his approval. The classification based upon the composition of the skeletal elements and the one widely used in the current literature on fossil sponges is as follows:

Myxospongiæ.—These are recent forms entirely lacking any kind of skeleton.

Ceratospongiæ.—These are horny sponges possessed of a skeleton consisting of a network of anastomosing fibres of spongin, the fibres being either solid or containing an axial canal which is at times filled with particles of foreign matter such as sand grains or minute shell fragments. There are no undoubted fossil representatives of the Myxospongiæ or Ceratospongiæ, although it has been claimed that horny sponges have been found in the Mesozoic. This claim is open to question and probably all such horny sponges will be found to have been improperly identified. All fossil sponges are thus seen to fall into one or the other of the two remaining subclasses the Calcispongiæ or the Silicispongiæ.

The *Calcispongiæ* secrete a skeleton of calcareous spicules which are rod-like or else star-shaped with three or four rays, the three-rayed spicules being the most common. The calcareous sponges, at no time very abundant, are best represented in the Mesozoic, but become practically extinct in the Tertiary, though occasional characteristic spicules are found in the rocks, showing that they still inhabited the littoral zone of the sea. They have also been reported sparingly in the Palæozoic, but such occurrences are to be doubted. There are a few living forms such as species of *Leucosolenia, Grantia,* and others.[1]

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[1]Specimens of recent forms are exhibited in the Darwin Hall of Invertebrates in The American Museum of Natural History.

The *Silicispongiæ* are the most complicated and highly organized of the sponges and show the widest geological and geographical range. The skeleton is composed of siliceous elements alone or of siliceous spicules embedded in horny fibres. (See Chapter II for details.)

This classification is unsatisfactory not so much because of any failure on Zittel's part to recognize essential morphological characteristics—for he has the honor of being the first to classify fossil sponges on the basis of the form of the spicules—as because of the poor terminology for the larger subdivisions. Zittel, throughout his work on sponges, emphasized the value of the spicules in taxonomy and pointed out that while they show great variability in form, nevertheless, they are constant in each species and, being embedded in the soft parts, are least likely to be affected by any of the factors of environment, for which reasons he made the type of element the basis of classification not only for the smaller taxonomic divisions but for all higher divisions up through the orders. On account of the variability in external form and in the size of the sponges, it is at once apparent that such characteristics cannot be used in classification. Neither can the present chemical composition of the elements be considered diagnostic, for the siliceous spicules may become calcified, and even more frequently are the calcareous spicules silicified. One is thus reduced, for the fossil sponges at least, to the erection of a classification based almost wholly upon the form of the skeletal elements, although to a minor extent, where perfection of preservation permits, the character of the canal system and other structural features may be used.

A few comparatively slight changes in nomenclature used by von Zittel for the larger taxonomic divisions will suffice to emphasize in the classification the fundamental importance of the spicules which was first pointed out by that author and employed in all of his systemic work. It is interesting to note that the revised classification approaches closely the one first proposed by Zittel in 1878 in his 'Stammes-Geschichte der Spongien' and later amplified by him in his 'Handbuch der Palaeontologie.' At that time he had not adopted the term Silicispongiæ, but simply recognized seven orders of equal value as follows:

MYXOSPONGIÆ Haeckel
CERAOSPONGIÆ Bronn
MONACTINELLIDÆ Zittel
TETRACTINELLIDÆ Marshall
LITHISTIDÆ Schmidt
HEXACTINELLIDÆ Schmidt
CALCISPONGIÆ Blainville

The following is the most recent expression of workers in this field, as it appears in the 1915 edition of Zittel's text-book edited by Broili, and there is given also the Zittel classification for comparison.

	Zittel Classification, 1913 (Eastman translation)		Zittel Classification, 1915 (Broili revision)	
	Subclass	*Order*	*Subclass*	*Order*
Phylum Porifera	MYXOSPONGIÆ			Myxospongia
	CERATOSPONGIÆ		Demospongia	Ceraospongia
	SILICISPONGIÆ	Tetractinellida		Tetractinellida
		Lithistida		Lithistida
		Monactinellida		Monactinellida
		Hexactinellida	SILICISPONGIÆ	Hexactinellida
	CALCISPONGIÆ		CALCISPONGIÆ	Pharetrones
				Sycones

Zittel recognized that the Lithistida were very closely related to the Tetractinellida and, while he made a separate order of them, he frankly stated that many zoologists included them with the Tetractinellida. Schrammen's detailed studies over a period of twenty years have convinced him so thoroughly of the impropriety of separating the Lithistida as a distinct order that in his Monograph he drops that class name altogether.

CHAPTER I.—HISTORICAL RÉSUMÉ

The study of fossil sponges has been persistently, though not inexplicably, neglected by palæontologists. The Porifera were not even mentioned in the literature until a little over two hundred years ago —and then not by that name—while accurate and detailed investigations of the morphological characteristics and of the skeletal structure were undertaken only within the last forty years. This neglect of the fossil forms is due, first, to the failure of zoologists to acquire an intimate knowledge of living sponges and, second, to the belief held by palæontologists until very recently that fossil sponges could not be studied anatomically and structurally as the recent ones could be and that the only method of approach in description and classification was by the examination of the shape and external form. Since the history of the

recently-developed science of Palæospongiology is intimately connected with the discoveries made in Neospongiology, it is essential to have in mind the important steps in the evolution of the latter science.

Résumé of History of Investigations on Recent Sponges

Period from the Days of the Ancients to the Seventeenth Century

As in all branches of natural science one turns to the Father of Science for the first rays of light, so too, in the history of the investigations on sponges one looks to Aristotle. He was the first to recognize the sponges, to comment upon their mode of life and growth, and above all to realize that they were animals not plants. Later writers of the classical period either copied what he wrote or made translations into Latin, but when they attempted to add to what he had done they only fell into error, their chief mistake being to consider the sponges as plants. For more than fifteen hundred years nothing of scientific value was contributed to the few facts established by Aristotle. Beginning with the seventeenth century, the next three hundred years may be divided into four periods, each one of which marked the completion of a certain group of investigations on recent sponges.

Period of Determination of Systematic Position (1600-1750)

The great problem in connection with living sponges during the Middle Ages was the determination of their taxonomic position. Were they plants or animals? Aristotle had placed them in the animal kingdom, but few subsequent writers followed him in this, most of them considering that sponges were plants. Italian authors particularly held to the vegetable nature of these organisms as shown in the writings of Ferrante Imperato (1599), Ulysses Aldrovandi (1606), and de Marsigli (1711). In the century following Imperato the works by English writers all show a ready acceptance of the Italian dictum as in Ray's publications of 1686, 1690, and 1704, in the paper by Sloane (1696), and in that by Plukenet (1696). The earliest attempt to break away from the belief in the vegetal nature of the sponges was made in 1553 by Belon, who assigned to the sponges a position intermediate between plants and animals. In 1635 J. Eusebius Nieremberg came out strongly for the animal nature of sponges, but the idea did not spread very rapidly and for another hundred years they were, as we have seen, generally placed in the plant kingdom. Indeed, in the first edition of the 'Sys-

tema Naturæ' (1735) the genus *Spongia* will be found under the Cryptogamia in the group of the Lithophyta. It cannot be said that any one writer succeeded in convincing his contemporaries as to the true position of the sponges, but we find that they gradually took their place among the animals instead of among the plants, so that by 1750 zoologists began to turn their attention more especially to the anatomy and the description of new species.

Period of Anatomical Discoveries and of Classification (1750-1825)

This period dates from the middle of the eighteenth century, but an account of it would be incomplete without the mention of the experiments and microscopic studies of the skeletal network carried on by Antony van Leeuwenhoek, a brief notice of which appeared in the Transactions of the Royal Society of London in 1706. Leeuwenhoek's contribution consists not so much in the discovery of some single fact, although it is to be remembered that he did make the keen observation that the horny skeleton did not soak up water as was commonly believed, but rather in the introduction of the microscope for the study of the anatomy of living sponges. This great improvement in the method of work was not immediately seized upon by zoologists who were still debating the more fundamental question of broad classification. By 1750, however, the position of the sponges in the animal kingdom was scarcely any longer a subject for controversy and attention began to be turned to the details of structure which the microscope revealed. The spicules were discovered by Donati (1750), the canal system by Ellis (1765), while many observations upon living sponges were made by Schweigger (1819), who discovered the free-swimming larvæ.

As in the development of any branch of science, so it was in the belated study of the sponges—as soon as a certain number of characteristics were discovered which varied for different individuals, just so soon did a crude classification begin to spring up, depending upon the presence or absence of one or more of the characteristics or upon their various modifications. In the dozen and more editions of the "Systema Naturæ," beginning with the first folio edition of 1735, may be traced the steps in the progress of classification. Among the pioneers in the task of describing and arranging in natural order the vast number of living sponges may be mentioned Pallas (1766), Esper (1788-1830), Olivi (1792), Lamarck (1813), and Lamouroux (1816, 1821, 1824).

Period of Detailed Microscopic Studies (1825-1874)

Beginning with the year 1825 the literature on sponges assumes a more scientific terminology; descriptions of species are more accurate; detailed anatomical studies and physiological experiments are made and the results described; and, in consequence of these improvements, classifications are refined. In the production of descriptive works on recent sponges the British investigators formerly stood in the foremost ranks and one need only mention the numerous papers by Grant, the first of which appeared in 1825 and which from time to time for more than three decades continued to help in the unravelling of sponge anatomy and classification; the classical volumes by G Johnston (1832-1842) culminating in the 'History of British Sponges and Lithophytes' (1842); the many short papers by Carter (1848-1881); and, finally, the three large volumes (including plates) by Bowerbank on 'The Anatomy and Physiology of the Spongidæ' (1858-1874). Belonging to this same period of detailed descriptions and refinements of classification are the contributions by Oscar Schmidt, beginning in 1862 and extending over some twenty years or more, the studies by Haeckel on the Calcispongiæ, of which the first appeared in 1875, and numerous lesser contributions by French writers, such as those of Dujardin (1838, 1841), and Laurent (1838, 1840, 1844, etc.).

Period of Modern Investigations (1875-present)

This last period opens with the first paper published by Franz Eilhard Schulze in 1875. His method of work has been so thorough and the field of his investigations so broad that he has practically revolutionized the study of living sponges. He was the first to discover the three cellular layers, while his observations on the embryology and the detailed anatomy of sponges leave little to be done by future workers on the ground which he covered. Within the last forty years there have been so many writers on recent sponges in all the European countries that it becomes difficult to mention even a few without seeming to slight many students of equal rank. As the foremost in Germany must be noted Schulze, Haeckel, Keller, and von Lendenfeld; in England, Sollas, Ridley, Dendy, and Marshall; in Holland, Vosmaer; in Russia, Dybowski, Czerniawsky, and Merejkowski; and in America, Alpheus Hyatt (Revision of the North American Poriferæ; with Remarks upon Foreign Species. Mem. Bost. Soc. Nat. Hist., II, pp. 399-408, 481-554, Pls. XIII, XV, XVI, XVII).

Résumé of the Literature on Cretaceous Sponges

Fossil sponges of any age have come under the notice of the palæontologist only within the last two hundred years, while it is only with the beginning of the nineteenth century that we can claim that any contributions of value were made to the literature. In the present discussion attention will be confined almost exclusively to the work done on Cretaceous sponges, but this will cover by far the greater part of the literature on all fossil sponges, since there has been comparatively little written on Palæozoic sponges with the exception of a few standard monographs such as Hall and Clarke's 'Palæozoic Reticulate Sponges' in America, Rauff's 'Palæospongiologie' in Germany, and Hinde's 'British Fossil Sponges.'

In going through the literature on fossil sponges, one is struck with the close parallelism in the development of thought in the study of fossil and recent forms but one sees epitomized in the palæontological literature of two hundred years what is spread out over two thousand years in zoological literature. The besetting difficulty for both groups of investigators was the determination of the best method of work and, until this was discovered, all classifications were unsatisfactory and often artificial. In the case both of living and of fossil sponges the form of the skeletal elements, being least affected by the environment and mode of growth of the organisms, has been found to be the most reliable basis for classification, but it was not until the last quarter of the nineteenth century that this basis was adopted with the refinement that was necessary. It is interesting to note that the method of study of both recent and fossil sponges was revolutionized practically simultaneously, the first of F. E. Schulze's papers appearing in 1875, the first of von Zittel's in 1876.

I shall now give a very brief résumé of the literature which has appeared in Great Britain, France, Russia, Bohemia, and Germany on Cretaceous sponges and shall include an evaluation of the more important books on the subject.

Great Britain

The earliest attempt in England to describe Cretaceous sponges was that made by Parkinson in volume II of his 'Organic Remains of a Former World' (1808). Scattered through the volume are picturesque descriptions of a number of sponges from the Chalk of England, most of which are figured. The descriptions are of practically no value

but, relying upon the illustrations, later authors have included some of Parkinson's species in their synonymies, though usually such a proceeding is rather unsafe. In this first work of his, Parkinson made no attempt to use a binomial system of nomenclature, but in his 'Outlines of Oryctology' (1822 and 1830) he wrote in a much more scientific manner and described several genera with as much precision as was possible at that time.

A noteworthy advance in the description of species was made by Gideon A. Mantell. In 1815 he published a description of a sponge which he called *Alcyonium chonoides* (changed in 1822 to *Ventriculites radiatus*) and gave several very satisfactory illustrations of it. In 'The Fossils of the South Downs' (1822) he described eleven species and figured most of them. Mantell is to be commended for his attempt to distinguish different species, even though he frequently failed in his endeavor and included distinct forms under the same specific name. He recognized that the external form was exceedingly variable in fossil as in living sponges and that one could not rely upon shape in determining species. His illustrations depicted clearly the surface characteristics which were observed and in that respect were superior to many of the figures which appeared in books by later writers.

Phillips in the 'Illustrations of the Geology of Yorkshire' (1829, 1835 and 1875) listed sixteen species of sponges (ten new) from the White Chalk (Senonian) of Danes' Dike in Yorkshire. He gave rather poor illustrations and no descriptions but, because his types were available, many of the species have been described by Hinde and credited by him to Phillips, so that later authors have accepted a number of Phillips' manuscript names.

In 1831 Miss Benett published her 'Catalogue of the Organic Remains of the County of Wilts.' In this she listed forty-seven species and varieties of sponges, thirty-three of which were new. The drawings which she made were very good but she gave no descriptions. Consequently, since her specific names were only manuscript names (chironyms), it has been solely through the courtesy of a few later authors that any of those which she proposed have been credited to her. Michelin, while using her names, took the credit as describer, as he had a perfect right to do, but Hinde in three instances ascribed the species to Miss Benett on the ground that her illustrations could leave no doubt as to the forms she meant.

By far the best descriptive contribution which appeared in the first half of the nineteenth century in England was J. Toulmin Smith's

series of papers 'On the Ventriculidæ of the Chalk' (1847, 1848). In these papers Smith studied the sponges under the microscope, noting differences in the tissue and in the meshes of the network. He failed altogether to make any use of the form of the spicules in the separation of species, but he was at least nearer to the correct method of work than had been his predecessors, who relied solely upon the shape and upon surface characteristics in describing species.

There were a number of writers who described one or two species, or perhaps only figured some specimens, and their names will here be listed without comment since their contributions are of historic interest only: Conybeare (1814), Webster (1814), William Smith (1816), Martin (1828), Rose (1829), Fitton (1836), Lee (described eight new species from Yorkshire, 1839), Bowerbank (1839), Morris (1843, 1854), Dixon (1850), and Tate (described four new species from Ireland and listed eighteen more, 1865).

Among the British workers on Cretaceous sponges there are only two men who stand out as having produced epoch-making contributions to the science; these two are William Johnson Sollas[1] and George Jennings Hinde. The former has written a number of short papers on recent and fossil sponges, as well as the volume on the Tetractinellida in the Challenger Reports, but he has devoted his attention primarily to Cretaceous species. In 1873 he published his first contribution, a short discussion of some of the Ventriculidæ, which is noteworthy as being the first attempt in Great Britain to study fossil sponges in the same way that living ones were studied, that is by a microscopic examinnation of thin sections with particular reference to the spicules. In time Sollas made a careful investigation of a representative genus of each order of Silicispongiæ, but it was not until 1885 that he finished carrying out his original plan.

Far above all other past or contemporaneous British students of fossil sponges stands Professor G. J. Hinde. As a young man he was attracted to the European center of palæontologic research, the University of Munich, where Professor Karl A. von Zittel occupied the chair of geology and palæontology. Von Zittel, in the early seventies, undertook to monograph all the fossil sponges and by 1880 he had completed his task. It was during the last part of this eventful decade that Hinde went to Munich, taking with him a single and not very bulky nodule from the Chalk of Horstead, Norfolk. The contents of

[1]Professor of Geology and Palæontology at the University of Oxford. (Born 1849.)

this one nodule provided him with material for his doctorate dissertation which, as is not at all surprising when we consider how full must have been the Munich air at that time with discourses on sponges, was entitled 'Fossil Sponge Spicules from the Upper Chalk.' The nodule, about a foot in diameter, was found to contain thirty-eight species of sponges, all represented by spicules, which were studied and described by Hinde, under the guidance and supervision of von Zittel. Shortly after Hinde returned to England in 1880 he was asked by the Keeper of the Geological Department of the British Museum to arrange the collections of fossil sponges. He found that so many of the species were new to science or needed to be redescribed that he had to enlarge the plan of procedure first proposed and, with ample funds and plenty of time at his disposal, he finally in 1883 brought out the famous 'Catalogue of the Fossil Sponges in the Geological Department of the British Museum.' All of the types of older British authors, such as those of Toulmin Smith, Phillips, and Mantell, were redescribed and many of them figured, so that foreign workers no longer were forced to depend upon the meagre protologs and sketchy protographs. As was natural, Hinde accepted Zittel's classification almost without change and employed the Munich method of studying and identifying spicules. This catalogue led Hinde on to the monographing of British fossil sponges in a more elaborate and detailed fashion. In 1887 appeared the first part of this Monograph, dealing with Palæozoic species. It contains several general sections, including a résumé of the more important literature on the subject (232 references), an account of the structure and morphological characteristics of fossil sponges and a revised classification. The second part of the Monograph, taking up the systemic discussion of Palæozoic species, appeared in 1888 and the third part, dealing with Jurassic sponges, appeared in 1893, while the volume upon the Cretaceous species is now in preparation. Hinde has done more for British fossil sponges than had all of his predecessors put together and, of living palæontologists,[1] he and Rauff are the two foremost specialists on palæonspongiology.

France

The earliest and, in many ways, the most illustrious French palæospongiologist was J. E. Guettard, who wrote several memoirs on fossil sponges and corals (1751, 1768, 1786). He was far ahead of his time,

[1]Hinde died March 18, 1918. See Appreciation of him by M. O'Connell, Science, N. S. XLVIII, No. 1250, pp. 588-590, Dec. 13, 1918.

both in the accuracy of his observations and in the correctness of many of his conclusions. One very important thing which he realized and which was lost sight of even in his own country for many decades after him was that the fossil sponges are to be compared with living ones and that in their structure and anatomy both are alike. He did not confine himself to the study of the outer form alone, as did his contemporaries, but he made observations on the canal system and upon the spicular network visible on the surface of the fossil sponges. He was, however, of the opinion that the sponges had originally been soft-bodied (presumably, I suppose, horny) and that the hard structures had been developed through the processes of fossilization. Guettard described and figured many species from the Cretaceous of France and some also from the Jurassic.

The works published subsequent to Guettard's memoirs were of little value, and are now only of historic interest. They encumbered the literature with a vast number of specific names, all of which must be taken account of in synonymies, and they introduced artificial classifications which served only to retard, not to advance, the science.

We may pass over as of little importance the brief notices in the 'Dictionnaire des Sciences Naturelles'—published in sixty volumes from 1816 to 1830 under the direction of Cuvier—by de Blainville and Defrance. In the general articles by the former author attention was paid only to the recent sponges and in the scattered notes on the fossil forms by Defrance the descriptions are brief and superficial. Blainville took a step forward in supporting the idea—then forgotten or overlooked by many—that the corals (Actinozoa) and sponges (Amorphozoa) were totally distinct. Even the distinguished Lamarck, in his 'Histoire Naturelle des Animaux sans Vertèbres' (1816, first edition; 1836, second edition), treated the fossil sponges cursorily and held to the opinion that they were closely related to the Alcyonarian corals.

In spite of the fact that Ellis and Sollander in 1786 pointed out the distinctness of the sponges and corals, these two phyla were indiscriminately mixed up by palæontologists for a long time after that. Lamouroux, for instance, in his 'Exposition méthodique des Genres de l'Ordre des Polypiers, des Zoophytes D'Ellis et Solander' (1821) included in his order of Polypiers: Bryozoa, Porifera, rugose corals, and Alcyonarian corals (according to modern terminology). He did not recognize the true distinctions between the various phyla here grouped together either at that time or in his later 'Encyclopédie méthodique. Histoire naturelle des Zoophytes, ou Animaux Rayonnés' (1824).

Hardouin Michelin was another of the truly great French palæontologists who unconsciously found the sponges a stumbling-block, and followed de Blainville in treating them as a distinct group under the name of Amorphozoa. He described a large number of new species from the Cretaceous of France, but he made no mention of the skeleton, relying wholly upon the form for the determination of species. Furthermore, one cannot rely upon his brief synonymies, because he had a weakness for proposing new specific names and of then making those proposed by other authors synonymous with his own when there was actually no justification for such a procedure.

Alcide D'Orbigny (1849, 1850, 1852) was the first to undertake the classification of fossil sponges as a whole and he divided them all into two groups, *Amorphozoaires à squelette corné* and *Amorphozoaires à squelette testacé*, to the latter of which belonged practically all of the fossil forms. In this second order he recognized five families, using as determinative characteristics the external form and the presence or absence of central opening (i. e., paragaster), epitheca, and openings on surface (i. e., ostia and postica). It is apparent that the value of the skeleton and its elements was not, as yet, recognized and that classification was still based upon practically worthless, because absolutely unreliable, features. But the making of even a poor classification is praiseworthy when no other has been attempted, and we might look back to D'Orbigny with gratitude if he had not proceeded to overshadow his small, but genuine, contribution by a blunder fraught with disastrous consequences for the development of palæospongiology in France. He believed that fossil sponges had had stony skeletons, not horny ones as many had claimed, and in this opinion he embodied an important truth, but he also thought that recent sponges are not possessed of such a hard skeleton and that, therefore, the two groups were wholly distinct and that nothing was to be derived in the understanding of the fossil forms from a study of the living ones. Thus he took no note of the discoveries being made by zoologists, missing all that he might have acquired in rich suggestions from their work. And, because of his greatness and of the loyalty of his followers in the French school of palæontology, progress in this field was blocked for two decades, by which time the opportunity to accomplish anything either in broad classification or in the details of structure had passed beyond the borders of France.

The impulse given by D'Orbigny in a wrong direction led to one of those eventually self-destructive orthogenetic lines of development

visible at intervals throughout the history of the biologic world and found no less often in the progress of man than in the evolution of the invertebrates. One such orthogenetic outgrowth was Fromentel's 'Introduction à l'Étude des Éponges Fossiles' (1859). In this work, fifty species (ten new) of Cretaceous sponges from France were described and most of them were figured, although the illustrations were as a rule only copies of those given by Goldfuss and Michelin. An entirely new classification was introduced, based not upon the form, nor the skeletal structure, nor the canal system, but upon the openings visible upon the surface of the sponge. These openings were termed *oscules, tubules,* and *pores;* and, according to their size, arrangement, and position, orders, families, and genera were determined. According to the type of opening developed, Fromentel recognized three suborders of sponges: Les Tubulés, Les Osculés, and Les Poreux. The delimitations of families were based upon the presence or absence of different types of openings and, when necessary, also upon the form. Fromentel further conceived a highly artificial nomenclature for the genera, in which all forms in a particular family bore names with a uniform ending, notwithstanding the fact that this necessitated a ruthless disregard of the laws of priority. It was not that he redefined and restricted old genera, for often his descriptions are most meagre; he simply changed the names to fit into his arbitrary scheme. Thus *Cribrospongia* became *Cribroscyphia, Cœloptychium* became *Cœlochonia,* and *Siphonia* became *Siphoneuda.* The work is of little value and, outside of France, never received much notice, authors not even including Fromentel's names in their synonymies.

In the same year E. Courtiller attempted to describe the fauna from the Cretaceous of Saumur in Maine-et-Loire in a paper entitled 'Éponges Fossiles des Sables du Terrain Crétacé Supérieur des Environs de Saumur' (1859). In it he described one hundred and thirty-eight "new" species, making every smallest variation in shape an excuse for erecting a new species. A few words suffice for each characterization, but the paper is copiously illustrated with forty plates, which, however, are of no more scientific value than are the descriptions. Practically none of Courtiller's names have any standing at present, because it has been impossible for later workers to determine what species he was trying to describe and because many of his "species" were only different forms of a single one.

We may mention, at this point, a number of writers who produced descriptive works for small areas but who did nothing to advance the

classification or the better understanding of sponges; they either noted already known species in new localities or described a few new species in the prevailing unscientific manner. Among these are: Faujas-Saint-Fond (1797), Ramond (1801), D'Archiac (1840, 1846*a*, 1846*b*, 1846*c*), Deshayes (1831), Passy (1832), Leymerie (1841, 1842), Marcou (1848), Pictet (1857, sponges listed in 'Traité de Paléontologie'). For complete references, see bibliography.

The next, and last, name to stand out in French literature is that of A. Pomel. He was decidedly handicapped by his geographical isolation, for he carried on his work in the Province of Oran, northern Algeria, with few books at his disposal and no museum collections to study. In 1872 appeared the fifth fascicule of his 'Paléontologie ou description des animaux fossiles de la Province D'Oran.'[1] This section was devoted to the sponges and represented much hard work on the part of its author, who was hampered not alone by the lack of important literature but also by an insufficient knowledge of zoology. Thus, Rauff records that in the zoological section he made no reference to the works of Lieberkühn, Köllicker, Gray, Wyville-Thompson, Carter, Miclucho Maclay, Haeckel, and others, while it was only in the later part of his paper that he referred to Bowerbank, whose volumes had appeared ten years before. For his insistence on the close relation between fossil and living sponges and his attempt to wipe out old classifications, Pomel is to be commended. He made no detailed investigations of the skeletal elements, nor did he figure any, but he did insist upon the importance of the structure of the skeleton in making the large divisions of the phylum. For families, tribes, and smaller taxonomic divisions he was satisfied with the external form and the character and position of the oscula, thus following D'Orbigny and Fromentel closely. For the Miocenic and other Tertiary faunas his work is very valuable, since it contains descriptions of many new species of sponges from Oran.

One year later Sollas published his short paper on the Ventriculidæ of the Chalk (1873) and three years after that appeared the first part of Zittel's monograph which he completed by 1879. This monograph was so revolutionary in its method of treatment of the sponges and so comprehensive that nothing remained to be done except to extend the method to the study of faunas in different countries. The English under

[1] I have been unable to see this volume, because so far as I know there is no copy in the United States, unless it be in some private library. I am compelled, therefore, to rely upon Rauff's estimation of the paper. For an excellent account of Pomel's life and contributions to science, the reader is referred to the 'Notice Biographique sur A. Pomel' by M. E. Ficheur in the Bull. Soc. Géol. France, 1899, (3) XXVII, pp. 191–223.

Hinde's leadership started in immediately on the fossil sponges of Great Britain, Hinde doing the major part of the work, as we have seen. The German fossil sponges were taken up in even greater detail under Rauff, Kolb, and Schrammen; in Bohemia Frič and Počta, more particularly the latter, monographed the Cretaceous sponges; in Russia the work was carried on by various Germans. But France alone possesses no classic on her abundant Cretaceous sponge fauna; one who would list that fauna would have to include the practically uncharacterized species named by D'Orbigny, Fromentel, Courtiller, and their followers. The only modern contributions on the French sponges are the two by Počta (1892, 1907) and one by Barrois (1898) which are discussed below, pages 65, 66, and 68.

Russia

The Cretaceous sponge fauna of Russia has not been described in its entirety by any one. Local faunal studies have led to the description of a few species in scattered areas, but that is all. The early work by Knorr and Walch (1775) dealt only with the Jurassic species, and the first notice that I have come across of Cretaceous sponges is at a much later date. Fischer von Waldheim's costly and elaborate large quarto volume entitled 'Oryctographie du Gouvernement de Moscou' appeared in 1837 and contained the description of a single species of sponge, *Siphonia pyriformis* Goldfuss, from the Chalk of Bouchevoë, near Moscow. In the same year appeared 'Polens Paläontologie' by Pusch, in which the sponges are briefly referred to. This was followed in 1843 by a short paper by Fischer von Waldheim in which were described three new species of *Cœloptychium*, and by a second short paper in 1844 entitled 'Observations sur le Genre de Polypier Cœloptychium' in which five more new species were described from the Chalk of the government of Simbirsk.

In 1865 the second volume of E. von Eichwald's classic 'Lethæa Rossica ou Paléontologie de la Russie' appeared and in it were the descriptions of many species of sponges, a large number of which were new to science. They were considered more from the stratigraphic than from the palæontologic viewpoint, the descriptions being brief and without details regarding the structures.

One of the few Russian papers which has appeared on the sponges is that by Sinzow (1872), entitled 'Ueber Jura und Kreideversteinerungen im Gouvernement Saratow,' but here, too, the sponges are not treated by a specialist; the descriptions are brief and the skeletal structure or

elements are not used in definition. The author has given brief synonymies and seems to have had access to the chief large works on sponges, if not to all the shorter papers. His illustrations are well drawn and excellently reproduced and are to be noted for the care given to the details of the surfaces of the species described, enlargements having been made for each plate.

In 1877 Trautschold described four species from the Cretaceous of Russia, but the descriptions are of only the external characteristics and the illustrations are very poor.

Another stratigraphic paper containing mention of sponges is that by Pianitzky (1890, 'Recherches des Dépôts Crétacés des bassins du Don et des affluents gauches du Dnieper.'

Thus far the Cretaceous sponges of Russia have been considered by stratigraphers and the work done on them has been descriptive but not taxonomic. With the unparalleled development of the chalk in that country there is undoubtedly to be found a large sponge fauna but, so far, the field is practically untouched.

Bohemia

In 1840 August Emanuel von Reuss began his elaborate work which appeared under the title of 'Geognostische Skizzen aus Böhmen' (1840-1844), on the stratigraphy of the Bohemian Mittlegebirge in the neighborhood of Teplitz and Bilin. This was followed in 1845-1846 by a volume on the palæontology entitled 'Die Versteinerungen der böhmischen Kreideformation.' In this he described forty-three species of sponges but, like other Germans at that time, he followed Goldfuss in dwelling only upon external characteristics and his illustrations, though carefully drawn, show only the outer form of the sponges.

In 1869 the Natural History Survey of Bohemia was inaugurated and there appeared at Prague the first volume of the 'Archiv für die naturwissenschaftliche Landesdurchforschung von Böhmen' containing the exhaustive 'Studien im Gebiete der böhmischen Kreide-Formation.' Johann Krejči (1869) wrote the general stratigraphic section, establishing the geologic succession and giving many detailed vertical and columnar sections, while Anton Frič[1] undertook the palæontological investigations of the individual formations of the Cretaceous, and for forty years there have been appearing in the archives of the Bohemian

[1]German spelling, Fritsch.

survey monographs by the latter, these being completed in 1911 with a total of nearly a thousand pages. During this period he brought together, in connection with his studies, a marvellous collection of the Cretaceous fauna and flora of Bohemia, which is to be found in the Barrande Museum (Barrandeum) at Prague of which Frič was curator until his death two or three years ago. The stratigraphy and palæontology have been treated with equal care and with a detail so great that it is highly improbable that future workers will need to make changes of more than minor significance. While the sponge fauna was found to have many species in common with that of northwest Germany, there was also revealed a large proportion of wholly provincial forms which, so far, seem not to have occurred elsewhere. Frič did not essay the complete description of the entire sponge fauna but turned the monographing of it over to his pupil Philipp Počta, in accordance with the general plan of the Natural History Survey to have complete faunal studies made for each phylum.

In Počta's 'Beiträge zur Kenntniss der Spongien der böhmischen Kreideformation,' which appeared in three parts in 1883 and 1884, we find the one standard reference work for the Cretaceous sponges of Bohemia, corresponding to Hinde's 'Catalogue' in England and to Rauff's Palæospongiologie' for the German Palæozoic and Schrammen's 'Kieselspongien' for the German Cretaceous. Zittel's classification and method are followed and the book will be found to be of especial value in containing the most complete synonymies for the species described that have appeared in any one treatise.

Additional species of sponges have been described from time to time in late years as new discoveries have been made, while already known species have been found in new localities. The more important recent writers are Ceněk Zahálka (1885, 1886*a*, 1886*b*, 1887*a*, 1887*b*, 1888), Jaroslav Jahn (1891), Břetislav Zahálka (1912*a*, 1912*b*, 1913), and Scupin (1907). Ceněk Zahálka wrote only short papers discussing previously named species or calling attention to new occurrences, his work being very local in character and confined mostly to the Cretaceous around Roudnice (German Raudnitz). Many of his papers are short contributions, written in Bohemian and thus rather inaccessible. The stratigraphy of the Cretaceous around Prague has been worked out in the utmost detail by Břetislav Zahálka (1912*a*, 1912*b*, 1913, papers in Bohemian), who has not, however, paid much attention to the faunas, merely mentioning species in the text and listing them in summary tables.

Germany

In spite of the fact that German palæontologists knew of the existence of fossil sponges as far back as 1702 when Scheuchzer's memorable volume entitled 'Specimen Lithographiæ Helveticæ Curiosæ' appeared, absolutely no mention of Cretaceous sponges was made for over a hundred years, although both French and English writers, especially the former, were publishing at length on Cretaceous species. All of the early contributions by Germans are on Jurassic sponges and it was not until the nineteenth century was well on its way that the Cretaceous rocks and included organic remains came into their own. Then quite suddenly there sprang up in this erstwhile barren field the surprisingly comprehensive 'Petrefacta Germaniæ' by Goldfuss (1826–1833). Its share in the development of the science of palæontology as a whole is well known but it did an especially great service to the sponges, so long neglected. To be sure, the value of internal structures was not recognized and classification was based largely on external characteristics and form, but the work surpassed what was being published in other countries both in precision of description and accuracy of illustration and it sufficed to do that very necessary thing for all progress—it called attention to the existence of the German Cretaceous and other fossil sponges. While classifications were progressing in other countries and large numbers of new species were being described, practically nothing was appearing in Germany. In 1839 Hagenow, in discussing the faunas and stratigraphy of Rügen, described a few species of sponges, but his contribution was a comparatively small one.

The year 1841 marks the second mile-stone on the road of advancement in palæospongiology. The eldest of the three Roemer brothers, Friedrich Adolf Roemer (1809-1869), published his 'Versteinerungen des norddeutschen Kreidegegirges.' Born in the quaint mediæval town of Hildesheim, in Hanover, he was fortunate enough to find himself in the very midst of the most fertile field for Cretaceous sponges that there is anywhere in the world, so far as we know. He collected from localities in Hanover, Braunschweig and adjoining regions, working out the stratigraphic succession as well as describing the fauna. His collections and all of his types are now in the Roemer Museum at Hildesheim in buildings given to the town by Hermann Roemer, the second brother.[1] Many new species were named by F. A. Roemer, but his des-

[1]See Obituary by Dr. Sprengell in Jahreshefte des naturwissenschaftlichen Vereins für das Fürstentum Lüneburg, XII (1893), 1890-92, pp. 40-42.

scriptions were altogether too brief and his illustrations very poor compared with those given by Goldfuss. Since the Roemer proterotypes are all available, it has been possible to redescribe them in modern terminology, and this great service has been performed by Schrammen in his Monograph (1910–12). Roemer's 1841 contribution dealt with the entire fauna of northwest Germany; in 1864 he brought out 'Die Spongitarien des norddeutschen Kreidegebirges' in which he described all of the species of sponges then known from that region, that is 261, distributed through 47 genera. Most of the descriptions were still very brief and Roemer even then made no use of the microscopic features of the sponges.

The period from 1870–75 was marked by the appearance of the descriptions of sponge faunas of various localities. It was at this time that Dr. Clemens Schlüter, former director of the Geologisch-palæontologisches Institut der königlichen Universität zu Bonn, began the publication of his numerous papers on the stratigraphy and palæontology of Münsterland and later of northwest Germany. His chief contributions on the sponges appeared in 1868, 1870, 1872, and 1895. In Saxony, Hanns Bruno Geinitz was studying the Quadersandstein and during the years from 1871 to 1875 he published his memoir, entitled 'Das Elbthalgebirge in Sachsen,' in which he carefully described the sponges of that region giving good synonymies and well executed illustrations. The youngest and most distinguished of the three Roemer brothers, Ferdinand Roemer, more primarily a stratigrapher than a palæontologist, had at an earlier date (1854) published 'Die Kreidebildungen Westphalens' in which the sponges are simply listed. But in 1870 he brought out the monumental 'Geologie von Oberschlesien' to accompany his geological map of Upper Silesia and in this he described and figured the sponge faunas of the district including the fauna of Oppeln. He followed his brother largely and was thereby at times led into error but, for the most part, his descriptions are to be commended for their definiteness and his synonymies, though often including references which were misplaced, yet pointed the way to later authors, for most of the works up to that time, with the exception of those by Schlüter and Geinitz, had contained at most but one or two references in the synonymies. "The Father of Geology in Texas," as Dr. F. Roemer is frequently called, cannot be considered one of the great contributors to palæospongiology, but his name will always be remembered in connection with the Oppeln sponge fauna.

Although slightly out of chronological order, it is fitting to mention at this point a work which might well have been written at a much earlier date so blameworthy was it in all respects. Rauff very truly remarks that, "It was an especial mishap for Quenstedt that the fifth volume of his 'Petrefactenkunde Deutschlands,' treating of the sponges [1878], should have seen the light of the world at the same time as Zittel's monographs appeared" (Rauff, 1893–94, p. 87). It was indeed a mishap for Quenstedt but, since the book appeared at all, it was great good fortune for science that it came out just at the time when it could do least harm, since Zittel's monographs effectually served to throw into strong relief all of the errors in Quenstedt's volume. Quenstedt formulated and then became completely enmeshed in a highly artificial system of classification, which was incorrect in its fundamental concepts and in every detail of superstructure. His discussion opens with the following novel and startling classification (1878, pp. 6, 7):

Cœlenterata (Corals)

(1) *Spongiæ* (sponges)
(2) *Sternkorallen* (i. e., the Tetracoralla and Hexacoralla.)
(3) *Octactiniæ* (i. e., the Octacoralla, also the Alcyonarian corals.)
(4) *Favositen* (i. e., the Favositidæ).
(5) *Quallen* (i. e., Hydrozoa).
(6) *Bryozoen* (Bryozoa).

In the 600-page volume devoted to the sponges he described many new "genera," not taking particular pains to define them because he thought that characteristics suitable for strict differentiation were wanting. He arbitrarily discarded many old generic names and was as ruthless in his disregard of the laws of priority as Fromentel had been. A great number of new "species" was described, these being based upon unimportant external variations. In the delimiting of genera and species he considered form and habitat as of first importance; then the presence or absence of an epitheca was considered; and third the type of surficial meshwork, under which Roemer's two divisions were recognized: the network (*gitterförmiges Gewebe*), and the vermiform meshwork (*wurmförmiges Gewebe*).

Quenstedt's method of treatment and arrangement of subject matter were such as to make the book very difficult to use. The synonymy references are not brought together in one place under each species but are scattered through profuse and often valueless discussions

on unimportant matters, and from the text alone one often is unable to determine which generic and specific combination Quenstedt considers to be correct; this point can be determined only by consulting the descriptions of the plates. No use was made of the finer structures of the sponges or of the skeletal elements. Most of the Jurassic species have been redescribed by Kolb and the Cretaceous ones by Schrammen, the work done by these authors meaning an entire revision. The atlas of illustrations accompanying the volumes shows carefully executed drawings of the form and surficial characteristics of over a thousand specimens of Mesozoic sponges. The Calispongiæ and Silicispongiæ are indiscriminately mixed up, Quenstedt not having had a clear idea of which genera belonged in the two groups.

In the history of palæospongiology the year 1876 will be memorable as the one in which was published the first of Professor Karl A. von Zittel's contributions, namely, that entitled 'Ueber Cœloptychium' (1876*a*). Ten years previously von Zittel had been appointed to the chair of palæontology at the University of Munich as Oppel's successor, and during the next four decades he raised his science from a position of obscurity to one of enviable prominence in Germany. Among his students and those whose work was directly influenced by him are to be counted the three foremost authorities on fossil sponges: Hinde, Rauff, and Schrammen. Von Zittel not only introduced practically new classifications of recent and fossil sponges but he developed the method of study and laid the foundations for all future taxonomic work. His classification, however, carried the revision of the phylum only down through the genera. He revised, emended, redescribed, and newly described all of the higher taxonomic divisions and erected many new genera. The overlapping of the older generic terminology, particularly that of the early French writers, may be seen by the synonymies given by Zittel under his new genera. Oftentimes there are parts of eight or ten of the older names included under one of the new generic names. But when it came to the species Zittel merely listed, usually without description, a number of representative species of each genus and sometimes he would give one or two synonymous names for the species listed but, on the whole, he did little in the way of revision for the smaller taxonomic groups. He figured the skeletal elements of at least one species under each genus and in so doing made his great departure from his predecessors, who had figured the inconstant and almost valueless external forms of their species but had never studied, described, or figured the spicules. The classification made by Zittel for a whole

phylum and for recent as well as fossil forms has been universally adopted by palæontologists and zoologists and, while detailed studies on species have led to minor changes, they have also served to show how fundamentally accurate was the revision in its essentials. Von Zittel did not plan to end his work on the fossil sponges with this one monograph, which covered the whole field in a comprehensive way; he wished to take up the sponges of each era and thoroughly to revise and systematize the species, but this he was not able to do. He proposed to Dr. Hermann Rauff, then a Privatdozent at the University of Bonn, to collaborate with him, Rauff to do the Palæozoic sponges, Zittel the Mesozoic. Rauff, not without a full appreciation of the immensity of the task, nevertheless, accepted, for the honor of being a fellow worker of Zittel's was great and with such assistance and inspiration as he would receive the work would be less difficult than it would be if he had to undertake it alone. The Professor, however, found himself unable to carry out his plan, but he urged Rauff to go ahead alone. Thus we are brought to another mile-stone in the history of palæospongiology.

Dr. Rauff published the first part of his 'Palæospongiologie' in 1893–94, in the Palæontographica, of which von Zittel was the editor. Rauff, throughout the writing and publishing of the monograph, had Zittel's assistance and advice. The bibliography of 650 references and the chapter on the literature were taken from manuscript which had been written by Zittel in 1878 and had been turned over by him to Rauff. And Zittel had made a wise selection in the choice of some one to carry on his work for Rauff, with a thoroughness that calls forth constant admiration, took up the Palæozoic sponges of the world, describing them species by species, illustrating them as individuals and by enlarged views of the spicules, and including complete synonymies and notes on occurrence. In the chapter on the morphology of the sponges the spicules are described and illustrated, enlargements up to 450 diameters being used. The modes of fossilization were exhaustively discussed and abundant evidence was brought forward to show that the condition in which the sponges are found in the rocks is no indication of their original condition, on account of the number of chemical changes that may take place in the preservation of the spicules. Rauff completed the systematic study of the Palæozoic sponges in the succeeding volume of the Palæontographica (1894–95.)

The monographing of the Mesozoic sponges fell to two men: Rudolf Kolb, a student of the late Professor Dr. von Koken of Tübingen, and Dr. Anton Schrammen, of Hildesheim. Very little had been done

on the Jurassic sponges since the fifth volume of Quenstedt's 'Petrefactenkunde' had appeared (1878). We have already spoken of that work and have seen how much there still remained to be done for the Jurassic species. Quenstedt's proterotypes were nearly all at Tübingen, so that Kolb was able to redescribe them and to give satisfactory illustrations especially of the spicules; since the broad classification of the sponges had been made by Zittel and since Rauff had covered the literature on the subject and had fully described the structure and spicules, Kolb had only the systematic work for the Jurassic so that his task was far easier than had been that of those who went before him (Kolb, 1910–11).

To a dentist and local collector at Hildesheim, Zittel entrusted the monographing of the Cretaceous sponges. Dr. Schrammen had published four preliminary papers on the Silicispongiæ (1899–1903) in connection with his own collections and with his studies of the types in the Roemer Museum. His papers appeared as contributions (Mittheilungen) from the Museum and no doubt served to attract Zittel's attention to their author. Schrammen collected vast quantities of material from all the famous sponge localities around Hildesheim, nearly all of which he could visit by covering an area not more than 15 km. in radius. He also collected in Braunschweig, in Münsterland, and in Oberschlesien, and visited the museums in these different states. He perfected the methods of cleaning the specimens, etching them out with acid when possible, but often counting on only a needle with which the matrix was scraped away grain by grain. As a result of his careful collecting and of his laborious and painstaking methods in the preparation of the material, the collection in the American Museum is exceptionally valuable.

Schrammen's Monograph deals only with the Silicispongiæ of northwest Germany and the occurrence of species in other regions is not usually given. The chief criticism of the work is that the synonymies are misleadingly incomplete. By the omission of references it is often made to appear that a certain author was responsible for a given generic and specific combination, whereas he had only accepted some earlier writer's revision, reference to which has been omitted by Schrammen. The failure to include all of the occurrences of each species in other European countries also gives a misleading impression, for oftentimes a species appears to be very restricted in its geographical range, whereas in reality it is widespread. These are mistakes of omission; the one great mistake of commission in the Monograph is a deplorably lax usage

of the term *Belegestück*. After a careful study of the types in the collection in the Museum and after an equally careful study of the Monograph, I have found that Schrammen uses *Belegestück* to cover any kind of a type—proterotype, hypotype, or apotype (for definitions, see below, p. 99)—and that more commonly he means by it only typical specimen and not a proterotype as one would naturally infer. For instance, he claims to have in his collection the *Belegestück* of a species the holotype of which is known to be, say, in the University of Göttingen. What he means is that he has collected specimens from the type locality. Again he uses *Belegestück* to refer to the specimens which he has used to further amplify some one else's protograph or protolog. He evidently knew nothing either of Schuchert's or of Buckman's work on types and of their classification. He is no more to be criticized than is any other palæontologist on the Continent, for the nomenclature of types seems not yet to have been adopted outside of America and Great Britain and, even in those countries, many authors make no use of the classification but still speak indiscriminately of types when they mean typical specimens or else, if they use the type nomenclature, they employ it incorrectly, speaking, for instance, of having the holotype and cotypes of a species which very obviously they could not have. Schrammen, thus, is no more lax in his terminology than are many others, but his use of the term *Belegestück* was particularly unfortunate in his labelling of the collection sent to the American Museum, for he called nearly all of the 800 specimens *Belegestücke*, from which one would infer that they were proterotypes, whereas only about one fourth of them are.

I have given the criticisms of Schrammen's Monograph first so that we might pass on to a consideration of its very great value, which should be remembered more than its shortcomings. The only comprehensive works on the German Cretaceous sponges which had appeared before 1910 were those by Roemer (1841, 1864), which were altogether inadequate and out of date. Small numbers of species had been described by different authors, but the Cretaceous fauna as a whole was still in chaos. Schrammen undertook all of the refinement of specific revision which Zittel had not had time to do and altogether described 321 species in 140 genera. He erected many new families and genera and described a large number of new species. The illustrations which he gave far surpass all that had previously appeared. He has given forty plates figuring entire specimens all from carefully prepared photographs and, in addition, he has figured the skeletal elements of all of his new species and of many species described by other authors. He has made

up the first complete faunal lists of the Silicispongiæ of various localities in northwest Germany and also for the region as a whole. He has given lists of species for each horizon and has included tables of the genera zoologically arranged. The work is a treasure-house of useful information on Silicispongiæ and must be placed in that select group of masterpieces in which already repose the monographs by Hinde and Rauff.

CHAPTER II.—MORPHOLOGICAL CHARACTERISTICS OF THE SILICISPONGIÆ

General Anatomy

Sponges found in a fossil state are as variable in shape as are living ones and show almost as great a range in size. They occur in the form of discs, platters, vases, tops, balls, and mushrooms and are so inconstant in shape that even within the same species it is almost impossible to use this characteristic in identification. In size they vary from individuals a millimeter in diameter to those a meter and a half across and in height they range up to thirty-nine centimeters and perhaps more.

Fossil sponges belong to the sedentary benthos, being in nearly all cases attached to the sea-bottom or to some object resting thereon. Many Silicispongiæ were supported by a cylindrical stem or peduncle (*Stiel*), which ended basally in root-like proliferations (*Würzeln*) used for anchoring (e. g., *Ventriculites radiatus* Mantell). When a stem was absent the basal portion of the body of the sponge was provided with such attaching appendages or else the animal rested on the sea-floor without any particular anchoring processes (e. g., *Plinthosella squamosa* Zittel).

The only sponges found in a fossil state are those which possessed a hard skeleton, either calcareous or siliceous, those with a ceratose or horny framework never having been found in the rocks. That the horny sponges should not have been preserved when the remains of organisms apparently equally perishable are found even in Palæozoic rocks (e. g., the graptolites and many crustacea) is explained by the fact that the ceratose sponges have a framework made of spongin which appears from experiment and observation to be very much more perishable than chitin.[1] Since all that remains of the fossil forms are the hard parts, the student of palæospongiology is confined to observations on the canal

[1]Rauff. 1891. Ueber *Palæospongia prisca* Bornem, Eophyton z. Th., *Chondrites antiquus* Haliserites Z. Th., und ähnliche Gebilde. Neues Jahrb. f. Min. Stuttgart, II, pp. 92-104. (Footnote at bottom of p. 98, on spongin and chitin.)

system, when preserved, and on the skeletal structures, which, as we have seen, are the only reliable morphological characteristics available in the determination of genetic relationships and of specific identification.

Fossil sponges undoubtedly possessed a canal system almost as complex as that discernible in living forms but, on account of the vicissitudes attending fossilization, the infiltration of the canals by silica, lime, iron oxide, or other substances, or their complete collapse through pressure in burial, only the larger of the canals are preserved sufficiently intact to be studied and even these are frequently obliterated. In some genera a recognizable canal system seems to have been entirely absent, as in *Callodictyon* and *Farrea* among the Hexactinellidæ and in the Ascones among the Calcispongiæ. As in recent so in fossil sponges, there are two sets of canals: the incurrent or epirrhysa (Rauff), passing from the surface to the interior, and the excurrent or aporrhysa (Rauff), passing from the interior and opening on the inner surface or into the paragaster (Sollas). The epirrhysa in living sponges carry currents of water to the flagellate chambers in the body of the sponge wall and the aporrhysa carry the currents thence into the paragaster. After the food particles are abstracted the water is passed out by way of the osculum (*Paragastermündung*) or aperture of the paragaster. In some cases the epirrhysa and aporrhysa cannot be separated, a single set of canals serving the function of both, as in *Aphrocallistes*. The epirrhysa open upon the the outer surface of the sponge in small pores, termed incurrent-canal apertures or *ostia* (Sollas), while the aporrhysa open into the paragaster in oscula or better *postica* (Rauff).[1] The paragaster is flask-shaped, tubular, funnel-shaped or shallow bowl-shaped, or at times it is absent altogether. The ostia and postica must be distinguished from the *dermal* and *gastral* pores, respectively, which are smaller and are found only in the epidermal layer and do not penetrate the mesoglœa. The postica, as a rule, are larger than the ostia and differ from them in form, arrangement, and location. (Rauff, 1893–94, p. 124.)

Form of the Skeletal Elements

The skeleton of all known fossil sponges is made up of minute mineral particles, usually microscopic in size, composed of either silica or carbonate of lime, and generally termed *spicules* (*Skeletelemente*). The spicules of siliceous sponges are of two types:

[1]For a detailed description of the types of canal-systems reference should be made to Zittel (1878, p. 75) and Hinde (1887, pp. 50-54).

I. MEGASCLERES (*Stütznadeln*)—the true skeletal-forming spicules either free or united into a solid structure or skeleton. These can be readily determined under an enlargement of 20-60 diameters.

II. MICROSCLERES (*Fleischnadeln*)—minute spicules scattered only through the fleshy part and never united into solid skeletons. They require an enlargement of 200-300 diameters for their determination. In many fossil sponges they are unknown and probably not preserved.

In structure, the siliceous spicules are built up of concentric layers of colloidal silica, probably always around an axial canal filled with fine, granular organic substance, which sometimes contains foreign materials. During fossilization this canal is often enlarged, in part or throughout, by destruction of the inner layers of the spicule. The calcareous spicule (of calcite) shows more rarely a concentric structure, and the axial canal, when present, is without organic matter.

According to Rauff, all spicules may be classified into the following types on the basis of the number of arms, without reference to their arrangement or to the angle included between the arms:

Polyactines—many-armed (more than eight),
Octactines—eight-armed,
Heptactines—six-armed,
Pentactines—five-armed,
Tetractines—four-armed,
Triactines—three-armed,
Diactines—two-armed,
Monactines—one-armed.

The further classification is made on the basis of the form and termination of the arms, these variations being designated by the following prefixes:

Oxy—simple and gradually tapering to a point, e. g., *Oxytetractine*,
Torn—abruptly pointed, e. g., *Tornodiactine*,
Strongyl—simply rounded, e. g., *Strongylhexactine*,
Tyl—with knob-like termination, e. g., *Tylhexactine*,
Dicho—with forked termination, e. g., *Dichotriactine*.

In spite of the complexity of the spicules in the Silicispongiæ, in contradistinction to their simplicity in the Calcispongiæ, it is possible to reduce all of the types to a few simple fundamental forms. Indeed,

it is proable that all recent and fossil sponge spicules have been dervied from three primary types: namely,

Regular three-rayed forms or *Triods*,
Regular four-rayed forms or *Tetraxons*,
Regular six-rayed forms or *Triaxons*.

At present it is necessary to add to these three fundamental types the following, which have not yet been shown to be derivable from any one of the three: namely, uniaxial, polyaxial, and anaxial.

The regular three-rayed spicules are fundamental for the Calcispongiæ; the four-rayed and six-rayed spicules for two sharply contrasted orders of Silicispongiæ, namely, the Tetractinellida or Tetraxonia, and the Hexactinellida or Triaxonia, respectively.

The uniaxial spicules are alone characteristic of the order Monaxonia, no other type being found in the supporting skeleton of this order. They are further common in the Tetraxonia and Triaxonia, as in the recent and fossil Calcispongiæ. The polyaxial and anaxial types are found principally in the Tetraxonia, less frequently in the Monaxonia; they are wanting in the Triaxonia and Calcispongiæ.

Although most of the spicules are derivable from the fundamental forms above enumerated, their modifications are extreme, being principally along the following lines:

(1) Through differentiation of the arms in length, thickness, and form,
(2) Through suppression of arms,
(3) Through increase in number of arms as the result of forking,
(4) Through special modifications of the ends of the arms,
(5) Through modification of the median knob from which the arms radiate,
(6) Through peculiar and very variable ornamentation,
(7) Through other modifications.

It is evident that similar types of spicules may be derived from different fundamental forms by the suppression or, at times, through the division of the rays. Thus, three-rayed types may be derived by the suppression of one ray of the primary four-rayed type or of three rays in the primary six-rayed type. Therefore, the name Triod must be taken as referring to the form rather than to the genetic relation of the derivation of the spicule.

Details of Spicule Types

It seems advisable and indeed highly necessary to include a systematic classification of the types of spicules since in no text-book or special treatise in English is there any description of all of the recognized types of spicules, nor is there a complete classification with definitions in any single English or German work, despite the fact that all identifications are based primarily, often entirely, upon the determination and proper designation of the form of spicules. Furthermore, Schrammen, throughout his monograph, has referred to the various kinds of spicules without defining them, having counted upon specialists being able to find the definitions in original source books, but this is a tedious process involving much loss of time. Sollas, Rauff, and Hinde are responsible for most of the terms, but their definitions are not compact and are very often buried in a mass of technical detail so that they are not available for ready reference. Some new terms have been introduced by Schrammen but have not been defined at all or else have been described in the text of some protolog where one who had not gone through the whole monograph would be unable to find it. On Plates I-V an illustration is given for each type of spicule, copies being made of the line drawings in Schrammen's text plates of skeletal elements, these being chosen from the illustrations of species represented in the American Museum Collection. On Plates VI-XIV the actual skeletal arrangements are shown as they appear in each genus represented in the Schrammen Collection. These illustrations show the manner of occurrence of the individual spicules and their mode of union into a solid skeleton.

Types of Spicules

A.—TRIOD (original.)—Three equal arms in one plane diverging at an angle of 120°.

General Termination: simply and gradually tapering to a point (*Oxytriod*) (Pl. I, fig. 1).

Modifications: When arms are not in the same plane but form a pyramid, spicule is designated *Tripod* (Pl. I, fig. 2.).

Modifications in form produced by various curvatures of rays; suppression of one or more rays; forking of rays.

B.—TETRAXON.—Four equal arms arranged so as to extend from center to four corners of a regular tetrahedron. Angle between arms 109° 28′ 16″.

I. Regular Forms (Regularia)

Caltrop.—Regular type of tetraxon generally tapering to a point (*Oxycaltrop*). This is also an oxytetractine with four equal angles (Pl. I, fig. 3). In the Tetraxonia each arm contains a central axial canal which unites with the others in the center.

Ornamentation

1. *Rays bearing small spines or nodes throughout or at the ends.*
2. *Criccaltrop.*—Rays regularly ringed (Pl. I, fig. 4.).

Modifications

1. *Tetrod.*—Four arms in same plane.
2. *Tetrapod.*—Four arms forming regular pyramid.
3. *One arm of the caltrop suppressed.*
   a.—Three remaining arms forming regular pyramid (*Tripod*).
   b.—Three remaining arms in one plane (*Triod*, derived type).
   c.—Three remaining arms forming a T (*Orthotriod*).
4. *Diactine Type.*—Two arms of the caltrop suppressed.
   a.—Two remaining arms at right angles (*Orthodiactine*).
   b.—Two remaining arms at 180° produces a monactine type.
5. *Monactine Type.*—Three arms of the caltrop suppressed.
6. *Arms forked.*
   a.—Ends of arms forked (*Dichocaltrop*).
   b.—Forking from center complete (*Oxyaster*).

Triæne.—One arm elongated or changed in form; longer arm called *rhabd* or *rhabdome*, each short arm called a *cladisc* or *cladus*. The three arms together form a *cladome*. (These may be derived from the regular caltrop, but spicules similar in form but diverse in origin may also be derived from the triaxons, as noted below).

Modifications in the Relations of the Cladiscs and Rhabdome

1. *Protriæne.*—Cladiscs and rhobdome form angle larger than 109½° (Pl. I, fig. 5).
2. *Orthotriæne.*—Cladiscs and rhabdome form angle not over 109½° nor less than 90° (Pl. I, fig. 6).
3. *Anatriæne.*—Cladiscs and rhabdome form angle less than 90° (Pl. I, fig. 7).
4. *Mesotriæne.*—Rhabdome prolonged above axial point.

Modifications in the Form of Cladiscs

1. *Oxytriæne.*—Common form; cladiscs regularly pointed. Any of the four preceding types may have this form of cladiscs, and they are then designated in turn: *Proöxytriæne, Orthoöxytriæne, Anaoxytriæne, Mesoxytriæne.*
2. *Dichotriæne.*—Cladiscs forked once (Pl. I, fig. 8). Types: *Orthodichotriæne,* etc., *Dichoxytriæne,* etc., *Orthodichoxytriæne,* etc.
3. *Didichotriæne.*—Cladiscs forked twice (Pl. I, fig. 9).
4. *Tridichotriæne.*—Cladiscs forked three times.
5. *Trichotriæne.*—Cladiscs three-pointed (Pl. I, fig. 10.) Types: *Orthotrichoxytriæne,* etc., *Ditrichotriæne, Tritrichotriæne,* as under preceding.
6. *Phyllotriæne.*—Cladiscs expanded leaf-like (Pl. II, fig. 1).
   Types: *Orthophyllotriæne,* etc., *Dichophyllotriæne,* etc.
7. *Symphyllotriæne.*—Leaf-like expansions of cladiscs united into disc or bowl or cup (Pl. II, fig. 2). When simply a disc the form is also called by Sollas *Discotriæne.*

Modifications of the Rhabdome

1. *Triod* (derived type).—Formed by suppression of rhabdome. Special forms resulting: *Dichotriod, Phyllotriod, Pinakid* (Pl. II, fig. 3). (Pinakid is the symphyllotriæne with rhabdome suppressed, forming a mere disc of silica.)

2. *Amphitriæne.*—A second cladome formed on free end of rhabdome (Pl. II, fig. 4). This may have variously modified cladiscs as defined under 2, 3, 4 above.
3. *Candelaber.*—End of rhabdome branched candelabra-like (Pl. II, fig. 5).

Diæne.—Four-rayed spicule with one cladisc suppressed. Types: *Prodiæne, Orthodiæne, Anadiæne, Dichodiæne.*

Monæne.—Four-rayed spicule with two cladiscs suppressed. Types: *Promonæne, Orthomonæne, Dichodiæne,* etc.

II. Irregular Forms (Irregularia)

Especially characteristic of skeleton of Lithistida. Ends of arms (or *clones*) variously modified by branching, becoming slit, developing knobs, etc. By means of these modified ends the spicules interlace and become firmly united. These striking types of spicules are called *desmomes* (*desma* of Sollas). The arm end by which the union is effected is called the *zygome.* The method of union by zygomes is designated *zygosis. Crepidome* or *crepid* is the name applied to the simple original spicule (single rod or caltrop) which by addition of silica grows into the desmome; accordingly there are *monocrepid* or *tetracrepid* fundamental forms, having a single canal and four axial canals, respectively, by which the original nature of the crepidome is determined.

Tetraclone.—A desmome of tetraxon or caltrop type (four arms equal). Ends thickened or rooted (Pl. II, fig. 6).

Trider.—One arm or clone of tetraclones of different length or form from the others. (This type parallels the triæne.) The three equal arms or clones constitute the *clonome,* the modified clone constitutes the *brachyome:* a lengthening of the modified arms as in the triæne takes place, but it is often shorter or of the same length as the clonomes, and is otherwise modified.

Modifications in the Form of the Clonome Arms

1. *Orthotrider* (not given by Rauff).
2. *Dichotrider.*—All arms of clonome fork once (Pl. II, fig. 7).

3. *Dilophic tetraclone.*—Only two arms fork.
4. *Monolophic tetraclone.*—One arm forks.

Modifications in the Form of the Brachyome

1. *Amphitrider.*—Parallel of Amphitriæne.
2. *Ennomoclone.*—Regular Trider with clones of clonome simple or forked, but with brachyome shortened and generally much thickened or swollen. The forking of the clones is often close to the point of origin, and sometimes only one or two forks, producing irregular forms, with apparently an odd number of clones coming from the center (Pl. II, fig. 8).
3. *Didymoclone.*—Spicule with median rod or *epirhabd* which has thickened or swollen ends from each of which 3 or 4, seldom more, simple or forked clones arise with variously formed zygomes (Pl. II, fig. 9).
4. *Dicranoclone* (Schrammen[1]).—Monocrepid desmomes, typically with a basal part which has a thickened button-like, or thick and rounded end, and is furnished with especially strong wart-like elevations, and from which diverge 2, 3, or more, rarely one or four, knobby clones which themselves end in claw-like zygomes. The angle between the clones may be acute or obtuse (Pl. II, fig. 10).
5. *Rhabdoclone.*—Like No. 3, but with additional clones arising between the ends (Pl. III, fig. 1).
6. *Megaclone.*—Large rhabdoclone with few clones (Pl. III, fig. 2).
7. *Rhizoclone.*—Like the preceding, but all the clones arise from a medium curved or irregular stem and are short, irregular and root-like (Pl. III, fig. 3).

[1]Schrammen, 1910-1912, p. 65.

8. *Megarhizoclone.*—Very large rhizoclone; this type characteristic of the family Megarhizidæ Schrammen (Pl .III, fig. 4). Similar large monocrepid spicules found in the family Corallistidæ have been called by Schrammen *megarhizoclonids*[1] (Pl. III, fig. 5).
9. *Sphæroclone* (Schrammen[2]).—Desmomes consisting of a spherically thickened base from which diverge 1 to 8 smooth or thorny arms (clones), the ends of which expand into serrated discs. They are characteristic of the family Sphærocladinidæ (Schrammen) (Pl. III, fig. 6). Schrammen thinks that the didymoclone of Rauff may be formed of two sphæroclones united by one of the clones.
10. *Heloclone* (Schrammen[3]).—Comparatively large, thread-like desmomes with short, saddle-like elevations and pincer-like indentations, more or less curved and hook-like at the ends, and penetrated throughout their entire length by a single axial canal. They unite by zygosis, the hook-like ends holding on to the saddles and knobs of a neighboring spicule. They are characteristic of the family Helomorinidæ Schrammen (Pl. III, fig. 7).

C.—TRIAXON.—Six equal arms cutting one another at right angles. Fundamental for the Hexactinellida.

I. Regularly Developed Forms

Hexactine.—Arms simple and regular in form (Pl. III, fig. 8).

1. *Orthohexactine.*—Regular form with equal arms at right angles; the fundamental one from which the following are derived.
   a.—Oxyhexactine. Rays regularly tapering to a point (Pl. III, fig. 9).
   b.—Tornhexactine. Rays suddenly pointed.

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[1]Idem, p. 65.
[2]Idem, p 169.
[3]Idem, p. 129.

c.—Strongylhexactine. Ends rounded (Pl. III, fig. 10).

d.—Tylhexactine. Ends thickened or swollen into button (Pl. III, fig. 11).

e.—Discohexactine. Ends terminated with discs or rosettes (Pl. III, fig. 12).

2. *Pinulhexactine.*—One arm thicker than others and beset with appressed, outward-pointing thorns or scales (Pl. III, fig. 13).

Hexaster.—Arms divided.

1. *Orthohexaster.*—Arms regularly once or several times divided, points sometimes bent over. This simple fundamental type may be modified as follows:

a.—Oxyhexaster. Branches regularly tapering.

b.—Tylhexaster. Ends of arm branches thickened (Pl. IV, fig. 1).

c.—Graphihexaster. Arms divided in brush-like manner (Pl. IV, fig. 2).

d.—Discohexaster. With serrated discs or cups at ends of all or of some branches (Pl. IV, fig. 3).

e.—Floricom. Ends of divisions of arms bent into S-shape, broadened and toothed distally, and arranged in the form of a flower calyx (Pl. IV, fig. 4.)

f.—Plumicom. Ends of branches of arms of different lengths, curved, and arranged in bell form (Pl. IV, fig. 5).

Lychnisk.—Each of six arms at the proximal point of junction sends out four supporting branches which unite with those of its neighbors (Pl. IV, fig. 6).

II. Modifications of the Triaxon Through the Suppression of One or More Arms. These modified spicules are distinguished from others of similar form but diverse origin by the presence of the rudiments of the triaxial cross of the canals.

Pentactine.—By the suppression of one arm of the Triaxon a *Pentactine* is formed (Pl. IV, fig. 7).

1. *Pinulpentactine.*—One arm elongated and beset with thorns (Pl. IV, fig. 8).

2. *Tetræne.*—One arm suppressed, opposite arm elongated.

Tetractine.—By the suppression of two arms of the Triaxon a *Tetractine* is formed, in which the following modifications may take place:

1. *Triæne.*—Three short arms and one long arm, not in same plane. Identical in form but not in derivation with Tetraxon triæne.
2. *Stauractine.*—Tetractine spicules with four arms in the same plane (Pl. IV, fig. 9).

Triactine.—Three arms of Triaxon rudimentary or suppressed.

1. *Diæne.*—One long arm and two short arms arranged anchor-shape.

Diactine.—Four arms rudimentary or suppressed.

1. *Amphidisc.*—Diactines with two opposite arms capped by divided umbrella-shaped discs; other arms aborted (Pl. IV, fig. 10).
2. *Amphiaster.*—Both ends of opposite arms divided into spines; other four arms aborted (Pl. IV, fig. 11).
3. *Uncin or Oncin.*—A spindle-shaped diactine, beset throughout its entire length with numerous small thorns (Pl. IV, fig. 12).
4. *Orthodiactine.*—Two remaining arms of diactine at right angles to each other producing a monactine type.

Monactine.—Five arms suppressed.

1. *Tylostyle* (derived form).—Rhabd with rudiments of suppressed arms forming a knob at one end. Rudimentary arms recognizable by axial canals.
2. *Scopula.*—A long rhabd with 2, 3, generally 4, occasionally 5, 6, or more, outward divergent branches at one end, which are thickened distally and often barbed (Pl. IV, fig. 13). These branches are not modified arms because the axial canals do not extend into them, but form a cross at or below the point of divergence of the branches.

3. *Clavula or Clavule.*—One end of rhabd pointed, other with backward-bending, umbrella-shaped disc or ring of branches which are not the modified arms, as shown by the position of the cross in the axial canals (Pl. IV, fig. 14).

D.—MONAXON.—Straight or variously curved spicules with single axis or two axes in opposite directions; other axes rudimentary or absent.

I. MEGASCLERES.—Monaxon megascleres are designated by the general name *rhabd.*

According to Origin

1. *Monactine.*—Rhabd growing from one end only; ends different in form.
2. *Diactine.*—Rhabd growing from center in opposite directions; ends generally, but not always, similar.

According to Form and Termination of Rhabd

1. *Amphiox.*—Rhabd regularly tapering towards point at both ends (Pl. V, fig. 1).
2. *Amphitorn.*—Ends of rhabd suddenly pointed (Pl. V, fig. 2).
3. *Dor.*—Lance-shaped rhabd. One end regularly pointed, the other spear-shaped with 2 or 3 sharp edges. Two ends separated by a ring or annular growth (Pl. V, fig. 3).
4. *Amphistrongyle.*—Rhabd rounded at both ends (Pl. V, fig. 4).
5. *Style.*—Rhabd rounded at one end, tapering to point at other (Pl. V, fig. 5).
6. *Tylostyle.*—Pin-shaped with button-like knob at one end, pointed at other (Pl. V, fig. 6).
7. *Amphityle.*—Rhabd thickened or button-like at both ends (Pl. V, fig. 7).
8. *Ophirhabd* (Schrammen[1]).—Long, smooth monaxons of irregular or snake-like curvature, generally tapering towards both ends. They are characteristic of the family Ophiraphididæ Schrammen in the order Tetraxonia (Pl. V, fig. 8).

[1]Schrammen, 1910-12, p. 119.

According to the Ornamentation of the Rhabds

1. *Cricorhabd.*—Rhabd with rings or thickenings at intervals.
   a.—Cricostyle. A style with knobs at intervals.
   b.—Cricamphityle. An amphityle (knobbed at both ends) with rings throughout entire length (Pl. V, fig. 9).

II. Microscleres.—The small non-supporting, straight or curved spicules or microscleres occur singly or in bundles (*drax*).

Simple Forms

1. *Rhaphid.*—Slender, whip-like spicule.
2. *Tox.*—Bow-shaped spicule.
3. *Labid.*—Spicule shaped like sugar tong.
4. *Spirule.*—Simple, spirally-wound spicule, with more than one volution (Pl. V, fig. 10).
5. *Sigmaspire.*—A small *s*- or *c*-shaped, curved and spirally-wound spicule (Pl. V, fig. 11).
6. *Sigma.*—An S or sigma-shaped spicule.
7. *Sigmatoid.*—A C-shaped spicule.
8. *Diancistra.*—S or C-form, with knife-shaped ends, hooked; middle notched (Pl. V, fig. 12).
9. *Chela* (*Amphichela*).—C-form, with two or more shovel or hook-shaped, sharply recurving teeth at ends. Characteristic of Desmacidonidæ.
   a.—Anisochela. Both ends dissimilar (Pl. V, fig. 13).
   b.—Isochela. Both ends similar (Pl. V, fig. 14).

Ornamented Forms

1. *Diaspid.*—Ends with small shield, often toothed (Pl. V, fig. 15).
2. *Sanidaster.*—Rhabd a thick shaft with rosettes or spicules at intervals and at ends. Sometimes intermediate spines scattered along rhabd (Pl. V, fig. 16).
3. *Spiraster.*—Gently spiral, thorny rhabd (Pl. V, fig. 17).
4. *Discorhabd.*—Short rhabd, pointed at one end, spiny at other, with several toothed disc-like expansions between (Pl. V, fig. 18).

E.—ANAXIAL AND POLYAXIAL SPICULES

1. *Sphær.*—Spherical or ball-shaped spicule (Pl. V, fig. 19).
2. *Euaster.*—Small spherical center with comparatively long radiating spines (Pl. V, fig. 20).
3. *Sphæraster.*—Large central ball with short spines (Pl. V, fig. 21).
4. *Pycnaster.*—Spines blunt, not sharply distinct at base, coming from central ball (Pl. V, fig. 22).
5. *Sterraster.*—Ball with short blunt knobs formed of confluent spines (Pl. V, fig. 23).
6. *Rhax.*—Like preceding, but center kidney-formed (Pl. V, fig. 24).

ASSOCIATION AND UNION OF SPICULES IN THE SILICISPONGIÆ

A.—PRINCIPAL OR SUPPORTING SKELETON (STÜTZSKELET). This is primarily confined to that part of the mesoglœa which contains the cilaited chambers (*choanosome*).

I. MONACTINELLIDA.—In this order four types of arrangement of spicules have been observed. (1) Spicules irregularly scattered, ends united only by spongin; (2) spicules forming triangular meshes; (3) spicules radially arranged; and (4) spicules intercrossed in net-like arrangement.

II. TETRACTINELLIDA.—Arrangement of spicules radial or irregular. Dermal triænes with rhabdomes pointing inward and cladomes tangential to surface.

In the *Choristida* (choristid type), the spicules are chiefly smooth caltrops, triænes and amphioxes; free (only in a single case united by spongin).

In the *Lithistida* (lithistid type), the desmomes are generally closely joined by their ends, so as to form solid skeletons but no actual fusion of elements occurs (a single recent form has desmomes joined by spongin, according to Sollas). Junction may be irregular or may produce regular structures.

III. Hexactinellida

Classification According to Method of Union of Spicules

Lyssacina.—Spicules not generally firmly united, being either distinct or closely placed; sometimes hold on to one another by various modifications, or their arms interlace. Touching ends sometimes joined by superimposed siliceous lamellæ, or surrounded and joined by siliceous annuli. Some full-grown individuals have their spicular ends fused, as in the next division.

Dictyonina.—Normally spicules united by regular apposition of arms of adjoining spicules, and union of these is by a layer of silica; original distinctness of spicules recognizable only by observation of separate axial canals. The method of junction produces a regular skeletal scaffold or lattice work (*Dictyonalgerüst*) each bar of which consists of two united arms of adjoining spicules (Pl. XII, fig. 4). A transition to the preceding type is formed by the presence of irregularly placed and joined spicules.

Classification According to Function, Position and Arrangement of Spicules. The spicules of the Hexactinellida have been classified by F. E. Schulze on the basis of function, position and arrangement (not to be confused with classification on basis of form) as follows:[1]

1. *Principalia* (*principal*).—Spicules forming supporting skeleton of the Lyssacina.
2. *Dictyonalia* (*dictyonal*).—Spicules forming supporting skeleton of the Dictyonina.
3. *Parenchymalia* (*parenchymal*).—All the spicules in the soft tissue except dermal and gastral ones (see below).
4. *Prostalia* (*prostal*).—All larger spicules which project above the outer surface of the sponge. They may be:

   a.—Basalia (basal). Long, hair-like or thickened spicules projecting from the base of the sponge and used for anchorage.

[1]Schulze, F. E. 1886. Ueber den Bau und das System der Hexactinelliden. Abhl. könig. Akad. der Wissenschaften, Berlin, pp. 24-32; 1887, Report on the Hexactinellida, Challenger Reports. Zoology, pp. 40-46.

b.—Pleuralia (pleural). Spicules projecting from side-wall of sponge.

c.—Marginalia (marginal). Spicules projecting free around the osculum of the sponge.

5. *Comitalia* (*comital*).—Very thin, long drawn-out needles, closely adjoining the strong *principalia* in the Lyssacina.
6. *Dermalis* (*dermal*).—Confined to dermal membrane. These with the prostalia or these alone form the dermal skeleton.
7. *Gastralia* (*gastral*). Confined to gastral membrane (paragaster). Form gastral skeleton.

B.—SURFICIAL OR PROTECTIVE SKELETON (SCHUTZSKELET). These skeletons are formed chiefly on the dermal surface in the outer layers of the mesoglœa and in the ectoderm (ectosome), more rarely on the inner or gastral surface.

Dermal skeleton (*Dermalskelet*). These are common and are very important in systematic work; often differences in them constitute the only mark of generic distinction when the supporting skeletons are entirely similar. They are, however, rarely preserved in the fossil forms, generally because they are minute (microscleres), but sometimes they are larger than the spicules of the supporting skeleton. Their arrangement is irregular or in regular series or groups. In the matter of arrangement there is no relation between the supporting and protective skeleton. Dermal spicules generally project beyond the surface of the sponge (*prostal*), giving it a rough, bristly, hairy or velvety character, in proportion to the amount of projection. More rarely do they form a smooth surface if the spicules or their cladomes (in the triænes, tetrænes, etc.) assume an arrangement parallel to the surface. Sometimes, in connection with foreign bodies, such as sand grains, spicules of other sponges, etc., they make a solid cortex.

The Blanket Layer (*Deckschicht*) *or epiderm and Blanket Net* (*Deckgespinst*) *or dictyoderm.* In many fossil siliceous, as well as in calcareous, sponges a continuous *blanket layer* covers the lower part and sometimes the entire sponge. In this, separate elements have rarely been determinable (see *Ventriculites*, etc.). Rauff holds that these blanket layers are due to

secondary refilling of the pores and inter-spicular spaces by mineral matter, and the accompanying destruction or metamorphosis of the spicules. In other cases (many Hexactinellida, etc.), the blanket layer consists of separate, more or less closely packed, individual elements of similar form which appear to be modified or enlarged spicular ends (1893–94, p. 183). Sometimes the blanket layer (epiderm) is formed by a modification of the outer part of the supporting skeleton, chiefly through thickening of the outer spicule ends (*Callodictyon*, etc.).

A net-like, surface-covering with the parts often raised, is found on the paragastral surface in the Ventriculitidæ, Sporadiscinidæ, etc., and constitutes the blanket net (*Deckgespinst*) or dictyoderm. This is a derivative of outward-directed lychnisk rays of the paragaster surface. In form the net is scale-like or tussock-like.

CHAPTER III. SUMMARY OF THE STRATIGRAPHY OF THE UPPER CRETACEOUS FORMATIONS OF EUROPE

Introduction

The Cretaceous system was first studied and subdivided by a number of British geologists during the early decades of the nineteenth century, the pioneer in these investigations being William Smith, who from 1815 to 1821 mapped the entire series of Mesozoic strata in England, established the sequence of formations, and enumerated and carefully figured the diagnostic fossils from successive horizons. John Middleton (1812), Thomas Webster (1814, 1824), and W. Fitton (1824, 1836) made important contributions toward the solution of the early problems of classification and correlation of the different divisions of the Cretaceous but to Smith belongs the credit of the recognition of the correct stratigraphic succession in its broad aspects, as may be seen from the following sequence which is the one given by Smith in 1819 and in a less complete form in 1815:

Chalk	Upper Chalk Lower or Grey Chalk
Greensand	
Golt or Brickearth	

The fact that subsequent investigators have not altered the order of succession then established and the formation names then proposed testifies eloquently to the accuracy and keenness of observation of the "Father of Historical Geology." The formation names proposed by Smith and his followers were lithological terms and in that respect were unsatisfactory, though perfectly in accord with the usage of that time. Later researches in Great Britain have been directed toward the establishing of palæontological zones, the working out of structure and of underground geology, the tracing of lithological variations in the formations, and the correlation of the beds with the Continental equivalents. (See Jukes-Brown, 1900, 1903, 1904, and bibliography at the end of series in volume for 1904.)

In France a lithological and faunal succession closely paralleling that in England was recognized by D'Orbigny, who, however, introduced a series of locality names to replace the lithological terms proposed by Smith, thereby rendering an inestimable service to stratigraphy. In the 'Paléontologie Française,' II, 'Terrains Crétacés' (1842), D'Orbigny divided the Cretaceous into the following six stages in descending order:

Étages	Derivation of Terms
Senonien	*Senones*, Latin for Sens, in Yonne.
Turonien	*Turonia*, the ancient Touraine.
Cenomanien	*Cenomanum*, Latin for Mans, in Sarthe.
Albien	*Alba*, Latin for Aube.
Aptien	Apt, a city in the department of Vaucluse in Provence.
Neocomien[1] *s. str.*	*Neocomum*, Latin for the village of Neuchâtel in Switzerland.

While the names of these *étages* are still very generally used, they are being replaced in France by newer terms which have been introduced to refer to shorter time periods, or else the original name has been retained, but the epoch for which it was proposed has been subdivided into a number of stages as in the case of the Senonien which is at present divided into five *étages*. Thus, though D'Orbigny's nomenclature has been modified by the introduction of restrictions and refinements in classification, nevertheless, every one of the names which he proposed is

[1]This name was proposed by Thurmann in 1835, but he used it in a broader sense.

in use and they have all been accepted by the Germans and, though to a less degree, by the English, who still generally employ the confusing lithological terms.

In Germany, as in England, the earliest classification of the Cretaceous formations was made upon the basis of the different lithological units recognized. Thus we find in the writings of H. B. Geinitz, F. H. Roemer, and A. E. Reuss, which appeared from 1840 to 1846, many names which have persisted in the literature to the present day, such as Hilssandstein and Hilsthon, Quadersandstein and Plänerkalk. But it is now recognized in Germany that the rocks which were thus variously designated are only particular facies representatives of local development. D'Orbigny's nomenclature is used in the main, though for the Lower Cretaceous the later French modifications have been adopted and for the Upper Cretaceous the Senonien has been restricted by the introduction of the Emscher as a division coördinate with the Cenomanien, Turonien, etc., and by the addition of the Danien as the highest stage of the Cretaceous.

For Europe as a whole the general classification of the major subdivisions of the Cretaceous is as follows:

	France, Belgium Switzerland, Spain, etc.		Germany	England
Upper Cretaceous		Danien	Dänische Stufe	Upper Chalk
		Senonien	Senon / Emscher	
		Turonien	Turon	Middle Chalk
		Cenomanien	Cenoman	Lower Chalk[2]
Lower Cretaceous		Albien	Gault or Aube Stufe	Gault[1] and Upper Greensand
	Upper Neocomien	Aptien / Barrémien	Hils or Neokom	Lower Greensand
	Neocomien *Sens. str.*	Hauterivien / Valanginien	Weald	Weald

[1]The English have recognized that the Gault and Upper Greensand, which were originally supposed to be distinct and consecutive formations, are in large measure replacing facies of deposits of the same age. They have, however, considered that there were certain Upper Greensand beds which were higher than the highest Upper Gault and that these beds were not anywhere represented by the Gault facies but were, in fact, deposited after Upper Gault time. Such are the Warminster beds and all greensands containing *Pecten asper* and *Cardiaster fossarius*. Recent studies which I have made have convinced me that these highest "Upper Greensand" beds are only facies representatives of the Lower Chalk and should not be included in the stratigraphic series under the Albian. (The details of this problem will be given in a paper now in preparation.)

[2]Including the highest Upper Greensand, i. e., the Warminster beds, etc.

STANDARD STRATIGRAPHIC SUBDIVISIONS
UPPER CRETACEOUS WITH GER

Standard Stratigraphic Succession			Ammonite Zones[1] (Applicable for most of Europe)	German Stratigr Equivalents
Upper Cretaceous	Senonian	Danian	*Hercoglosa danica*	Dänische Stufe
		Mæstrichtian	*Parapachydiscus neubergicus* *Bostrychoceras polyplocum*	Obersenon or Mucronatenkreide[2]
		Campanian	*Hoplites vari* *Mortoniceras delawarense* *Placenticeras bidorsatum*	Untersenon or Quadratenkreide[2]
		Santonian	*Placenticeras syrtale* *Mortoniceras texanum*	Marsupitenkreide or Granulatenkreide[2]
		Coniacian	*Mortoniceras emscheris* *Barroisiceras haberfellneri*	Emscher[3] or Westfalicuskreide[2] or Oberquader
	Turonian		*Acanthoceras deverianum* *Acanthoceras ornatissimum* *Acanthoceras bizeti* *Mammites nodosoides*	Turon or Oberpläner or Mittlerquader 5. Cuvieriplän 4. Scaphitenplä 3. Galeritenplä 2. Brongniartip 1. Mytiloidespl
	Cenomanian		*Acanthoceras rhotomagense* *Acanthoceras mantelli*	Cenoman or Variansplaner (Unterp or Unterquader

[1]After de Grossouvre
[2]Name given by Stolley
[3]Name given by Schlüter
[4]Zones recognized by Schlüter for the Cenomanian
[5]Von Strombeck's subdivisions and zonal cation
[6]Schlüter's subdivisions of the Turonian
[7]Zones established by G. Müller

ÆONTOLOGICAL ZONES OF THE EUROPEAN
IVALENTS FOR COMPARISON

Major Palæontological Zones	Palæontological Subzones
nnitella mucronata	*Scaphites constrictus, Trigonosemus pulchellus, Bostrychoceras polyplocum* *Epiaster gibbus* and *Micraster glyphus*
ocamax quadratus	*Actinocamax quadratus* *Scaphites binodosus*
upites testudinarius and *ocamax granulatus*	*Marsupites testudinarius* *Uintacrinus westfalicus* *Inoceramus cardissoides*
ocamax westfalicus	*Inoceramus haenleini*[7] *Inoceramus digitatus*[7] *Inoceramus involutus*[7] *Inoceramus koeneni*[7]
noceramus cuvieri *caphites geinitzi* *alerites* (*Echinoconus*) *albogalerus* *noceramus brongniarti* *noceramus mytiloides* (=*labiatus*)	4. *Inoceramus cuvieri* and *Epiaster brevis*[6] 3. *Heteroceras reussianum* and *Spondylus spinosus*: c. *Micraster cortestudinarium*; b. *Neoptychites peramplus*; a. *Micraster breviporus* 2. *Inoceramus brongniarti* and *Prionotropis woolgari* 1. *Inoceramus labiatus* and *Mammites nodosoides*

thoceras rhotomagense and *Holaster subglobosus*[4]
penbachia varians and *Hemiaster griepenkerli*[4]
en asper and *Catopygus carinatus*[4]

Throughout Europe there has been carried on during the last few decades the most profound and minute study of the palæontological zones in the Cretaceous. As in all such faunal work, the cephalopods, being pelagic, are considered the most reliable in the establishing of zones of limited vertical but wide horizontal extent, for which reason the standard zonal subdivisions of the Cretaceous are based upon the ammonites. Following the method which was inaugurated by Oppel in his memoirs on the Jurassic, A. de Grossouvre, W. Kilian, and C. Jacob have established an ammonite succession which is applicable for the greater part of Europe, though many of the zones are missing in the north as in Russia and northern England where local successions have to be employed. In many regions it has been found practicable to make use of phyla other than the cephalopods; thus, in England half of the zones are characterized by echinoderms; in Germany the Cenomanian contains at times pelecypods or echinoderms which are entirely as diagnostic as the ammonites, which may or may not be present, while the Turonian may be subdivided on the basis of the pelecypods, or the ammonites, or the echinoderms, and the Emscher and Senonian show a clear succession of belemnite zones which are of more than local applicability. In order to have for ready reference the general scheme of the succession of stratigraphic divisions and faunal zones for the Upper Cretaceous of northwest Europe, the following table is included.

The Cenomanian and Turonian, together with the Albian which precedes these, are classed by Haug in his text-book (1910, II, p. 1170) as Middle Cretaceous (*Mésocrétacé*), for he recognized a three-fold subdivision of the period. This practice is not common in Europe and does not accord with the American usage, according to which the time period designated by Europeans as Lower Cretaceous is called the Comanchic, while the European Upper Cretaceous is our Cretacic proper. In view of the fact that the Cenomanian marks the great transgression of the Cretaceous, it would seem that the diastrophic evidence favors the two-fold division, which is the one generally accepted and the one which will be adopted in this paper.

Upper Cretaceous Provinces of Europe

Despite the persistence of certain comparatively small positive elements which were dominantly emergent land masses or ridges and areas of non-deposition during the Upper Cretaceous, there can be little doubt that the greater part of Europe was covered by the marine or non-marine sediments of that period, and that it was the subsequent

domings and prolonged erosion, largely in early and middle Tertiary time which gave rise to the present isolated outcrops. The scattered patches of Cretaceous strata now visible in Europe are structural, not lithological, units, being in some places the eroded rim of a basin, in others the escarpments developed by the erosion of a dome, and, again, there are areas where the strata have been but slightly disturbed and, in their horizontal position, have been protected by later formations, as in the plains of Hanover. These various structural units are generally considered as distinct provinces, because the lithological and faunal characters of the rocks are often quite distinct in them and, the connecting formations with their transitional facies and organic remains being absent through post-Cretaceous erosion, there is produced a lithological diversity more apparent than real. Of such structural provinces eleven major ones may be recognized.

(1) Great Britain

The Upper Cretaceous of the British Isles consists almost wholly of chalk, on which account the rocks of that period have for over two hundred years been designated the Chalk.[1] This formation, which is the depositional equivalent of the Cenomanian, Turonian, and Senonian of the Continent, and which was at first thought to be so uniform that no stratigraphic subdivisions could be recognized in it, has proved, on long study by British geologists and palæontologists, to be marked by pronounced lateral variations so that in some places it is not a chalk at all but a marl, a pure quartz sandstone, a conglomerate, or a greensand. Generally speaking, the formation is most impure in the lower part, where there is a considerable admixture of siliceous and other detrital materials, but becomes almost wholly calcareous in the upper part. However, one of the coarsest boulder conglomerates known from the Chalk is at the base of the Senonian in Ireland, so that the general rule for gradation in purity does not always hold, yet, on the other hand, the occurrence of clastic material in the higher divisions of the Chalk does not vitiate the truth of the generalization and can easily be explained, as we shall see when we consider the stratigraphic relations.

[1]The word is derived from the Saxon *cealc* from which also comes the present German form *Kalk*. Even at the present time the country folk in Lincolnshire call the rock *kalk*, but in the southern counties the word is softened to chalk (Jukes-Brown, 1900, p. 14). Since the Germans applied the term *Kalk* to any limestone, while the British reserved the name chalk for the particular foraminiferal limestone which is commonly understood when we speak of chalk, the Germans had to introduce a new name for this latter rock and have called it *Schreibkreide*. When they use *Kreide* as a formation name, they use it as synonymous with Cretaceous; as a lithological term, *Kreide* means limestone, not chalk.

The present outcrop of the Chalk in the British Isles is but a skeletal picture of its former extent, the main line of exposure extending from Devon to Yorkshire with a broad eastward-projecting tongue formed by the Wealden anticlinal.[1] In the Isle of Wight a sharp anticline has exposed the most complete section of the entire Cretaceous that is found anywhere in England, the Chalk alone here reaching a thickness of 1600 feet, which is the maximum development in England for the formation as a whole. A narrow band of the Chalk rims the Antrim basin in northeast Ireland, where the beds are preserved beneath the great Tertiary volcanic plateau, a position which is likewise held by the outcrops on the opposite coast of Scotland on the island of Mull and on the neighboring mainland in the peninsula of Morvern.

The present topography of the Chalk escarpment is the result of Tertiary and recent erosion. During early Lower Cretaceous time practically the whole of Great Britain was dry land, subject to erosion except in the extreme south and southeast where the continental deposits of the Wealden were forming. Towards the end of the Lower Cretaceous there began that advance of the sea which in its wider expression is known as the great Cenomanian transgression, a positive eustatic movement which, with only slight interruptions, continued into Senonian time. The sea entered southern England from the south, and Yorkshire and Lincolnshire from the east, spreading, respectively, northward and westward. The basal series of deposits accumulated in these advancing seas is always sandy or conglomeratic and contains much glauconite. From the method of deposition it is apparent that this siliceous-glauconitic facies is a lithologic not a chronologic unit, so that it is not surprising to find it of Aptian age in southeast England, of Cenomanian age in southeast Antrim, Ireland, and of Senonian age in northern Antrim. In the greensands and conglomerates thus formed, siliceous sponges abound, though often their presence is shown only by the immense numbers of spicules which are found. Following the sandy facies the beds usually become marly and then impure, and finally pure, chalk. Sometimes the facies transitions are very rapid, taking place within a few feet as, for instance, in northern Antrim where Senonian chalk containing 98% $CaCO_3$ is found only twelve feet above the thin one-foot basal conglomerate which rests upon the eroded Triassic surface. Sponges are there found in the conglomerate as well as further up in the pure chalk. The highest chalk which is now found in

[1]The Weald anticlinal is composed of four distinct anticlines.

Ireland is that of the zone of *Belemnitella mucronata;* the highest in England belongs to the zone of *Ostrea lunata* and is probably to be considered Mæstrichtian in age. Thus there are no remnants of the latest Cretaceous deposits in Great Britain and whether they were never deposited or whether their absence is due to erosion we cannot tell. But we do know that toward the end of the Cretaceous the sea began to retreat in response to a slow doming which was in progress and which had its center of elevation in North Wales and the present Irish Sea. During the Palæocenic the dome was peneplaned, the Cretaceous rocks being stripped back entirely from the central region in Wales, while the alternating hard and soft bands now composing the Worcester lowland, the Cotswold Hills, the Oxford lowland and the Chiltern Hills or Chalk Escarpment were exposed by erosion on the flanks of the dome, though the present expression as escarpments and lowlands is due to the subsequent Tertiary erosion of the revived and reëlevated peneplane which cut down the Welsh dome.[1]

The following detailed stratigraphical subdivisions and palæontological zones of the Upper Cretaceous are recognized in England, where, however, it is customary to include the Upper Cretaceous Greensand and Gault, which are of Albian age in that period, although Continental workers are practically unanimous in placing the Albian in the Lower Cretaceous. (Table, p. 56.)

In the Cretaceous rocks of Great Britain no siliceous sponges are known below the horizon of the Upper Gault (Albian) or zone of *Schloenbachia inflatus,* which is classed by Continental geologists with the Lower Cretaceous but is placed by the British in the Upper Cretaceous. The Folkestone beds (Upper Gault) of the Sussex coast have yielded a single species, *Siphonia tulipa* Zittel, which is found also in the Blackdown and Haldon beds in Devon but disappears in the lower Cenomanian. In the Malmstone (zone of *Schloenbachia inflatus*) of Devon and of the Isle of Wight, *Jerea websteri* Sowerby has been found and, at Blackdown, *J. reticulata* Hinde. These three species constitute the sole siliceous sponge representation for the Lower Cretaceous of England, if we consider the horizon of *S. inflatus* as belonging to that period and not to the Upper Cretaceous. If, on the other hand, the British classification is followed, then the Lower Cretaceous contains no Silicispongiæ. The question involved is one of stratigraphic correlation and subdivision and cannot be taken up in this paper.

[1]O'Connell, M. 1917. The Ancient "Coastal Plain" of Central England. Paper presented before the N. Y. Acad. of Sci., May 21, 1917.

The first siliceous sponge fauna to appear in England came in with the assemblage of organisms the remains of which constitute the distinctive and long famous Warminster or *Pecten asper* fauna. In the environs of Warminster, Wiltshire, the beds of that name are about

Standard Classification		British Lithological and Stratigraphical Subdivisions		Palæontological Zones
Senonian	Maestrichtian	Upper Chalk maximum 1000′+ (with flints)	Chalk of Trimingham	Zone of *Ostrea lunata*
			Chalk of Studland Bay and of Norwich	Zone of *Belemnitella mucronata*
	Campanian		Chalk of Newhaven and Brighton	Zone of *Actinocamax quadratus*
	Santonian		Chalk of Cuckmere, Margate, Bridlington, Salisbury, Danes' Dike	Zone of *Marsupites testudinarius*: Upper part with *Marsupites* and *Actinocamax granulatus*; Lower part with *Uintacrinus and Actinocamax verus*
Emscherian			Chalk of Broadstairs, Flamborough Head	Zone of *Micraster coranguinum*
			Chalk of Dover	Zone of *Micraster cortestudinarium*
Turonian		Middle Chalk (without flints) up to 240′	Rough nodular Chalk of Dover "Chalk Rock"	Zone of *Holaster planus*
			Chalk without flints, Dover, Hessle, etc.	Zone of *Terebratulina lata* (=*gracilis*)
			Hard nodular Chalk of Shakespeare's Cliff, etc. "Melbourn Rock"	Zone of *Rhynchonella cuvieri*
Cenomanian		Lower Chalk 60′—250′	Grey Chalk of Folkstone; Belemnite marl at top. "Totternhoe Stone"	Zone of *Holaster subglobosus* with subzone of *Actinocamax plenus* at top
			Chalk marl "Chloritic marl," Glauconitic Marl and Cambridge Greensand	Zone of *Schloenbachia varians* with subzone of *Stauronema carteri* at the base
			Warminster beds	Zone of *Pecten asper* and *Cardiaster fossarius*

thirty-five feet thick and consist of greensands at the base and top with sands and interbedded cherts (Chert beds) in the middle, the latter being the horizon from which practically all of the siliceous sponges of Wiltshire have come. They were figured but not described by Miss Benett in 1831, and recently Hinde has redescribed and reidentified all of the specimens so that the fauna is now known to comprise twenty-three species (Jukes-Browne, 1900, pp. 247-248, 480, 481). Two of these also occur in the highest *Pecten asper* beds on the Isle of Wight, where one species (*Axinella stylus* Hinde) not recorded from Warminster has also been found, while the fauna also includes the three Upper Gault species already mentioned.

These twenty-four species then, constitute the total known siliceous sponge fauna in the Cretaceous rocks of England below the Chalk. I believe that all of these but the three from the zone of *Schloenbachia inflatus* belong to the Cenomanian, though I cannot discuss the point here. However, in giving the total number of species for the Upper Cretaceous of England, I shall include therein the Warminster fauna of the *Pecten asper* zone, since it would otherwise be difficult to compare with the figures for entire faunas on the Continent, where the rocks containing *P. asper* are always recognized as marking the base of the Cenomanian.

The total Chalk fauna of England includes 131 species of Silicispongiæ exclusive of those occurring in the *P. asper* zone or 155 species if they are included. In the following table the distribution in periods is shown.

Period	*Total number of species*
Senonian	83
Emscherian	47
Turonian	40
Cenomanian (including zone of *P. asper*)	45

Since the zone of *P. asper* has six species in common with the zone of *S. varians*, the number of separate species for the Cenomanian is 24+27 —6=45. This includes one species from the Lower Chalk of South England, the exact horizon not being known.

The zonal distribution of the Silicispongiæ is as follows, so far as may be judged by the data now at hand, but had Hinde completed his monograph on the British Cretaceous sponges the fauna would undoubtedly have been found to be much larger.

Geological Period	Palæontological Zone	Number of Species
Senonian	Zone of *Ostrea lunata*	4
	" " *Belemnitella mucronata*	19
	" " *Actinocamax quadratus*	45
	" " *Marsupites*	36
Emscherian	" " *Micraster coranguinum*	33
	" " *Micraster cortestudinarium*	40
Turonian	" " *Holaster planus*	39
	" " *Terebratulina lata*	27
	" " *Rhynchonella cuvieri*	16
Cenomanian	" " *Actinocamax plenus*	0
	" " *Holaster subglobosus*	0 or 7[1]
	" " *Schloenbachia varians*	26 or 19
	" " *Pecten asper*	24

From the figures here presented it will be seen that, while there are fluctuations in the numbers of species in successive horizons, nevertheless, there is a fairly constant increase reaching the maximum in the zone of *Actinocamax quadratus*. This closely parallels the distribution in northwest Germany where, however, the fauna is very much larger and includes 197 species for the *A. quadratus* zone, as compared with 45 for the same zone in England. These faunal maxima are in decided contrast with the representation in Bohemia, where 82 species occur in the Cenomanian and the number steadily decreases until the fauna disappears entirely in Upper Emscher time.

In the Cenomanian of Great Britain there is no large siliceous sponge fauna except that of Warminster, already referred to. Species occur in no great abundance in the various subzones of the zone of *Schloenbachia varians* and at scattered localities, most of which are in south and southeast England, only three species being known from as far north as Hunstanton, Norfolk. With the exception of seven species from Dover, the horizon of which is in doubt but which is either that of the zone of *S. varians* or of *H. subglobosus*, there are no siliceous sponges found in the Cenomanian above the zone of *S. varians*.

[1]There are seven species listed by Jukes-Browne as coming from either the zone of *H. subglobosus* or that of *S. varians;* it seems more probable that they came from the latter.

The Turonian, while not showing a numerical increase in species, yet contains in reality much larger faunal groups than does the Cenomanian in which the species are of more or less sporadic occurrence. Thus thirty-five of the forty Turonian species occur in the Chalk at Dover or in the nearby cliffs along the Kentish coast. Practically all of the siliceous sponges of this period are found at localities south of the London basin, though a few species in the highest Turonian are found as far north as Bedfordshire.

There is a similar geographical aggregation of species in the Emscherian Chalk, for most of the sponges occur in sections along the Kentish or Sussex coast and only one species has been reported north of Bedfordshire. The Emscher species have, on the whole, a broader distribution in southern England, than do those of the preceding period; thus, many are noted from Wilts, and even from southern Dorset, and a few have been found in Hampshire and Surrey. A single species, *Camerospongia subrotunda* Mantell, occurs as far north as Norfolk, foreshadowing the wider range which is noticeable in the Senonian.

It is thus apparent that the siliceous sponges of the Cenomanian, Turonian, and Emscherian of England are confined to the southern and southeastern counties, the two most prolific areas being Wiltshire and the coast in the vicinity of Dover together with the Sussex region. But in the Senonian, where the largest and most diversified sponge faunas appear, the center of sponge population moved northward so that we find the best representation in Norfolk and Yorkshire, although some of the species are also found along the southern and eastern coasts. Thus, in the zone of *Actinocamax quadratus* twenth-nine of the forty-five known species come from Yorkshire, while nearly all the remaining species come from Sussex. The fauna as a whole loses its provincial character and becomes cosmopolitan being much the same as that which is so well developed in Germany. Above this zone the siliceous sponges rapidly disappear so that in the zone of *Belemnitella mucronata* there are only nineteen species recorded, these mainly from Norfolk, while in the highest Chalk in England which has been found only at Trimingham, Norfolk, there are only four species. These occur also in the Mæstrichtian of Rügen and Belgium and they thus serve to corroborate the evidence furnished by the rest of the interesting fauna of the Trimingham Chalk that there is at least a slight representation of the highest Senonian *sens. str.* in England.

The chief writers on the important areas in which siliceous sponges have been found in the British province are the following: Mantell

(1822) and Dixon (1850) for Sussex, Phillips (1829, 1835, 1875) and Lee (1839) for Yorkshire, Hinde (1880) for Norfolk, Benett (1831) for Wiltshire, and Tate (1865) for Ireland. The most important single work on the British sponges is the 'Catalogue of the Fossil Sponges, etc.' by Hinde (1883), which contains descriptions of all of the species in the British Museum. The same author began but did not complete a volume to be devoted to the Cretaceous species alone. In the three volumes by Jukes-Browne on the Cretaceous rocks of Great Britain complete faunal lists for each horizon in each county will be found and in the last volume a list for the entire British Cretaceous, but there are no descriptions of species (Jukes-Browne, 1900, 1903, 1904).

(2) Subprovinces on the Borders of the Central Plateau

To the south and southeast of the Welsh dome lie the London and Hampshire synclines with the Wealden anticlinal between them. During the Cretaceous these structural features did not exist, so that deposition took place throughout the area and the Chalk was continuous from the Isle of Wight to Hunstanton and from Dover and Yarmouth westward to, and perhaps over, Wales. The London and Hampshire synclines are now filled by the Tertiaries so that the Cretaceous rocks are known only from borings, while the Chalk has been stripped off from the Wealden anticlinal leaving only the Lower Cretaceous to view. South of the Hampshire syncline the Cretaceous beds are again brought to the surface in the sharp anticline which gives rise to the Isle of Wight, the southern portion of which is formed of Lower Cretaceous rocks, the northern of Tertiaries, while a narrow strip running east and west through the center of the island consists of the Chalk which is exposed on the steep northern limb of the anticline. The folds constituting the Weald anticlinal and the Isle of Wight anticline have been traced into northern France, where they assume an easterly southeasterly trend and finally die out beneath the Paris Basin. Thus one line of folding, the northernmost, strikes northwest from Arras, reaches the French coast between Calais and Boulogne, continues to the English coast, where it appears at Dungeness, whence it proceeds from east to west through the northern part of the Weald, in the direction of Frome and the Bristol channel. This is the axis of Artois, first recognized and named by D'Archiac in 1846. To the south of this Hébert has recognized a second line, the axis of La Bresle, which leaves France at Tréport and enters England between Hastings and Beachy Head, where it constitutes the Greenhurst anticline which is recognized to the west in the Vale of

Warminster. The axis of the Pays de Bray in the department of Seine-Inférieure, first described by Élie de Beaumont and later in great detail by De Lapparent, probably finds its continuation in England in the fold which runs through the Isle of Wight and into Purbeck. The Paris Basin is bounded on the north by the Artois axis, on the east by the Rhenish dome (Grabau), of Palæozoic, early Mesozoic, and crystalline rocks, which is breached by the Rhine graben, on the south by the Central Plateau and on the southwest by the eroded core of the Armorican mountain chain, the remnants of which form the hills of Brittany and are continued across the English Channel in folds of ancient rocks in Devon. Within this arc of ancient sedimentary and crystalline rocks lies the Paris Basin, the center of which is filled with the Tertiaries but the rim of which is composed of a number of escarpments formed by the edges of the Jurassic and Cretaceous rocks where these have been exposed by the circumferential stripping of the Tertiaries from the more elevated outer portion of the basin. Thus we may picture a basin filled with progressively smaller and smaller saucers, the basin being the structural depression in the embrace of the older rocks, the largest saucer being the layer of Triassic rocks, the next smaller the layer of the Jurassic, then the Cretaceous, and, finally, the saucer in the center being the Tertiaries. This mode of deposition over the entire basin and of subsequent erosion accounts for the occurrence of the Chalk in the Paris Basin as an arc, concave toward Paris and England and finding its continuation beyond the Boulonnais along the northern limb of the Wealden anticline. The Chalk has been eroded more or less along the French coast but is still preserved intact under the numerous scattered outcrops of the Eocenic which have not yet been removed in the general stripping away of the Tertiary cover. In the central part of the Paris Basin the Chalk is known only from borings and in a few places where the rivers have cut down through the Oligocenic and Eocenic into the Mesozoic beds.

In France two main provinces are recognized for the Lower Cretaceous: (1) the Paris Basin, which is structurally, stratigraphically, and palæontologically united with south and southeast England, and the deposits and fauna of which belong primarily to the northern or boreal sea; and (2) southern France, in the Rhone region and the old province of Provence, the deposits and fauna of which belong, together with those of the Alps, to the southern or Tethys sea. In southwest France lies the Aquitanian basin, which formed a westward embayment from the southern sea and which during the Lower Cretaceous was separated from the

northern sea by the massif of the Central Plateau and the dry land areas of Normandy and Touraine. In the Upper Cretaceous the two provinces lose their distinctness; the boreal sea advances from the northeast upon the plateau of Normandy, while the southern sea advances northward through the straits of Poitou, so that the Aquitanian basin is joined to the Paris Basin, as is shown by the intermingling in Charente of the typical northern ammonites and pelecypods with the southern rudistes fauna which penetrated into northern France, into Belgium, and even over to England. This union of Tethys with the boreal sea was effected by the end of the Cenomanian, by which time most of southeast France had become dry land through the emersion of a ridge which joined the Central Plateau on the west. In the Aquitanian basin and in Normandy and Touraine the sediments of the Upper Cretaceous were of terrigenous origin, differing both from those in the Paris Basin where Chalk was accumulating and from those in the deeper waters of the Rhone basin where shell limestones were forming.

a.—*The Paris Basin*

The same vertical lithological succession obtains in the Cretaceous of northern France as in that of England, namely, greensands at the base followed either by marls and chalk or immediately by chalk. There is likewise the same chronologic variability in the series of the two regions, the age of the basal greensand beds ranging from the Aptian to the Senonian with a concomitant range from the Albian to the later Senonian for the base of the overlying chalk.

On the southeastern border of the Paris Basin in the Department of Aube there was continuous marine deposition throughout the Cretaceous, for this region was about in the center of the "straits of Morven," a narrow connecting water-way between the Paris Basin and the southern sea. The stratigraphic succession in Aube does not follow the usual rule of beginning with a sandstone facies but, instead, the earliest Lower Cretaceous (here the Hauterivian) is a limestone which rests directly on the eroded Jurassic surface and which contains many sponges, pelecypods, and corals. In this region the chalk deposition began very early, appearing even in Albian time and continuing throughout the Cenomanian, Turonian, and Senonian. Leymerie has described and figured three species of siliceous sponges from the Cretaceous of Aube (1842), but it is probable that the fauna is very much larger, considering the abundance of species in adjoining portions of the Paris Basin. The occurrence of siliceous sponges in the Hauterive of Aube

and in the Neocomian of Germiney in Haute-Saône is of interest as being the first appearance of these organisms in the northern basin of France.

In following the chalk escarpment northwest from Aube it is found to pass through the departments of Marne, Ardennes, Aisne, Nord, and Pas-de-Calais; north of Ardennes the outcrops continue into Belgium in Hainault and Brabant. Towards the Franco-Belgian border the successive divisions of the Cretaceous overlap each other and each in turn comes to rest on the old Jurassic surface. Thus, in the department of Marne, the Aptian is the first bed to be deposited on the Jurassic; in the Ardennes, the Albian; at Lille in Nord, the Upper Cenomanian; at Aachen, the Lower Senonian, the lower beds of which fill in the hollows eroded in the surface of the primaries. The stratigraphic overlap and the rise of the chalk facies in the series indicate that the sea spread northward and the detailed evidence shows clearly that there was a land axis bounding the Paris Basin on the north and serving as a source of supply for terrigenous material as well as a partial barrier between the German and French basins. This land ridge was not completely submerged until middle Senonian time and, even then, it was never far below the surface of the sea.

If we return to Aube and follow the escarpment to the south through Yonne, Nièvre, and Cher, an overlap similar to that north of Aube is observed. Thus, near Sancerre in Cher the Albian overlaps the Aptian and lies upon the Jurassic, while west of Bourges in the same department no Albian is found but, instead, the Cenomanian is the first Cretaceous to have been deposited. The escarpment turns northwest from Cher, passing through Indre-et-Loire, Loire-et-Cher, Sarthe, Mayenne, Orne, and Calvados. There is a greater or less development of the Cenomanian in all of these departments and, because of the proximity to the mountain mass of Bretagne at the time of deposition, the Cenomanian beds are all of clastic origin, being sands and greensands with some shales. The broad central part of the Paris Basin lying between this southwest rim, where siliceous deposits were accumulating, and the northeast rim, where the sea lapped against the projecting land axis of the Belgian border, was comparatively free in the later Cretaceous from the influence of terrigenous sediments and there was accumulated the pure chalk which is particularly well developed in the lower reaches of the Seine in the departments of Eure and Seine-Inférieure. Pure chalk, however, was not formed in this central area until late Senonian time for, during the Cenomanian and Turonian, while the rivers from the bounding land

masses were supplying large quantities of siliceous clastics, the sea was charged with sands and even coarser material but, as the lands were lowered and the sea spread over them, less detritus was supplied and organic accumulations became dominant so that during the Senonian chalk formed in the very regions where sands had been deposited during the Cenomanian and Turonian.

It was pointed out in the chapter devoted to a résumé of the literature on siliceous sponges that we have no modern treatise on the French faunas. Therefore, it is impossible to state how many species occur in the different formations and it is equally impossible to make faunal comparisons with other regions, especially England and Germany. Since the descriptions given by Fromentel, Courtiller, and other French writers were based on the external form of the sponges and not upon the type of spicule or the skeletal arrangement, it will undoubtedly be found, when the revision is made, that a large number of the old "species" are in reality but morphological variants of a single species, as indeed has been found to be the case whenever any of the French species have been redescribed. However, an approximate idea of the size and distribution of the sponge faunas of the Paris Basin may be gained from the work which has already been done and I shall summarize briefly what is known, although it must be remembered that the entire French sponge fauna of the Cretaceous must be revised and the terminology and descriptions be brought up to date.

From the Lower Neocomian of Haute-Saône and Yonne, Fromentel (1859) has described five species which probably occur in the Hauterivian; from the Aptian of Aube, the same author has described a single species.

D'Orbigny (1850) listed 205 species of sponges from the Cretaceous but, unfortunately, he did not state which occurred in France and which were known only from England or Germany.

Michelin in his 'Iconographic Zoophytologique' (1840-47) described a large number of species from the Lower Cenomanian of various parts of France. Of all the early French works his is perhaps the most reliable, in spite of its unscientific phraseology, and his illustrations are so satisfactory that later authors have been able to accept many of his specific names in making their redescriptions. He makes no mention of skeletal elements or structures but otherwise his characterizations are at least no worse than those given by his contemporaries and in some cases they are better. His work is particularly helpful in including the distribution of the French species in other countries, mainly

England and Germany, and in containing the record of the occurrences of single species in various French localities.

From the *Craie Chloritée* (Cenomanian) of the departments of Calvados, Orne, Indre-et-Loire, Touraine, Loire-et-Cher, Seine-et-Oise, and Ardennes, Michelin has described fifty-one species (1840-47, pp. 120-147). From the *Grès vert inférieur* of Grandpré in the department of Ardennes and the *Tourtia de Cherk* near Tournai, Belgium, he has described a single species (p. 6). It is unfortunate that he spoke of all the species which he described as coming from the *Grès vert*, this lithological name being of no stratigraphic value, since the facies ranges, as we have seen, from the Aptian to the Senonian. Therefore, while it helps to some extent to know that a species comes from the greensand of a certain locality, the exact horizon cannot be ascertained because in a single place the section may begin with greensands which continue for some distance vertically, at least through two or more palæontological zones. Thus I can usually give only the approximate age of Michelin's various greensands. From the greensand in the environs of Mans, in Sarthe, eleven species are described by Michelin (p. 195).

From the Senonian Chalk of Saumur in Maine-et-Loire, Courtiller (1859) described 152 species and one variety, but that this fauna is by no means so large as the numbers seem to indicate may be judged from the fact that twelve of these "species" were included by Zittel under a single species of his own.

The most important contribution to the literature on the sponge faunas of any part of France is one made by Počta in which he described thirty-four species from the Senonian of Châteaux Meaulne, near Lude in the department of Maine-et-Loire (1892, list on p. 22). The specimens which he studied had been collected by Fräulein Boxberg and had been acquired by the Dresden Museum some twenty years before. H. B. Geinitz gave a preliminary notice of four species of the sponges which he had identified (1870, p. 149), but the full description of the fauna was not undertaken until 1892. This contribution is valuable for two reasons: first, because Počta employed the Zittel method of study and classification based on skeletal structure and arrangement and, second, because it was the first paper to be written on the large Paris Basin Cretaceous sponge fauna in which the species were designated according to modern terminology so that it is possible to institute comparisons with the faunas of nearby European regions. The description of this single fauna from the southwest portion of the Paris Basin enables us to gain a fair idea of the character of the fauna of the whole basin and

we find that the species all belong to the genera which were common in England and Germany and that nearly two-thirds of the assemblage is made up of the same species which occur in the Senonian of Germany.

The Cretaceous sponges of Seine-Inférieure have been in part described by Passy (1832), the distribution being as follows:

Upper Cretaceous—Dieppe, Rouen, Le Havre, etc...11 species.

Lower Cretaceous—Rouen, Le Havre, etc...4 species.

Lamouroux (1821, 1824) described from the Senonian Chalk of Caen in Calvados eleven species of sponges and from the "marne bleue" (Cenomanian?) two species.

Our knowledge of the fauna of the Chalk of the northeastern rim of the Paris Basin is derived largely from a short paper published by Barrois in 1898 in which he listed twenty-three species of sponges identified by him. He did not figure or describe any of the specimens nor did he note any new species. From the Cenomanian (Gaize à *Schloenbachia inflata*) in the environs of Vouziers and Rethel, department of Ardennes, he recorded six species; from the Marne de Givron with *Schloenbachia varians*, one species at Les Fondys; from the Tourtia with *Acanthoceras laticlavius*, one species from Dorignies, near Douai, Blanc-Nez; from the marl with *Acanthoceras rhotomagense* of Blanc-Nez two species. From the Turonian Chalk with *Micraster breviporus* he listed three species and from the Senonian, zone of *Micraster cortestudinarium*, of Lezennes, ten species. All of these species occur either in Germany or in England or in both countries.

b.—*The Aquitanian Basin*

The basin of Aquitania derives its name from the old Roman province of Aquitania, which extended from the Pyrenees to a little south of the Loire and from the Bay of Biscay to the lands bordering the Gulf of Lyon. During the early Lower Cretaceous this basin was dry land and was drained by rivers flowing southward and southeastward into the Tethys sea. An embayment from the Tethys gradually spread over the lands now forming the hydrographic basin of the Garonne River and for a time this southern sea, including the bay of Aquitania, was wholly cut off from the boreal sea of the Paris Basin by the uplifting of an axis across southeast France, the axis forming a continuous land bridge from the Central Plateau massif to the uplands occupying the site of the present Alps. The only marine connection during Cenomanian time between the Paris Basin and the Aquitanian basin was by a narrow channel which passed through Poitiers in the province of

Poitou west of the Central Plateau. The channel widened during the Turonian and in the Senonian there was free passage between the Tethys and boreal seas so that when the land axis of the Franco-Belgian border was submerged, the waters of a single sea covered France, England, Germany, and Russia, as is proved by the identity of the fossils in the Chalk of these countries.

There can be hardly any doubt that there are large numbers of siliceous sponges in the Cretaceous rocks of Aquitania, for in Touraine and Anjou at Tours and Saumur the Senonian Chalk has yielded an extensive fauna as we have seen. Furthermore, scattered references in the literature show that species have been recorded from Île de Noirmoutier in the department of Vendée, south of the embouchoure of the Loire, while it is known that sponges occur in the Lower Cretaceous to the south and therefore must have entered the Aquitanian basin as soon as that was filled by an arm of the Tethys. Thus, even though direct evidence of the presence of Silicispongiæ in this basin is lacking, we may yet feel sure that the organisms were there and that it is only a matter either of making collections or of describing collections which have been made and which may even now be in some museum awaiting attention.

c.—*The Rhone Valley and the Jura*

During the early Lower Cretaceous, the sea covering southeastern France and western Switzerland was entirely separated from the northern sea, for northern and central France were dry land. In this southern Mediterranean lived a fauna characterized by aberrant types of pelecypods, the rudistes, and by multitudes of distinctive ammonites. That siliceous sponges were abundant in the littoral facies in the province of Provence, in Dauphine, and in the Jura is known, but the fauna has for the most part never been described. Loriol described and figured a number of sponges from the Middle Neocomian of Mont Salève (1861-1863) and thirty species from the Lower Urgonian of Landeron in the Canton of Neuchâtel, Switzerland (Loriol and Gillieron, 1869), but he used Fromentel's nomenclature and classification with the result that the work will at some time have to be done again. It is probable that these sponges which are found in the extreme southeast of France and also along the routes of marine communication with the Paris Basin during Lower Cretaceous time contributed no small part to the Upper Cretaceous fauna of the northern basin. However, until the French sponges have been monographed, faunal comparisons must be mainly conjectural.

In the Upper Cretaceous the Tethys lost its integrity so that northern species entered its waters and many of the southern forms migrated northward, though stenothermal species were abundant enough to constitute persistent northern and southern faunas, the elements of which can readily be distinguished. In the department of Alpes Maritimes in the Senonian Chalk of Nice, siliceous sponges are found which, though belonging in part to species unknown in the northern fauna yet include some of the same forms which are abundant in England and Germany, while all of the genera are the same as those found in northwest Germany. The siliceous sponges of Nice were described by Počta according to modern methods, so that we are provided with some reliable information about the character of the southern fauna in the Upper Cretaceous and may predict that when the sponges of the Chalk of the Paris Basin receive a similar treatment the species will be found to be identical with, or closely related to, those of the Chalk of England and Germany, as has proved to be the case with the thirty-four species described by Počta from Meaulne (see above, p. 65) and with the twenty-three listed by Barrois (1898). According to Počta (1907), the sponges at Nice are excellently preserved so far as internal structure is concerned but the delicate surface structure has in many cases been effaced because the sponges were much rolled and worn before their final entombment. Thus, there are actually many more species than Počta has been able to name but, because of the fragmentary condition, further identifications are impossible. His list follows (Počta, 1907):

Doryderma ramosum (Mantell)
Scytalia laghetensis Počta
Verruculina cazioti Počta
Verruculina species
Chonella andreensis Počta
Siphonia ficus (Goldfuss)
Cymmatina inflata Michelin
Thamnospongia pauciramea Počta
Pachycorynia erecta Počta
Ragadinia species

From the *Grès vert inférieur* of Uchaux in the department of Vaucluse on the east side of the Rhone, Michelin described five species which are Turonian (?) in age.

(3) Subprovinces on the Borders of the Rhenish Dome

There are four important subprovinces on the northwestern, northern, and southeastern borders of this dome. These are, from west to east: (*a*) the Maastricht-Aachen district on the German-Belgian border, (*b*) the Westphalian district between the Rhine and the Plain of the Ems, (*c*) the plains of Hanover and the northern border of the Harz, and (*d*) the Bavarian region near Regensburg (see map).

a.—*The Maastricht-Aachen District*

This small area is made up of Senonian beds which are nearly horizontal or but slightly inclined and which lie unconformably upon the strongly folded and faulted Carbonic and older beds. They show the following succession in descending order:

UPPER SENONIAN.—Mucronatenkreide with *Belemnitella mucronata*

4.—Maastricht beds. Tuffkreide, many bryozoa, echinoids, baculites, gryphæas, terebratulas, and foraminifera. Sponges occur particularly at Petersberg near Maastricht. (20 m.).

3.—Chalk marl with flints in the upper part, *Gryphæa vesicularis*, *Nautilus*, etc.

LOWER SENONIAN.—Quadratenkreide with *Actinocamax quadratus*

2.—Greensand with many fossils including *Baculites incurvatus;* conglomerate at the base.

1.—Aachen sand. Chiefly an old beach and dune sand with numerous plants, especially silicified woods, and with *Exogyra*, *Inoceramus*, *Actæonella purgulifera*, etc., up to 100 m. or more in thickness.

The Mucronatenkreide here locally transgresses over the Quadratenkreide, while each zone of the Senonian, according to Holzapfel, begins with a basal conglomerate, indicating repeated transgressions and regressions of the sea and, on the whole, shallow water conditions. The composition of the successive faunas suggests a littoral habitat where, however, the waters were not charged to any great extent with terrigenous material. The sponges from this section are found mostly in the Maastricht beds, and have been described by Schlotheim (1820), Roemer (1841 and 1864), and Dewalque (1880), and listed by Mourlon (1881, pp. 127, 128).

b.—*The Westphalian District*

This area lies east of the Rhine and north of the old folded series of the Schiefergebirge, and is known as the Westphalian or Münster basin. On the east and northeast it is bounded by the Teutoburger Wald, which is a Post-Cretaceous uplift separating this basin from the adjoining

Hanover basin. This uplift has brought the Jura, Trias, and older beds to the surface in a series of northwest-trending hills, the beds dipping away steeply on either side of the uplift, to the west in Westphalia, to the east in Hanover. It is in this area that the oldest Cretaceous beds occur. The Lower Cretaceous is found upon the borders of the basin, a boring near Bentheim showing over 844 meters, but the beds thin away toward the south and west where they are overlapped by the Cenomanian and higher formations. The base of the Cretaceous series consists of the Teutoburger sandstone, a white, heavy-bedded, quartz sandstone which in a few localities has furnished fossils indicative of Neocomian age, though for the most part it is unfossiliferous and undoubtedly is of continental origin. This is succeeded by sands and clays representing the Gault and by Pläner beds of the higher series. Along the southern border of the basin the series begins with the Cenomanian Essener greensand, which is represented in the Teutoburger Wald by the Flammenmergel. Following upon the Essener greensand, are the Turonian Pläner with intercalated greensands, the Emscher marls, and the Senonian sand marls and sandstones, the higher beds occurring toward the center of the basin. We may look at these Upper Cretaceous formations in more detail.

Turonian.—This is found mainly toward the center of the basin and consists of brightly colored pläner. Schlüter and Johann Böhm have recognized the following zones in descending order:

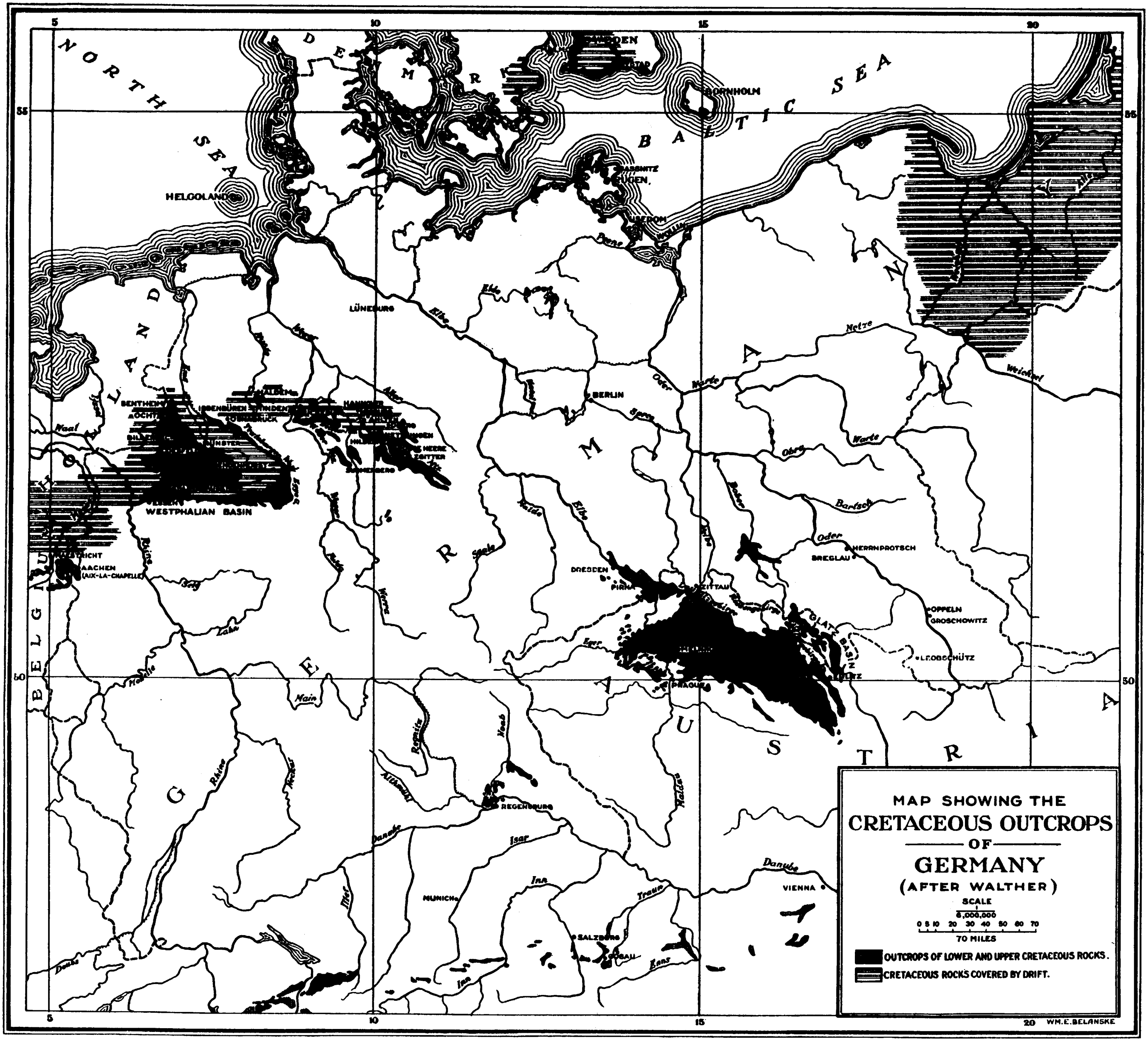
4.—Zone of *Inoceramus schloenbachi* and *Epiaster brevis* (Schloenbachi Pläner).

3.—Zone of *Heteroceras reussianum*
- (c) Greensand with *Micraster cortestudinarium.*
- (b) Greensand of Soest with *Neoptychites peramplus.*
- (a) Kalkmergel with *Micraster breviporus.*

2.—Zone of *Voliceramus lamarcki* and *Prionotropis woolgari* (Lamarcki Pläner).

1.—Zone of *Inoceramus labiatus* and *Mammites nodosoides* (Labiatus Pläner).

Emscher.—Along the southern border of the basin is the Emsche River, a small tributary of the Rhine lying between the Ruhr and the Lippe. The section along the river is the type locality for the Emscher marls, which consist of bluish green, lime and clay marls, with some greensands, and which have a thickness of 300 meters. These marls form the transition series to the Senonian, with which they were formerly included and from which they were separated as a distinct formation by Schlüter. The Emscher rests directly upon the Cuvieri Pläner and is limited above by the Recklinghäuser sand marls. From the presence


MAP SHOWING THE
CRETACEOUS OUTCROPS
OF
GERMANY
(AFTER WALTHER)
SCALE
70 MILES
OUTCROPS OF LOWER AND UPPER CRETACEOUS ROCKS.
CRETACEOUS ROCKS COVERED BY DRIFT.
WM. E. BELANSKE
NORTH SEA
BALTIC SEA
DENMARK
HOLLAND
BELGIUM
GERMANY
AUSTRIA
HELGOLAND
BORNHOLM
LÜNEBURG
BERLIN
WESTPHALIAN BASIN
AACHEN
(AIX-LA-CHAPELLE)
DRESDEN
PIRNA
ZITTAU
GLATZ BASIN
HERRNPROTSCH
BRESLAU
OPPELN
GROSCHOWITZ
LEOBSCHÜTZ
PRAGUE
REGENSBURG
MUNICH
SALZBURG
VIENNA
Elbe
Oder
Weichsel
Netze
Warte
Spree
Saale
Rhine
Main
Lahn
Danube
Isar
Inn
Traun
Enns
Moselle
Weser
Werra
Eger
Waal

in the latter of *Actinocamax westfalicus* Schlüter, the entire series has also been called the Westfalicus Kreide (see table, p. 50). G. Müller has recognized the following faunal zones in descending order[1]:

4.—Zone of *Inoceramus haenleini* and *Ammonites hernensis*.
3.—Zone of *Inoceramus digitatus, I. subcardissoides, Ammonites texanus*, etc.
2.—Zone of *Inoceramus involutus, I. exogyroides*, etc.
1.—Zone of *Inoceramus koeneni, I. kleini*, etc. and *Ammonites subtricarinatus*.

Senonian.—This division, about 350 meters thick, begins north of the Emsche River at Recklinghäusen with 50 meters of yellowish marls and is followed by light colored sandstones and sandy limestones often rich in fossils. In some places gigantic ammonites, up to 2½ meters in diameter, are found. The higher parts of the series comprise the thin platy limestones of Sendenhorst and Billerbeck, which contain numerous sponges as well as fish, crustacea, and belemnites.

Generally the subdivision of the Senonian has been into a lower part with *Actinocamax quadratus* (Quadratenkreide) and an upper part with *Belemnitella mucronata* (Mucronatenkreide). Schlüter, however, restricts the Lower Senonian to the lower half of the Quadratenkreide and unites the upper half with the Mucronatenkreide into the Cœloptychium beds, because of the presence of the sponge *Cœloptychium* which is restricted to this horizon (see below, p. 74).

The chief work on the Cretaceous sponges of Westphalia has been done by F. Roemer (1854), and C. Schlüter (1868, 1870, 1872, 1874, 1876*a*, 1876*b*, 1876*c*, 1895); short papers by Ewald (1873). There are no sponges from Westphalia in the Schrammen Collection.

c.—*The Plains of Hanover and the Northern Border of the Harz*

This area is separated from the preceding by the Teutoburger Wald uplift. (See map.) In it are most of the localities from which the sponges of the Schrammen Collection came, such as Oberg, Misburg, Ahlten, Salder, Nettlingen, *et al.* (See below, p. 75.) It is undoubtedly the richest collecting ground in northern Europe for Cretaceous Silicispongiæ. Along the southwestern border the beds are disturbed so that they dip east (see sections, Figs. 1 and 2), while faulting in places has even cut out certain members altogether. This series may be con-

[1]Müller, G., 1900, Zeit. d. d. geol. gesell. Protcol., p. 39.

sidered as a northern extension of the Cretaceous beds of Helgoland, near which island the Lower Cretaceous beds rest disconformably upon Middle Muschelkalk (Walther, 1910, p. 189).

In northern Hanover are certain scattered outcrops of the Cretaceous projecting through the drift. Three such outliers may be seen in the area around Lüneburg, about 45 km. southeast of Hamburg. There, in a quarry at Judenkirchhof, the Turonian is exposed; in Pieper's quarry, west of Lüneburg, the Cenomanian and Turonian may be seen;

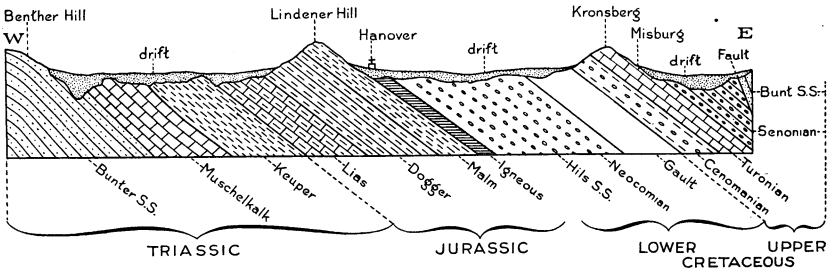


Fig. 1. Cross Section of the Country around Hanover, Germany, showing the stratigraphic relation of the formations in which sponges are found. (After Credner)

while at Zeltberg, north of Lüneburg, the Cenomanian, Turonian, and Senonian are all present. The first stratigraphic work to be done on the Cretaceous of Zeltberg was that by Strombeck (1863), but he overlooked many of the zonal subdivisions, because at that time quarry operations had not brought a sufficiently large number of sections to view and because stratigraphic work in general in northwest Germany was not so detailed as it is now. Since then the chief workers on the region have been Wollemann (1902*a*), Müller, and Stolley. The following zonal classification of the Cretaceous of Lüneberg is recognized by Wollemann (1902*a*, p. 6):

SENON (*sens. lat.*)

Mucronaten-Senon.	Trigonosema-Schichten.
Mucronaten-Senon.	Heteroceras-Schichten.
Mucronaten-Senon.	Unterste Schichten.
Quadraten-Senon.	
Granulaten-Senon.	
Emscher.	

TURON

Cuvieri-Pläner.
Scaphiten-Pläner.
Brongniarti-Pläner.
Labiatus-Pläner (Mytiloides-Pläner).

CENOMAN

Rhotomagense-Pläner.
Varians-Pläner.
Tourtia.

In the Osnabrück region, Lower Cretaceous of the Wealden type rests unconformably upon folded and eroded Lias and older beds and is succeeded by marine Upper Cretaceous, the character of which, on the whole, is much like that of the Westphalian basin. Here, as there, it is noteworthy that Turonian Pläner is succeeded by Emscher marls and Senonian sands, the series thus marking a decreasing depth of the Cretaceous sea from the Turonian onward.

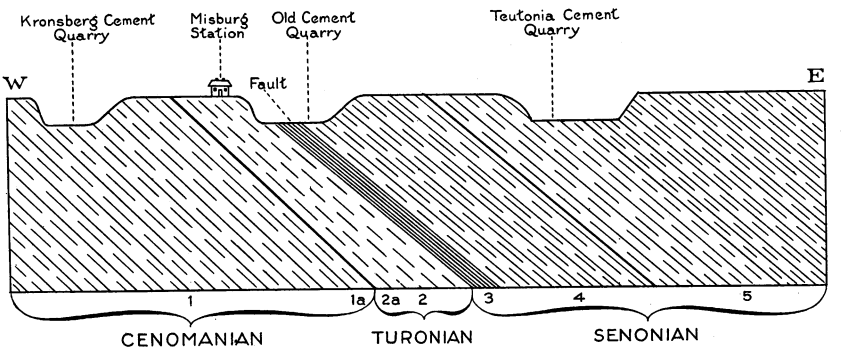


Fig. 2. Detailed Cross Section of the Upper Cretaceous at Misburg, Hanover, Germany. (After Schrammen, 1899.)

1. Limestone marls or Pläner with *Schloenbachia varians* Sowerby, *S. coupii* Brongniart and *Acanthoceras mantelli*.....Varians Pläner.
1a. Position of zone of *Acanthoceras rhotomagense*—not recognized here.
2a. Position of zone of *Inoceramus mytiloides* (*I. labiatus*)—Mytiloides or Labiatus Pläner—not recognized here.
2. Limestones with *Inoceramus brongniarti* Sowerby, generally poor in fossils. Between beds 2 and 3, fault cuts out Scaphites Pläner, Cuvieri Pläner and Emscher.
3. Clay bed (2-3 m. thick) with *Actinocamax granulatus* Blainville emend. Schlüter, *A. verus* Miller, and *Marsupites*.....Granulatenkreide.
4. Limestone marls (Pläner) with *Actinocamax quadrata* Blainville, *Micraster gibbus* Desor, *M. göttschii* Stolley, *M. hassi* Stolley, *Offaster pilula* Lamark, *Echinocoris vulgaris* Bleyn. and many sponges.....Quadratenkreide.
5. Limestone marls (Pläner) with *Belemnitella mucronata* Schlotheim, *Epiaster gibbus* Schlüter, *Offaster corculum* Goldfuss, *Echinocoris vulgaris* Bleyn. and many sponges..Mucronatenkreide.

The strong disturbances which raised the Harz, in line with the Teutoburger Wald uplift, caused the beds of the north border of the Harz at Goslar and Harzburg to be overturned and the Jurassic and Triassic often to be faulted out. The Cretaceous of this section north of the Harz consists largely of marls, such as the famous sponge marls of Quedlinburg, of Lower Senonian age, from which many of Goldfuss' and Giebel's sponge types were obtained (see Goldfuss 1826 and 1862; Giebel 1849, 1851), and of sands like those of Goslar and Sudmerberg, of Gault (Albian) age, from which were collected many of the types described

by Roemer (1841, 1864*a*, and 1864*b*), and Schrammen (1910-12). The Cretaceous is followed unconformably by the brown-coal-bearing Oligocenic beds. Strombeck has done the chief part of the stratigraphic work in this region near the Harz (see also Beyrich, 1849, 1851) and the subdivisions which he recognized over half a century ago are still accepted without much change; they are as follows in descending order (Strombeck, 1857, pp. 785-787; see also 1859):

B.—Upper Pläner (Turonian)
8.—Cuvieri beds.
7.—Scaphites beds.
Lithologically the same as 6*a*.
6*a*.————Synchronous deposits———— 6*b*.
White Brongniarti beds. Galerites beds.
(Gray and snow-white limestone.)
5.—Red Brongniarti beds.
Red marly limestone, fairly compact, in part showing conchoidal fracture.
Sharp break. Disconformity. Few or no species pass upwards.
A.—Lower Pläner (Cenomanian)
4.—Beds poor in Rhotomagense.
3.—Rhotomagense beds with *Acanthoceras rhotomagense*.
2.—Varians beds, gray limestone with *Schloenbachia varians*, etc.
1.—Tourtia, green clay, sand, and clayey marl.

The plains of Hanover and the Westphalian basin are often classed together as the Cretaceous area of northwest Germany. It is with the sponge faunas of this region especially that Schrammen deals in his Monograph. Schlüter, whose studies were carried on primarily in Westphalia and whose stratigraphic work has been approached in large measure from the palæontologic side with little or no attempt at lithogenetic interpretations, has established the following zonal subdivisions for northwest Germany (1876*b*, see also other references in bibliography):

Upper Senonian (*Cœloptychium* beds)
3.—Zone of *Heteroceras* (*Bostrychoceras*) *polyplocum* and *Scaphites pulcherimus*. Soft, yellow sandstones and marls of Haldem and Lemförde in Westphalia, Ahlten near Hanover, etc.
Obere Mucronatenkreide.
2.—Zone of *Hoplites coesfeldensis* and *vari*, *Micraster glyphus*, *Lepidospongia rugosa*, etc. Here belong the marl, limestone and marl sandstone of Coesfeld, Darup, Rorup, etc.
Untere Mucronatenkreide.
1.—Zone of *Becksia soekelandi*. Contains also *Pachydiscus stobœi*, *Desmoceras obscurum*, etc.....Obere Quadratenkreide

LOWER SENONIAN

3.—Zone of *Scaphites binodosus* and *Exogyra laciniata*. Here belongs the sandy limestone of Dülmen. Other fossils: *Pachydiscus duelmensis, Inoceramus lobatus,* and *balticus* (=*cripsi auct.*).
Untere Quadratenkreide.

2.—Zone of *Pecten muricatus, Inoceramus lobatus,* etc., sandstone of Haltern.

1.—Zone of *Marsupites testudinarius*. Here belongs especially the Recklinghäuser sandmarl of Westphalia.

EMSCHER

Zone of *Ammonites margæ* and *Inoceramus digitatus*

TURONIAN (Oberer Pläner)

Zone of *Inoceramus cuvieri* and *Epiaster brevis*.....Cuvieri Pläner.
Zone of *Heteroceras reussianum* and *Spondylus spinosus*..Scaphites Pläner.
Zone of *Inoceramus brongniarti* and *Prionotropis woolgari*.
Brongniarti Pläner.
Zone of *Inoceramus labiatus* and *Mammites nodosoides*.
Mytiloides Pläner.
Zone of *Actinocamax plenus*.

CENOMANIAN (UNTERER PLÄNER)

Zone of *Acanthoceras rhotomagense* and *Holaster subglobosus*.
Rhotomagense Pläner.
Zone of *Schloenbachia varians* and *Hemiaster griepenkerli*....Varians Pläner.
Zone of *Pecten asper* and *Catopygus carinatus*.....Tourtia.

The major part of the Schrammen Collection comes from Hanover, from an area not more than fifteen kilometers in radius. The localities from which the types have come are as follows:

LOCALITY	HORIZON	NO. OF SPECIES	NO. OF TYPE SPECIES	NO. OF SPECIMENS[1]
Ahlten	Mucronatenkreide	4	4	6
Haldem	Mucronatenkreide	1	1	2
Misburg	Mucronatenkreide	87	85	177
Misburg	Quadratenkreide	50	49	60
Oberg	Quadratenkreide	135	130	359
Sudmerberg	Emscher Marl	18	18	21
Grosse Heere	Cuvieri Pläner	23	20	50
Salder	Cuvieri Pläner	2	2	6
Nettlingen	Scaphites Pläner	32	29	46
		352	338	727

[1]The total of 727 specimens includes all of the specimens from the 1914 Schrammen Collection from the localities listed, but does not include specimens from the 1903 collection except in two or three instances which are noted in the text in Chapter IV.

The Cretaceous sponges of Hanover and of the northern border of the Harz have been described by: A. Roemer (1841, 1864*a*, 1864*b*), Quenstedt (1876-1878), Zittel (1876, etc.; see bibliography). The most complete and detailed work for this area has been done by Schrammen (1899, 1901, 1902, 1903*a*, 1903*b*) and special mention is to be made of his monograph entitled 'Die Kieselspongien der oberen Kreide von Nordwestdeutschland' (1910-1912).

For the duchy of Braunschweig one must turn to the works of Griepenkerl (1888-1890) and especially of Wollemann (1901, 1902*a*, 1902*b*, 1902*c*).

d.—*The Regensburg-Passau Area*

This comprises a small outcrop in the neighborhood of the junction of the River Naab with the Danube along the borders of the Bohemian forest. Remnants of a formerly more extensive deposit of Cretaceous strata, once undoubtedly continuous with those of Bohemia, here rest upon the eroded and more or less dissolved surface of the Upper Jurassic. The series begins with Cenomanian greensands, though somewhat older iron-bearing beds, representing probably old surface soils, are found near Amberg. The Turonian consists of sands and marls with *Inoceramus labiatus* and, in the higher beds, *Scaphites geinitzi* and *Spondylus spinosus*. The Emscher has not been differentiated. The Senonian consists of gray marls with *Baculites anceps* and of coarse sandstones with *Exogyra laciniata* (Gümbel, 1894, 'Geologie von Bayern,' II, p. 834). The strata are mostly horizontal and their continuation lies below the Tertiary and alluvial deposits of the Danube plain.

(4) The Bohemian Basin, and Adjoining Districts of Saxony (Valley of the Elbe-Elbthal) and of Silesia

The Cretaceous deposits of Bohemia are found only in the northern and northeastern area of the basin. On the northwest the Erzgebirge and its southwestward continuation, the Elster and Fichtelgebirge, all composed of Palæozoic and older rocks, separate the Cretaceous rocks of Bohemia from those of the kingdom of Saxony and from the Mesozoic area of northwest Germany. (See map.) The ridge of old mountain chains is separated by the valley of the Elbe from the Lausitz granite mass which forms a part of the northern rim of the basin. The Cretaceous deposits extend down the Elbe valley, forming the picturesque sandstone cliffs of the so-called Böhmisch-Säxische Schweiz, a region familiar to all who have travelled from Dresden to Prague by boat or train and one frequently illustrated and described in German

texts. The deposits here exposed find their northernmost outliers for this region in the vicinity of Dresden and of the river gorge known as the Plauenscher Grund, famous for its remarkable fossiliferous basal conglomerates of the Cretaceous.

A second breach in the old rim of the Bohemian basin is formed by the Neisse river from Zittau northward. This depression separates the Lausitz granite mass from a similar granitic and folded Palæozoic complex which constitutes the Riesengebirge, a line of mountains trending southeastward and, with its two arms, the Erlitz and Adlergebirge and the Sudetic mountains, separating the Bohemian basin from Silesia (Schlesien) on the northeast.

North of the Riesengebirge, between the valleys of the Bobir and the Ketzbach, is a much disturbed area of Mesozoic rocks which form an embayment eastward from the Neisse depression in the old Palæozoic complex. This is the Löwenberg embayment, which, like that of the Elbe depression, marks a northward extension of the Cretaceous deposits into Lower Silesia (Niederschlesien). The connection of the Cretaceous of this embayment with the Bohemian Cretaceous is, however, concealed by the Tertiary and later deposits of the Neisse depression.

Between the two arms of the Riesengebirge, the southwestern or Erlitzgebirge and the eastern or Sudetic Mountains (Die Sudeten, partly in Austrian Silesia), lies the basin of Glatz, which contains Cretaceous strata now completely separated from those of Bohemia by older rocks but undoubtedly formerly continuous with it. Northeast of this highland of folded older rocks lies the flat Silesian region of Germany which is traversed by the Oder River, the course of which is nearly parallel to the old-land mountain mass of the Bohemian border. This flat land is covered by Tertiary and younger deposits, but from the midst of these at Oppeln on the Oder, rise isolated Cretaceous outcrops which have long been famous for their wonderfully preserved sponge remains, fifteen species of which are represented in the Schrammen Collection. Southeastward from the Oppeln region is the great upper Silesian Trias plateau, where deposits of this age more than 2000 meters in thickness overlie the folded and eroded Carbonic and Permic beds. The Silesian deposits of Oppeln will be described in a separate section, but those of Saxony (Elbthal) and of Löwenberg and Glatz will be considered with the Bohemian deposits of which they are an integral part. The following table (p. 78) shows the subdivisions of the Cretaceous deposits of all of these areas except Oppeln, and their correlation according to the recent interpretations of Scupin (1907, p. 714):

SCUPIN'S CORRELATION TABLE OF THE UPPER CRETACEOUS OF SAXONY, SILESIA AND BOHEMIA

	Succession in Northwestern Germany	Upper Cretaceous of the Löwenberg Region in Lower Silesia	Upper Cretaceous of Saxony	Upper Cretaceous of Bohemia	Upper Cretaceous of Glatz
SENONIAN	Lower Senonian *s. str.*	Silesian Super Quader (Überquader)			
	Emscherian	Silesian Upper Quader (Oberquader) Neu-Warthau Beds		Chlomek Beds *s. str.* Kreibitz Beds (= Lower Chlomek Beds)	Heuscheu Quader: Congolmerate of Hirtenstein; Kieslingswald Sandstone
TURONIAN	*Cuvieri*-zone	Ludwigsdorf Sandstone	Saxon Superquader (Überquader)	Priesen Beds	Clay and Pläner of Karlsberg; Kieslingswald Clay
	Scaphites-zone	Gross-Rackwitz *Scaphites* Marl	*Scaphites* Marl of Zatschke		
	Brongniarti-zone	Löwenberg Marlsandstone: Rabendockener Sandstone, at base contains *Inoceramus labiatus*	*Brongniarti* Quader and Pläner of the Saxon geologists: Strehlen Pläner	Teplitz Beds; Malnitz Beds: Iser Beds	Pläner Limestone: Quader of the Wünschelburger Lehne and west of Habelschwerdt
	Labiatus-zone		*Labiatus* Quader and Planer	Weissenberg Beds	Pläner Limestone: Quader of the Wünschelburger Lehne and west of Habelschwerdt
CENOMANIAN	Zone of *Actinocamax plenus*	Pläner and Pläner Sandstone of the *Plenus*-zone	*Carinatus* Pläner and Pläner Sandstone	Pläner, Pläner Sandstone and Glauconite Sandstone of the *Plenus*-zone	Pläner Sandstone and Transition Quader
	Lower Cenomanian	Lower Quader (Unterquader)	*Carinatus* Quader Crednerian Division	Korytzan Beds Perutz Beds	Quader of Albendorf and Habelschwerdt

a.—*The Bohemian-Saxon Cretaceous Deposits and Those of the Löwenberg and Glatz Basins*

Beginning in the Dresden region, and continuing along the banks of the Elbe southward into Bohemia, there is found a wonderful succession of exposures of the Upper Cretaceous rocks. The Lower Cretaceous and older Mesozoic beds are everywhere absent in this district, the series beginning with beds of Cenomanian age. In many places a non-marine, river and pond deposit, with impure coal and leaf beds, forms the basal portion of the series, occupying the local depressions in the igneous or Palæozoic old-land surface. These are the *Credneria beds* of Saxon geologists and are characterized by several species of *Credneria*, together with ferns and other plant remains. The equivalent plant beds of Bohemia are called the *Perutz* (or Peruc) *formation* (Frič, 1869, pp. 46, 186; Frič and Bayer, 1901). This consists generally of a basal sandstone, followed by carbonaceous shales. The sandstone in places becomes of considerable thickness, replacing the shales, and is locally iron-bearing. Throughout, the series is devoid of marine fossils and contains conifers, ferns, and unios.

These non-marine beds were submerged by the transgressing Cenomanian sea which entered the region from the north and filled the old basins of continental deposition, overflowing their rims and eventually spreading out as a broad epeiric water body. This expansion of the sea accounts for the fact that around the margins of the old basins the marine deposits of the succeeding series overlap the preceding continental beds, resting in many places directly upon the crystallines or upon the folded and eroded Palæozoics, as first noted by Reuss (1845-46, p. 15). The contact with these older rocks is often a remarkable one as seen in the vicinity of Dresden (Plauenscher Grund) where a basal bed of large well-rounded boulders and cross-bedded sands lies in depressions of the older rock. These deposits were undoubtedly of continental origin, formed during the preceding period, and they were so little disturbed by the waves of the advancing sea that brachiopods, molluscs, and even entire sponge skeletons occur in a perfect state of preservation among these boulders. In some cases, deep, pot-hole-like excavations extend into the older rocks for ten, twenty or more feet and are filled with boulders, sand, and calcareous material abounding in beautifully preserved sponge and molluscan remains.[1] A section of such a deposit at Kahlebusch, near Dresden, kindly furnished to the author by Professor Grabau, is shown herewith (Fig. 3).

[1]Grabau, A. W. 1913. Principles of Stratigraphy, p. 651.

Bohemian geologists call these lower marine beds the *Koritzan* (or Korycan) *formation;* while by Saxon geologists they are known as the *Carinatenquader* from the presence in them of *Ostrea carinata,* the zone fossil. (The term *quader,* first used in the literature, I believe, by Reuss in 1845-1846, or perhaps in his 1844 paper which I have not seen, is applied to any heavy-bedded sandstone which can be quarried in large blocks or "quader.") The series is also known as the Lower Quader (*Unterquader* of Reuss), which term is especially applied in the basins of Löwenberg and Glatz. The formation is frequently glauconitic and

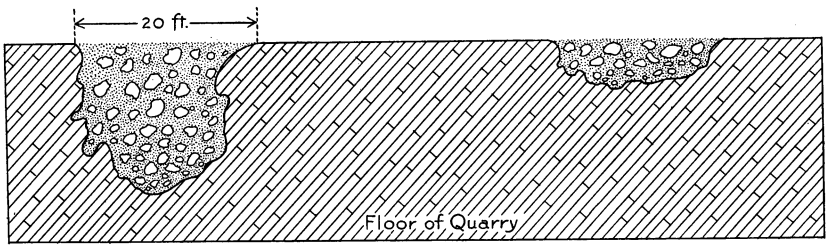


Fig. 3. Section in Quarry at Kahlebusch, near Dresden, Saxony, showing Nature of Contact between the Cretaceous and the Crystallines.

The rock is a basic porphyry with columnar structure, the columns inclined as indicated. The cavities are filled with worn boulders of the porphyry up to a foot in diameter and with sand and organic detritus in which fossils of Cenomanian age, especially sponges, abound. The form of the cavities is determined by the columnar structure, but the walls are worn smooth, and on these, in places, Cenomanian oysters grew. (From a sketch made by Professor A. W. Grabau in 1910.)

sometimes conglomeratic, and, in northern Bohemia, contains few fossils except the molds of large, thick-shelled, shallow-water Mollusca (e. g., *Trigonia, Cardium, Turritella* and *Rostellaria*). There is a remarkable difference in the fauna, however, in the southern part of the Cretaceous area, in the region between the Elbe and the Moldau, where calcareous beds with the aberrant molluscs of the order Rudistes (*Radiolites saxonicus*) follow upon conglomerates of local origin. These Rudistes beds contain the southern Cretaceous fauna and indicate a temporary connection between, or close approach of, the two great areas of deposition of the Cretaceous formations of Europe.

In northern and eastern Bohemia and in the Glatz basin the Koritzan series is entirely sandy but in Saxony it becomes calcareous and passes upward into the Carinatus Pläner and Pläner sandstone. (The name *pläner* is applied to any thin-bedded limestone, while *plänersandstein,* as a lithological term, is any sandy formation similarly separating into thin layers and indicating a more offshore deposit. There are

no equivalent lithological terms in English, for which reason the German names will be used.) The Pläner sandstone formation is characterized by the zone fossil *Actiñocamax plenus*, a belemnite, and hence the zone is commonly designated the *Plenus* zone. It is especially well developed in the southern Silesian basin (Löwenberg) and in Saxony, where it is called the Lower Pläner (*Unter Pläner*). With it the Cenomanian division is brought to a close.

The Turonian begins in the south and east with the Middle Quader, a heavy-bedded quartz sandstone, and in the north with pläner limestones. These constitute the Weissenberg formation of Bohemia, and the Labiatus Quader and Pläner of Saxony, so named from the zone fossil *Inoceramus labiatus*. This species is characteristic of the Benton formation of the American Cretacic, with which this horizon is correlated. The Weissenberg beds include calcareous and marly sands and marls, generally richly fossiliferous with gigantic individuals of *Inoceramus labiatus* predominating. Besides these, occurs *Prionotropis woolgari*, another form characteristic of the American Benton formation. Towards the north and east these beds become more sandy, especially in the Löwenberg embayment. In the Glatz basin both Quader sandstone and Pläner occur.

The next higher division of the Turonian is characterized by *Inoceramus brongniarti* and is known as the Brongniarti Pläner and sands. In Bohemia the series constitutes the Malnitz beds, calcareo-arenaceous, thin-bedded strata, rich in glauconite grains, for which reason Reuss called this formation in the northwestern and northern region the Greensand. The most common fossil is *Lucina lenticularis* Goldfuss, which occurs in great abundance. Eastward this series merges into sandstones of the Iser type (see below).

In the western part of the Bohemian basin the Teplitz beds succeed the Malnitz greensands. These consist of pläner limestone and marl containing molluscan remains, among which *Ostrea sulcata* should be noted. The presence of *Scaphites geinitzi* and *Spondylus spinosus* in beds of this series indicates their correlation with a part of the Scaphites zone of northwestern Germany.

The Iser sandstone replaces more or less completely both Malnitz and Teplitz beds towards the east and northeast. It consists of a great series of frequently arkosic sandstones, ranging in thickness up to 122 meters or over, and is displayed in a remarkable succession of erosion pillars and pinnacled hills along the Elbe River on the Bohemian-Saxon

border. From the similarity of the striking scenery, produced by the erosion of this sandstone, to the scenery of Switzerland, this region has received the name of the Böhmisch-Sächsische Schweiz. Between the town of Milnik in Bohemia and the Riesengebirge, these sandstones form a great series of high plateaus rising above the Iser River, from which the formation takes its names. Fossils occur in certain zones and localities, those most characteristic being *Exogyra columba* and *Spongites saxonicus* (now considered to be inorganic) while beds largely composed of *Rhynchonella bohemica* and *Ostrea vesicularis* are also present. Westward this formation wedges out between the calcareous Malnitz and Teplitz beds, which there replace it. This points to an eastern, or rather northeastern, origin of the sands which composed the Iser formation.

A part of the succeeding Priesen beds of the Bohemian region is still included in the Scaphites-zone, while the remainder belongs to the Cuvieri-zone. In Saxony the marls of Zatzschke, with *Scaphites geinitzi*, separate the Upper Quader (Oberquader) from the Super Quader (Ueberquader), the latter being correlated by Scupin (1907, p. 714) with the upper part of the Priesen beds of Bohemia and the Cuvieri-zone of northwestern Germany (zone with *Inoceramus cuvieri*). In Bohemia the Priesen beds consist largely of clays which abound in *Baculites faujasi* (a Senonian form) and *B. anceps*, from the presence of which they are known as the Baculite marl (Bakulitenmergel). In the lower part of the formation *Scaphites geinitzi* still occurs.

This brings us to the top of the Turonian, which is the top of the section in Saxony. Two higher formations occur in northern Bohemia and are likewise represented in the Glatz and Löwenberg regions. In Bohemia they are known as the Krebitz and Chlomek formations, respectively, and consist for the most part of sandstones with some marls, characterized by *Baculites incurvatus*, *Exogyra laciniata*, and other Mollusca. In the Glatz basin they are represented by Quader sandstone and conglomerates, and in the Löwenberg embayment by the Neu-Warthau beds and the Silesian Oberquader which, as will be seen by consulting the correlation table, is not only higher than the Ober Quader of Saxony but is actually above the Super Quader of that section, which still belongs in the Turonian, while the Silesian Oberquader is Upper Emscher (Scupin, 1907, 1912–1913). In Silesia, too, occurs a Super Quader (Schlesischer Ueberquader) the age of which, however, is Lower Senonian.

For the most part, the Cretaceous beds of these areas are but little disturbed, having usually only a gentle dip. Locally, however, especially

in Bohemia, steep dips are found. Throughout much of the region great basalt masses broke through the Cretaceous strata, forming extensive sheets and necks, the remains of which are now seen in the numerous basalt-capped peaks and knobs, which nearly everywhere characterize the district.

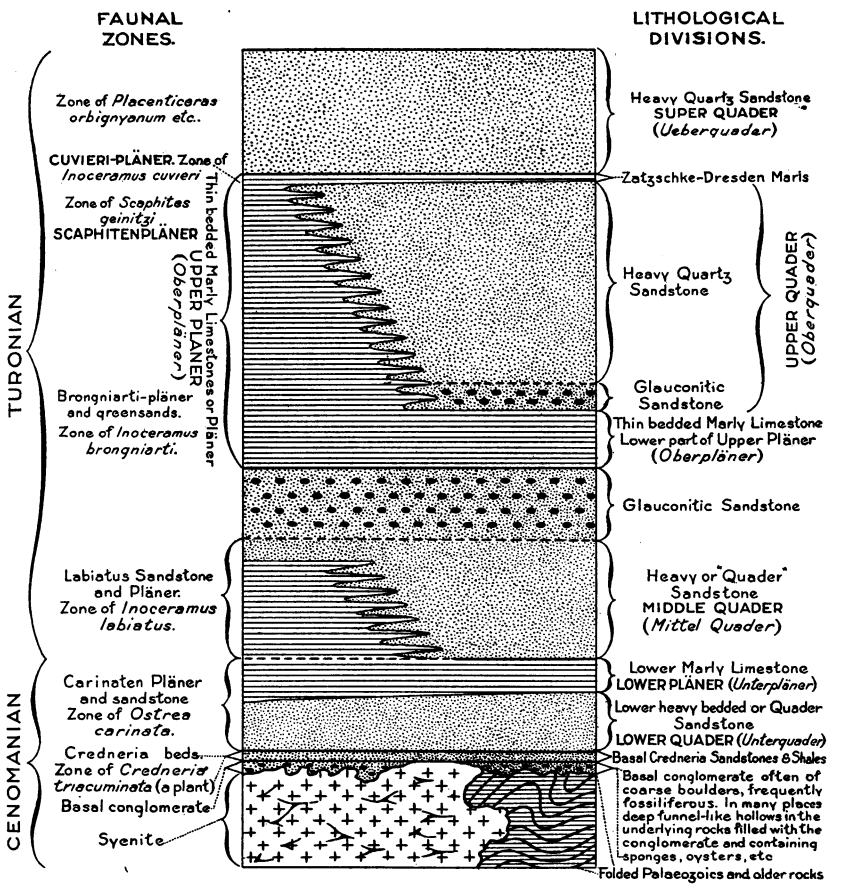


Fig. 4. Generalized Columnar Section of the Cretaceous of Saxony and Bohemia (Modified from Walther.)

Summarizing the Cretaceous deposits of this section, we see that sandstones predominate in the central region from north to south, and that these sands merge westward into greensands and more or less pure limestones, a similar though less pronounced change also occurring towards the north. (A generalized columnar section for Saxony and

Bohemia is given in Fig. 4; a cross-section in northern Bohemia in Fig. 5.) That a like transition to more open water sediments takes place towards the east is shown by the calcareous deposits of the Oppeln region, to be discussed next. This clearly points to a southward source of the sands which spread out as a series of great sandstone plains in the transgressing sea which lay to the northwest and east. That these sandstones were often deposited as delta plains above normal sea-level seems to be indicated by their frequent unfossiliferous character and by their well-marked torrential and, in places, eolian cross-bedding. There can be little doubt that these sands are traceable southward and southeastward into the Vienna Sandstone, or Flysch, and into the Carpathian Sandstone, both of which are chiefly continental deposits, comprising a series of confluent river-flood plains and deltas which throughout Cretaceous and part of Tertiary time characterized the southern margin of the northern Cretaceous area of Europe.

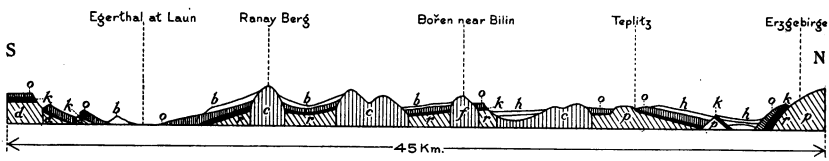


Fig. 5. Generalized Cross Section showing the highly disturbed Cretaceous Rocks of Bohemia and their Relation to the underlying beds. In the Leitmeritz Mittelgebirge, northern Bohemia. (After Krejči, 1869.)

Crystallines: *r* (gneiss), *p* (porphyry); Permic formation *d;* Cretaceous: Perutz and Koritzan beds *k*, Weissenberg, Malnitz and Teplitz beds *o*, Priesen beds *b*; Oligocenic brown-coal *h;* basalt *c;* phonolite *f*.

The earliest stratigraphic and faunal work on Bohemia dates back to the papers by Reuss (1840, 1844, 1845-1846), but for details, sections, correlations, and faunal studies one must go to the classic Studien im Gebiete der böhmischen Kreide-Formation (see Frič, 1869, and Krejči, 1869, especially) and to the recent correlation papers by Scupin (1907, 1912-1913). The sponges of Saxony have been described by H. B. Geinitz (1871-1875). The sponge faunas of Bohemia have been monographed by Počta (1883, 1884*a*, 1884*b*), who subsequently added more species to his earlier lists (Počta, 1890); additional shorter contributions have been made by Jahn (1891) and Čeněk Zahálka (1886*b*, 1887*a*, 1887*b*, 1888). From Počta's papers the author has compiled the following summary of the silicisponge faunas of Bohemia, showing the number of species at each horizon.

Orders	Cenomanian	Turonian		Senonian			
	Korytzan Formation	Weissenberg Formation	Malnitz Formation	Iser Formation	Teplitz Formation	Priesen Formation	Chlomek Formation
Hexactinellida	31	4	3	3	12	2	..
Lithistida	46	5	3	1	3	1	..
Tetractinellida	1	12	..	4	..	1	..
Monactinellida	4	5	..	6	1	..	..
Total number of species in each horizon	82	26	6	14	16	4	..

The number of species described and listed by Počta is as follows[1] (1884*b*, p. 38):

Hexactinellida	52
Lithistida	57
Tetractinellida	13
Monactinellida	7
	129

(5) The Cretaceous of Oppeln in Upper Silesia

This region is of especial interest to us on account of the great development of the sponge faunas which are so well represented in the Museum Collection. It is an isolated area on the Oder River, with the

[1]All figures for the Calcarea and other orders are here omitted.

Upper Cretaceous rising from beneath the Tertiaries and younger beds and resting disconformably upon the great Triassic deposits which form the main mass of the Upper Silesian Plateau. That the series formerly extended much more widely is shown by the lithic character of the deposits which still remain.

The lowest known division of the Cretaceous in the Oppeln region is a sandstone of Cenomanian age shown on the banks of the Oder and found in borings to have a thickness of over forty-three meters. Beneath the sandstone is a gray-blue clay, which rests in turn upon the red shales of the Keuper. A limited outcrop of the Cenomanian is seen at Grosschowitz, southeast of Oppeln, and Cenomanian sandstones are also exposed in the neighborhood of Leobschütz, where, as at Oppeln, they consist of fine-grained, white quartz sands, in which fossils are rare. The rock is generally broken down into fine, white sand grains, among which glauconite grains are more or less common. Three subdivisions were made by F. Roemer, two of them being fine white sandstones, between which is a more glauconitic bed. This three-fold subdivision is, however, hardly constant. The lowest sandstone appears to represent a basal bed of a transgressing series, since it is of younger age in the Oppeln region than at Leobschütz eleven km. southwest of Oppeln, where it is of Lower Cenomanian age.

This sandstone contains plant remains described by Roemer (1870, p. 290) as:

Pinites lepidodendroides Roemer,
Arundites oppelensis Roemer,
Culmites sp.,
Fossil wood

There are also animal remains, among which are *Siphonia pyriformis* Goldfuss (see Roemer, 1870, Pl. XXVIII, fig. 1) and *Siphonia* sp., as well as the following (1870, pp. 292 *et seq.*).

Isastræa sp.,
Catopygus carinatus Agassiz,
Rhynchonella sp.,
Inoceramus striatus Mantell (?),
Turrilites costatus Lamarck,
Ammonites (*Acanthoceras*) *rhotomagensis* Defrance.

The Cenomanian sandstone is succeeded by the Cretaceous marls of Oppeln, which are the main sponge-bearing formation. They are of Turonian age and have a total thickness of over forty-four meters, as

shown by borings (Leonard, 1897-1898, pp. 15, 16). Petrographically, the main portion of these beds is similar to the Pläner of Saxony, consisting mostly of marl. The strata are horizontal and rest upon the Cenomanian sandstone; no overlying beds are shown. Roemer has listed the following flora and fauna from this horizon (1870, pp. 299 *et seq.*).

Plantæ:	*Rhizodendron oppeliense* Göppert, *Protopteris sternbergii* Corda, *Geinitzia cretacea* Endlicher, *Pinites* species, Dicotyledonous leaves.
Porifera:	*Chenendopora tenuis* A. Roemer, *Retispongia radiata* Mantell, *Cribrospongia fragilis* A. Roemer, *Camerospongia fungiformis* (Goldfuss), *Camerospongia megastoma* F. Roemer, *Siphonia elongata* (Reuss), *Limnorea nobilis* A. Roemer, *Plocoscyphia labyrinthica* Reuss, *Cylindrospongia angustata* A. Roemer.
Cœlenterata:	*Parasmilia centralis* (Mantell).
Echinodermata:	*Micraster leskii* Desmoul, *Micraster* species, *Ananchytes ovata* Lamarck, *Holaster planus* (Mantell).
Molluscoidea:	*Terebratula semiglobosa* Sowerby, *Rhychonella plicatilis* Sowerby, *Terebratulina striata* d'Orbigny, *Crania ignabergensis* Retzius.
Pelecypoda:	*Ostrea hippopodium* Nilsson, *Spondylus spinosus* Deshayes, *Spondylus striatus* Goldfuss, *Lima hoperi* Mantell, *Pecten dujardini* A. Roemer, *Pecten cretosus* Defrance, *Inoceramus latus* Mantell, *Inoceramus brongniarti* Sowerby.
Gastropoda:	*Teredo amphisbœna* (Goldfuss), *Pleurotomaria linearis* (Mantell).

Cephalopoda: *Nautilus elegans* Sowerby,
Ammonites peramplus Mantell,
Scaphites geinitzi d'Orbigny,
Helicoceras annulifer F. Roemer,
Helicoceras polyplocus (A. Roemer),
Hamites ellipticus Mantell,
Baculites anceps Lamarck (?).

Vertebrata: *Scalpellum maximum* Darwin (?),
Oxyrhina mantelli Agassiz,
Otodus appendiculatus Agassiz,
Ptychodus latissimus Agassiz,
Osmeroides lewesiensis Agassiz (?).

What appears to represent a higher horizon than the Cenomanian marls is found in a white sandstone discovered by borings beneath the Tertiary at Herrnprotsch on the Oder, twenty kilometers below Breslau. This was met with at a depth of 191 meters below the surface and was followed through a thickness of sixteen meters. Roemer placed this sandstone in the Cretaceous, because no other sandstones are found in this region, but that it is of Senonian age is doubted by Leonhard. It appears to indicate, nevertheless, a shoaling of the sea in Upper Turonian, in Emscher, or in Senonian time, with a return of the sand-bearing currents. Leonhard concludes that the isolation of the Silesian basin and its partial separation from the north German area, of which it was a prolongation, is shown by the remarkable depauperation of its fauna (Leonhard, 1897-1898, p. 22).

About seven miles south-southwest of Oppeln is another small inlier of Cretaceous beds at Leobschütz. The lowest rock exposed is a white sandstone with *Exogyra columba*. This is usually from 4.5 to 9 meters thick, and is made up of layers 7.6 cm. to 30 cm. thick composed of white or yellow sands with a siliceous cement. The sandstone rests unconformably upon the steeply inclined Culm and older formations and is usually covered by diluvium. It is Cenomanian in age, corresponding to the Quader sandstone of Saxony, but, unlike that formation, containing no siliceous sponges.

In this same region occur gray, sandy marls 0.9 to 6 meters in thickness with *Acanthoceras rhotomagense*, indicative of Upper Cenomanian age. These marls are horizontal and, as in the case of the sandstone with *Exogyra columba*, rest unconformably upon the steeply dipping Culm.

It is not unlikely that the two formations are merely different facies of the same stratum. In some places the marls are followed by the Tertiaries, but usually by the diluvium.

In the American Museum Collection there are twenty-seven specimens of sponges from Oppeln, representing fifteen species, thirteen of which are types. The pioneer work on the faunas of Silesia was done by Ferdinand Roemer (1870). More recently, Leonhard has discussed the stratigraphy and described the fauna, listing, with brief descriptions, six species of sponges (1897-1898, pp. 23-25), and R. N. Wegner (1913) has likewise made a valuable contribution. Schrammen (1910-1912) has noted the occurrence of many of the northwest German species in Oppeln.

(6) The Vienna Sandstone or Flysch[1] of the Wiener Wald and the Carpathians

The Flysch is, for the most part, a thin-bedded bluestone formation extending through the Lower and Upper Cretaceous and originating as a river delta, or series of confluent deltas formed by streams flowing from the mountainous mass which separated the north and the south European Cretaceous seas. These deltas probably mark the sites of the mouths of the streams which brought the Quader sands into the Cretaceous sea. In the Flysch, plant remains are the chief fossils, though shells of marine organisms occasionally occur.

Along the northern flanks of the Carpathians the Lower Cretaceous is represented by marine shales, marls, and limestones, followed by sandstones and conglomerates for the most part unfossiliferous. The Upper Cretaceous is represented only by the Friedecker Baculite marl and the Baschka sandstone. The former contains only *Baculites faujasi*, the latter *Inoceramus* species and *Aptychus* species. The *Baculites* is typically Senonian, though also found at lower horizons, so that the age of these beds is somewhat in doubt.

(7) The Polish Area

On the east side of the Polish Jura ridge the Cretaceous is developed as a series of sandstones, marls, and lime-marls, the latter occasionally being chalky and containing flints.

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[1]For further details see Paul, 1898, Jahrb. d. geol. Reichsanstalt, XLVIII, p. 53.

The following subdivisions have been recognized:

UPPER.—White lime marl and chalky beds with flints: 9.1-12.2 m. at Krakau; 183 m. in borings at Wislica. Contains *Belemnitella mucronata, Micraster gibbus, Inoceramus cripsi,* and sponges.

LOWER.—Chloritic sandstones passing into sandy marls, with *Galerites subrotundus* Agassiz; solid sandstones, fossils practically absent.

The sandy marls of the lower division in some sections contain *Discoidea subuculus* Desor, *Holaster, Marsupites testudinarius* Schlotheim, etc. (See Roemer, 1870, pp. 352-353). It is the white lime-marls which contain the sponge fauna (Roemer, 1870, p. 355).

The Polish Cretaceous is related most closely to that of the Baltic province and is distinct from that of the Bohemian-Saxon basin and from that of Silesia.

(8) The Central Russian Basin

The Upper Cretaceous of this basin covers an immense area reaching from Orenburg to the Vistula and shows an unusually great development, considering that it is all marine, so that in places it rivals and even surpasses the thickness attained in the British Isles. Thus at Charkow, in the government of Charkow, southern Russia, it is 600 meters thick. The lithologic and faunal development is similar to that in western Europe. The Cenomanian, which is not so thick as the higher formations, is represented by greensands carrying *Schloenbachia varians.* The Turonian consists of limey or chalky marls, with various species of *Inoceramus* such as *brongniarti, cuvieri,* etc. The Emscher marl has been recognized and contains the usual *Inoceramus involutus* and *Actinocamax westphalicus.*

The Senonian is the most widespread of the formations, being developed either as a marl, e. g., the baculite-bearing marls of Lemburg, or as a true chalk, as in the government of Simbirsk, where the sponges are found, and at Charkow and in the Donetz basin. It is doubtful if there is any Danian in this region.

The Silicispongiæ of Russia have been described by Fischer-de-Waldheim, who identified a single species, *Siphonia pyriformis* Goldfuss, from the chalk at Bouchevoë, near Moscow (1837, p. 176), and described five new species of *Cœloptychium,* three (*C. truncatum, C. münsteri,* and *C. eichwaldi*) from the Chloritic Chalk of Yazikova in the government of Simbirsk and two (*C. goldfussi* and *C. jasikovii*) from the Chalk Marl of Chilovka, also in Simbirsk (1844, pp. 278-283). In the second volume of

the 'Lethæa Rossica,' Eichwald (1865) described the sponge fauna of the Jurassic and Cretacic of Russia and subsequently Trautschold described two new species (1877) and noted the occurrence of three others in the Upper Cretaceous (1877, 1878).

(9) The Baltic Province

This includes the Chalk deposits of Rügen, Usedom, and Wollin, and the outliers in the vicinity of Mecklenburg. Here, too, are to be classed the deposits of Bornholm, Denmark (Stolley, 1892), and Scania.

On Rügen true chalk is found well exposed in the sea cliffs. It contains layers of flint and is characterized by echinoids of the genera *Ananchytes*, *Micraster*, *Galerites*, *Cidaris* and *Cyphosoma*, and by *Gryphœa vesicularis*, *Spondylus fimbriatus*, *Terebratula cornea*, Bryozoa, and *Belemnitella mucronata*. The beds containing the last mentioned fossil are Upper Senonian and are to be correlated with the Mucronatenkreide of northwest Germany. Lower Senonian, or Quadratenkreide, seems to be wanting, but near Greifswald borings show Turonian, Cenomanian, and Gault.

The chalk beds of Usedom and Wollin with *Inoceramus brongniarti* belong to the Turonian, while the numerous scattered outcrops near Mecklenburg (Geinitz, 1888) represent mainly Senonian, though Turonian and Cenomanian also occur. Glauconitic marls of Emscher age with *Actinocamax granulatus* (Granulatenkreide) have been found near Revahl in inner Pomerania (Hinterpommern). The Cretaceous rocks and faunas of the island of Wollin were first described by G. Behrens (1878), although Hebert in 1869 and Schlüter in 1876 had mentioned the Cretaceous of Wollin in their correlations. On the basis of faunal studies, Behrens showed that the Wolliner limestone belonged to the Scaphites Pläner horizon (1878, pp. 265, 267).

In the province of Scania, in southern Sweden, siliceous sponges have been collected from the *Schreibkreide*, or chalk, at six localities near Malmö. Holst, the government geologist in Stockholm, sent the material to Schrammen to identify. The specimens are silicified and the skeleton is usually destroyed but, by a comparison with the sponges of northwest Germany, Schrammen was able to determine twenty-five distinct species, nine of which also occur in Germany, the others being called only "new species" but, on account of their poor preservation, not receiving new names (Schrammen 1910-1912, pp. 353-354).

Friedrich von Hagenow described the Cretaceous of Rügen in 1839 and especially mentioned the fine exposures shown along the coast north

and south of Sassnitz. There are two specimens in the Schrammen Collection from this locality. Hagenow identified nineteen species of sponges from Rügen, but did not specify which came from Sassnitz.

(10) The Prussian Region

In west and east Prussia the Cretaceous is known only from borings which show a thickness of over 300 meters. Cenomanian, Emscher, and Lower and Upper Senonian are idicated[1] but, to my knowledge, no sponges have been found.

(11) The South European (Mediterranean) Cretaceous Area

This includes the Cretaceous of the Alps, from southern France eastwards, and the deposits in northern Africa and Asia.

The deposits of Lower Cretaceous time are characterized by the abundance of *Requienias*, *Monopleura*, and similar aberrant types of pelecypods; by peculiar ammonoids (*Crioceras*, *Ancyloceras*, *Macroscaphites*, *Hamites*, etc.); and by genera of normal ammonoids which held over from the Jurassic, such as *Phylloceras*, *Lytoceras*, etc. Enormous accumulations of foraminiferal limestones (*Orbitolina*) and coral reefs characterize this period.

The deposits of the Upper Cretaceous are especially marked by the dominance of the Rudistes (*Radiolites*, *Hippurites*, etc.). Frequently the whole formation is composed largely of Hippurite limestones, which form reef-like masses and pass laterally into clastic limestones with few fossils. The Upper Cretaceous is known as the *Seewer limestone* in the west Alps, the *Couches rouges* in the northwest Alps, the *Gosau formation* of the eastern Alps, the *Scaglia* of the southern Alps.

In age, these formations vary in different localities, not infrequently showing a transgressing basal portion. Beginning with Cenomanian, frequently the Turonian and higher divisions overlap, resting directly on the Lower Cretaceous or older rocks. Nevertheless, the Upper Cretaceous of the southern section is, on the whole, a depositional unit in which the pronounced lithologic variation characteristic of the northern area is not very strongly marked, while the various members present gradational features which make subdivision difficult.

In Istria, Krain, and Dalmatia, the *Rudistes* limestones are followed by brackish- and fresh-water formations (*Cosina* beds) of late Cretaceous age, designated the Liburnian stage. They mark a retreat of

[1]For further details see Jentzsch, H. Der vorviluviale Untergrund des norddeutschen Flachlandes. Jahrb. d. preuss. geol. Landesanstalt für 1899, p. 266.

the sea and a gradual replacement of the marine by continental sediments, as is indicated by the presence of coal beds in some of these formations. That this change towards the end of the Cretaceous was widespread, even in the Mediterranean area, is shown by the intercalation of similar fresh-water beds in the upper marine Cretaceous formations of Aja in Bakony, in Portugal, and in Provence, southeast France, where, near Aix, Fuveau, etc., these terrestrial beds reach a thickness of 800 meters and contain brown-coal and enclose brackish-water Mollusca. This retreat of the sea corresponds to that shown by the advance of the sands in southern Germany and in Bohemia in Senonian time and by the development of the continental Laramie deposits which mark the closing stages of the American Cretacic.

In north Africa (Egypt, Libyan desert) and in Palestine, the Cretaceous begins with the non-marine Nubian sandstone, which contains chiefly silicified woods and which was transformed into a basal bed by the transgressing Cenomanian sea, the calcareous beds of which rest directly and conformably upon it. "In Mount Lebanon where this sandstone is 1600 feet thick, it is succeeded by Turonian strata, while in the Libyan desert Senonian chalk follows it, making the age of the sandstone itself probably Turonian."[1] The Nubian sandstone thus rose diagonally across the successive divisions as a basal sandstone and continued as a basal transgressing member into Senonian time. Uppermost Senonian (Mæstrichtian) and even Danian are known from upper Egypt, where they are of typical marine character.

There are very few references in the literature to Silicispongiæ in the rocks of this vast southern province, yet we have seen that they occur in southeastern France in abundance throughout the entire Cretaceous and it is not at all improbable that when the rocks of this age in Africa and in Italy and the Balkans are searched for siliceous sponges this phylum will be found to have been as well represented in ancient Tethys as in the boreal sea.

Outline of the Palæogeography of Europe in Cretaceous Time

During the Lower Cretaceous or Comanchic period, the south of Europe was covered in the main by a large mediterranean (the Tethys of Suess) which extended southward into north Africa and northward to the present plains of the Danube. A number of island masses rose

[1]Grabau, A. W. 1906. Types of sedimentary overlap, Bull. Geol. Soc. Amer., XVII, p. 593.

from this sea, the chief of these being (Kilian, 1907, pp. 101-104): (1) the Iberian méseta (Spain); (2) the Central Alps (?); (3) Sardinian island including Corsica; (4) Caucasian island (?); (5) East Hungarian island; (6) Dinarian island; (7) Macedonian island; (8) Megarian island; and (9) the island of Asia Minor. This ancient mediterranean contained an abundant fauna consisting of ammonites and other Mollusca, especially the thick-shelled, often more or less spirally twisted pelecypods which, from their massive and coarse teeth, are grouped together as Pachydonta (e. g., *Disceras*, Upper Jurassic; *Requienia*, *Monopleura*, etc., Lower Cretaceous; *Caprina*, *Plagioptychus*, *Radiolites*, *Hippurites*, Upper Cretaceous), and of corals, echinoids, Orbitolinas, etc. Some of these organisms, particularly the corals and sedentary molluscs, formed reefs, as shown in the Urgonian reef facies. A northern or boreal sea covered parts of north Europe, including western England, northern France, northwest Germany, parts of the Baltic region, and a portion of the Russian area. This sea was at times connected with the Mediterranean region on the east by the Volga straits, and on the west by way of Dijon and the Paris Basin. No direct connection appears to have existed in the earlier part of Lower Cretaceous time between the Russian and Baltic regions (which latter formed an embayment from the North Sea of today), though during the earlier periods both areas were united by the waters which then covered the Arctic regions around the northern Scandinavian border. This connection was, however, non-existent during the period of the Gault, when various pathways across middle Europe were opened by the beginning of that great transgression which became so marked in Cenomanian and Turonian time.

The land mass which separated Tethys from the northern Cretaceous sea and which was partly submerged and dismembered in Upper Cretaceous time comprises the Vosges mountains, the Ardennes, the Black Forest, the Hunsrück, and Thuringerwald, or the central portion of the Post-Cretaceous Rhenish dome, as well as the Bohemian mass, the Sudetic mountains, and other parts of Silesia, Poland, and a part of south Russia. To the north of the Baltic region was the great Fenno-Scandian land mass, which also included part of northwest Russia.

Only in the Alpine region of the Mediterranean was there continuous deposition of marine beds from the Jurassic into the Lower Cretaceous; elsewhere the evidence of a great regression of the Jurassic sea is indicated, and either erosion or the deposition of continental beds (Wealden, etc.) marks the interval before the retransgression of the sea

in Lower Cretaceous time. This transgression brought with it marked overlaps and basal deposits which rise in age from point to point in the direction of transgression. Such a basal bed of the transgressing Lower Cretaceous sea is found in the Hils formation of northern Germany. It consists of sandstones and conglomerates at the base and rests, generally with a marked hiatus, upon the Upper Jurassic (from the Kimmeridgian to the Purbeckian), of which it commonly contains pebbles and worn fossils. The age of the Hils itself varies from point to point, as is shown by the age of the succeeding fossiliferous formations in various localities.

The transgression continued with more or less interruption into Upper Cretaceous time where, during the Cenomanian, it became so pronounced that beds of this age over much of northern Europe rest directly upon the older formations, even upon the folded and eroded Palæozoics and in some sections upon the crystallines. This great transgression is widely recognized throughout northwest Europe and is generally spoken of as the Cenomanian transgression, although it only marks the culmination of the broad positive eustatic movement inaugurated in Lower Cretaceous time. The cause of this wide extent of the Cenomanian and later deposits is, no doubt, due to the completion of the peneplane which beveled the Palæozoic mountains, these, up to that time, having formed effective barriers to the advance of the Lower Cretaceous sea. An instructive and typical example of the Cenomanian transgression in the British Cretaceous has been worked out by Professor Grabau from whom I quote.[1]

> In England the basal formation is the lower Greensand (Aptian), which rests on the non-marine Wealden, and is a glauconite and clay formation with basal conglomerates. The corresponding lithic bed in Antrim county, Ireland, is the Cenomanian, which rests on Lias and Rhætic. The distance is from 300 to 400 miles, in which interval the lower Greensand and Gault have disappeared by overlap, bringing the Cenomanian directly on the old land surface. During the advance, however, the deepening of the English area, and above all the removal of the coast, permitted the deposition of chalk in that region, so that the Cenomanian of England is a chalk, though it still contains Greensand and marl. It is the Lower Chalk of the British geologists. The corresponding lithic bed of Ireland—that is, the Lower Chalk of Ireland, lithically considered—is lower Senonian. Between this and the basal Lower Greensand (Cenomanian of Ireland, Aptian of England) is a glauconitic sand, clay, and marl formation, which in England is the Gault or Upper Greensand (Albian), while in Ireland it is the Turonian, and in part perhaps Upper Cenomanian. The Turonian, or Middle Chalk of England, is already a pure white chalk, a lithic

[1]Grabau, A. W. 1906. Types of sedimentary overlap, Bull. Geol. Soc. Amer., XVII, p. 592.

characteristic attained in Ireland only in the upper Senonian. Thus a regular and progressive advance of the sea from southeast to northwest is indicated, with a corresponding change in lithic character as the sea advanced.

The transgressive character of the deposits of Upper Cretaceous time against the northern border of the north Cretaceous basin is seen in the remarkable basal conglomerates which are found in the Scanian district of Sweden. At Tosterup and elsewhere in Scania the conglomerates contain *Actinocamax mamillatus* and thus represent the Quadratenkreide of Lower Senonian age, which here rests directly upon much older beds. At Küllernölla (Scania) lower beds with *Actinocamax granulatus* (Granulatenkreide) occur, while Emscher greensand is found on Bornholm. Farther north in Sweden the basal conglomeratic beds (Trümmerkreide) are of Upper Senonian age (Mucronatenkreide), thus showing essentially a northward overlap.

That the Cenomanian transgression was also, though perhaps less strongly marked, in the Mediterranean region is shown by the overlaps there against the northern land barriers, of the several members of the more uniform southern Upper Cretaceous formations, as well as by the fact that in many sections the Upper Cretaceous alone is present, having overlapped the Lower, as already noted in the preceding section.

The continued transgression from Cenomanian to Senonian time over the southern border of the Mediterranean basin is well shown by the Nubian sandstone of North Africa and Palestine, which is successively followed by Cenomanian, Turonian, and Senonian formations in the direction of transgression (see p. 93 above).

In the northern basin, in addition to the marine deposits, there was also accumulated a remarkable series of continental sediments which were built out into the basin by rivers flowing from the old mountain systems. These fluviatile deposits of sand, containing almost no other organic remains but Chondrites—commonly referred to the Algæ, but possibly a land plant—were continuous in their deposition from Lower Cretaceous on through Upper Cretaceous, and indeed into Tertiary time, and are known by the broad name of Flysch. They form a thick series of continental deposits best developed in the Vienna basin, for which reason they are there called the Wiener Flysch or Wiener Sandstein, while to the southeast they are designated the Carpathian Sandstone. This inpouring of river-borne sands retarded and at times neutralized the southward transgressive movement of the Cretaceous sea, besides furnishing it with the sands which now constitute the several quadersandstones of Bohemia, Saxony, and Silesia, and the

Senonian sands of similar origin and lithology found in the northwest of Germany. Thus the history of Upper Cretaceous time may well be looked upon as a record of the struggle between the sea, which was attempting to encroach upon the land, and the rivers, which by their deposition of large amounts of detritus were able not only to prevent the sea from advancing but even to load up the littoral zone with more waste material than the waves could remove, so that slowly but surely the sea was pushed back northward in the last stages of the Upper Cretaceous, that is in late Senonian time, until it was forced out of the greater part of northern Europe. The resultant retreat was probably not eustatic in origin, as had been the Cenomanian advance which was due to a world-wide transgressive movement of the sea; rather was the late Senonian retreat from northern Europe in response to the synchronous broad advance over Great Britain, marked by the deposition of chalk in England, Scotland, and Ireland, and perhaps to some extent in response to a similar advance in the Mediterranean basin. The Senonian changes of sea-level in the northern basin seem thus to have been compensatory in their nature, the retreat in Germany corresponding to the advance in the British area. A cross-section from Vienna to northern Ireland would show the advance of the continental sands over the marine beds. In Vienna the entire Upper Cretaceous is of continental or near-shore origin, but northwestward, as in the Elbthal, the Cenomanian is marine, showing the farthest southward advance of the sea, for all the higher beds were probably in part at least continental, though now largely removed by erosion. In northwestern Germany the sea held its own through Cenomanian and Turonian time, but in the Upper Senonian the advancing sands from the south filled up the sea margin and the marine waters were forced still farther north. The relation here indicated is one of "replacing overlap," as defined by Professor Grabau.

CHAPTER IV.—NOTES ON THE GENERA AND SPECIES IN THE SCHRAMMEN COLLECTION IN THE AMERICAN MUSEUM OF NATURAL HISTORY

Introduction

The Schrammen Collection of Cretaceous Silicispongiæ contains 800 specimens representing 116 genera including 218 species, one variety, and three mutations. The collection of type species is the one which was purchased by The American Museum of Natural History in 1914 from Doctor Anton Schrammen. Prior to that date, in 1903, a smaller

collection had been purchased consisting of 300 specimens representing 171 species. Many of these are icotypes, a few are apotypes and some may be proterotypes (see definitions below), but it has been impossible, in most cases, to determine which kinds of types, if any, the specimens represented. Furthermore, even the supplementary types are only duplicates of the types of the same or higher order in the 1914 collection. With the exception, therefore, of about half a dozen specimens, no part of the 1903 purchase is included among the types now exhibited in the center cases Nos. TTC-17 and 18 in the Hall of Geology and Invertebrate Palæontology, and what few apotypes there are have been set aside to be incorporated in a zoological exhibition of the Silicispongiæ.

The specimens in the collection are arranged primarily upon a stratigraphic basis from the oldest to the youngest of the Cretaceous formations represented. Further subdivision is made upon the geographical occurrence, all of the specimens of the same age from the same locality being placed together. For each locality the arrangement of the species is zoological, the order used by Schrammen in his Monograph having been followed. For the convenience of students who desire to refer quickly to the monograph, page references are given in parentheses after each species in the following discussion. In referring to the common works on sponges, the abbreviations which are customary in the literature will be employed, but the name of the author and the date of his work will always be given, so that the complete reference may be found by consulting the bibliography at the end of this paper.

All of the specimens come from the Upper Cretaceous of northwest Germany, from the provinces of Hanover, Saxony, and Silesia, and two from the Island of Rügen. Less than one-fourth of the specimens come from the Turonian, twenty species from the Emscher-Mergel and the remainder or over three-fourths come from the Quadratenkreide and Mucronatenkreide, or zones 3 and 4, respectively, according to Stolley's classification of the Senonian.

In the notes on the individual species the references to the literature usually, but not always, constitute complete synonymies. All references affecting the status of the genus and species are taken account of, but I have not in every case incorporated all notices in the literature of the occurrences of species in different localities when such notices include no change in synonymy. The object of the present paper is to determine the status of the types in the collection, not to make complete synonymies for the species. During the progress of the work, over four thousand references to species have been accumulated, and at some later date it is

the intention of the author to assemble and pass judgment upon these and all other available references to European Cretaceous sponges and to publish a complete synonymy thereof. That, however, will be a work of years, not of months, and will necessitate, probably, the consultation of the types in the European museums, as well as of a great mass of literature not to be found in this country.

Classification of Types

The following classification of types, proposed in large part by Schuchert and Buckman,[1] and slightly modified by Grabau,[2] is the one used in the arrangement of the collection.

I. Primary Types (Proterotypes)

(1) Holotype.—The original specimen selected as the type and from which the original description (protolog), or the original illustration (protograph), is made.

(2) Cotype.—A specimen of the original series when there is no holotype, the describer having used a number of specimens as of equal value.

(3) Paratype.—A specimen of the original series when there is a holotype.

(4) Lectotype.—A specimen chosen from the cotypes subsequent to the original description to represent the holotype.

II. Supplementary Types (Apotypes)

(5) Heautotype.—A specimen figured or described by an author as a further illustration of his own already founded species, such not belonging to the proterotypes.

(6) Plesiotype.—A similar specimen, but selected by some one else than the original describer of the species.

(7) Neotype.—A specimen identified with an already described and named species and selected to represent the holotype in case the original material is lost or too imperfect for determination.

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[1]Schuchert, Charles and Buckman, S. S. 1905. The nomenclature of types in natural history. Science, N. S. XXI, No. 545, pp. 899-901. See also 'Catalogue of the Type and Figured Specimens of Fossils, Minerals, Rocks and Ores in the Department of Geology, United States National Museum, Washington,' 1905, pp. 10-18.

[2]Grabau, A. W. 1913. Principles of Stratigraphy. New York, pp. 918-920.

III. TYPICAL SPECIMENS (Icotypes)

(8) Topotype.—A specimen (not used in the literature) from the same locality and horizon as the holotype (or other proterotype) or lectotype.

(9) Metatype.—A topotype identified by the nomenclator himself.

(10) Idiotype.—A specimen (not used in the literature) identified by the nomenclator himself, but not from the original locality or horizon of the proterotype with which it is identified, i. e., not a topotype.

(11) Homœotype.—A specimen (not used in the literature) identified by a specialist, after comparison with one of the proterotypes.

(12) Chirotype.—A specimen upon which a chironym or manuscript name (a name never published) is based.

IV. CASTS OF TYPES (Plastotypes)

(13) Plastotype.—Casts of types may or may not be used in descriptions or illustrations.

GENOHOLOTYPE.—The original species on which the genus is founded, or the species selected by the author from those originally described as the type of the genus.

GENOSYNTYPE.—One of a series of species upon which a genus is founded, when there is no genoholotype.

Of the total representation of 377 species from all the localities[1] 358 are types. These are distributed as follows:

I. Primary Types		
(1) Holotypes: 1 figured, 4 (spicules only)	5	
(2) Cotypes: 41+1 ?+2 figured	43	
(3) Paratypes: 38	38	
		86
II. Supplementary Types		
(5) Heautotypes: 14	14	
(6) Plesiotypes: 169	169	
		183

[1]Many of the species occur at several localities so that there is a duplication. Of separate species (or varieties) there are only 222.

III. Typical Specimens		
(7) Topotypes: 1	1	
(8) Metatypes: 10+1 ?	11	
(9) Homœotypes: 9	9	
(10) Idiotypes: 21	21	
(11) Chirotypes: 10	10	
		52
Absolute Determination Not Possible		
Holotype or Metatype: 1	1	
Paratypes or Metatypes: 3	3	
Paratypes or Heautotypes: 19	19	
Cotypes or Heautotypes: 14	14	
		37
	Total	358

Sponges from the Turonian or Oberer Planer

The Scaphites Pläner (Strombeck's Zone 4 of the Turonian; Schlüter's Zone 2 or Lamarcki Pläner)

Species from Halberstadt, Saxony

18180.—**Doryderma (Brochodora) roemeri** (Hinde) (p. 58). Plesiotype

The generic name *Doryderma* was proposed by Zittel in 1878 to include *Spongia* of Phillips, part of Roemer's *Polyjerea* and part of Pomel's *Dichojerea*. The first species which he lists under *Doryderma* is *Polyjerea dichotoma* Roemer from the Mucronatenkreide of Ahlten (1878, p. 131, Pl. vii, figs. 1, *a*, *b*, *c*, *d*, *e*). Here, too, he includes the forms identified by Quenstedt as *Polyjerea dichotoma* Roemer ('Petrefactenkunde,' V, 1878, p. 423, Pl. cxxxv, figs. 10, 11), forms which came from the lower Turonian, the Middle Pläner (Cuvierikreide), of Windmühlenberg, near Salzgitter, Hanover.

For Roemer's species as revised by Zittel, Hinde in 1883 ("Catalogue of Fossil Sponges," p. 49) proposed the name *Doryderma roemeri* for the following reason. Miss Benett in her 'Catalogue of the Fossils of Wilts' had named and figured a sponge from the Upper Greensand of Warminster, Wiltshire, as *Polypothecia dichotoma* (1831, p. 9, Pl. xiii). Hinde found that this species belonged to Zittel's genus *Doryderma*, for which reason Miss Benett's usage of *dichotoma* claimed priority. Thus it was necessary to assign a new name to the German species described by Roemer and consequently Hinde proposed the specific designation *roemeri* in memory of the discoverer of the species.

Hinde's holotype was a fragmentary specimen from a chalk flint supposed to have come from the Upper Chalk of Wiltshire (protograph, 1883, Pl. VIII, figs. 3, 3*a*; two spicules from Ahlten, Hanover, also illustrated, Pl. VIII, fig. 3*b*). Hinde, for what reason he does not state, includes under his species Parkinson's material which was figured in the 'Organic Remains' (1808, II, Pl. VII, figs. 7, 12) and described as a "ramose alcyonite from Berkshire" (*loc. cit.*, p. 91). Although Quenstedt ('Petrefactenkunde,' V, 1878, p. 400) states that Mantell was referring to Parkinson's species when he gave the name *Spongia ramosa*, Hinde does not consider this to be the case (1883, p. 49). Since he had Mantell's types and presumably those of Parkinson, we must, until better information is available, accept Hinde's synonymy. He considers that F. A. Roemer's *Polyjerea dichotoma* (1864, p. 36, Pl. XIV, fig. 1), described from the Cuvierikreide of Salzgitter, the Quadratenkreide of Wahrenberge near Biewende, in the Köhlerholz near Ilsenburg, and from the Mucronatenkreide of Ahlten, is the same as Parkinson's "ramose alcyonite," although Roemer himself had given no such synonymical reference. Parkinson's figures and description certainly do not seem to warrant Hinde's procedure but, if he had the types, as we may with considerable certainty assume, and since he had specimens of Roemer's species presented by Zittel to the British Museum, then we may assume that he was justified in putting Parkinson's and Roemer's species in the same synonymy.

Schrammen, in his Monograph, separates from Zittel's *Doryderma* two subgenera, *Brochodora* and *Homalodora*, the former characterized by a coarsely porous skeleton and a surface covered with large, skeletal, net-like meshes lying one on top of the other and serving as ostia, while *Homalodora* is characterized by a dense skeleton and a smooth, fine-meshed surface, with irregularly spaced, round ostia (1910-1912, pp. 58, 59). In the subgenus *Brochodora* Schrammen places *Doryderma roemeri* Hinde. Without giving any explanation, he includes in his synonymy of the species the forms identified by Wollemann from the Senonian of Gr. and Kl. Biewende, Braunschweig, as *Doryderma ramosa* Mantell (Wollemann, 1900, p. 5). It may be stated that Schrammen placed this species in his synonymy in accordance with the description given by him for the subgenus *Brochodora*, for Wollemann distinctly calls attention to the fact that it is the meshes of the net-work which serve as ostia and this characteristic is diagnostic of *Brochodora*, while the true *Doryderma ramosa* Mantell has well-developed ostia and is, therefore, placed in the subgenus *Homalodora*.

Schrammen has added to the localities from which this species was already known Nettlingen, Halberstadt, Misburg, Oberg, and Adenstedt. The specimen which he figured is from the Quadratenkreide of Oberg (*loc. cit.*, Pl. XVIII, fig. 5, text plate II, fig. 1). Since Schrammen revised and further described and illustrated the species, the specimens from Germany which he used are plesiotypes.

18181. **Thecosiphonia torgeri** Schrammen (p. 83). COTYPE

This species was described by Schrammen in 1910 from the Scaphites Pläner of Halberstadt and Nettlingen, from which localities he had examined twenty specimens. Since he published no figures of the species and designated no holotype, all of the specimens are cotypes.

18182. **Jerea quenstedti** von Zittel (p. 89). PLESIOTYPES

This species was described by Goldfuss (1833, p. 221, Pl. LXV, fig. 14) as *Siphonia ficus* from the Quadersandstein of Quedlinburg, Saxony. Roemer in 1864 (p. 27) simply lists the species with a brief description but does not note occurrences. Quenstedt (1878) records it from the Pläner of Quedlinburg and states that it had been described by Parkinson (1808, p. 95, Pl. IX, fig. 4) as *Alcyonium ficus* from the Chalk of Wiltshire. Parkinson quite rightly takes no credit for proposing the name but ascribes it to Linnæus. It is to be noted that Linnæus (1792, Systema Naturæ, I, pars VI, p. 3813) used the name *Alcyonium ficus* only for living forms; Mantell was the first to identify a fossil sponge under the Linnean name. In 1821 Lamouroux (p. 79, Pl. LXXVIII, fig. 3) described the genus *Jerea* with *J. pyriformis* as the genoholotype. It is to this genus that Zittel ('Studien,' 1878, II, p. 145) ascribes Quenstedt's species *Siphonia ficus* and, at the same time, he changes the specific name to *quenstedti* without stating his reasons. Schrammen, however, explains this apparent error in the recognition of priority (1910, p. 90). Schrammen considers that *Siphonia ficus* Goldfuss and *Siphonia ficus* Quenstedt are the same because he feels that there is the highest probability that the type specimens came from the same horizon —indeed, both were described from the Turonian of Quedlinburg— and, furthermore, the descriptions of the two species are closely parallel. There is also no doubt that *Siphonia ficus* Quenstedt is synonymous with *Jerea quenstedti* Zittel. Zittel, however, held that the *Siphonia* of Goldfuss and of Quenstedt belonged to separate genera, and left *Siphonia ficus* Goldfuss under that name (Zittel, 1878, p. 143) as a representative species of *Siphonia* but he gave a new name to Quenstedt's *Siphonia*

ficus. Now, if, as Schrammen thinks to be the case, there is no difference between *Siphonia ficus* Goldfuss and *Siphonia ficus* Quenstedt, then, by the laws of priority, Goldfuss' name would have priority and Zittel's would have to be dropped from the literature. The reason that Schrammen does not recognize Goldfuss' apparent claim to priority is that the locality given by Goldfuss is indefinite and the figure is too schematic to be perfectly certain of the identity of the species.

In 1841 Roemer (1841, p. 4) noted the occurrence of *Siphonia ficus* Goldfuss from Sudmerberg, near Goslar, Hanover, but Schrammen states that it is apparent from the description that Roemer had another species in mind.

Schrammen also points out that Griepenkerl is wrong in his identification of material from the Quadratenkreide of Glentorf, Braunschweig, as *Siphonia ficus* Goldfuss, for the paragaster in the Griepenkerl specimen is not deeply sunk but only as deep as, or a little less deep than, broad.

Hinde (1883, p. 65) has described and figured (Pl. XIII, figs. 3, 3*a*), specimens from the Grey Chalk (Cenomanian) near Dover, which he calls *Siphonia ficus* Goldfuss. Hinde, accepting Zittel's revision, lists *Jerea quenstedti* Zittel (p. 71) as distinct from the species just mentioned but, if we accept Schrammen's revision, the two will appear in the same synonymy.

Počta (1884, p. 34) lists *Siphonia ficus* Goldfuss from the Malnitz beds of Leneschitz and from the Korytzan beds of Bilin in Bohemia. These occurrences are also to be included under *Jerea quenstedti* Zittel.

In 1901 Schrammen described a new genus, *Pachycalymma*, with the genoholotype and sole species *P. subglobosa* (pp. 9, 10, Pl. I, fig. 1, Pl. III, fig. 1, Pl. IV, fig.4). After studying better material, Schrammen, at the time of publication of his Monograph, came to the conclusion that this species was in reality a *Jerea quenstedti* and represented simply young individuals in which the epitheca (Deckschicht) was especially well preserved. His former genus, *Pachycalymma*, is therefore a *nomen nudum*. From the Quadratenkreide of Oberg, Schrammen figured four specimens and some spicules (1910, Pl. II, figs. 1-4, text plate IV, fig. 2).

18183. **Pachycothon giganteum** (Roemer) (p. 130). PLESIOTYPE

This species was described by Roemer in 1864 as *Cupulospongia gigantea* (p. 51, Pl. XVIII, fig. 1) from the Quadratenkreide of Suderode. Zittel in 1878 ('Studien,' II, p. 132) erected the genus *Carterella* to include parts of *Jerea* of Roemer and Gümbel and under this he included

Jerea spiculigera of Roemer, which had been described by that author in 1864 (p. 34, Pl. XII, fig. 6) from the Cuvierikreide of Windmühlenberg near Saltzgitter. Schrammen includes in his synonymy the species designated under the Zittel revision as *Carterella spiculigera* (1910, p. 130) but, since this was Roemer's *Jerea spiculigera*, then Schrammen should include this also in his synonymy. Hinde (1883, p. 55) notes the presence in the British Museum of spicules of *Carterella spiculigera* (Roemer) from the Zittel Collection from Ahlten, Hanover. This is also included in the synonymy given by Schrammen for *Pachycothon giganteum*. Schrammen does not make clear in his Monograph why he includes these species in his synonymy, but in 1901, when he described the genus *Pachycothon*, he made his genoholotype *giganteum*.[1] At that time, however, he made the mistake of ascribing the species to himself, but this error he rectified in 1910. He calls attention in 1901 to the fact that Zittel had placed Roemer's *Cupulospongia gigantea* under *Seliscothon* (1878, 'Studien,' II, p. 118) without, however, having seen the types in the Roemer Museum. Yet, in 1910, Schrammen fails to include in his synonymy *Seliscothon giganteum* (Roemer) emend Zittel, as he should have done. *Carterella spiculigera* Zittel is only a stem of *Pachycothon giganteum* (1910, p. 130).

In 1890 Počta described a new species *Isoraphinia simplicissima* from the Cuvieri Pläner of Paderborn, Westphalia (1890, p. 229), a species which Schrammen includes in his synonymy of *Pachycothon giganteum* without stating his reasons. The figures given by Počta are very poor (*loc. cit.*, Pl. VI, figs. 1*a*, *b*).

This species ranges from the Scaphites Pläner through the Mucronatenkreide and occurs at Halberstadt, Nettlingen, Misburg, and Oberg, besides the localities already mentioned. The specimen figured by Schrammen is from the Quadratenkreide of Oberg (Pl. XVII, fig. 6).

18184. **Leiostracosia alcyonoides** (Mantell) (p. 284).

In 1808 Parkinson ('Organic Remains,' II, Pl. x, fig. 12) figured, without naming, "an alcyonite found in the chalk-pits of Wiltshire," and he gave a brief and insufficient description of the specimen on p. 213. Mantell, in 1822 ('Fossils of the South Downs,' p. 176), gave the name *Ventriculites alcyonoides* to this species. He notes that it is "rare in Sussex, but common in a contracted state at Heytesbury, Wiltshire" (p. 176); it occurs in the Upper Chalk at Lewes. Roemer

[1]Through an error in proof reading this appears as *gigantenum* in 1901 (Neue Kieselschwämme, p. 12).

(1841, p. 9, Pl. IV, fig. 2) revised Phillips' species *Spongia cribrosa*, described from the Chalk of Yorkshire (1829, p. 118), and placed it under Schweigger's genus *Scyphia*, recording it from the Pläner of Goslar and Oppeln; this species is included by Schrammen in his synonymy of *Leiostracosia alcyonoides*.

Ferdinand Roemer (1870, p. 309, Pl. XXX, figs. 7, 8) identified certain specimens from Oppeln, Silesia, and from Schonau near Teplitz, Bohemia, as A. Roemer's *Scyphia angustata*, which he placed under the genus *Cylindrospongia*. As Hinde first pointed out (1883, p. 114), this species is not the same as the one originally called *Scyphia angustata* by F. A. Roemer (1841, p. 8, Pl. III, fig. 5) and now known as *Leiostracosia angustata* (*q. v.*) but really belongs under Mantell's species *alcyonoides*. Leonhard (1897, p. 31), while stating that *Ventriculites angustatus, s. str.* is *V. alcyonoides* Mantell according to Hinde, does not accept the Hinde revision nor does he allow the priority of species name to go to Mantell, but prefers to retain F. Roemer's 1870 designation, so that he speaks of *Ventriculites angustatus* A. Roemer when referring to the species called by Hinde *V. qlcyonoides* Mantell, and he used Quenstedt's term *V. angustatus distortus* for the form called by A. Roemer in 1841 (p. 8) *Scyphia angustata*. The specific name *angustata* undoubtedly must be retained for the sponge described in 1841 and Quenstedt (1877, p. 44), therefore, was unjustified in erecting a new name for the 1841 species, and in retaining the original 1841 designation for the 1870 species of Roemer. Other authors, with the exception of Leonhard, have not followed Quenstedt in this.

Schrammen has made a final generic revision, placing both *angustata* and *alcyonoides* under his new genus *Leiostracosia*. He records *L. alcyonoides* from the Scaphites Pläner and the Cuvieri Pläner, from Oppeln, Dörnten, and Grosse Heere, but has not mentioned its occurrence in the Lamarcki Pläner of Halberstadt so that the specimen in the Collection is not a type.

18185. **Plocoscyphia roemeri** Leonhard (p. 300). PLESIOTYPE

In 1844 Reuss (p. 173) described the species *Scyphia labyrinthica* from the Plänerkalk of Bohemia. In his work of the following year, 'Die Versteinerungen der Böhmischen Kreideformation' (1845, p. 77, Pl. XVIII, fig. 10) he erected the genus *Plocoscyphia* with this species as genoholotype. F. Roemer (1870, p. 309, Pl. XXXIII, figs. 7, 8) gives this species from the Turon Pläner of Oppeln. In 1877 Quenstedt (p. 485, Pl. CXXXVIII, figs. 12, 13) placed Roemer's species under the

genus *Gyrispongia*, but this generic revision has not been recognized by authors. In 1897 Leonhard (1897, p. 35) pointed out that Roemer had made a mistake in identifying specimens from Oppeln with *Plocoscyphia labyrinthica* Reuss from Bohemia, a mistake due to the fact that Roemer had only crushed and incomplete specimens. Because of the mistaken identification, Leonhard proposed the new specific name *Plocoscyphia roemeri* for Roemer's *P. labyrinthica.*

Schrammen (1910, p. 300) records this species from Nettlingen, Oppeln, and Halberstadt, at all of which localities it occurs in the Scaphites Pläner.

18186. **Plectascus clathratus** (Roemer) (p. 308). PLESIOTYPES

This was originally described as *Dendrospongia clathrata* by Roemer (1864, p. 20, Pl. VIII, fig. 5) from the Cuvieri beds of Windmühlenberg near Salzgitter. Schrammen records it from the Scaphites beds of Nettlingen and Halberstadt.

SPECIES FROM OPPELN, SILESIA

18187. **Phymatella intumescens** (Roemer) (p. 73). HOMŒOTYPE

This specimen is from the collection purchased by the Museum from Schrammen in 1903. Nowhere in print does he refer to the occurrence of this species at Oppeln, although he records its presence in the Scaphites Pläner of Heere, Salder, Nettlingen, and Halberstadt. It is quite likely that he had failed to take note of the occurrence at Oppeln before he sent away the specimens in 1903, so that when he published his Monograph this locality was not listed. The specimen is thus a homœotype.

18188. **Thecosiphonia nobilis** (Roemer) (p. 84). PLESIOTYPES

This species were described by Roemer (1864, p. 37, Pl. XV, fig. 1) as *Limnorea nobilis* and is reported by him from the Cuvieri beds of Immenrode, Haverlah, and Immenstedt, and from the Quadratenkreide of Suderode. At the same time Roemer described another species, from the same localities and horizons, as *Tremospongia grandis* (1864, p. 40, Pl. XV, fig. 3). Zittel (1878, p. 148, Pl. X, fig. 3) described the genus *Thecosiphonia*, under which he included *Lymnorea, pars*, and *Tremospongia.* Schrammen has gone even further in regard to *Tremospongia grandis*, not only accepting Zittel's generic revision, but placing the species under *Thecosiphonia nobilis*, the two being beyond doubt identical (Schrammen 1903*b*, p. 21). Schrammen gives as the reason for Roemer having made two distinct spcies the fact that in one case he

was dealing with a form with a very deep "Scheitel," in the other case with one the "Scheitel" of which had been truncated; but such differences are often observed in the same species and should not be made the basis for separation into distinct species, according to Schrammen. This species is recorded by Schrammen from the Cuvieri Pläner of Salder and Oppeln and he calls attention to the fact that Senonian beds with sponges are not developed at Suderode and that, therefore, the examples recorded by Roemer must have come from the Cuvieri beds at that locality (1910, p. 85).

18189. **Scytalia terebrata** (Phillips) (p. 150). PLESIOTYPES

This species was named and figured by Phillips in 1829 (p. 118, Pl. I, fig. 10) as *Spongia terebrata* from the White Chalk of Danes' Dike, Yorkshire. The first description of the species was given by Hinde, who described a single specimen in the British Museum from the Upper Chalk of Flamborough ('Catalogue,' 1883, p. 45). This is three times as large as the specimen indicated in Phillips' illustration, for which reason Hinde thinks that Phillips must have made his drawing at one-third the natural scale.

Reuss in his 'Geognostische Skizzen aus Böhmen,' II, described the species *Cnemidium pertusum* (1844, p. 299) from the Lower Plänerkalk of Schillinge near Bilin, Bohemia. In the following year he again described the species giving many figures of it (1845–1846, p. 71, Pl. XVI, figs, 7, 8, 11-14). A. Roemer gave a brief description and poor figure of a form which he called *Jerea turbinata* from the Mucronatenkreide of Ahlten (1864, p. 32, Pl. XII, fig. 1). All of these species, together with *Spongia terebrata* Phillips, Zittel placed in his new genus *Scytalia* (1878, p. 128), figuring the skeletal elements of *Scytalia turbinata* (Roemer) (Pl. V, fig. 3). Schrammen, in his synonymy, not only accepts the Zittel generic revision but includes all of the species just discussed under *Scytalia terebrata*. He admits that there is an element of doubt in referring to *Cnemidium pertusum* Reuss and *Scytalia pertusa* (Reuss) of authors as a synonym of *Scytalia terebrata* (Phillips), for he had not examined any of the Bohemian material and was dependent solely upon descriptions and figures. His reason for making *S. pertusa* a synonym of *S. terebrata* seems to be insufficient; it is because he has found in the Cuvieri Pläner around Oppeln not only specimens which are indistinguishable from the typical *S. terebrata* but also specimens like those figured and described by Počta and described by Zahálka as *S. pertusa* (Reuss). These specimens differ from *S. terebrata* only in the possession on the basal portion

of elevations with knobby and lobular excrescences and proliferations. Schrammen regards such structures as probably only peculiarities of growth. This may be so, but in external form the specimens figured by Reuss (1845-1846, Pl. XVI, figs. 7, 8, 11-14) are in no way related to *S. terebrata* (Phillips), though similar in many respects to *S. turbinata* (Roemer). The illustrations of *Cnemidium pertusum* Reuss show either cylindrical or inverted top-shaped individuals, while the only one which has the stem partially shown displays the very abrupt contraction characteristic of Roemer's *S. turbinata.* It would perhaps be justifiable to make *Cnemidium pertusum* Reuss and all later references to this species synonyms of *Scytalia turbinata* (Roemer), but certainly the illustrations and descriptions available (including all protologs and protographs) do not justify the inclusion of *C. pertusum* under *S. terebrata* Phillips. According to Schrammen, the following species (to which I have added those listed by Frič and Pomel, since they were merely references based on the literature) are questionably included by Schrammen under *S. terebrata;* I would be inclined not to consider them even provisional synonyms.

1845–46, *Cnemidium pertusum* Reuss
1869, *Cnemidium pertusum* Frič
1872, *Calpia pertusa* Pomel
1878, *Scytalia pertusa* Zittel
1885, *Scytalia pertusa* Počta
1886, *Scytalia pertusa* Zahálka

Similarly, if we accept the Schrammen revision, all identifications referring to A. Roemer's *Jerea turbinata* are likewise to be included in the synonymy of *Scytalia terebrata.* Thus:

1864, *Jerea turbinata* Roemer
1878, *Scytalia turbinata* Zittel
1889, *Scytalia turbinata* Griepenkerl

It seems to me, however, that Schrammen is not justified in considering *Scytalia turbinata* (Roemer) as a synonym of *S. terebrata* (Phillips). The data which he had at hand were Phillips' illustration of *Spongia terebrata,* Hinde's description of a specimen which he thinks must represent Phillips' species, Roemer's type of *Scytalia turbinata,* and the description and illustrations of specimens identified by Griepenkerl from the Upper Quadratenkreide of Glentorf, Braunschweig (Griepenkerl, 1888-1889, p. 18, Pl. II, figs. 4*a*, *b*). There is no reason to doubt that Griepenkerl's identification was correct, for his illustrations show forms in all outward respects similar to that figured by Roemer

(1864, p. 32, Pl. XII, fig. 1). There is in my mind, however, great doubt as to the identity of *S. terebrata* and *S. turbinata*, for the protograph of the first species shows a sponge which is decidedly tapering and neither "club-shaped" nor "cylindrical," as given by Schrammen in his description, while *S. turbinata* is thick and perfectly cylindrical, contracting abruptly into a comparatively slender cylindrical stem with a diameter only one-third as great as that of the upper portion. The description of *S. terebrata* given by Hinde is, in part, as follows:

> Sponge massive, subcylindrical, with a flattened conical summit. The lower portion of the body contracts to a cylindrical stem. The lateral surface carries numerous concentric, slight, subangular ridges and shallow open furrows. The only specimen in the collection is 220 mm. in length by 87 mm. in greatest width. (Hinde, 1883, p. 45).

This description seems not to preclude entirely such a form as *S. turbinata* (Roemer), but Phillips' figure shows a tapering sponge gradually narrowing to a stem, while Roemer's illustration is of a form which was constricted abruptly. It is, of course, possible that the differences in form are of no significance and that all gradations between the tapering and cylindrical forms have been observed, for Schrammen in his description of *S. terebrata* says: "thick club-, top-, or thick cylinder-shaped." Yet, since neither Phillips, Hinde, nor any later author, Schrammen included, has figured the skeletal elements of *S. terebrata*, identifications must be made by such characteristics as form, size, and the measurements of various parts of the sponge. For these reasons, it seems to me that there is at least a strong element of doubt as to the wisdom of including *S. turbinata* (Roemer) and authors in the synonymy of *S. terebrata* Phillips.

If it should be true that *S. terebrata* and *S. turbinata* are distinct this would account for the great dissimilarity observable in the specimens labelled by Schrammen *S. terebrata*. A specimen from Oppeln, thus identified, has the characteristics of *S. turbinata* as figured and described by Roemer and as amplified by further description and illustrations by Griepenkerl. On the other hand, a specimen from Heere, identified by Schrammen as *S. terebrata*, fits in perfectly with the illustration of that species given by Phillips. Along with this specimen, however, is a second one which in form is very unlike the tapering, slender sponge figured by Phillips but is quite like *S. turbinata*. These two specimens had only one label and that bore the name *S. terebrata* (Phillips). In the higher horizon of the Quadratenkreide this same diversity of shape is seen in speci-

mens collected from Misburg, but whether or not Schrammen is wholly justified in considering all of these forms as belonging to one species is by no means certain.

18190. **Leptophragma glutinatum** (Quenstedt) (p. 236). TOPOTYPE

Quenstedt described this species as *Scyphia glutinata* (1878, p. 465, Pl. CXXXVII, figs. 9-12) from the Pläner of Oppeln. Leonhard placed it under the genus *Leptophragma* (1897, p. 34), including as a synonym the skeletal structure figured by F. Roemer in 1870 and called *Cribrospongia fragilis* (1870, p. 304, Pl. XXXI, figs. 2*a*, 2*b*). Schrammen does not agree with Leonhard in this, as may be seen by consulting the notes on *Callodictyon fragile* below (No. 18195). Schrammen (1910, p. 236) accepts Leonhard's general revision of the species, however, but states that he has searched for the species in vain in the northwest Germany equivalents of the Oppeln beds.

18191. **Ventriculites radiatus** (Mantell) (p. 265). PLESIOTYPE

This species was figured and described by Mantell in his 'Geology of Sussex' (1822, p. 168, Pls. X, XI, XII, XIII, XIV) from the Upper Chalk of England. Mantell clearly included several species under the one name and this has led to great confusion in the literature. In 1826 Goldfuss described *Scyphia oeynhausi* from the green chalk of Darup in Westphalia (1826, p. 219, Pl. LXV, figs. 7*a*, *b*). At the end of the 'Petrefacta Germaniæ' Goldfuss put some corrections and additions, among which is the statement that Mantell's species *Ventriculites radiatus* is a synonym of *Scyphia oeynhausi* (p. 246), a statement which he incorporates in the body of the book in the second edition (1862, p. 204) where he gives no further recognition to Mantell's species. Since Goldfuss considered the forms which he described to be the same species as those described by Mantell, he was unwarranted in erecting a new specific name and in ignoring Mantell's claim to priority. The name proposed by Goldfuss must automatically be dropped and wherever later authors use the name *Scyphia oeynhausi* it must be changed to *Ventriculites radiatus* Mantell. This applies to A. Roemer's 'Kreidegebirge' (1841, p. 7) and von Zittel's 'Studien,' I (1877, p. 50). To be sure, Zittel has placed *Scyphia oeynhausi* Goldfuss in Mantell's genus *Ventriculites*, but he does not make any statment about the position of the species. A. Roemer's mistake in 1841 is plainly due to his acceptance of the statement made by Goldfuss in regard to the synonymity of Mantell's species with *Scyphia oeynhausi*.

In 1829 Phillips named and figured, though he did not describe, a species from the Chalk of Yorkshire as *Spongia cribrosa* (1829, p. 118, Pl. I, fig. 7). The specimen figured is evidently the stem of a *Ventriculites radiatus*, as may be seen by comparison with the illustrations given by Mantell (1829, p. 125 and on Pls. XII and XIII). Attention should here be called to the fact that A. Roemer (1841, p. 9) identified certain sponges from the Pläner of Goslar and Oppeln as *Scyphia cribrosa* Phillips and figured one of these (Pl. IV, fig. 2). The Roemer form is obviously different from that figured by Phillips and has been correctly assigned by Schrammen to Mantell's species *Ventriculites alcyonoides*, revised by Schrammen to *Leiostracosia alcyonoides* (*q. v.*).

D'Orbigny (1852, Terrains Crétacés, p. 284) erected the genus *Retispongia* with *Scyphia hoeninghausii* Goldfuss as the genoholotype. (The spelling *hoeninghausii* is incorrect; it should be *oeynhausi*). Fromentel followed D'Orbigny, except that he changed the generic spelling to fit in with his plan of nomenclature, calling the genus *Retiscyphia*, but both authors considered the Mantell species as distinct and called it *Ocellaria radiatus*.

A. Roemer in his 'Spongitarien des Norddeutschen Kreidegebirges' (1864, p. 15) accepted the generic revision given by D'Orbigny for *Ventriculites radiatus* and placed it under D'Orbigny's genus *Retispongia*, figuring a specimen from Germany. Roemer's illustration is the first in the literature which may be considered even a fair representation of the species. Roemer had by this time recognized Mantell's claim to priority and included in his synonymy *Scyphia oeynhausi* Goldfuss.

F. Roemer, in his 'Geologie von Oberschlesien,' accepted the D'Orbigny revision and cited *Retispongia radiata* (Mantell) from Oppeln and elsewhere.

Schlüter (1872, p. 30) considers the Goldfuss species distinct from Mantell's, since in the former (*oeynhausi*) he finds evidence of elongated, oval, radially and alternatingly placed postica, and longer meshes (occasionally an inch or more in length), whereas in *V. radiatus* Mantell the inner surface is covered with tubular postica. Schlüter comes to no conclusion as to the position of the genus *Retispongia*. He has found the species only in the Mucronatenkreide of Westphalia, while Hagenow thinks that he has found it also in Rügen. According to Zeuschner, it is found at Monoga near Krakau; according to Pagaard, also on the Island of Moen. Reuss and A. Roemer cite this species from the Pläner, but

this may be *Scyphia sulcata*, which species A. Roemer (1841, p. 10) does not refer to again in his later writings.

According to Schlüter, the true *V. radiatus* is found only in the Senonian, all of the forms from lower horizons being distinct.

In 1833 S. Woodward figured, but did not describe, from the Chalk of Norfolk, *Ventriculites infundibuliformis* (Pl. IV, figs. 20, 21). Hinde considers this a distinct species from *V. radiatus* Mantell, but Schrammen unites the two and, so far as one may judge from figures and descriptions, he is justified in considering the Woodward species and all later references to it as belonging to *V. radiatus* Mantell. Hinde, who had examined all of Mantell's and Smith's types, united under *V. infundibuliformis* the following species described by Smith: *V. bicomplicatus*, *V. latiplicatus*, *V. striatus*, "*V. radiatus* T. Smith (*non* Mantell)." Since Schrammen has included the *V. infundibuliformis* Woodward of Hinde in his synonymy of *V. radiatus* Mantell, then all of Smith's species given in the Hinde synonymy are to be included in the synonymy of *V. radiatus*. After studying the descriptions and figures of the four species of Smith's mentioned by Hinde, I am convinced that Schrammen followed the correct course in including these species under *V. radiatus*. The variety *V. radiatus discus* described by Quenstedt (1878, Pl. CXXXVI, fig. 26) and based upon Mantell's figure, Pl. XIV, in 'The Geology of Sussex' is considered by Schrammen a typical *V. radiatus*. Since the revision made by Schrammen has placed *V. striatus* Smith in the synonymy of *V. radiatus*, the two references to *V. striatus* made by Wollemann in 1901 and 1902, being based directly upon the Smith description, are likewise to be included in *V. radiatus*.

In regard to Schrammen's revision of *Ventriculites radiatus* it may be stated that his synonymy is the most accurate that has yet appeared in the literature. Yet a revision based upon phylogenetic development would undoubtedly lead to the recognition of a large number of varieties and mutations. It might well be found that the species is polyphyletic and that there are included in it many forms which are end members of totally unrelated branches. Schrammen has pointed out that this is one of the best known and long-lived species of Cretaceous Hexactinellida; its geological range is from the Scaphiten-Turon through the Mucronaten-Senon. Schrammen has also called attention to certain morphological changes observable as one passes from the lower geological horizons to the higher. The oldest individuals, those occurring in the Scaphites Pläner, are the smallest and have the thinnest walls; but in the Senonian the walls become twice as thick or even thicker and there

is a corresponding increase in size. The general form of the sponge shows a constant type of variation at all horizons, the common shapes being funnel-like, discoidal or umbrella-shaped. For these morphological variants Quenstedt erected varietal names and Leonhard adopted the same nomenclature; but Schrammen quite rightly states that he cannot follow these authors in this. The ostia likewise show a definite trend in development, those in the oldest species being oval but those in the later ones displaying a marked tendency to form as long narrow slits. The postica similarly change from circular in the Turonian to more or less elongated oval in the Senonian, although, even in the Quadraten, forms with round postica are not of rare occurrence. These various differences in morphological characteristics at successive horizons have undoubtedly given rise to many of the specific names that have been introduced into the literature. While it is true that the *Ventriculites radiatus*, as now used by authors, does beyond doubt contain more than one species, the older method of making new species upon single morphological characteristics is of doubtful value. The only way of approach to the correct revision of the species will have to be through phylogenetic studies and these will be difficult to make because ontogenetic studies are almost impossible on account of the lack of preservation in sponges of the early ontogenetic stages. Since there are definite and recognizable morphological changes within the successive horizons, we have here an illustration of Waagen's mutations and a mutational name for the members of each horizon ought to be applied. Each of these mutations shows a series of variations in the Waagen sense, these variations being of the same kind in each mutation. Authors have previously classed together the corresponding variations of each mutation as constituting a distinct species, thus basing their classification on single characteritiscs which have evidently appeared through parallelism in development. The mutations show changes in form in the ostia and postica; the variations show changes in external form.

18192. **Ventriculites decurrens** T. Smith (Not in Schrammen Monograph).

This species was described by Toulmin Smith from the Chalk of England (1848, p. 215, Pl. XIII, fig. 8) and was later accepted by Hinde (1883, p. 111) who, however, included under it *V. decurrens* var. *tenuiplicatus* of T. Smith (1848, p. 215, Pl. XIII, fig. 9) and also *V. cavatus*, described by Smith from a fragment (1848, p. 212, Pl. XIII, fig. 5). Hinde considers that this species is probably the same as part of Mantel's *Ventriculites radiatus* (1822, Pl. XIII, fig. 4) and also a part of

Quenstedt's *V. radiatus* (1878, Pl. CXXXVI, fig. 23). In 1883, but before the appearance of the Hinde 'Catalogue,' Počta published his first 'Beiträge zur Kenntniss der Spongien der Böhmischen Kreideformation' in which he erected the variety name *Ventriculites radiatus* Mantell *var. subcylindrica* for that portion of Mantell's species figured by Quenstedt (1883, p. 33). He did not have a reference to Toulmin Smith's contributions. Hinde, on his part, makes no reference to Počta's paper but, if he is correct in considering that the specimen figured by Quenstedt as *V. radiatus* (1878, Pl. CXXXVII, fig. 23), is in reality the same as *V. decurrens* Smith, the latter constituting a stricter characterization of a part of Mantell's original comprehensive species *V. radiatus*, then Počta's varietal name *subcylindrica* has no standing.

In the discussion of *V. radiatus* we have already seen that Phillips' species, *Scyphia cribrosa*, is to be considered as *V. radiatus*. Yet Leonhard (1897, p. 33) placed *V. cribrosus* (Phillips) as used by Počta (1886, p. 34) in his synonymy of *V. decurrens* Smith. Now Počta's use of *V. cribrosus* is based upon the original figure given by Phillips in 1829, Pl. I, fig. 7, and he refers also to Hinde's *V. cribrosus* (Phillips). Since *Scyphia cribrosa* Phillips is *Ventriculites radiatus* Mantell, *sens. str.*, then the *Ventriculites cribrosus* (Phillips), as used by Hinde 1883, Počta 1886, and Leonhard 1897, is to be considered *Ventriculites radiatus* (Phillips). Thus, Leonhard includes in his synonymy of *V. decurrens* T. Smith two references to *V. cribrosus* which do not belong there and Počta in 1886 includes in his synonymy of *V. cribrosus* Phillips the variety *V. radiatus* var. *subcylindrica* Počta, which is based upon Quenstedt's figure of *V. radiatus* and which had been revised to *V. decurrens* by Hinde. Počta, too, therefore, includes references of two distinct species in his synonymy of *V. cribrosus*.

Schrammen does not refer in any way to *V. decurrens* in his Monograph, yet he has labelled two specimens from Oppeln and one from Grosse Heere by this name. He apparently overlooked the presence of these specimens in his collection and consequently did not describe the species in his book. The specimens have undoubtedly been correctly identified by Schrammen, for they agree with Smith's description and figure of this species.

An examination of all the original descriptions and figures of all the species involved in the present discussion has led me to the following conclusions.

Mantell in his description and figures of *Ventriculites radiatus* included at least two species: *V. radiatus, sens. str.*, and *V. decurrens* T.

Smith. Hinde had access to the types of both Smith and Mantell and we may accept his restrictions and fuller definitions of the species. The particularly distinguishing characteristic of *V. radiatus* is the appearance on the outer surface of elongated, oval ostia about 3 to 5 mm. long and 1.5 to 2.5 mm. wide, according to Schrammen. The inner surface is covered with round or oval postica 2 to 4 mm. wide. The appearance of the outer surface is most frequently referred to by authors and it is this surface that is usually figured. *Ventriculites decurrens* Smith is a distinct species characterized by long ridges which are usually vertical, but at times oblique or bifurcating. *Spongia*, later *Scyphia cribrosa* Phillips, is a typical *Ventriculites radiatus* Mantell, so far as one may judge from the figure, since there is no description, and Schrammen so regards it. Počta's synonymy (1886, p. 34) is badly mixed up, for he includes under *Ventriculites cribrosus* (Phillips) the following forms:

1829, *Spongia cribrosa* Phillips;
1864, *Ventriculites multicostatus* Roemer;
1883, *Ventriculites radiatus* var. *subcylindrica* Počta;
1883, *Ventriculites cribrosus* Hinde.

All of these species belong to *Ventriculites radiatus* (Mantell).

Leonhard's synonymy for *Ventriculites decurrens* Toulmin Smith stands, revised, as follows:

Leonhard, 1897	Revised Standing
1822, *Ventriculites radiatus* Mantell, Pl. XIII, fig. 4	*Ventriculites decurrens* T. Smith
1878, *Ventriculites radiatus* Mantell; Quenstedt, Pl. CXXXVI, fig. 23	*Ventriculites decurrens* T. Smith
1883, *Ventriculites decurrens* Smith; Hinde	*Ventriculites decurrens* T. Smith
1886, *Ventriculites cribrosus* (Phillips) Počta	*Ventriculites radiatus* Mantell
1889, *Ventriculites cribrosus* (Phillips) Frič	*Ventriculites radiatus* Mantell

18193. **Leiostracosia alcyonoides** (Mantell) (p. 284). PLESIOTYPES

See No. 18184.

18194. **Leiostracosia angustata** (A. Roemer) (p. 284). PLESIOTYPES

The history of the naming of this species has already been discussed under *L. alcyonoides* (see No. 18184). Roemer's species was described from the Pläner of Schonau near Teplitz, Bohemia (1841, p. 8, Pl. III, fig. 5). While Schrammen states that he has the types in his collection (1910, p. 284), it is highly improbable that he means the holotype, since

practically all of Roemer's types are now in the Roemer Museum at Hildesheim. There is no doubt, however, that Schrammen in making his revision of this species consulted the Roemer holotype, so that the specimens in the collection are plesiotypes.

18195. **Callodictyon fragile** (Reomer) (p. 289). PLESIOTYPE

From the Pläner of Oppeln, A. Roemer described *Scyphia fragilis* (1841, p. 8, Pl. III, fig. 11) but later he assigned it to D'Orbigny's genus *Cribrospongia* (1864, p. 12), at that time giving the horizon more definitely as the Cuvieri Pläner. F. Roemer in his 'Geologie von Oberschlesian' speaks of the abundance of this species at Oppeln where it is usually preserved by iron oxide (1870, pp. 304, 305, Pl. XXXI, figs. 2, 2*a*, 2*b*).[1] Quenstedt figured specimens of this species from Oppeln (1876-1878, pp. 468-470, Pl. CXXXVII, figs. 14-16) calling them *Spongites fragilis*. In 1878 Zittel founded the genus *Leptophragma* including under it Roemer's *Scyphia fragilis* (1878, p. 48). This revision was accepted by Hinde (1883, p. 103), who records the species from the Upper Chalk of southern England. In 1884 Počta in his third paper on the 'Spongien der böhmischen Kreideformation' reported this species as abundant in the Teplitz beds of Bohemia in the neighborhood of Raudnitz, Tschischokovitz, Zidovitz, and Rohatce (1884, p. 34, Pl. I, fig. 26). Leonhard (1897, p. 33) simply listed the occurrences given by earlier authors without adding anything new, referring to the species as *Leptophragma fragile*.

Schrammen in his Monograph overlooked the Zittel revision, supposing that Leonhard had placed the species in the genus *Leptophragma* whereas Zittel himself had done so. Schrammen omitted the reference to Zittel in his synonymy so that it is made to appear as though Leonhard is responsible for assigning the species to the Zittel genus. Schrammen does not believe that it belongs to this genus and places it in *Callodictyon* Zittel on the basis of the skeletal elements (1910, p. 289).

18196. **Becksia nidiformis** (Leonhard) (p. 296). PLESIOTYPE

This species was described by Leonhard as *Plocoscyphia nidiformis* (1897, p. 35, text figures 5*a*, *b*) from the Scaphites Pläner of Oppeln. At the same time he described *P. crassilobata* (1887, p. 35, Pl. III, fig. 62*b*) from the same horizon and locality. Schrammen (1912, p. 296) states that he has the types (*Belegestücke*) in his collection; but, while

[1]Through an oversight on Roemer's part the figures of the illustration on Plate XXXI do not correspond with the ones used by him in the text. Anyone consulting this plate should therefore read or figures 3, 4, 5, figs. 2, 2*a*, 2*b*, which are the illustrations of *Cribrospongia fragilis*.

the inference would naturally be that he meant Leonhard's holotypes of *nidiformis* and *crassilobata*, such is not the case. All of Leonhard's types are in the collection of the Museum of the University of Breslau, so that Schrammen could only have been referring to his own specimens used in his further description of the species. After working out the specimens better, Schrammen came to the conclusion that Leonhard's two species are the same and that they belong not to the genus *Plocoscyphia* but to *Becksia* and constitute the oldest known representatives of the latter. Since the specimen in the American Museum Collection comes from the original locality and horizon from which the holotype was described, it is a plesiotype.

18197. **Plocoscyphia roemeri** Leonhard (p. 300). PLESIOTYPE

See No. 18185.

Since Oppeln is the locality from which Roemer's material came, the specimen in the collection is a plesiotype of especial importance in making identifications.

18198. **Onchotœchus cavernosus** Schrammen (p. 309). PARATYPE

From the Scaphites Pläner of Oppeln, Schrammen described *O. cavernosus* as a genoholotype (1910, p. 309, text figure 5). The specimen in the Museum Collection is almost identical with the figured holotype but, unfortunately, is only one of the paratypes of which Schrammen has examined fifteen.

18199. **Camerospongia monostoma** (A. Roemer) (p. 134). PLESIOTYPE

= *Camerospongia fungiformis* F. Roemer (*non* Goldfuss).

In 1826-1833 Goldfuss (p. 218, Pl. LXV, figs. 4*a*, *b*, c) described *Scyphia fungiformis* from the green-gray chalk of Coesfeld, Westphalia. This form was recognized by A. Roemer in his 'Versteinerungen' (1841, p. 7) and at the same time he described a form as *Manon monostoma* from the Lower Cretaceous of Peine in Hanover and from Oppeln, Silesia, (1841, p. 2, Pl. I, fig. 8). Goldfuss' species was made the genoholotype of the genus *Camerospongia* by D'Orbigny in his 'Prodrome' (1850, II, p. 285), and he considered that *Manon monostoma* A. Roemer was a synonym of this; the characterization of the genus was very incomplete. Bronn in 1852 describes and figures *Scyphia fungiformis* ('Lethæa Geognostica,' 1852, part 5, p. 70, Pl. XXIX, fig. 6*a*, *b*, *c*). In his synonymy he includes *Scyphia fungiformis* Goldfuss, *Manon monostoma* A. Roemer and *Camerospongia fungiformis* (Goldfuss) D'Orbigny. E. de Fromentel in 1859 described and figured Goldfuss' species as *Camero-*

scyphia fungiformis (p. 41, Pl. II, fig. 16) but he did not include in his synonymy *Manon monostoma* A. Roemer. A. Roemer in 1864 again refers to (1864, p. 5) *Scyphia fungiformis* and *Manon monostoma* A. Roemer as *Camerospongia fungiformis*, citing the species previously figured by these authors. F. Roemer in his 'Geologie von Oberschlesien' (1870, p. 305) accepted his brother's synonymy which, in turn,was an acceptance of D'Orbigny's revisions.

Schrammen thinks that the species described and figured by F. Roemer as *Camerospongia fungiformis* is distinct from that originally described as *Scyphia fungiformis* by Goldfuss, but uses Goldfuss' specific name crediting it to F. Roemer. He includes here the species described by Quenstedt (1877, V, p. 499, Pl. CXXXIX, figs. 2-6) as *Cephalites monostoma* and the species figured by Leonhard (1897, p. 36, Pl. III, fig. 3) as *Camerospongia fungiformis*. It is clear that the specific name cannot be credited to F. Roemer and, if Goldfuss' species is distinct, as held by Schrammen, the name *Camerospongia monostoma* (A. Roemer) must be ascribed to the species described by Schrammen. The species, according to A. Roemer, occurs in the Scaphites Pläner of Oppeln and at Heiningen in Braunschweig, also commonly in the Quadratenkreide of Ilsenburg, Eickhorst, Vordorf, and Peine. Goldfuss' original specimen is from the Mucronatenkreide of Coesfeld, while a related species described by Toulmin Smith as *Cephalites campanulatus* (1848, p. 289, Pl. XIV, figs. 12, 13) was obtained from the White Chalk of England. This F. Roemer considers as probably identical with the present form.

In conclusion, it may be stated that a study of the original descriptions and illustrations leads me to the belief that *Scyphia fungiformis* Goldfuss and *Manon monostoma* A. Roemer were undoubtedly distinct species, for Goldfuss speaks especially of his species having a stem and appearing like a mushroom, while A. Roemer, who originally recognized the Goldfuss species as distinct from his *M. monostoma*, though he later united the two, does not in describing the latter make any reference to the presence of a stem. The uniting of the two species as one has undoubtedly been done by authors because the Roemer illustration shows a form which looks like the top of Goldfuss' species, a form which might result were a mushroom-like individual deprived of its stem.

18200. **Camerospongia fungiformis** (Goldfuss).

In the Schrammen Collection purchased in 1903 there is a very good specimen labelled "*Camerospongia fungiformis* Goldfuss sp." All of the enclosing limestone has been worked away so that the form and surface

features of the sponge and the characteristics of the stem may be seen. This specimen, if any, approaches the species described by Goldfuss and if we rely upon Schrammen's label we have here a representative of the true *C. fungiformis*. The species is not described by Schrammen in his Monograph, probably because he had sent to America his only representative of the species many years before he wrote his book, although this is only an assumption. The specimen is not a type but is included because it is of use in the determination of the perplexing problem of the identity or distinctness of *Camerospongia monostoma* A. Roemer and *C. fungiformis* (Goldfuss).

18201. **Cameroptychium patella** Leonhard (p. 320). PLESIOTYPE

This species was described from a single specimen from the Scaphites Pläner of Oppeln (Leonhard, 1897, p. 37, Pl. IV, figs. 2*a*, *b*, *c*, *d*). Schrammen found this specimen and gave it to Leonhard to describe so that it became the holotype. Subsequently Schrammen found two more specimens and was able to add some data to the original description (1910, p. 320). Although Schrammen states that he has the types in his collection one must bear in mind that he has only the two plesiotypes, not the original holotype which is in the Mineralogical Museum of the University of Breslau according to Leonhard's statement (see 1897, *Erklärung für Tafel IV*). Schrammen also regards Leonhard's *Plocoscyphia tenuilobata* (1897, p. 36, Pl. IV, figs. 1*a*, *b*) as a specimen of this species partly modified in preparation.

SPECIES FROM NETTLINGEN, HANOVER

18202. **Doryderma (Homalodora) plana** Schrammen (p. 59). IDIOTYPE

Schrammen described this species from the Quadratenkreide and Mucronatenkreide of Misberg and Oberg (1910, p. 59, Pl. XVII, figs. 3, 4), the figured cotypes being from the Quadratenkreide of Oberg. He appears to have overlooked the specimen from the lower horizon at Nettlingen, so that the individual in the collection is an idiotype.

18203. **Amphilectella piriformis** Schrammen (p. 61). IDIOTYPE

This is the genoholotype of, and sole species in, the genus *Amphilectella* described by Schrammen in 1901 (p. 13, Pl. III, fig. 3) from the Quadratenkreide and Mucronatenkreide. The figured holotype is from the Mucronaten of Misberg and is now in the Roemer Museum. In the Monograph, Schrammen figured a specimen from the Quadratenkreide of Oberg (1910, Pl. XVIII, fig. 8; skeletal elements, text plate II, fig. 6)

and more fully described the species. As in the case of the preceding species he failed to record the occurrence from the lower horizon at Nettlingen although he himself had labelled the specimen.

18204. **Pachinion scriptum** (Roemer) (p. 67). PLESIOTYPE

Roemer described this species as *Jerea scripta* (1864, p. 34, Pl. XIII, fig. 4), recording it from the Mucronatenkreide of Tadensen not far from Duddenstedt. Hinde ('Catalogue,' 1883, p. 46, Pl. VII, fig. 1) has found it in the Upper Chalk of Flamborough and in the south of England. He also notes that in Zittel's collection are specimens from Schwiechelt. The species was further described by Zittel (1878, II, p. 130), but its range was not extended. Schrammen, however, records it from as low as the Scaphites beds and from Nettlingen, Heere, Misburg, Oberg, Adenstedt, and Biewende (1910, p. 67, Pl. XVIII, fig. 4, Pl. XIX, fig. 1; skeletal elements, text plate III, fig. 1). Since Schrammen amplified Roemer's original description, the specimens identified by him are plesiotypes.

18205. **Phalangium cylindratum** Schrammen (p. 70). IDIOTYPE

This is a species described and figured by Schrammen from the Cuvieri beds of Heere where he has collected five specimens (1910, p. 70, Pl. XVIII, fig. 2). He does not record its presence at any lower horizon nor at Nettlingen, yet he has labelled a large specimen therefrom. It appears to be a case of oversight. The specimen probably is an idiotype; it is hardly likely that it is a cotype, for if Schrammen had used it in making his description he would surely have recorded its presence.

18206. **Phymatella intumescens** (Roemer) (p. 73). PLESIOTYPE

This species, occurring in the lower Senonian horizons, the Scaphites and Cuvieri beds, is regarded by Schrammen merely as an older mutation of *Phymatella tuberosa* (Quenstedt) and *P. bulbosa* Zittel which have undergone certain morphological changes, the latter perhaps in response to a changing environment. *P. intumescens* was described as *Eudea intumescens* by Roemer (1864, p. 26, Pl. XI, fig. 1) who records it as abundant in the Cuvieri beds of Windmühlenberg near Salzgitter, at Dörnton and in the Quadraten limestone in the Köhlerholze near Ilsenberg. Roemer considers that his species may be identical with Michelin's *Eudea* (*Scyphia*) *trilobata*. The specimen in the collection is the oldest known mutation of the species.

In 1878 Quenstedt described *Spongites plicatus* (1878, p. 395, Pl. CXXXIV, figs. 1-2) from the Pläner of Oppeln. This species Schrammen states, is synonymous with *Phymatella intumescens* (Roemer), for he has collected an abundance of the forms corresponding to Quenstedt's figures and description and has compared them with the Roemer types. On the strength of this revision all species referred by later authors to *Spongites plicatus* (Quenstedt) must be called *Phymatella intumescens* (Roemer).

In the second part of the Zittel 'Studien' the name *Phymatella* is erected to include parts of a large number of genera (1878, p. 138) and under this new genus the author includes among others *Eudea intumescens* A. Roemer and *Spongites plicatus* Quenstedt, but he does not unite them both under the one species as does Schrammen.

Počta has identified specimens from the Weissenberg beds of Leneschitz near Laun, Bohemia, as *Phymatella plicata* (Quenstedt) (1884, p. 32). This is to be referred to *P. intumescens* (Roemer). The same may be said for the reference by Leonhard (1897, p. 38) to *Phymatella plicata* (Quenstedt).

18207. **Phymatella bulbosa** Zittel (p. 75).

Until the discovery by Schrammen of a specimen from Nettlingen, this species described by Zittel in 1878 ('Studien,' II, p. 138) was known only from the higher Senonian, the Quadraten and Mucronatenkreide. Schrammen succeeded in finding a considerable number of specimens not only from these horizons, but he also found at least one specimen at Nettlingen in the Cuvieri beds, for he has labelled it and with a full appreciation of its importance, for he calls it the oldest mutation of the species. But he overlooked its presence in his collection apparently, for in his Monograph he does not record this species either from the Cuvieri horizon or from Nettlingen.

Schrammen in 1901 erected the genus *Pseudoploscyphia* with *P. mœandrina* as the genoholotype and sole species (1901, p. 4, Pl. II, fig. 1; skeletal elements, Pl. IV, fig. 2). The species at that time was known to him only from the Mucronatenkreide of Misburg; the holotype of the genoholotype is in the Roemer Museum. In his Monograph Schrammen includes this species under *Phymatella bulbosa*, so that the genus *Pseudoploscyphia* becomes a *nomen nudum*.

18208. **Phymatella aff. tuberosa** (Quenstedt) (p. 176).

See No. 18298 for discussion of this species.

This species is reported by Schrammen only from the Quadratenkreide and Mucronatenkreide and from Misburg, Oberg, and Ilsenburg. He appears to have overlooked the specimen from the Scaphites Pläner of Nettlingen, which is, however, identified only as a form related to *P. tuberosa.*

18209. **Thecosiphonia torgeri** Schrammen (p. 83). COTYPE

See No. 18181.

18210. **Siphonia tubulosa** (Roemer) (p. 93). HOMŒOTYPE

A. Roemer described this species as *Scyphia tubulosa* from the Lower Cretaceous of Peine (1841, p. 8, Pl. III, fig. 10). The description is meagre; the illustration schematic and, as Schrammen points out, the Roemer holotype was figured standing on its head. Schrammen has supplemented the original description (1910, p. 93) and has figured three specimens from the Quadratenkreide of Oberg (Pl. II, figs. 6-8; skeletal elements, text plate IV, fig. 11). Griepenkerl described as *Siphonia ovalis* an abundant form from the Quadratenkreide of Glentorf in Braunschweig (1888-1889, p. 20, Pl. III, figs. 3*a*, *b*). This Schrammen refers to *S. tubulosa* (Roemer). The occurrences cited by Schrammen are from Misburg, Oberg, Adenstedt and Glentorf, and he mentions no lower horizon than the Greensand of the Quadratenkreide. Thus he has again overlooked the specimen from the Scaphites Pläner of Nettlingen now in the Museum.

18211. **Pholidocladia dichotoma** Hinde (p. 108). PLESIOTYPE

This species is one of the two genosyntypes of Hinde's *Pholidocladia* and was described from the Upper Chalk of Wiltshire, the figured holotype being now in the Jermyn-Street Museum, London (Hinde, 1883, p. 81, Pl. XX, figs. 5, 5*a*, 5*b*). Schrammen has found a few specimens in the Scaphites Pläner of Nettlingen and in the Kalkmergel of the Quadratenkreide of Oberg (1910, p. 108, Pl. IV, fig. 2; skeletal elements, text plate VI, fig. 3).

18212. **Isoraphinia texta** (Roemer) (p. 129). PLESIOTYPE

Roemer described this species as *Siphonocœlia texta* (1864, p. 29, Pl. X, fig. 11) from the Cuvierikreide of Vorberg near Haverlah. Quenstedt called this species *Eulespongia texta* and gave good illustrations of specimens from Haverlah, Sehlde, and Steinlah (1876-1878, Pl. CXXXV, figs. 3-7). It was Roemer's species which Zittel made the genoholotype of *Isoraphinia* (1878*c*, p. 133, Pl. V, fig. 8, Pl. VII, fig. 3).

In the synonymy are to be included *Isoraphinia texta* (Roemer) Hinde (1883, p. 55, Pl. x, figs. 3, 3*a*, 3*b*) from Flamborough, Yorkshire, and *I. texta* (Roemer) Zahálka (1886, p. 647, Pl. I, figs. 1, 2) from the Teplitz beds of the southern border of the Rohatetzer hill in Bohemia.

Schrammen has also placed in his synonymy *Jerea spiculigera* described by Roemer in 1864 (p. 34, Pl. XII, fig. 6) from the Cuvierikreide of Windmühlenberg near Salzgitter, for he thinks that the form in all probability is only the stem of an *I. texta*. This being the case, Zittel's *Carterella spiculigera* (1878*c*, p. 133, Pl. VII, fig. 2) must also be included in the *I. texta* synonymy.

Schrammen gives the range of this species as from the Scaphites through the Cuvieri Pläner and he records its occurrence at Nettlingen, Heere, and Salder.

18213. **Pachycothon giganteum** (Roemer) (p. 130). PLESIOTYPE

See No. 18183.

18214. **Halichondria vosmæri** Schrammen (p. 131). PARATYPE

There is in the collection a specimen from the Scaphites beds of Nettlingen labelled *Halichondria lendenfeldi*. Since Schrammen has described in his Monograph only a single species of the genus *Halichondria*, namely, *H. vosmæri*, it would appear that the specimen in the American Museum is a chirotype. However, it agrees perfectly with the illustrations and descriptions of *H. lendenfeldi;* furthermore, the descriptive headings for the illustrations both appear under the name *H. lendenfeldi* (Schrammen, 1910-1912, Pl. XIII, fig. 2 and text plate VIII, fig. 10), although in the body of the text the species is called *H. vosmæri* with the plate references above given immediately following. Apparently Schrammen labelled some of his specimens of this species *H. lendenfeldi* and others *H. vosmæri* and through an oversight the illustrations bear the name of *H. lendenfeldi* while the species appears in the text as *H. vosmæri*. It may have been that the name *lendenfeldi* was used at first for all of the specimens, since Schrammen had only five, and that at a later time he found it necessary to change the name and simply failed to change all the labels and to correct all of the places where *lendenfeldi* occurred in his manuscript. There is no way of telling which name had priority in Schrammen's own work, but I have accepted the name of *H. vosmæri* as the one to stand because the description of the species was given under that designation. The specific name *lendenfeldi* becomes a synonym of *vosmæri*.

18215. **Rhizopsis horrida** Schrammen (p. 132). PARATYPES

To certain peculiarly shaped sponges in the Scaphites Pläner of Nettlingen and the Quadratenkreide of Oberg, Schrammen has given the name *Rhizopsis horrida* (1910, p. 132). The species is the genoholotype and, so far, the sole species in the genus. A single specimen from the Scaphites Pläner of Nettlingen was figured by Schrammen (*loc. cit.*, Pl. XIII, fig. 4), while the skeletal elements come from the Quadratenkreide of Oberg (text plate VIII, fig. 11). Since there is a possibility that the skeletal elements may not have been correctly identified, the complete specimen must be considered the holotype and Nettlingen the type locality.

18216. **Opetionella poculum** Schrammen (p. 134). METATYPE

Schrammen in describing this species from the Scaphites Pläner of Nettlingen states (1910, p. 134) that he has only a single specimen and this he has figured (Pl. XIII, fig. 3). He sent to the Museum a specimen which he designated as a type, but on comparison with the protograph the specimen is seen not to agree with it nor yet with the dimensions which are recorded in the text. Assuming that the identification of the specimen which Schrammen sent is correct, then he must have overlooked this specimen, which is only a metatype, since no use is made of it in his protolog.

18217. **Verruculina tenuis** (Roemer) (p. 136). PLESIOTYPES

From the Lower Chalk of Oppeln, Roemer described *Manon tenue* (1841, p. 3, Pl. I, fig. 7) which he later called *Chenendopora tenuis* (1864, p. 43, Pl. XV, fig. 4), although in giving the horizons in his second paper he speaks only of the Cuvierikreide of Salzgitter and Gr. Döhren and the Scaphitenmergel of Heiningen. His brother, F. Roemer, followed him in this designation (1870, p. 301, Pl. XXXI, figs. 6, 7, 8, [*non* fig. 1 according to Schrammen]) as did also Quenstedt (1866-1868, p. 324; Pl. CXXXI, fig. 8; Pl. CXXXII, figs. 46-48).

Zittel placed the species in his genus *Amphithelion* (1878*c*, p. 124) and this revision was accepted by the following authors: Počta (1884, p. 23), Leonhard (1897, p. 37), Schrammen (1901, p. 21).

Hinde, supposing that *Manon tenue* and *Chenendopora tenuis* were distinct species, because Roemer himself does not include the first in the synonymy of the second and the horizons and localities for the two are different, and also because he thought that both belonged to the genus

Verruculina, stated that Roemer's original type should be called by the specific name *tenuis*, but that for the species described by Roemer in 1864 another name would have to be proposed and so for the English species from the Upper Chalk of Flamborough, Yorkshire, he proposed the name *Verruculina pustulosa* (1883, p. 39, Pl. III, figs. 2, 2*a*) and included in his synonymy:

1845, *Manon miliare* Reuss, *pars* (p. 78, Pl. XIX, fig. 13)
1864, *Chenendopora tenuis* F. A. Roemer, *pars* Pl. XIII, fig. 4
non Manon tenue F. A. Roemer, 1841, Pl. I, fig. 7.

Schrammen, who had the advantage of being able to study all of the Roemer types, and who had himself collected both from the Oppeln and the northwest German horizons, explains that Roemer's *Manon tenue* 1841 and *Chenendopora tenuis* 1864 are the same species and for this reason he includes both of them and also Hinde's *Verruculina pustulosa* and *Manon miliare* Reuss in his synonymy of *V. tenuis*.

While Hinde, Počta and Leonhard hold that *Manon tenue* Reuss (1845-1846, p. 78, Pl. XX, fig. 2) are synonyms of *V. tenuis* Roemer, Schrammen does not agree with them and considers rather that the fragment figured by Reuss as *Manon miliare* (1845-1846, p. 78, Pl. XIX, fig. 13) belongs to *V. tenuis* Roemer (Schrammen, 1910, p. 137).

The species ranges from the Scaphites Pläner through the Mucronatenkreide and occurs at Oppeln, Nettlingen, Heere, Sudmerberg, Misburg, Oberg, Biewende.

18218. **Verruculina damæcornis** (Roemer) (p. 137). PLESIOTYPES

This species was described by Roemer as *Verrucospongia damæcornis* (1864, p. 45, Pl. XVI, fig. 5) from the Cuvierikreide of Windmühlenberg near Salzgitter, and was included by Zittel under his genus *Amphithelion* (1878*c*, p. 124). Schrammen reports its further occurrence in the Scaphites Pläner of Nettlingen.

18219. **Verruculina convoluta** (Quenstedt) (p. 138). PLESIOTYPES

Phillips figured and named a specimen from the White Chalk of Danes' Dike, Yorkshire, as *Spongia convoluta* (1829, p. 118, Pl. I, fig. 6) and he later changed the name to *Chenendopora convoluta* (1875, p. 234, Pl. I, fig. 6). The figures in both cases are poor, and Hinde says that it is impossible to be sure which of a number of species represented in the Chalk of Yorkshire was intended by Phillips when he gave the name (1883, p. 38).

Quenstedt had already called attention to the fact that the Phillips' illustration was poor and he figured from the Upper Pläner of Dörnten, south of Salzgitter, specimens which he considered as apparently belonging under Phillips' "appropriate name" *Spongia convoluta* (Quenstedt, 1878, p. 369, Pl. CXXXII, figs. 49, 50, 51).

In 1841 A. Roemer described from the Lower Kreide of Oppeln *Manon tenue* (1841, p. 3, Pl. I, fig. 7), the name of which he later changed to *Chenendopora tenuis* (1864, p. 43, Pl. XV, fig. 4) recording it further from the Cuvierikreide of Salzgitter and at Osterkopfe near Gr. Dörnten as well as in the Scaphitenmergel of Heiningen. The illustrations are very poor, the figure in 1841 being of almost no value. F. Roemer cites *Chenendopora tenuis* A. Roemer from the Turonian Pläner of Oppeln and gives excellent illustrations (1870, p. 301, Pl. XXXI, figs. 1, 1*a*).[1] It is not at all certain, however, that the figures given by F. Roemer are illustrations of his brother's type and a comparison of the figures and descriptions given by the two authors leads one rather to the conclusion that the two species are distinct. Furthermore, since F. Roemer included under his *C. tenuis* two different species, the identity of the form is difficult to determine and authors have followed Hinde in considering part of F. Roemer's *Chenendopora tenuis* as a synonym of Quenstedt's species *Verruculina convoluta*.

Zittel placed *Spongia convoluta* Quenstedt in his genus *Amphithelion* (1878*c*, p. 124) which, by both Hinde and Schrammen, has been considered a synonym of *Verruculina* Zittel.

Schrammen records the species from Nettlingen, Oppeln, Dörnten, Misburg, and Oberg and gives the range as from the Scaphites Pläner through the Mucronatenkreide.

18220. **Verruculina crassa** (Roemer) (p. 138). PLESIOTYPES

This species was described as *Chenendopora crassa* by A. Roemer (1864, p. 43, Pl. XVI, fig. 1) from the Cuvierikreide of Kahnstein. Schrammen unites with Roemer's species, *Manon circumporosum* of Quenstedt described from the Middle Pläner of Gustedt north of Salzgitter (1878, p. 372, Pl. CXXXII, fig. 55). Since Zittel considered that both of these species belonged to his genus *Amphithelion*, there must be included in the synonymy of *Verruculina crassa*, *Amphithelion circumporosum* and *A. crassa* as given by Zittel (1878*c*, p. 124). As is usually

[1] On the same plate he gives figures of a specimen which he calls *C. tenuis* (Pl. XXXI, figs. 6, 7, 8), but these are of another species.

the case, the illustration given by Roemer is very poor, that by Quenstedt good. The two specimens in the collection are quite as perfect as that figured by Quenstedt (*loc. cit.*).

18221. **Stichophyma verrucosa** (Roemer) (p. 143). PLESIOTYPES

This species was called *Polyjerea verrucosa* by Roemer (1864, p. 35, Pl. XIII, fig. 5) and was referred by Zittel to *Stichophyma verrucosa* (1878*c*, p. 125). Reuss in 1845-1846 described *Manon turbinatum* (p. 78, Pl. XIX, figs. 1-6) from the lowest Plänerkalk of Schillinge near Bilin, Bohemia. This latter combination of generic and specific names had been preoccupied by Roemer (1841, p. 3, Pl. I, fig. 5) for another species now recognized as *Stichophyma turbinata* (Roemer). Počta (1884, p. 25) referred the Bohemian species of Reuss to *Stichophyma: S. turbinata* (Reuss) Počta. Reuss had described *Manon sparsum* (1845-1846, p. 78, Pl. XVIII, figs. 12-20) which was referred to in 1884 by Počta (p. 26) as *Stichophyma sparsa* and this form is now considered by Schrammen as the young of *S. turbinata* (Reuss), not *S. turbinata* (Roemer). Schrammen, on account of the lack of Bohemian material for comparison, was unable to determine whether *Manon* (*Stichophyma*) *turbinatum* (Reuss) and *Polyjerea* (*Stichophyma*) *verrucosa* (Roemer) were identical, but he considers that *S. turbinata* Reuss is undoubtedly closer to *S. verrucosa* (Roemer) than is the *S. turbinata* of (Roemer). Should the Bohemian and the northwest German species prove identical, then the name *S. sparsum* (Reuss) has priority, provided, of course, that it is the young of *Manon* (*S.*) *turbinatum* (Reuss). It is probably wise to use Roemer's name (*S. verrucosa*) for this species, even though *Manon turbinatum* Reuss (*Stichophyma turbinata* Počta) prove, on further study, to be identical with *Polyjerea* (*Stichophyma*) *verrucosa* Roemer, since it would very likely be impossible to show that *M. sparsum* Reuss is really the young of *M. turbinatum* Reuss. As above stated, *turbinatum* cannot be used for this species, since that name was preoccupied by Roemer in 1841 for another species of the same genus.

18222. **Stachyspongia ramosa** (Quenstedt) (p. 148). PLESIOTYPES

This species was described as *Spongia ramosa* by Quenstedt (1878, pp. 309, 400, Pl. CXXXIV, figs. 7, 8) from the Middle Pläner of Gustedt and the Upper Pläner of Dörnten. It occurs abundantly in the Scaphites beds of Nettlingen from which Schrammen has examined about 50 specimens (Schrammen 1910, p. 148).

18222*a*. is a young individual.

18223. **Chonella auriformis** (Roemer) (p. 161). PLESIOTYPES

This species was described as *Achilleum auriforme* by A. Roemer (1841, p. 2, Pl. I, fig. 3) from the Lower Kreide of Peine and the Lower Kreidemergel of Ilseburg. The illustration is very unsatisfactory, but it shows the characteristic shape of the species. Roemer mentions it again in his later work without further illustrating or describing it, and he there places it in D'Orbigny's genus *Cupulospongia* (1864, p. 51). Zittel included this species in his genus *Chonella* and figured the skeletal elements (1878*c*, p. 116, Pl. III, figs. 6, 7). This revision is accepted by Schrammen who, in his Monograph, gives the first satisfactory illustrations which have appeared in the literature (1910, p. 161, Pl. XIX, figs. 3, 4), the specimens figured coming from the Scaphites Pläner of Nettlingen. Schrammen also records the species from the Lower Senonian Sandmergel of Sudmerberg and from the Kalkmergel of the Mucronatenkreide of Misburg.

18224. **Seliscothon planum** (Phillips) Hinde (p. 163). PLESIOTYPES

This was described by Phillips in the first edition of the 'Geology of Yorkshire' as *Spongia plana* (1829, p. 177, Pl. I, fig. 1). Hinde, having access to the types figured by Phillips, places *Spongia plana* and *Spongia capitata* both under Zittel's genus *Seliscothon* and calls them *Seliscothon planus*. He says: "As no description whatever accompanies the figures of the sponges from the Flamborough Chalk given by Phillips in the 'Geology of Yorkshire,' and as the figures are very imperfectly drawn, it is often a matter of great difficulty to determine the forms which they are supposed to represent" ('Catalogue,' p. 32). He adds that while the figures given by Phillips of *Spongia capitata* and *Spongia plana* seem to be of distinct species, in reality the only difference consists in the outer form, the summit of *S. capitata* not having been developed to the same extent as that of *S. plana*. In the British Museum are specimens showing a complete gradation from the one "species" to the other. Schrammen corroborates Hinde's classification and likewise includes, under *Seliscothon planum*, *Spongia capitata* Phillips (Phillips, 1829, p. 177, Pl. I, fig. 2) on the ground that it represents only the young of the former and not a distinct species. He further includes under this species *Chenendopora explanata* Roemer (1864, p. 44, Pl. XIV, fig. 3), described from the Mucronatenkreide of Ahlten, and *Seliscothon planum, explanatum*, and *capitatum* listed as separate species by Zittel (1878*c*, pp. 117, 118). The species in Germany ranges through all the horizons

of the Upper Cretaceous and has been found at Nettlingen, Salder, Heere, Misburg, Oberg, Adenstedt, and Biewende (Schrammen, 1910, p. 164).

18225. **Craticularia maaki** Schrammen (p. 233). CHIROTYPE

This species is represented by two fragments of the wall, there being a small piece and a larger one, the latter measuring 3.5 cm. in width by 3.2 cm. in height. The outer surface is covered with round ostia arranged in parallel vertical and horizontal rows. The aporhyza open on the inner surface in oval postica showing a linear arrangement similar to that characterizing the ostia. This species is similar to *C. relicta* Schrammen, but smaller. The thickness of the wall is only 5 mm. in *C. maaki*, but 8 mm. in *C. relicta*. In the latter there are sixteen ostia and postica to the square centimeter, in *C. maaki* there are thirty-six. The two new species of *Craticularia* described by Schrammen are from the Quadratenkreide, whereas *C. maaki* is from the Scaphites Pläner of Nettlingen.

18226. **Guettardia striata** Schrammen (p. 241). IDIOTYPES

This species was described by Schrammen (1910, p. 241, Pl. XXX, figs. 6, 7, 8, text plate IX, fig. 5) from the second, third, and fourth zones of the Senonian at Gleidingen, Misburg, and Oberg, but he does not record it from so low an horizon as the Scaphites beds, nor from Nettlingen. The two specimens in the collection are undoubtedly from Nettlingen and they are labelled by Schrammen himself. They are, therefore, idiotypes.

18227. **Botryosella labyrinthica** Schrammen (p. 259). IDIOTYPE

From the Cuvieri Pläner of Grosse Heere, Schrammen described this species which is founded upon two specimens, one of which is figured (1910, p. 259, text fig. 3; skeletal elements, text plate IX, fig. 3). The species is the genoholotype of Schrammen's *Botryosella* which is monotypic. Since Schrammen did not note the occurrence of this species at Nettlingen, though he himself had written the label, the specimen in the American Museum Collection is in idiotype.

18228. **Ventriculites radiatus** Mantell (p. 265). PLESIOTYPE

See No. 18191 for full notes on the species. The specimen from Nettlingen and the one from Oppeln are the oldest known mutations of this species.

18229. **Leiostracosia alcyonoides** (Mantell) (p. 284).
See No. 18184.

18230. **Leiostracosia angustata** (Roemer) (p. 284). HOMŒOTYPE
See No. 18194.

18231. **Becksia nidiformis** (Leonhard) (p. 296). HOMŒOTYPE

In the 1914 collection obtained from Schrammen there was no representative of this species, but in the 1903 collection there was a single specimen. Since Schrammen had examined all of Leonhard's types in the Museum of the University of Göttingen, the specimen identified by Schrammen as *Becksia nidiformis* is a homœotype. For further notes on the synonymy see No. 18196.

18232. **Plocoscyphia roemeri** Leonard (p. 300). PLESIOTYPE
See No. 18185.

18233. **Plectascus clathratus** (Roemer) (p. 308). PLESIOTYPE
See No. 18186.

The Cuvieri Pläner (Zone 5 of Strombeck)

SPECIES FROM SALDER, HANOVER

18234. **Thecosiphonia nobilis** (Roemer) (p. 84). PLESIOTYPES
See No. 18188.

18235. **Isoraphinia texta** (Roemer) (p. 129). PLESIOTYPE
See No. 18212.

SPECIES FROM GROSSE HEERE, HANOVER

18236. **Procorallistes polymorphus** Schrammen (p. 69). HEAUTOTYPES

Schrammen described this species in 1901 from the higher Senonian of Oberg and Misburg (1901, p. 15), the figured holotype coming from the Quadratenkreide of Oberg (*loc. cit.*, Pl. I, fig. 10) and being now in the Roemer Museum. At the same time Schrammen described *P. tuberosus* from the Quadratenkreide of Oberg, the two constituting the genosyntypes for his *Procorallistes* (1901, p. 15, Pl. I, fig. 11); the holotype of the second species is likewise in the Roemer Museum. In his Monograph, Schrammen states that he considers *P. tuberosus* only a young stage of *P. polymorphus* and thus the genus is left with only a single species (1910, p. 69, Pl. XX, figs. 1, 2; skeletal elements, text plate III,

fig. 3). Since Schrammen in the protolog recorded the species from Oberg and Misburg and only subsequently in his Monograph noted it from Grosse Heere, the specimens in the collection are heautotypes. One of the two specimens shows this species and *Phalangium scytaliforme* growing together.

18237. **Procorallistes turonensis** Schrammen. CHIROTYPE

In the 1903 collection is a specimen labelled *Procorallistes turonensis*. It is identical in all outward respects with a specimen in the 1914 collection labelled *P. polymorphus*. It seems highly probable that the two are the same species and that Schrammen used the specific name *turonensis* as a manuscript name only—for it appears nowhere in print—and that when he described the new species *polymorphus* for the Monograph he forgot that he had used *turonensis* at an earlier time. As it is at present impossible to determine with certainty whether the two specimens do belong to the same species, we may retain the earlier name as a chironym.

The specimen of *P. turonensis* is auriforme and shows the stem. It is 11 cm. high and the stem, which is broken off, is 2 cm. in diameter.

18238. **Phalangium scytaliforme** (Schrammen) (p. 70). IDIOTYPES

This is one of two genosyntypes for Schrammen's genus *Phalangium* founded in 1910 (p. 69). *P. scytaliforme* was described from the Kalkmergel of the Mucronatenkreide of Misburg whence the figured holotype came (*loc. cit.*, Pl. XVIII, fig. 1; skeletal elements, text plate III, fig. 2) and whence Schrammen examined ten specimens. Of any occurrences at lower horizons or other localities he makes no mention, so that the four specimens in the collection, which were apparently overlooked by the author when he wrote his Monograph, constitute significant idiotypes

18239. **Phymatella intumescens** (Roemer) (p. 73). PLESIOTYPES

See No. 18206.

18240. **Phymatella** aff. **bulbosa** von Zittel mut. **postera** Schrammen CHIROTYPE

For notes on *P. bulbosa* see No. 18207. Schrammen does not list this species from any lower horizon than the Quadratenkreide, but this specimen labelled by him mut. *postera* shows that a specimen at least related to *bulbosa* occurs as low as the Cuvierikreide.

18241. **Phymatella sphæroides** Schrammen (p. 76). IDIOTYPE

As is the case with so many of the specimens from Grosse Heere, which were described by Schrammen from higher horizons and were not recorded from the Cuvieri Pläner, the specimen of the present species becomes for the same reason an idiotype. The species is described from the Kalkmergel of the Quadratenkreide and Mucronatenkreide of Oberg and Misburg, the figured cotypes coming from the Quadratenkreide of Oberg (1910, p. 77, Pl. II, figs. 6-8).

18242. **Isoraphinia texta** (Roemer) (p. 129). PLESIOTYPES

See No. 18212.

18243. **Verruculina tenuis** (Roemer) (p. 136). PLESIOTYPES

See No. 18217.

18244. **Verruculina convoluta** (Quenstendt) (p. 138).

See No. 18219.

18245. **Verruculina crassa** (Roemer) (p. 138). PLESIOTYPE

See No. 18220.

18246. **Scytalia terebrata** (Phillips) (p. 150). PLESIOTYPE

See No. 18189.

18247. **Scytalia lævis** Schrammen. CHIROTYPE

In the 1903 collection is a fairly complete specimen labelled *Scytalia lævis*. It is 15 cm. in length, and 3.5 cm. in greatest diameter. It is cylindrical and shows about 2.5 cm. of the stem which is broken off. The form and depth of the paragaster are unfortunately not shown. The specimen agrees with the description of *Scytalia radiciformis* (Phillips) in all outer characteristics and shows especially well the annular thickenings. Until studies are made of the skeletal elements, however, it would be unwise to include *S. lævis* in any previously described species.

18248. **Cytoracea turbinata** Schrammen (p. 156). COTYPE

Schrammen in describing this species figured two specimens from the Mucronatenkreide of Misburg (1910, Pl. XXIII, figs. 4, 5) and spoke also of the occurrences at Heere (pp. 156, 157). Since he did not designate a holotype, all of the specimens become cotypes, as does the single individual from Grosse Heere in the collection.

18249. **Leiochonia pinguis** Schrammen (p. 159). IDIOTYPE.

From the Cuvieri Pläner of Salder, Schrammen describes three specimens (given to him by Wollemann) as *L. pinguis* (1910, p. 159). He does not figure the type and fails to record the occurrence of the species at any other locality, yet there is a specimen in the collection labelled by him as coming from Heere, which is, therefore, an idiotype.

18250. **Macrobrochus emscheris** Schrammen (p. 174). IDIOTYPE

There is a single specimen in the collection labelled *Macrobrochus emscheris* from the Cuvieri Pläner of Grosse Heere. This species was described by Schrammen in 1910 (p. 174) from the Westphalicuskreide of Ilsede, the holotype and only known specimen having come therefrom (protograph, Pl. XXIV, fig. 4; skeletal elements, text plate VIII, fig. 2) from the Untersenon of Adenstedt-Bühlten near Peine. The bottle of spicules in the collection constitutes, therefore, an idiotype.

18251. **Botryosella labyrinthica** Schrammen (p. 259).
PARATYPE AND METATYPE

For notes on this species see No. 18227. Schrammen described the species from the Cuvierikreide of Grosse Heere and stated that he had examined two specimens therefrom, one of which he figured (1910, text fig. 3). In the Museum Collection are two specimens and he had marked them in his manuscript list as types, but neither specimen corresponds to the illustration of the holotype, so that one is presumably the paratype and the other is a metatype, or both may be metatypes.

18252. **Ventriculites radiatus** Mantell (p. 265). PLESIOTYPES
See No. 18191.

18253. **Ventriculites decurrens** T. Smith.
See No. 18192.

18254. **Leiostracosia angustata** (Roemer) (p. 284). PLESIOTYPE
See No. 18194.

18255. **Plocoscyphia roemeri** Leonhard (p. 300). HOMŒOTYPE
See No. 18185.

18256. **Onchotœchus subrutus** (Quenstedt) (p. 309). PLESIOTYPE

Quenstedt described and figured (1878, Pl. CXXXVIII, figs. 2-6) this species as *Gyrispongia subruta* from material which he found at Dörnten, some 37 km. southeast of Hildesheim. Quenstedt (1878, p

480) states that probably *Achilleum formosa* Reuss belongs also to this species, but Hinde does not agree to this on account of the differences in form of spicules in the two species (Hinde, 'Fossil Sponges,' p. 135). Hinde has found this species in the Chalk Marl at Rocken End on the Isle at Wight. Schrammen has described the skeletal elements very fully and figured them on text plate XIV, fig. 7, in his Monograph. He has added a new locality to the places whence this sponge had already been obtained, for he has found it at Heere.

18257. **Tremabolites leonhardi** Schrammen (p. 217). IDIOTYPE

Reuss in his 'Versteinerungen der böhmischen Kreideformation' notes the occurrence of *Manon megastoma* Roemer in the Upper Plänerkalk of Kutschlin and in the Lower Plänerkalk of Schillinge near Bilin, Bohemia (1845-1846, p. 77, Pl. XX, fig. 1; Pl. XLII, fig. 9). Schrammen considers that Reuss and other authors who have claimed that they have found this species in the Lower Turonian have been mistaken in their identifications and that the earlier forms are wholly distinct from the true *Manon megastoma* described by Roemer from the Senonian. For this reason Schrammen has erected the new specific name *leonhardi* for the Turonian forms (1910, p. 317). Previous to this change there had been a number of generic revisions. F. Roemer (1870, p. 307, Pl. XXXIII, fig. 6) placed the species in the genus *Camerospongia* because of certain external morphological characteristics. In 1878 ('Studien' I, p. 56) Zittel erected the generic name *Tremabolites* and included under the genus *Manon megastoma* Roemer. Počta in his first contribution on the 'Spongien der Böhmischen Kreideformation' (1883, p. 37) gave a very complete synonymy for *Tremabolites megastoma* including therein *Cephalites perforatus* T. Smith from the Lower Chalk of Burnham, Kent and Charing, England, *Porospongia megastoma* A. Roemer, *Pachychlœnia megastoma* Pomel and *Cephalites polystoma* Quenstedt. Leonhard adopted Počta's synonymy and revision without adding anything new (1897, p. 36) except in the localities in which he mentions the Korycan beds of Bohemia, the Turonian of Löwenberg, the not infrequent occurrence at Oppeln (horizon not given, but presumably the Scaphites Pläner), the Senonian of Peine and the Quadraten of Westphalia, which last two are cut out by Schrammen who recognizes the Zittel generic revision, but who, as we have seen, proposes the specific name of *leonhardi* for the Turonian forms. Schrammen gives only the Scaphites Pläner of Oppeln for occurrences, therefore the specimen from Grosse Heere in the Museum Collection is an idiotype.

18258. Aff. **Camerospongia fungiformis** (Goldfuss) *non* F. Roemer.

See No. 18198 for a discussion of these species. The specimen from Grosse Heere has the external appearance of the species described by Goldfuss, but a more accurate determination seems impossible.

Sponges from the Emscher Marl (Siphonien Marl)

Species from Sudmerberg, near Goslar, Hanover

18259. **Pachypoterion koeneni** Schrammen (p. 63). Paratype

The holotype was described and figured from a specimen occurring in the Emscher Marl at Goslar (Schrammen, 1910, p. 63, Pl. xv, fig. 6). The species is also found at Sudmerberg, Bülten-Adenstedt and at Misburg, occurring in the last locality in the Kalkmergel of the Quadratenkreide.

18260. **Pachinion familiare** (Roemer) (p. 68). Plesiotypes

This species was described by Roemer as *Polycœlia familiaris* from the Quadratenkreide of Sudmerberg (1864, p. 31, Pl. xi, fig. 10). While Zittel considered the species a *Cœlocorypha* (1878*c*, p. 64), Schrammen, making a reëxamination of the skeletal elements, holds it to be a *Pachinion*. The specimen in the collection might be considered only among the typical specimens and as such would be a topotype, coming from the same locality and horizon as the type; but because Schrammen amplified the original description given by Roemer, which is characteristically meagre, and gave the dimensions and kind of skeletal elements present, the specimens must be considered plesiotypes.

18261. **Siphonia griepenkerli** Schrammen (p. 92). Cotype

In the first edition of the 'Petrefacta Germaniæ,' Goldfuss described a sponge from the "Verhärteter Mergel von Coesfeld" (1826-33, p. 17) and figured in a most schematic way the under side of a specimen (Pl. xxx, fig. 5) which he called *Siphonia incrassata*. Roemer changed the generic designation to *Jerea*, but gave no illustrations and only one line of description (1864, p. 32); he referred to the Goldfuss figure and description. Zittel, in giving a list of the species which should be included under *Siphonia*, included *Siphonia incrassata* (Goldfuss) and cited the reference to that author; he gave no figure or description. In a similar manner, Hinde simply listed the species without comment (1883, p. 65), giving, however, a number of localities comprising: Bohemia (Plänerkalk); France, Vaches noires (*Craie Chloritée*); Ger-

many, Sudmerberg; he, too, cited the Goldfuss description. It is thus apparent that the three authors referred to *in seriatim*, who cited the Goldfuss species, added nothing to the original description and illustration. Thus, unless the Goldfuss holotype is accessible and could be described with precision by some one, it will not be possible to obtain an accurate definition of this species and the name cannot be used.

Griepenkerl has given a very good description and three clear illustrations of a sponge occurring in the Quadratenkreide of Glentorf in Braunschweig (1888-1889, p. 19, Pl. II, figs. 5*a*, *b*, *c*). This he calls *Siphonia incrassata* Goldfuss, but as Schrammen points out, there is no way of being sure that this form is really the Goldfuss species. Therefore, for Griepenkerl's species, Schrammen has proposed the new name *Siphonia griepenkerli* (1910, p. 92). Under this he includes parts or the whole of *Siphonia ficus* of authors, giving the following synonymy:

1841, *Siphonia ficus* Roemer, Kr., p. 4 (*pars*).
1878, *Siphonia ficus* Quenstedt, Petr., p. 412, Pl. CXXXIV, fig. 22 (not p. 431, Pl. CXXXV, figs. 20-23)
1878, *Siphonia ficus* Zittel, Studien II, p. 143, Pl. IX, fig. 6.
1883, *Siphonia ficus* Hinde, Catalogue, p. 65 (*pars*).
1888–89, *Siphonia ficus* Griepenkerl, Königslutter, p. 19.
1888–89, *Siphonia incrassata* Griepenkerl, Königslutter, p. 19, Pl. II, fig. 5*a*, *b*, *c*.

The species occurs in the Emscher Marl of Sudmerberg and in the Greensand of the Quadratenkreide of Glentorf.

The specimen in the collection is a plesiotype of *Siphonia incrassata* Griepenkerl *non* Goldfuss and a cotype of *Siphonia griepenkerli* Schrammen.

18262. **Trachysycon muricatum** (Roemer) (p. 96). PLESIOTYPE

From the Quadratenkreide of Sudmerberg Roemer described *Plocoscyphia muricata* (1864, p. 28, Pl. X, fig. 9) and Zittel made it the genoholotype of his monotypic genus *Trachysycon* (1878*c*, p. 140). The single specimen in the collection comes from the same locality and horizon as Roemer's holotype and is, therefore, a plesiotype of especial importance.

18263. **Lopadophorus janus** (Roemer) (p. 109). PLESIOTYPE

This species was doubtfully ascribed to *Oculispongia* as *O? janus* by Roemer (1864, p. 48, Pl. XVI, fig. 12) who records it from the Quadratenkreide of Sudmerberg. The specimen figured by Schrammen is in the Palæontological Collection of the University of Göttingen, and is the largest one known to that author (1910, Pl. X, fig. 3). Schrammen

gave the first definite and complete description and the specimen in the American Museum Collection from the type locality must be looked upon as a plesiotype.

18264. **Verruculina angulata** Schrammen (p. 143). COTYPE

Schrammen based his description of this species upon four specimens from the Lower Senonian Sandmergel of Sudmerberg, and since he did not figure or designate a holotype they are all cotypes, one of which is in the Museum Collection.

18265. **Stichophyma turbinata** (Roemer) (p.144). PLESIOTYPE

From the Obere Kreidemergel of Goslar Roemer described this species as *Manon turbinatum* (1841, p. 3, Pl. I, fig. 5). Reuss identified an abundant form in the lowest Plänerkalk of Schillinge near Bilin, Bohemia, as *M. turbinatum* Roemer (1845-1846, p. 78) and gave several good illustrations (Pl. XIX, figs. 1-6). In his synonymy he includes with a question Phillips' *Spongia osculifera*. D'Orbigny in the 'Prodome' assigns the *Manon turbinatum* of Reuss to his genus *Verrucospongia* (1850, II, p. 287), while Roemer's original species he places in his genus *Forospongia*. The *Manon turbinatum* of Reuss has finally been revised by Schrammen and put as a probable synonym of *Stichophyma verrucosa* (Roemer) *quid vide* (No. 18221).

In 1864 Roemer revised the generic standing of his own species and called it *Verrucospongia turbinata* (1864, p. 44), but this was an incorrect designation since D'Orbigny had already called the species identified by Reuss *Verrucospongia turbinata* and we have seen that the Reuss and Roemer species were not the same. Roemer in 1864 refers only to his own original *Manon turbinatum* and does not attempt to include Reuss' species as a synonym of his *V. turbinata*. At this time he states that Morris was in error in including *Manon turbinatum* Roemer 1841 in the synonymy of *Spongia osculifera* Phillips and that the latter species should rather be included in the synonymy of the former. Roemer is justified in this contention by the fact that Phillips gave no description of the form which he named and figured (1829, p. 118, Pl. I, fig. 3), and since Roemer both figured and described *Manon turbinatum* and considered Phillips' species as a synonym of it, then we must accept Roemer's statement to that effect, for Phillips' specific name is only a list name and unless Roemer felt that he wished to give credit to Phillips as the author of the species no one else can do it; therefore the references in Morris' Catalogue are incorrect (1854, p. 28).

Zittel placed *Manon turbinatum* Roemer in Pomel's genus *Stichophyma*, while *Manon turbinatum* Reuss he assigned to *Stichophyma serialis* Pomel (Zittel, 1878c, p. 125). The skeletal elements of *S. turbinatum* he figured on Pl. IV, fig. 5.

Hinde lists, without figure or description, *Stichophyma turbinatum* (Roemer) accepting the Zittel revision (Hinde, 1883, p. 41).

Griepenkerl has given the first extensive description of the species and has stated that it is one of the commonest sponges in the Upper Quadraten beds of Glentorf, Braunschweig (1888-1889, p. 16).

Schrammen notes that the species is abundant in the Emscher Marl of Sudmerberg, and rather rare in the Upper Senonian Kalkmergel of Misburg.

18266. **Jereica punctata** (Münster) (p. 146). PLESIOTYPE

From the Quadersandstein of Goslar, Münster described *Siphonia punctata* in the 'Petrefacta Germaniæ' (Goldfuss, 1826, p. 221, Pl. LXV, figs. 13*a*, *b*). Roemer in listing this species ascribes it to Schröter instead of Münster (1841, p. 4), noting its occurrence in the Obere Kreidemergel of Sudmerberg and in the Untere Kreidemergel of Ilseburg and Coesfeld.

Quenstedt under the name *Spumispongia punctatus foveatus* describes and figures a form (1878, p. 406, Pl. CXXXIV, fig. 13) which appears to correspond with Münster's species. Schrammen has included this species under the synonymy of *Jereica punctata* (Münster), but has given the wrong page and figure reference, citing 1878, p. 405, Pl. CXXXIV, fig. 12 instead of p. 406, Fig. 13.

Zittel placed *Jerea punctata*, which he assigned to Goldfuss not to Münster, in his genus *Jereica* (1878c, p. 127, Pl. V, fig. 1). Hinde accepted Zittel's generic revision and was the first author to ascribe the species to Münster instead of to Goldfuss as had commonly been done.

Schrammen has added little to our knowledge of this species, except that he has pointed out that it may be easily confused with *Cœlocorypha subglobosa* von Zittel, especially when the summit is poorly preserved, since the under side of the two species is the same. A distinction is to be found in the central opening which is simple in *Cœlocorypha subglobosa* while in *Jereica punctata* more or less numerous large postica cover the summit (1910, p. 146). He then explains how it happened that Quenstedt figured representatives of both of these species under the name *Spumispongia punctatus*.

18267. **Cœlocorypha subglobosa** von Zittel (p. 152). PLESIOTYPES

Zittel erected this species to include a part of Quenstedt's comprehensive *Spumispongia punctatus* (Zittel, 1878, p. 128, Pl. II, fig. 4, Pl. VI, fig. 9) and he cited Pl. CXXXIV, figs. 9, 13, 14, 15 of Quenstedt (1876-1878) as the parts of *S. punctatus* to be included in his new species *Cœlocorypha subglobosa*. Schrammen cites the same Quenstedt reference in his synonymy and refers to Zittel, reporting the species as abundant in the Emscher of Sudmerberg. Since Zittel in naming his new species based upon a part of Quenstedt's species figured a specimen from the Quadratenkreide of Sudmerberg, this place is the type locality. Zittel did not give a description of this species, although he gave a good generic description and figured the species. Since Schrammen has amplified the Zittel description the specimens from which his notes were made must be considered plesiotypes.

18268. **Cœlocorypha socialis** (Roemer) (p. 152). PLESIOTYPE

This species was described by Roemer from the Upper Kreidemergel of Sudmerberg as *Scyphia socialis* (1841, p. 6, Pl. II, fig. 5). Both Zittel and Schrammen have the reference in their synonymies as *Siphonia socialis* Roemer, but that author did not describe a *socialis* under *Siphonia* and, furthermore, both Zittel and Schrammen give the figure reference which fits *Scyphia socialis*. There is no doubt that they referred to that species and that it was the one which Zittel included in his genus *Cœlocorypha* (1878*c*, p. 128, Pl. IV, fig. 10). Schrammen has supplemented the original description from a study of three specimens which he collected from the type locality, one of which is in the American Museum Collection.

18269. **Cœlocorypha acuta** (Roemer) (p. 153). PLESIOTYPE

From the Upper Kreidemergel of Sudmerberg, Roemer described *Scyphia acuta* (1841, p. 6, Pl. II, fig. 4) and he subsequently changed the generic designation to *Siphonocœlia* (1864, p. 29). Zittel revised the species again, placing it under *Cœlocorypha* (1878*c*, p. 128). Schrammen added very little further to the description except the dimensions of some of the specimens which he had collected from the type locality, for which reason his specimens are to be considered plesiotypes. He had examined five from Sudmerberg, one of which is in the collection.

18270. **Cytoracea impressa** (Roemer) (p. 155). PLESIOTYPE

Roemer described this species from the Quadratenkreide of Sudmerberg as *Stellispongia impressa* (1864, p. 49). Quenstedt figured two

specimens from the same locality under the name *Spongites impressus* (1876-1878, p. 374, Pl. CXXXIII, figs. 1, 2). Zittel referred this species to his genus *Astrobolia* (1878, p. 115). In his reference to Quenstedt's illustration he has fig. 12 instead of figures 1, 2—undoubtedly an error in proof reading. Schrammen supplemented the original description and placed the species under Pomel's emended genus *Cytoracea*, but he gave no illustrations (1910, p. 155).

18271. **Cytoracea grandis** (Roemer) (p. 155). PLESIOTYPE

This species was figured and described by Roemer as *Stellispongia grandis* from the Quadratenkreide of Sudmerberg (1864, p. 49, Pl. XVII, fig. 1). Zittel included it in *Astrobolia* (1878*b*, p. 51), but Schrammen placed it in *Cytoracea* (1910, p. 155).

18272. **Cytoracea costata** Schrammen (p. 155). HOLOTYPE OR METATYPE

Schrammen based his description of this species upon a single specimen from the Emscher of Sudmerberg. The specimen in the collection agrees with the description, but, unfortunately, Schrammen did not figure his holotype. Were it not for the fact that he so often stated that he had fewer specimens than he actually possessed, and were it not for his broad usage of the term *Belegestück*, one would unquestionably consider the specimen in the collection the holotype. If it is not, then it is only a metatype.

18273. **Bolidium palmatum** (Roemer) (p. 158). PLESIOTYPE

This species was described by Roemer (1864, p. 55, Pl. XIX, fig. 8) from the Quadratenkreide of Sudmerberg as *Amorphospongia palmata*. Subsequently Zittel erected the genus *Bolidium* for a number of species characterized by their indefinite form and absence of large ostia or canals and having skeletal elements very similar morphologically to those of the genera *Astrobolia* and *Chonella*. The species, so far, is known only from Sudmerberg. Počta (1884, p. 10) has recorded the finding of two specimens at Kamajk, Bohemia, in the Korytzan beds, but Schrammen questions the identification. Počta does not figure his specimens. Hinde listed the species from Sudmerberg without description or figure (1883, p. 31). Schrammen adds a few points to the original description, giving dimensions and so forth.

18274. **Chonella auriformis** (Roemer) (p. 161). PLESIOTYPE

See No. 18223.

18275. **Seliscothon marginatum** (Roemer) (p. 166). PLESIOTYPES

From the Obere Kreide of Goslar Roemer figured and described *Scyphia marginata* (1841, p. 6, Pl. II, fig. 7). Quenstedt makes reference to this species and figures a specimen from Sudmerberg (1876-1878, p. 376, Pl. CXXXIII, fig. 5). In 1850 D'Orbigny made *Scyphia marginata* a synonym of Phillips' species *Spongia capitata*, changing the generic designation to *Cupulospongia*. Roemer quite rightly does not accept D'Orbigny's revision, except for the genus, and considers that his own specific name *marginata* has priority, because Phillips did not describe his species (Roemer, 1864, p. 50). Roemer not only includes *Spongia capitata* Phillips in his synonymy of *Cupulospongia marginata* but places there also *Spongia plana* and *Spongia terebrata* by the same author. Such a proceeding is unwarranted as one may judge from a study of Phillips' illustrations, and later authors have not followed Roemer in this step. *Cupulospongia marginata* Roemer is placed by Zittel in his new genus *Seliscothon* (1878, p. 118), a revision which Griepenkerl, Wollemann, and Schrammen have accepted, although Schrammen omits reference to Zittel in his synonymy. Griepenkerl reports the rare occurrence of this species in the Upper Quadraten of Glentorf, Braunschweig (1888-1889, p. 16). Wollemann notes its presence in the Senonian at Gr. and Kl. Bienwende in Braunschweig (1901, p. 4), while Schrammen collected from Sudmerberg (1901, p. 166).

18276. **Pachytrachelus conicus** (Roemer) (p. 171). PLESIOTYPE

Roemer described this species as *Cnemidium conicum* from the Emscher Marl of Sudmerberg (1841, p. 4, Pl. I, fig. 10). From the same locality and horizon Roemer subsequently described and figured another species, *Eudea tuberosa* (1864, p. 25, Pl. X, fig. 13) which Schrammen, who had access to the holotypes, considers to be the same as *Cnemidium conicum*. In 1864 Roemer accepted doubtfully the reference of his original species to D'Orbigny's *Stellispongia* which the latter author had made in the 'Prodrome' (1850, II, p. 287). Quenstedt called the species *Spongites conicus* (1878, p. 374) and figured a specimen from Sudmerberg (*loc. cit.*, Pl. CXXXIII, fig. 3).

Schrammen has added to the original description and has given two illustrations of a specimen from the type locality (1910, Pl. XXIV, figs. 1*a*, 1*b*); he states that it is abundant in the railroad cutting at Petersberg, near Goslar, Hanover.

Sponges from the Senonian

The Quadratenkreide (Zone 1 of the Obersenon of Schlüter; Zone 3 of Stolley)

Species from the Quadratenkreide of Oberg, Hanover

18277. **Tetillopsis longitridens** (Schrammen) (p. 50). Holotype (Spicules)

Schrammen founded this species upon a single specimen from the Kalkmergel of the Quadratenkreide of Oberg. He figured only the skeletal elements of the holotype (1910, p. 50, text plate I, fig. 7). The specimen in the Museum Collection is a bottle of spicules presumably from the holotype.

18278. **Stolleya ornatissima** Schrammen (p. 51). Heautotype

This species was described and figured from a single specimen from the Quadratenkreide of Oberg (1899, p. 7, Pl. I, fig. 4; skeletal elements, text plate IV, fig. 5). Subsequently the number of specimens which Schrammen examined was increased to twelve and included some from the Mucronatenkreide of Misburg (1901, p. 51; skeletal elements, text plate I, fig. 1). Since the specimen in the Museum is not the holotype, it is to be classed among the supplementary types as a heautotype, having been one of those selected by the describer to further illustrate his holotype.

18279. **Stolleya microtulipa** Schrammen (p. 51). Paratype or Heautotype

This species is one of two genosyntypes of Schrammen's *Stolleya* founded in 1899. *S. microtulipa* was described from three specimens from the Quadratenkreide of Oberg, but only the skeletal elements were figured (1899, p. 7, Pl. III, fig. 3). Schrammen listed it in 1901 without further description or illustration (1901, p. 19). In his Monograph, Schrammen amplified the original description (1910, p. 51), figured a few more skeletal elements (text plate I, fig. 2), and noted the occurrence of the species from the Mucronatenkreide of Misburg. In the Museum Collection are one specimen and a bottle of the spicules which are paratypes, since the figured skeletal elements accompanying the protolog must be considered the holotype. It is possible, as in the case of nearly all of the species described by Schrammen prior to 1910, that the specimen in the Collection is not one of the original series and therefore not a paratype, but belongs to material collected by Schrammen subsequent to the time of description and it would in that case be a heautotype.

18280. **Stolleya florida** Schrammen (p. 54). HOLOTYPE (Spicules)

The holotype of this species is a single specimen described but not figured by Schrammen in 1910 (p. 54; skeletal elements, text plate I, fig. 5) from the Quadratenkreide of Oberg. In the Museum Collection is a bottle of spicules presumably from the holotype, since Schrammen characterizes the species as "unicum."

18281. **Theneopsis steinmanni** (von Zittel) Schrammen (p. 55). PLESIOTYPE

Zittel in 1879 ('Studien,' III, p. 9) erected the genus *Tethyopsis* for a single specimen from the Mucronatenkreide of Ahlten which he called *T. steinmanni*. This species was not described, but the holotype was figured (*loc. cit.*, Pl. XI, fig. 3). The generic name was given because of the close similarity of the Cretaceous form to a species of the living genus *Tethya*. Schrammen, in his Monograph, discards Zittel's name and proposes *Theneopsis*, because *Tethyopsis* had already been preëmpted for a living species belonging to the same family of the Stellettidæ, *Tethyopsis columnifer* Stewart (Quart. Journ. Micr. Sc. 1870, p. 281). Schrammen evidently had not discovered this fact at the time of publication of his earlier papers, for in 1899 and 1901 he accepted the generic name proposed by Zittel (1899, p. 19; 1901, p. 19). To the original locality and horizon Schrammen has added discoveries from the Quadratenkreide of Oberg and Misburg and from the Mucronatenkreide of Misburg (1910, p. 55, Pl. XII, fig. 1; skeletal elements text plate I, fig. 5). Since Schrammen gave the first description of the species his specimens are plesiotypes.

18282. **Doryderma (Brochodora) roemeri** (Hinde) (p. 58). PLESIOTYPES

See No. 18180.

18283. **Doryderma (Brochodora) ramusculus** Schrammen (p. 59). PARATYPES

Schrammen described this species from the Quadratenkreide and Mucronatenkreide, from Misburg, Oberg and Adenstedt. The figured holotype comes from the Quadratenkreide of Oberg, but neither of the two specimens in the Collection corresponds to the illustration (1910, Pl. XVIII, fig. 6).

18284. **Doryderma (Homalodora) ramosa** (Mantell) (p. 59). PLESIOTYPES

Mantell described and figured this species as *Spongia ramosa* (1822, p. 162, Pl. XV, figs. 8, 11) and the holotype is now in the British Museum.

The type horizon and locality were the Upper Chalk near Lewes and Brighton, Sussex. Hinde, in his synonymy, includes Parkinson's "ramose alcyonite" figured on Pl. VII, fig. 6 in Vol. II of the 'Organic Remains' and described on page 92 in that volume. The specimen figured by Parkinson came from Berkshire. Zittel included the species in his genus *Doryderma* (1878*c*, p. 132) without further description or illustration. Hinde, who had examined Mantell's type, accepted Zittel's revision, gave a detailed description of the species and figured a specimen from Oare, Wiltshire (1883, p. 48, Pl. VIII, figs. 2, 2*a*). Schrammen recognized a more refined classification than that given by Zittel and made a new subgenus, *Homalodora*, for those forms having a dense or solid skeleton and in which the surface was fine-meshed and smooth with irregularly disposed, round ostia (1910, p. 59). Here he placed *D. ramosa*, figuring a specimen from the Quadratenkreide of Oberg (*loc. cit.*, Pl. XVIII, fig. 7), and noting its occurrence also in the Mucronatenkreide of Misburg.

18285. **Doryderma (Homalodora) plana** Schrammen (p. 59). COTYPES

This species was described from twenty specimens coming from Misburg and Oberg, the two figured cotypes coming from the Quadratenkreide of Oberg (1910, p. 59, Pl. XVII, figs. 3, 4). The two specimens in the American Museum Collection are cotypes, but are not the figured specimens.

18286. **Doryderma (Homalodora) tuberosa** Schrammen (p. 60). COTYPES

The two specimens in the collection are from among the cotypes upon which Schrammen founded this species. He examined ten specimens from the Mucronatenkreide and Quadratenkreide of Misburg and Oberg, but did not figure or select a holotype.

18287. **Doryderma (Homalodora) ficus** Schrammen (p. 60). PARATYPES

Schrammen's figured holotype of this species comes from the Quadratenkreide of Oberg (1910, p. 60, Pl. XVII, fig. 2). There are five specimens from this locality in the Collection, two being young individuals. The form has also been found in the Mucronatenkreide of Misburg. On account of its small size and form it might easily be confused with the young of *Amphilectella piriformis*. But *D. ficus* has "in the central portion of the summit not a simple osculum, but numerous postica 2 mm. wide and fine-meshed skeleton" (Schrammen, 1910, p. 61).

18288. **Amphilectella piriformis** Schrammen (p. 61). HEAUTOTYPES

In 1901 Schrammen made a subdivision of Zittel's genus *Doryderma*, erecting the subgenus *Amphilectella* with *A. piriformis* as the "subgenoholotype" (1901, p. 13). The figured holotype is from the Mucronatenkreide of Misburg (*loc. cit.*, Pl. III, fig. 3) and is now in the Roemer Museum. Schrammen recorded the occurrence of the species also in the Quadratenkreide. In 1910 he raised the subgenus to the rank of a genus (p. 61) and was able also to add Oberg to the locality list. By means of his additional material he amplified his original description and figured a specimen from Oberg (1910, p. 61, Pl. XVIII, fig. 8; skeletal elements, text plate II, fig. 6). (See also No. 18203).

18289. **Heterostinia obliqua** (Benett) Hinde (p. 62). PLESIOTYPE

From the Gray Sand and Chalk flints of Warminster and Wiley, Miss Benett listed and figured a species which she called *Polypothecia obliqua* (1831, p. 9, Pl. VIII, figs. 1, 2). Hinde placed the species in Zittel's genus and gave a full description of it with illustrations both of an individual specimen and of the skeletal elements (1883, p. 53, Pl. X, figs. 2, 2*a*, 2*b*, 2*c*). He explained that while Miss Benett had given no description of the species her illustrations left no doubt as to the sponge she had in mind, for there was no other from Wiltshire with the "peculiar elongated compressed stem or root shown in her figure." As Hinde pointed out, there was no certainty that the *Chenendopora obliqua* figured and described by Michelin (1840-1847, p. 132, Pl. XLI, figs. 2*a*, *b*) was the same as Miss Benett's *Polypothecia obliqua*, although Michelin made her species a synonym of his. Since Michelin undoubtedly had not seen Miss Benett's types, but depended solely upon the illustrations which she gave, and since Hinde had collected from the type locality and questioned Michelin's identification of the French forms with those from Wiltshire, we must consider that Michelin's species is distinct.

Schrammen includes in his synonymy of *H. obliqua* two species which he described in 1901 as genosyntypes of his *Asteroderma*, namely, *A. expansa* (1901, p. 14, Pl. III, fig. 4) and *A. conica* (p. 14, Pl. I, fig. 9). Schrammen has figured specimens from the Quadratenkreide of Oberg (Pl. XVI, fig. 2) and the Mucronatenkreide of Misburg (Pl. XVI, fig. 3, Pl. XVII, fig. 1).

18290. **Heterostinia immanis** Schrammen (p. 63). IDIOTYPE

For a complete discussion of this species see No. 18471.

Schrammen states in his Monograph that this species is confined to the Mucronatenkreide of Misburg, yet in the Museum Collection is a bottle of skeletal elements labelled by Schrammen himself from the Quadratenkreide of Oberg.

18291. **Pachypoterion auritum** Schrammen (p. 64). IDIOTYPE

The figured holotype of this species from the Mucronatenkreide of Misburg is stated by Schrammen to be the only known specimen, yet the fragments and spicules in a bottle in the Museum Collection are labelled by Schrammen himself and must have been overlooked by him when he was recording his occurrences.

18292. **Pachinion scriptum** (Roemer) (p. 67). PLESIOTYPES

See No. 18204.

18293. **Pachinion cylindricum** Schrammen (p. 68). HEAUTOTYPE

This species was originally the genoholotype of Schrammen's monotypic genus *Neohindia* (1901, p. 11). The figured holotype, now in the Roemer Museum, came from the Quadratenkreide of Misburg (*loc. cit.*, Pl. II, fig. 5; skeletal elements, Pl. V, fig. 2). This genus, furthermore, was the type for Schrammen's family Neohindiadæ. When he published his Monograph, Schrammen, having better material at hand, found that *N. cylindrica* was in reality a *Pachinion*. Consequently the genus *Neohindia* was left without a species and the family Neohindiadæ without a genus, both names thus becoming *nomina nuda*. While the specimen in the Museum Collection is quite as perfect as the figured one, it is, unfortunately, not the holotype. Schrammen states explicitly (1910, p. 69) that this species occurs only in the Quadratenkreide of Misburg in spite of the fact that he figured a specimen from the Quadratenkreide of Oberg and that he had labelled a specimen and bottle of spicules from Oberg which are now in the American Museum Collection. Since, however, he has figured a specimen from Oberg (1910, Pl. XVIII, fig. 3), even though he has failed to include that place in his localities, the specimen in the collection is a heautotype.

18294. **Procorallistes polymorphus** Schrammen (p. 69). PARATYPE OR HEAUTOTYPE

See No. 18236.

18295. **Propachastrella primæva** (von Zittel) (p. 71). PLESIOTYPE

In the third part of his 'Studien über fossile Spongien' Zittel, in 1879 (p. 10), described a new species, *Pachastrella primæva* (Pl. XI, fig.

4),[1] from the Quadratenkreide of Ahlten. In 1883, Hinde ('Catalogue,' p. 26, Pl. II, figs. 1, 1*a*) described from the Upper Chalk of Flamborough a new species *Pachastrella convoluta* which he states may be distinguished from *P. primæva* Zittel "by its mode of growth and also by the dimensions of the spicules." He admits that in form and arrangement of the spicules the two species are alike. His criteria of distinction are evidently not well taken, and Schrammen seems entirely justified in not admitting the British form as a new species.

In 1885 Počta ('Beiträge,' III, p. 8) identified certain skeletal elements which he had found in the Weissenberg beds of Rencov with Hinde's *Pachastrella carteri* (1889, 'Spicules,' p. 46, Pl, III, figs. 29-31) and this also Schrammen includes under *Propachastrella primæva*, a procedure which seems entirely justified on the basis of the form of skeletal elements. In 1899 ('Tetractinelliden,' p. 8) Schrammen placed *Pachastrella primæva* under Gray's genus *Dercitus*, but in 1910 he made a new genus *Propachastrella*, because the Mesozoic genus differs from the related recent ones *Dercitus* Gray, *Pachastrella* Oscar Schmidt and *Caltropella* Sollas in "the possession of a dermal covering of dichotriæns" (1910, p. 71). The species *primæva* is the only Mesozoic Pachastrellid which has been found in entire specimens; all others are known either from fragments or from spicules alone. (See Schrammen, 1910, Pl. XIII, fig. 1, illustration of large specimen from the Mucronatenkreide of Misburg.)

18296. **Phymatella intumescens** (Roemer) (p. 73). HOMŒOTYPES
See No. 18206.

18297. **Phymatella bulbosa** von Zittel (p. 75). PLESIOTYPES
See No. 18207.

18298. **Phymatella tuberosa** (Quenstedt) (p. 76). PLESIOTYPES

Quenstedt described this species as *Scyphia tuberosa* from the Quadratenkreide of Köhlerholz near Ilsenburg (1876-1878, p. 388, Pl. CXXXIII, figs. 18-20). He thought it was the same as Roemer's *Scyphia tuberosa* ('Verst. Norddeutschen Kreidegeb.,' 1841, Pl. II, fig. 9) but, according to Schrammen (1910-1912, p. 3), Roemer's type cannot be identified either as to genus or family. Quenstedt's *tuberosa* is, therefore, a

[1]Through an apparent oversight in proof-reading the reference given by Zittel for the figure of this specimen is Pl. XII, fig. 4, whereas it should be Pl. XI, fig. 4, as is readily seen by reference to the plates in question and to their description. Several subsequent authors have copied the incorrect reference.

distinct species and has been shown by Zittel (1878, p. 138) to belong to his genus *Phymatella*.[1] He retained the name *tuberosa* but credited it to Quenstedt, a procedure which is justifiable because Quenstedt's *tuberosa* did not belong to the genus under which Roemer had placed his *tuberosa*.

Schrammen suggests that probably the species *Scyphia attenuata*, *S. lobata* and *S. mamillata* of Courtiller (1859, p. 122, Pl. v, figs. 2-5, Pl. vi, fig. 1) belong to *Phymatella tuberosa* (Quenstedt).

This species is reported by Schrammen only from the Quadratenkreide and Mucronatenkreide and from Misburg, Oberg and Ilsenburg. He appears to have overlooked the specimen from the Scaphites Pläner of Nettlingen.

18299. **Phymatella sphæroides** Schrammen (p. 76). COTYPES

This species was described by Schrammen from the Quadratenkreide and Mucronatenkreide, from Oberg and Misburg (1910, pp. 76, 77), the figured cotypes being from the Quadratenkreide of Oberg (*loc. cit.*, Pl. i, figs. 6-8). None of the three specimens in the collection is a figured one.

18300. **Phymatella heteropora** von Zittel (*non* Roemer) (p. 77). PLESIOTYPE

In 1878 Zittel erected the genus *Phymatella* (1878*c*, p. 137) and included under it *Scyphia heteropora* Roemer. This had been described in 1841 from the Upper Kreidemergel of Sudmerberg (Roemer, 1841, p. 7), and a poor illustration of the holotype had been given (Pl. ii, figs. 13 *a*, *b*). Zittel gives no description of *Phymatella heteropora* (Roemer); but figures some tetraclones from a fragment from the Mucronatenkreide of Ahlten (1878*c*, Pl. viii, fig. 2). Zittel had not seen Roemer's type and Schrammen thinks that it would be impossible to tell solely from Roemer's very brief description and sketchy protograph whether or not *Scyphia heteropora* was a *Phymatella*. Schrammen, after a study of Roemer's holotype and other type material, came to the conclusion that *S. heteropora* was not a *Phymatella*, for which reason *Phymatella heteropora* Zittel is distinct from *Scyphia heteropora* Roemer. Schrammen (1910, p. 77) describes ten specimens from the Kalkmergel of the Quadraten- and Mucronatenkreide, from Misburg, Ahlten and Oberg, figuring one specimen from the Quadratenkreide of Oberg (1910, Pl. iii, fig. 1).

[1]Zittel in his 'Studien' (II, p. 138) incorrectly refers to Quenstedt's species as *Sponites tuberosus*. It is possible that the error is due to Quenstedt's manner of having generic and specific names printed, for he always has the latter in bold face type while the former are in Roman type. A number of species just preceding *tuberosus* had been under the genus *Spongites* and a reasonable explanation seems to be that Zittel overlooked the transition to *Scyphia*.

18301. **Aulaxinia sulcifera** (typica) (Roemer) (p. 78). PLESIOTYPE

This species was described by Roemer (1864, p. 30, Pl. XI, fig. 7) as *Siphonocœlia sulcifera*, from the Mucronatenkreide of Dolberg near Hamm and the Quadratenkreide of Ilsenburg. Zittel ('Studien,' II, 1878*c*, p. 138), subdividing Roemer's genus *Siphonocœlia*, placed certain of the species in a new genus *Aulaxinia*. He adds further occurrences from Linden and Ahlten. Griepenkerl has identified this species as of rare occurrence in the Quadratenkreide at Boimstorf, Braunschweig (1898-1899, p. 18). Schrammen has added the localities of Oberg, Glentorf, Misburg, Biewende and Adenstedt to those already known (1910, p. 78) and has figured three specimens from the Quadratenkreide of Oberg, none of which is among the five in the Museum Collection.

18302. **Craterella tuberosa** Schrammen (p. 80). HEAUTOTYPES

Schrammen described this species from the Quadratenkreide of Misburg and Oberg figuring from the former locality a large specimen which is now in the Roemer Museum (1901, p. 5, Pl. II, fig. 2). This species was the genoholotype and sole species in the genus at the time of description. By an oversight, Schrammen omitted in his Monograph reference to Oberg as one of the localities at which this species is found, although he figured a specimen therefrom (Pl. III, fig. 3) and there are three specimens in the Museum Collection.

18303. **Myrmeciophytum verrucosum** (Roemer) (p. 81). PLESIOTYPES

Roemer described this species in 1864 as *Stellispongia verrucosa* from the Quadratenkreide east of Sottmar and from Gr. Biewende (1864, p. 50). The figured holotype was only a fragment (*loc. cit.*, Pl. XVII, fig. 5) and the specimen figured by Schrammen is hardly any better except that the illustration is well executed (1910, Pl. IV, fig. 1; skeletal elements, text plate IV, fig. 3).

18304. **Callopegma acaulis** von Zittel (p. 81). PLESIOTYPES

From the Mucronatenkreide of Ahlten, Linden and Ciply, Zittel described this species in 1878 ('Studien,' II, p. 139). Hinde in his 'Catalogue' (1883, p. 61) described a species from the Upper Chalk of South England as *Callopegma obconicum*. Schrammen considers that the characteristics cited by Hinde as distinguishing his species from *C. acaulis*, namely, "its smaller size, the absence of a cup in the centre, and its even surface" are not necessarily those of a new species, but

simply of the young of *C. acaulis*. He holds that the figure given by Hinde of *C. obconicum* is that either of a young *C. acaulis* or else of an adult form from beds of earlier age than the Quadratenkreide. Schrammen reports it from Ilsede, Misburg, Adenstedt, and Ahlten and figures two specimens from the Quadratenkreide of Oberg (Pl. IV, figs. 3, 4; skeletal elements, text plate IV, fig. 9). The species ranges from the Lower Senonian sand marl through the Mucronatenkreide (1910, pp. 81, 82).

18305. **Thecosiphonia postumus** Schrammen (p. 85). PARATYPES

This is a very small species which was described by Schrammen (1910, p. 85, text plate IV, fig. 4) from eight specimens from the Quadratenkreide of Oberg. There are five specimens in the Museum Collection which are all paratypes, if we consider that the skeletal elements figured are the holotype.

18306. **Turonia variabilis** Michelin (p. 86). PLESIOTYPE

This is one of the few species described before 1850 which has retained its original name to the present day without generic revision by later students of the sponges. At the time of description *variabilis* was the genoholotype of the monotypic genus *Turonia*, a name given by Michelin because of the abundance of this species in the environs of Tours (1840-1847, pp. 125, 126). The specific name was chosen because of the great variability in form and size displayed by this sponge as shown in the figures of the many cotypes (*loc. cit.*, Pl. XXXV, figs. 1-8). Michelin records it from the Cretaceous of Chateauvieux near Saint-Aignan (Loir-et-Cher) and in the environs of Tours (Indre-et-Loire). Bronn, in the third edition of the 'Lethæa Geognostica,' described this species briefly and reproduced one of Michelin's figures (1852, part 5, p. 60, Pl. XXVIII, fig. 8). Fromental changed Michelin's generic name to *Turonifungia* to correspond to the system of nomenclature which he erected, but which has not been followed by later authors. He took Michelin's description, adding nothing to it, giving no new localities nor any figures and, therefore, the name *Turonifungia* has no standing. Fromental's plan of having uniform endings for all of the generic names in one family has its good points, but, unfortunately, cannot be adopted, if we adhere to the laws of priority. Courtiller figured and briefly described this species (1859, p. 141, Pl. XL, figs. 2, 3, 4) and of the illustrations Schrammen considers Fig. 2 to be a true *T. variabilis*, including here also Courtiller's *T. sulcata* (*loc. cit.*, p. 141, Pl. XL, fig. 1). In this

latter step he follows Zittel who accepts Michelin's descriptions and names and who includes the *T. sulcata* of Courtiller under the *T. variabilis* of Michelin (1878, II, p. 150). Hinde accepted all of Zittel's classification and noted the occurrence of the species in the Upper Chalk of Flamborough and of the South of England (1883, p. 76).

Schrammen has added two northwest German localities to those already known, reporting it from the Quadratenkreide of Oberg and the Quadratenkreide and Mucronatenkreide of Misburg (1910, pp. 86, 87) whence he has figured five specimens (Pl. XI, figs. 1-3, Pl. III, figs. 8, 9). The specimen in the Museum Collection from the Quadratenkreide of Oberg is not one of those figured. The species is very rare and small in the higher beds of the Quadratenkreide, but becomes more abundant, very much larger, and extremely variable in form in the Mucronatenkreide where Schrammen has found specimens up to 15 cm. in height and 30 cm. in thickness (1910, p. 87).

Michelin's protolog, supplemented by the numerous illustrations is sufficient to make it clear what sponge he was describing, yet it lacks all the details regarding structure and form which later day writers give. Especially is the protolog inadequate in that it contains no description of the skeletal elements. There was a very real need of a redescription and this Schrammen has given. The specimens from northwestern Germany which he used for this purpose are thus plesiotypes.

18307. **Turonia constricta** von Zittel (p. 87). PLESIOTYPES

From the Mucronatenkreide of Ahlten, Zittel described this species (1878*c*, p. 150), but he figured only the skeletal elements (*loc. cit.*, Pl. IX, fig. 3). Schrammen gave a fuller description of the species (1910, p. 87) based upon thirty specimens collected by him from the Quadratenkreide of Oberg and the Mucronatenkreide of Misburg, from the former of which he figured three specimens (Pl. III, figs. 5-7) and also the skeletal elements (Text Plate IV, fig. 6). Since the Schrammen material was used to further describe and illustrate Zittel's description, the fourteen specimens from Oberg are all plesiotypes.

18308. **Turonia cerebriformis** Schrammen (p. 88). COTYPE

Schrammen described this species and figured two cotypes (1910 p. 88, Pl. III, figs. 10, 11; skeletal elements, text plates IV, fig. 7) from the Quadratenkreide of Oberg to which horizon and locality he says the species is confined. However, there are specimens in the American

Museum Collection from another horizon and locality so that it is not so restricted as would appear to be the case from Schrammen's statement in print. (See No. 18478.)

18309. **Jerea quenstedti** von Zittel (p. 89). FIGURED PLESIOTYPE AND PLESIOTYPES

See No. 18182 for discussion of this species. There are six plesiotypes from Oberg, one of which, a young individual, is figured (Schrammen, 1910, Pl. II, fig. 4). Unfortunately the lower half inch of the specimen has been broken off and is missing.

18310. **Jerea gracilis** Schrammen (p. 91). (Figured). HOLOTYPE

The specimen of this species in the American Museum Collection is labelled *Jerea* sp. nov. by Schrammen. By a comparison with the description and illustration of the only new species of *Jerea* described in the Monograph, it was possible to determine that the specimen so labelled is the figured holotype of *J. gracilis* from the Quadratenkreide of Oberg (1910, p. 91). Only two specimens had been examined by Schrammen and the species is unknown elsewhere. On the surface of the specimen is a triangular break, where a portion has dropped out; in the figure the piece is still in place, but cracks are represented, marking the outline of the present hole in the surface (*loc. cit.*, Pl. II, fig. 5). This is the only figured holotype in the collection.

18311. **Siphonia tubulosa** (Roemer) (p. 93). PLESIOTYPES

Roemer described this species from the Lower Cretaceous of Peine, Hanover (1841, p. 8, Pl. III, fig. 10) as *Scyphia tubulosa*, a name which has been changed by Schrammen to *Siphonia tubulosa*. In 1888-1889, Griepenkerl described from the Quadratenkreide of Glentorf a form which he called *Siphonia ovalis* (1888-1889, p. 93, Pl. III, figs. 3*a*, *b*). His description and illustrations are good so that there can be no doubt of the form that he had in mind. With this definite information regarding the species from Königslutter and having Roemer's type material to consult, Schrammen came to the conclusion that Griepenkerl's species was synonymous with Roemer's *Siphonia tubulosa*. It is unfortunate that the three specimens figured by Schrammen (1910, Pl. II, figs. 6-8; skeletal elements, text plate IV, fig. 11) were all young individuals, for there is thus no good illustration in the literature of Roemer's species, the original figure as usual being very poor. In the Museum Collection are two young individuals and four others.

18312. **Siphonia micropora** Schrammen (p. 94). COTYPES

This species was described by Schrammen (1910, p. 94) from six specimens which he had examined from the Quadratenkreide of Oberg of which he figured two (Pl. II, figs. 9, 10; skeletal elements, text plate IV, fig. 10). There are three specimens in the Museum Collection but none corresponds to any of those figured.

18313. **Acrochordonia ramosa** Schrammen (p. 96). PARATYPES OR HEAUTOTYPES

In 1901 (p. 6), Schrammen erected the genus *Acrochordonia* with the single species and genoholotype *ramosa* (p. 7, Pl. I, fig. 8, Pl. V, fig. 1). The holotype is in the Roemer Museum. The species is known only from the Quadratenkreide of Oberg. In 1910 Schrammen gave a fuller description (p. 96) and figured two more specimens from Oberg (Pl. IV, figs. 5, 6; text plate VI, fig. 10). The five specimens in the collection may be either paratypes or heautotypes, depending upon whether they were part of the original series or belonged to the supplementary material.

18314. **Acorchordonia auricula** Schrammen (p. 97). PARATYPE

Schrammen described this species in 1910 from the Quadratenkreide of Oberg figuring the holotype (Pl. IV, fig. 7), the description of which was based upon three specimens. In the American Museum Collection the only representative is a bottle full of small fragments.

18315. **Discodermia antiqua** Schrammen (p. 97). COTYPES OR HEAUTOTYPES

This species was described by Schrammen in 1901 (p. 5) from specimens from the Quadratenkreide of Oberg and the Mucronatenkreide of Misburg, although the figured cotypes are all from the former locality and horizon (Pl. I, figs. 2-4; skeletal elements, Pl. IV, fig. 3) and are now to be found in the Roemer Museum. In his Monograph, Schrammen has figured three more specimens from the Quadratenkreide of Oberg (Pl. VIII, figs. 1-2, Pl. VII, fig. 7) and reprinted on Pl. VII, figs. 5, 6 the two original figures. There are six specimens in the Museum Collection, but none is figured.

18316. **Rhagadinia rimosa** (Roemer) (p. 100). PLESIOTYPES

In 1864 Roemer described *Cupulospongia rimosa* (p. 51, Pl. XVIII, fig. 8) from the Mucronatenkreide of Ahlten and the Quadratenkreide of Ilsenburg. Parts of Roemer's genus Zittel separated out for a new

genus *Ragadinia* (1878c, 'Studien,' II, p. 152, Pl. x, fig. 4). At that time *rimosa* was the only species to be placed under this genus, though Zittel states that the abundant material from Ahlten includes two or three different species. Počta (1884, p. 41) records the occurrence of a single poorly preserved specimen in the Korytzan beds of Kollin (Pl. II, fig. 14); he figures only the skeletal elements, the sponge itself being in too poor a state of preservation. Schrammen (1910, pp. 100-101) states that he has examined over 100 specimens and he adds to previously known localities Oberg, Misburg, and Adenstedt, from the first two of which he has figured four specimens (Pl. VII, fig. 4, Pl. VIII, figs. 6, 7, Pl. x, figs. 5, 6; skeletal elements, text plate v, fig. 3).

18317. **Rhagadinia doederleini** Schrammen (p. 101). METATYPE

Schrammen described this species in 1910 from two specimens obtained by him from the Kalkmergel of the Quadratenkreide of Oberg. He figured the upper and lower surfaces of one large platter-shaped specimen (Pl. VII, figs. 1 and 2) and a single view of a smaller auriforme one (Pl. VII, fig. 3). In the American Museum Collection is a specimen which closely parallels this third figure, but it is labelled *Discodermia doederleini* Schrammen. Since Schrammen described no species of that name under *Discodermia* and since the specimen in the collection is evidently a *Rhagadinia*, I have placed it under that genus. It comes from Schrammen's type locality, but not having been used by him in the literature it is only a metatype. It is likely that Schrammen at first identified his specimen as a *Discodermia* and later changed the determination to *Rhagadinia*.

18318. **Colossolacis plicata** Schrammen (p. 103). COTYPES

This species is the genoholotype of the monotypic genus *Colossolacis*. It was described in 1910 by Schrammen (p. 103, Pl. VIII, fig. 5, Pl. IX, figs. 1, 2; text plate v, fig. 1) from three specimens from the Quadratenkreide and Mucronatenkreide and from Misburg and Oberg. There is one fairly large fragment in the Museum showing the interior and exterior of the wall and the size and arrangement of ostia and postica. There is also a bottle of small fragments.

18319. **Rhoptrum scytaliforme** Schrammen (p. 104). COTYPES

This species is the genoholotype of Schrammen's monotypic genus *Rhoptrum*. The description is based upon four specimens from the Quad-

ratenkreide of Oberg (Schrammen 1910, p. 104, Pl. v, figs. 5-7; text plate v, fig. 2). There are in the Museum Collection two specimens, a third identified *affine* and a bottle containing a few spicules.

18320. **Phymaraphinia infundibuliformis** Schrammen (p. 105). COTYPES OR HEAUTOTYPES

This species was described as the genoholotype of the monotypic genus *Phymaraphinia* by Schrammen in 1901 (p. 9, Pl. I, figs. 6, 7, Pl. IV, fig. 8), the originals of the figured cotypes coming from the Mucronatenkreide of Misburg and the Quadratenkreide of Oberg and being now in the Roemer Museum. In 1910 (p. 105) Schrammen amplified the description figuring one new specimen from each of the two localities just mentioned (Pl. v, figs. 1, 2). It is impossible to determine whether the specimens in the collection are cotypes or heautotypes, for there is no way of telling whether they were of the original series or whether they were among the supplementary specimens collected by Schrammen after he wrote his description of the species.

18321. **Cycloclema compressa** (Hinde) (p. 105). PLESIOTYPES

This species was described as *Ragadinia compressa* by Hinde (1883, p. 82) from the Upper Chalk of Oare, and Huish, Wiltshire (Pl. XIX, figs. 3, 3*a*). Schrammen considers that this species cannot be regarded as a *Rhagadinia* "because the arms of the tetraclones around the osculum have circular elevations which the tetraclones in *Rhagadinia* never possess" (1910, p. 107). Schrammen has found the species at Misburg and Oberg in the Quadratenkreide and Mucronatenkreide and has figured a specimen from the Quadratenkreide of Oberg (Pl. v, figs. 3, 4; skeletal elements, text plate VI, fig. 5).

18322. **Procaliapsis clavata** (Hinde) (p. 108). PLESIOTYPE

This species was described by Hinde as *Ragadinia clavata* from the Upper Chalk of Wiltshire (1883, p. 84, Pl. XIX, figs. 4, 4*a*, 4*b*, 4*c*), the cotypes being in the Jermyn-Street Museum. In 1901 Schrammen (p. 7) erected the genus *Prokaliapsis*, with the species *cylindrica* as genoholotype. This species comes from the Quadratenkreide of Oberg and the Mucronatenkreide of Misburg, the figured holotype coming from the latter (Pl. I, fig. 5) and being now in the Roemer Museum. By the time of publication of the Monograph Schrammen had concluded that his species *P. cylindrica* was the same as Hinde's *Ragadinia clavata*, for which reason he accepted Hinde's specific name. Since, however,

the tetraclones in the central region are furnished with collar-like elevations such as never occur in *Ragadinia*, Schrammen did not follow Hinde in the generic designation.

18323. **Procaliapsis cretacea** Schrammen (p. 108). COTYPE

Schrammen in 1901 described, without illustrating, *Prokaliapsis cretacea* from the Quadratenkreide of Misburg. The type specimen is now in the Roemer Museum. Since Schrammen did not figure the specimen upon which he based his very brief (10 word) description of the species and since he did not state how many specimens he had, there is some doubt as to whether the protolog is to be considered as based on a holotype or cotypes. However, I have assumed that he had several specimens for he sent three to the Museum in 1903 and these were in all probability from the original series. Furthermore, since he neither figured nor designated a holotype it is unsafe to assume that he had one and I, therefore, am calling the specimens in the collection cotypes. That they are by no chance heautotypes is apparent from the fact that Schrammen sent them in the earlier collection to the Museum and also because in his Monograph he states that he has only two specimens upon which to base his fuller description.

In 1910 Schrammen figured some spicules from a specimen from the Quadraten of Oberg (text plate VI, fig. 2).

18324. **Astrocladia subramosa** (Roemer) (p. 111). HOMŒOTYPE

This species was described by Roemer in 1864 (p. 54, Pl. XIX, fig. 3) as *Asterospongia subramosa*, from the Quadraten marl of Sudmerberg [not "*Astrospongia* as given by Schrammen, 1910, p. 111]. Zittel in 1878 ('Studien,' II, p. 147) erected the genus *Astrocladia* for parts of *Asterospongia* and of several other genera. Griepenkerl reports the rare occurrence of this species in the Upper Quadraten of Glentorf (1888-1889, pp. 21, 22). Schrammen (1910, p. 111) has added Oberg and Misburg to localities already known and has figured two specimens from the Mucronatenkreide of Misburg (Pl. VI, figs. 4, 5, text plate VI, fig. 9).

18325. **Plinthosella squamosa** von Zittel (p. 114). PLESIOTYPE

This species was described by Zittel in 1878 ('Studien,' II, p. 153, Pl. II, fig. 10, Pl. X, fig. 5) from the Quadratenkreide of Ahlten and Linden in Hanover. In 1880 Hinde ('Sponge Spicules,' p. 56) described spicules of this genus and figured them (Pl. IV, figs. 35-46) from the Horstead flint nodule in the Upper Cretaceous of Norfolk, England. In

1883 (p. 85) he recorded the species from the Upper Chalk of the south of England, from Wiltshire and from Horstead, Norfolk. Počta reports (1884, p. 42) the finding in the Weissenberg beds of Renčov, Bohemia, fragments of a specimen which seems to fit Zittel's description. Schrammen (1910, pp. 114, 115) adds to the previous localities Oberg, Misburg, and Adenstedt and the higher horizon of the Mucronatenkreide. Počta claims that he has found in the sponge nodules of the Weissenberger Schichten, fragments of tetraclones which he supposes to be "those of *Plinthosella squamosa*"; this species, he adds, is not known to him from the equivalent beds of northwest Germany. Judging from the usual occurrence of this species, it would be classed as one of the smallest of the sponges, for it is about the size of a hazel-nut commonly, but at times it reaches a considerably greater size, Schrammen recording that he has seen one 3 cm. thick and 11 cm. broad. He has figured three specimens from the Quadratenkreide of Oberg (Pl. VI, figs. 7, 8, 9; skeletal elements, text plate VI, fig. 11).

18326. **Dactylotus micropelta** Schrammen (p. 115). COTYPE

This species was described by Schrammen from material from Oberg and Misburg, specimens from both localities having been figured (1910, Pl. VI, figs. 1-3; skeletal elements, text plate VI, fig. 8). There is thus no holotype and the nine specimens studied by Schrammen are all cotypes, one of those from Oberg being in the Museum Collection.

18327. **Geodiopsis microthrinax** Schrammen (p. 118). PARATYPE (Spicules)

Schrammen based his description of this species upon two specimens, one from the Mucronatenkreide of Misburg, one from the Quadratenkreide of Oberg (1910, p. 118). He gave no figure of an entire specimen of which, judging from the description, none is known, since only the skeletal elements are described and figured. The protograph is of spicules from the Quadratenkreide of Oberg (*loc. cit.*, text plate I, fig. 8). In the Museum Collection there is only a bottle of spicules.

18328. **Ophiraphidites cretaceus** von Zittel (p. 120).

In 1879 Zittel ('Studien,' III, p. 8) described this species from a specimen which had come from the Quadratenkreide of Linden near Hanover (protograph *loc. cit.*, Pl. XI, fig. 2), and which was in the Museum of the University of Göttingen. As Schrammen points out, the holotype and figured specimen of Zittel's description is only the frag-

ment of a stem, and while Schrammen has many similar specimens he is uncertain to what genus or species they belong (1910, p. 120). One such specimen is in the American Museum Collection.

18329. **Ophiraphidites annulatus** Schrammen (p. 120). PARATYPE

The description of this species is based upon eight specimens examined by Schrammen coming from the Cuvieri Pläner of Heere and from the Quadratenkreide of Heere and Oberg. The figured holotype is from the latter locality (1910, p. 120, Pl. XIV, fig. 9; skeletal elements, text plate VII, fig. 6). In the Museum Collection are two small broken fragments in a bottle.

18330. **Ophiraphidites cylindricus** Schrammen (p. 121). COTYPE OR HEAUTOTYPE

This species was described by Schrammen in 1899 (p. 5) from the Quadratenkreide of Oberg and Misburg and the Mucronatenkreide of Misburg at which time he figured a specimen from the Quadratenkreide of Oberg and one from the Quadratenkreide of Misburg (Pl. I, figs. 2, 3). When he published his Monograph Schrammen figured two other very beautiful specimens from the Quadratenkreide of Oberg (1910, p. 121, Pl. XIV, fig. 7, Pl. XVII, fig. 7), but the specimen in the collection is not one of those figured.

18331. **Ophiraphidites infundibuliformis** Schrammen (p. 121). COTYPE OR HEAUTOTYPE

This species was described in 1899 by Schrammen (p. 5) from the Quadratenkreide of Oberg and Misburg, both of the figured cotypes coming from the Quadratenkreide of Misburg (*loc. cit.*, Pl. I, fig. 1, Pl. II, fig. 6). In 1910 Schrammen (p. 121) more fully described the species and figured a specimen from the Quadratenkreide of Oberg (Pl. XIV, fig. 7, text plate VII, fig. 5).

18332. **Ophiraphidites tuberosus** Schrammen (p. 124). PARATYPE OR HEAUTOTYPE (Spicules)

This species was described from the Quadratenkreide of Oberg in 1899 (p. 5), the figured holotype being from that horizon and locality (Pl. II, fig. 5). Subsequently Schrammen found that the species also occurred in the Mucronatenkreide at Misburg and in 1910 he further described this form and figured another specimen from the Quadratenkreide of Oberg (1910, p. 124, Pl. XVII, fig. 8).

18333. **Cephaloraphidites milleporatus** Schrammen (p. 124). HOLOTYPE (Spicules)

This species was described by Schrammen from the Quadratenkreide of Oberg in 1899 (p. 9), two specimens having been found of which one was figured (*loc. cit.*, Pl. II, fig. 4). In his Monograph (pp. 124, 125) Schrammen states that there is only a single specimen, apparently having found that the other one belonged to another species. All that there is in the Museum Collection is a bottle with a few spicules in it. They presumably came from the holotype.

18334. **Cephaloraphidites cavernosus** Schrammen (p. 125). HOLOTYPE (Spicules)

This species was described by Schrammen from a fragment from the Quadratenkreide of Oberg (1899, p. 6) and the only figure that he gave was one of the spicules (Pl. III, fig. 4); subsequently he gave another illustration of the skeletal elements (1910, text plate VII, fig. 2). The holotype is now in the Hildesheim Museum and Schrammen has not succeeded in finding any other specimens (1910, p. 125). The few spicules in the collection must have come from the holotype.

18335. **Alloioraphium spongiosum** Schrammen (p. 126). METATYPE

In 1901 Schrammen (p. 17) described the new genus *Heteroraphidites* with the sole species and genoholotype *H. spongiosus*, from the Quadratenkreide of Oberg, the holotype being in the Roemer Museum (Pl. III, fig. 5, Pl. v, fig. 9). In 1910 Schrammen changed the generic name *Heteroraphidites* to *Alloioraphium* (the former thus becoming a synonym), because Ridley and Dendy had already used a name of similar sound in another family (i. e., Heteroraphidæ). *H. spongiosum* becomes, then, the genoholotype of *Alloioraphium* (1910, p. 126, text plate VII, fig. 4). Although Schrammen stated that the species was still in 1910 represented by only a single specimen, yet there is a specimen in the American Museum Collection labelled by him. This is not, however, the figured holotype which is in the Roemer Museum. Schrammen must therefore have overlooked the specimen sent to The Ameircan Museum of Natural History, and since it was not used by him in the literature it must be considered only a *metatype*, coming as it does from the type locality and horizon and having been identified by the nomenclator.

18336. **Polytretia seriatopora** Schrammen (p. 126). COTYPE (Spicules)

Schrammen based his description of this species (1910, p. 126) upon two specimens from the Quadratenkreide of Oberg, both of which

cotypes are figured (Pl. XIV, figs. 4-6; skeletal elements, text plate VII, fig. 8). In the Museum Collection is a bottle containing a few spicules which presumably came from one of the cotypes.

18337. **Megaloraphium auriforme** Schrammen (p. 124). COTYPE

This is the genoholotype of Schrammen's monotypic genus *Megaloraphium* and was described by Schrammen in 1910 (p. 27) from six specimens from the Quadratenkreide of Oberg, the three cotypes being figured on Plate XIV, figs. 1-3 (skeletal elements, text plate VII, fig. 7). In the Museum Collection is one specimen, a cotype, but not figured.

18338. **Helobrachium consecatum** Schrammen (p. 128). PARATYPE

This species is the genoholotype and sole species in the genus, and *Helobrachium* is the only genus thus far known in the family Helobrachiidæ. (See Schrammen 1910, pp. 127, 128.) Schrammen examined four specimens from the Quadratenkreide of Oberg in making the description, but figured only the skeletal elements (text plate VII, fig. 1).

18339. **Pachycothon giganteum** (Roemer) (p. 130). PLESIOTYPES

See No. 18183.

18340. **Rhizopsis horrida** Schrammen (p. 132). COTYPE

See No. 18215.

18341. **Verruculina tenuis** (Roemer) (p. 136). PLESIOTYPE

See No. 18217.

18342. **Verruculina seriatopora** (Roemer) (p. 141). PLESIOTYPE

Roemer described this species as *Manon seriatoporum* from the upper Kreidemergel of Sudmerberg, near Goslar, Hanover (1841, p. 3) and figured the holotype (Pl. I, fig. 6). In 1864 he placed it in Lamouroux's genus *Chenendopora* without adding to the protolog or figuring any new specimens (1864, p. 43).

In 1878 Zittel made *Manon seriatoporum* the genoholotype of *Verruculina* and figured part of the surface and the skeletal elements from specimens from the Mucronatenkreide of Ahlten (1878*c*, p. 123, Pl. IV, figs. 1*a*, *b*).

Hinde doubtfully referred a fragment of a sponge in the British Museum to *V. seriatopora* (Roemer) and figured some of the spicules

(1883, Pl. III, fig. 4). The specimen came from Zittel's Collection and was from the Upper Chalk of Sudmerberg, the type locality for Roemer's species.

Schrammen gave a further description of *V. seriatopora* and a long synonymy in which he included a number of other species. The geological range which he recorded was long, extending from the Scaphites Pläner through the lower Mucronatenkreide. The localities which he listed were Nettlingen, Sudmerberg, Misburg, Oberg, Adenstedt, Boimsdorf, Biewende (1910, pp. 141, 142). He figured a single specimen from the Quadratenkreide of Oberg (Pl. XXI, fig. 1) and some spicules from a specimen from the Mucronatenkreide of Misburg (text plate VIII, fig. 5).

In the Schrammen synonymy of *V. seriatopora* are included Roemer's *Manon distans*, described from the upper Kreidemergel of Goslar but not figured (Roemer, 1841, p. 3), and *Verruculina distans* Roemer of Zittel which was generically revised by the latter author without comment or specific description (1878c, p. 123). Since Schrammen had Roemer's types and since there is nothing in the literature but Roemer's brief description, and furthermore, since Roemer himself did not mention the species in his 1864 Monograph, we may feel fairly safe in accepting Schrammen's dictum in the matter.

In 1864 Roemer described, from the Quadratenkreide of the Ihme near Hanover and of Sudmerberg, a sponge which he called *Chenendopora aurita* (1864, p. 43, protograph, Pl. XVI, fig. 2). As a synonym of this species he included *Manon phillipsi* Reuss (1845-1846, p. 77, Pl. XIX, figs. 7, 8, 9) from the Unterer Plänerkalk of Schillinge near Bilin, Bohemia. Počta has revived *Verruculina phillipsi* (Reuss) to independent rank again and has included under that species *Chenendopora aurita* Roemer, which would be permissible by the laws of priority it if were certain that Roemer's species is the same as the one described by Reuss. This is to be doubted, for Počta says (1884, p. 22) that *Manon micrommatum* Roemer differs in no essential characteristic from *Verruculina phillipsi* (Reuss). Because of this statement Schrammen has included *V. phillipsi* (Reuss) in the synonymy of *Verruculina micrommata* and not in that of *V. seriatopora*. But Schrammen puts Roemer's *Chenendopora aurita* in the synonymy of *V. seriatopora* and along with it *Verruculina aurita* Roemer as listed by Zittel (1878c, p. 123). If Schrammen's decision regarding *C. aurita* Roemer be accepted, then all later references to that species are also to be included in the synonymy of *V. seriatopora*. Thus, Griepenkerl identified as *Verruculina aurita* (Roemer) a fragment which came from the Quadraten of Glentorf,

Braunschweig, (1888-1889, p. 16), and Wollemann twice referred to this species as occurring in the Senonian of Gr. and Kl. Biewende, Braunschweig, (1901, p. 5; 1902*b*, p. 58). Schrammen himself, even, at first considered *V. aurita* as a distinct species and listed it from the Quadraten and Mucronaten of Oberg and Misburg in 1901 (p. 21).

Zittel twice figured a species which he called *Verruculina auriformis* (Roemer) and which he cited from the Quadratenkreide of Linden near Hanover (1880, p. 153, fig. 68; 1895, p. 51, fig. 68). Under what genus Roemer originally described this species, I have been unable to find, for there is no species by that name under *Manon* in 1841 nor under *Chenendopora* in 1864. I have not come across the Roemer reference in any synonymy and Schrammen himself did not know it. The *V. auriformis* figured by Zittel is undoubtedly a *V. seriatopora* for which reason the two Zittel references have been included in the synonymy of the latter species.

Hinde described an abundant form in the Upper Chalk of Flamborough, Yorkshire and of Sudmerberg, Hanover, as *Verruculina plicata* (1883, p. 36, protograph, Pl. IV, figs. 2, 2*a*, *b*, *c*, *d*). He states that this species is distinguished from *V. seriatopora* (Roemer) "in the absence of a linear arrangement and the smaller size of the oscules, and also by the pores of the under surface" (1883, p. 37). However, in his description of *V. seriatopora*, he notes that the oscules (i. e., postica) are only "partly disposed" in linear arrangement, while this feature of linearity was not mentioned in the protolog nor yet in Schrammen's amplified description. Therefore, the arrangement of the postica in lines seems not to be an essential characteristic of *V. seriatopora*. Hinde lays great stress upon the presence of the "thick-set minute pores, 0.3 mm. each in width" on the outer surface of the wall in *V. plicata*. In his notes on *V. seriatopora* he states that the specimen in the British Museum is "not sufficiently free from the matrix to show if pores are present or not" (1883, p. 36). As a matter of fact, fine pores (ostia) are present on the outer surface of *V. seriatopora*, as is brought out by Schrammen in his description of the species. From these considerations, it is apparent that the very characteristics mentioned by Hinde as constituting distinguishing features of *V. plicata* are actually diagnostic of *V. seriatopora*, for which reason Schrammen was justified in placing the former in the synonymy of the latter.

18343. **Verruculina cupula** Schrammen (p. 142). COTYPES

The species name *cupula* is proposed by Schrammen for the form designated by Phillips *Spongia*, later *Chenendopora marginata* and

credited by several authors to him. Michelin described from several localities in France a form which he called *Chenendopora marginata* (1840-1847, p. 129) and he figured the holotype (Pl. XXVIII, fig. 7). He considered *Spongia marginata* Phillips as synonymous with his species, but did not give Phillips the credit for the specific name, a thing which he was not required to do, since Phillips had not described the species and had given only a very sketchy illustration of it. Roemer accepted Michelin's nomenclature and identified specimens from the Quadratenkreide of Peine, Hanover as *Chenendopora marginata* (1864, p. 42). Zittel later placed this species in his genus *Verruculina* (1878*c*, II, p. 123) and Griepenkerl (1888-1889, p. 16), Wollemann (1901, p. 4) and, in his early work, Schrammen (1901, p. 21) followed Zittel in this revision. It was not until 1910 that Schrammen proposed the name *cupula* for this species, the *marginata* of authors (p. 142). This he did because he found that this species was, as Zittel stated, a *Verruculina* and yet it did not correspond to the forms designated *Spongia marginata* by Phillips which is also a *Verruculina*. It was necessary, therefore, for Schrammen to assign a new name to the German forms, for which reason he proposed the name *cupula* which is to be used *not* for Phillips' *Spongia marginata*, but for the *Chenendopora marginata* of Roemer and the *Verruculina marginata* of Zittel, Griepenkerl, Wollemann, Schrammen (1901) *et al.* The specimen in The American Museum of Natural History is unusually fine, showing a large number of the "roots," while the arrangement of the ostia is clearly visible and the large elevated postica may be seen on the inside.

Schrammen records this species from Misburg and Oberg from the Quadraten and the lower Mucronatenkreide. Since he does not give any illustrations or select a holotype, the eight specimens which he examined, of which two are in the collection, are all cotypes. They are plesiotypes of Roemer's *Chenendopora marginata*.

18344. **Scytalia radiciformis** (Phillips) (p. 151). PLESIOTYPES

This species was described by Phillips in the first edition of the *Geology of Yorkshire* (1829) as *Spongia radiciformis;* in the third edition (1874) the generic name was changed to *Hippalimus* in acceptance of the revision made by D'Orbigny (1850, 'Prodrome,' II, p. 286). Zittel in 1878 ('Studien,' II, p. 128) placed the species under his genus *Scytalia*. Hinde in his Catalogue (p. 44) accepts Zittel's revision and figures a specimen (Pl. VI, figs. 4, 4*a*, *b*) from the Upper Chalk of Flamborough where this species "appears to be common."

In 1864 Roemer described and figured a species from the Cuvierikreide of Vorberg near Steinlah and from the Quadratenkreide between Sottmar and Gr. Biewende calling the form *Eudea annulata* (1864, p. 26, Pl. XI, fig. 2). Zittel placed this species in his genus *Scytalia* (1878*c*, p. 128, Pl. v, fig. 4) and Hinde, accepting the generic revision, went one step further and included *S. annulata* under *S. radiciformis*, without, however, stating his reasons. Wollemann in 1901, either ignorant of or ignoring Hinde's revision, identifies specimens as *Scytalia annulata* from Gr. and Kl. Biewende (1901, p. 5). Schrammen correctly calls the species *Scytalia radiciformis* and lists Misburg, Oberg, and Adenstedt among the new localities (1910, p. 151) figuring a specimen from the Quadratenkreide of Oberg (Pl. XXI, fig. 2).

18345. **Leiochonia cryptoporosa** Schrammen (p. 160). COTYPE OR HEAUTOTYPE

This species was described by Schrammen in 1901 (p. 16) for certain sponges from the Quadraten of Misburg and Oberg and the Mucronatenkreide of Misburg. The protograph is the figure of a single spicule, a rhizoclone (1901, Pl. v, fig. 6) which Schrammen states is now in the Roemer Museum. From the protolog it is evident that he had entire or at least fragmentary specimens, but at the time he figured none. In his Monograph Schrammen gives the first figures of the species (Pl. XXI, figs. 4, 5), these being of a specimen from Oberg. Schrammen includes in his synonymy, though with a question, Courtiller's species *Platispongia discus*, which had been briefly described from the Senonian of Saumur in Maine-et-Loire, and figured (Courtiller, 1859, p. 139, Pl. XXXVIII, fig. 1).

18346. **Chonella tenuis** (Roemer) (p. 161). PLESIOTYPES

This species was described by Roemer (1864, p. 51, Pl. XVII, fig. 7) as *Cupulospongia tenuis* from the Quadratenkreide of the Ihme in Hanover. Zittel (1878*c*, 'Studien,' II, p. 116) proposed the name *Chonella* for a part of D'Orbigny's *Cupulospongia* and for parts of a large number of other genera and included herein Roemer's species of *tenuis*. Hinde (1883, p. 31) gives the distribution as in the Upper Chalk of Sudmerberg, Biewende and Brunswick. To these localities Schrammen (1910, p. 161) adds Linden, Misburg, Oberg, Nettlingen, and Adenstedt, figuring a specimen from the Quadratenkreide of Oberg (Pl. XXI, fig. 6). Though widespread and having a great geological range—from the Scaphites beds through the Mucronatenkreide—the species appears not

to be abundant, for Schrammen has examined only eight specimens. There are two in the Museum Collection from Misburg, one of which shows the skeletal elements on the surface in great perfection.

18347. **Chonella auriformis** (Roemer) (p. 161). HOMŒOTYPE
See No. 18223.

18348. Cf. **Coscinostoma auricula** Schrammen (p. 163).

Schrammen described this species in 1910 (p. 163, Pl. XXI, fig. 8) from four specimens from the Mucronatenkreide of Misburg. This specimen from Oberg is identified only *confer* and is included with the type material solely because it is the only representative of the genus from Oberg. (For fuller notes see No. 18525).

18349. **Seliscothon planum** (Phillips) (p. 163). PLESIOTYPE
See No. 18224.

18350. **Seliscothon mantelli** (Goldfuss) (p. 165). PLESIOTYPES

Goldfuss described this species from the Green Chalk of Coesfeld, Westphalia, in 1826 ('Petrefacta Germaniæ,' p. 219, Pl. LXV, fig. 5) calling it *Scyphia mantelli*. D'Orbigny placed the species in his genus *Cupulospongia*, citing it from Goslar and Coesfeld. (Number 1528 in D'Orbigny's 'Prodrome de Paléontologie,' 1850, p. 288). Roemer (1864, p. 50, Pl. XVIII, fig. 6) mentions and figures a specimen from Sudmerberg, calling it *Cupulospongia mantelli*. Quenstedt (p. 375) reverts to the original designation by Goldfuss and reports *Scyphia mantelli* from "Schweinsberge" where the same sandy facies of the Upper Cretaceous is developed as at Sudmerberg. In 1880 Zittel ('Studien,' II, p. 117) proposed the name *Seliscothon* for *Scyphia* of Goldfuss and parts of genera of other authors. Wollemann ('Senon von Biewende,' 1900, p. 4) has identified two broken specimens from Grosse Biewende as *Seliscothon roemeri* (Pomel).

18351. **Regadrella petri-jacobi** Schrammen (p. 208). COTYPES

Schrammen founded this species upon six specimens examined by him from the Quadratenkreide of Oberg (1910, p .208). Of the six specimens he figured four (Pl. XXVII, figs. 9-11, Pl. XXXI, fig. 2; skeletal elements, text plate XI, fig. 4) apparently failing to figure only the two specimens in the Museum Collection.

18352. **Farrea clarkii** Schrammen (p. 120). COTYPE

This species was described by Schrammen in 1910 from four specimens from the Quadratenkreide of Oberg. Three of these he figured (Pl. XXVIII, figs. 5, 6, 7) and the fourth is in the American Museum Collection.

18353. **Farrea halli** Schrammen (p. 210). COTYPES

Schrammen described this species from three specimens from the Quadratenkreide of Oberg in 1910 and figured two of the specimens (Pl. XXVIII, fig. 4; Pl. XL, fig. 9; skeletal elements, Pl. XLIV, fig. 5, text plate XIX, fig. 10). In the American Museum Collection is one fragmentary specimen and there is also a bottle containing three broken pieces.

18354. **Eurete rauffi** Schrammen (p. 211). COTYPE

This species was described by Schrammen in 1910 from six specimens from the Quadratenkreide of Oberg. He figured two of the cotypes (Pl. XXVIII, figs. 8, 9). The specimen in the Museum Collection being very similar to, but not the one illustrated in, Fig. 9. The skeletal elements Schrammen illustrated on Pl. XLIV, figs. 3, 4 and on text plate XII, fig. 7.

18355. **Periphragella plicata** Schrammen (p. 214). HEAUTOTYPES

In 1902 Schrammen founded the genus *Proeurete* with the genoholotype and sole species *P. plicata* from the Quadratenkreide of Oberg (p. 22). The species was founded upon a single specimen, now in the Roemer Museum, which was figured by Schrammen at the time of description (1902, Pl. I, fig. 6). In 1910 (p. 214) Schrammen, without stating his reason, places the species *plicata* under Marshall's genus *Periphragella*, thus depriving the monotypic *Proeurete* of its genotype and leaving it a *nomen nudum*. He figures other specimens (Pl. XXV, figs. 3 and 4; skeletal elements, Pl. XLIV, figs. 1, 2, and text plate XII, figs. 2, 3) stating that he has examined eleven altogether. While there are five excellent specimens in the Museum Collection and one bottle of fragments, not one is figured, although several are better than those illustrated by Schrammen.

18356. **Chonelasma hindii** Schrammen (p. 217). PARATYPE

This species was described by Schrammen in 1910 from four specimens from the Quadratenkreide of Oberg, one of which he figured (Pl.

XXVIII, figs. 1, 2; skeletal elements, Pl. XLII, fig. 3, text plate XII, fig. 1). In the American Museum Collection is a bottle full of fragments.

18357. **Aphrocallistes alveolites** (Roemer) (p. 219). PLESIOTYPES

From Peine, Hanover, Roemer described and figured *Scyphia alveolites* (1841, p. 8, Pl. III, fig. 6). Zittel in the first of his "Studies" listed Roemer's species under Gray's genus *Aphrocallistes* (1878*b*, I, p. 49). Hinde identified, not without some question, two small sponge fragments from the Upper Chalk of the South of England as *A. alveolites* (1883, p. 106) and Wollemann identified, as the same species, forms coming from the Senonian of Kl. Biewende, Braunschweig, (1901, p. 8, 1902*b*, p. 58) and from the *Heteroceras* zone of the Mucronatenkreide at Zeltberg, near Lüneberg, Hanover (1902*a*, p. 8). Schrammen has collected this species from the Mucronatenkreide of Misburg and the Quadratenkreide of Oberg, figuring four from the latter locality (1910, p. 219, Pl. XXV, figs. 8, 9, 10; Pl. XXXI, fig. 3; skeletal elements, text plate XI, fig. 5). There are nine specimens in the Museum Collection, but not one is figured.

18358. **Aphrocallistes cylindrodactylus** Schrammen (p. 220). PARATYPES

This species was described by Schrammen in 1910 from four specimens coming from the Quadratenkreide and Mucronatenkreide of Oberg and Misburg, the figured holotype being from the latter locality (1910, text fig. 1). There are two specimens in the collection, but neither is the figured one.

18359. **Hexactinella angustata** Schrammen (p. 223). COTYPES OR HEAUTOTYPES

In 1902 (p. 26) Schrammen described a species *angustata* as the genoholotype of *Polyopesia*. The holotype is a small specimen from the Quadratenkreide of Oberg, figured on Plate II, fig. 1, and is now in the Roemer Museum. At the same time Schrammen described a second species *Polyopesia radiciformis* from the Mucronatenkreide of Misburg (p. 26) and figured it on Plate III, fig. 4. When he came to publish his Monograph he placed both of these species under Carter's genus *Hexactinella* (1910, p. 223, Pl. XXVI, figs. 6, 7, 10; text plate XI, fig. 8) which he emended. In his synonymy of *Hexactinella angustata* he included *P. radiciformis*, thus leaving *Polyopesia* a *nomen nudum*. He fails to state his reason for abandoning the generic name *Polyopesia* but it must be noted that in 1902 his determinations and classification

were rather of a provisional nature and that he was then in doubt about which tribe to place the family Craticularidæ Rauff in, this being the family to which he had assigned the genus *Polyopesia*. In 1910 he made use of F. E. Schulze's family Tretocalycidæ under which he separated two genera by restriction, *Hexactinella* of Carter, and Schulze's *Tretodyctium*, the former being characterized by anastomosing tubes with irregular canals, the latter by a more or less regularly developed canal system. In 1910 Schrammen was able to extend the geological range of the species down as low as the Cuvieri Pläner, because of occurrences in Heere. He figured three specimens from the Quadratenkreide of Oberg (Pl. XXVI, figs. 6, 7, 10) and the skeletal elements (text plate XI, fig. 8).

18360. **Hexactinella lævis** Schrammen (p. 224). PARATYPES

From four specimens from the Quadratenkreide of Oberg Schrammen described this species in 1910, and figured one of them (Pl. XXVI, fig. 5; skeletal elements, Pl. XLII, fig. 5). There are three specimens in the Museum Collection, probably the three paratypes which were not figured.

18361. **Auloplax spongiosus** Schrammen (p. 230). COTYPE (?)

Schrammen gave this name in 1910 to two specimens from the Quadratenkreide of Oberg, both of which he figured natural size and twice enlarged (*loc. cit.*, Pl. XXIX, figs. 7, 8, 9, 10; skeletal elements, text plate IX, fig. 10). In the Museum Collection is a bottle containing two small fragments and some spicules, presumably from one of the cotypes.

18362. **Stereochlamis præcissa** Schrammen (p. 231). PARATYPE

Stereochlamis præcissa is one of three genosyntypes described by Schrammen in 1910 (p. 231). It comes from the Kalkmergel of the Quadratenkreide of Oberg where Schrammen had collected two specimens, one of which he figured natural size and twice enlarged (Pl. XXIX, figs. 5 and 6; skeletal elements, text plate X, fig. 10). The specimen in the collection is a fragment of the sponge wall showing inner and outer surfaces. The ostia are markedly aligned in vertical rows not obscurely so, as Schrammen states (*loc. cit.*, p. 231). Furthermore, the ostia and postica are much smaller than the dimensions given by Schrammen indicate, while the curvature of the fragment of the wall suggests a much smaller individual than is figured in the protograph. One would hesitate to call the specimen in the collection *Stereochlamis præcissa*

did it not bear Schrammen's label; certainly one could not identify it as such from a study of the protolog and protograph. Presumably, the specimen in the Museum is a paratype, since it is not the holotype and since Schrammen stated that he had examined only two specimens.

18363. **Craticularia virgatula** Schrammen (p. 234). PARATYPES OR METATYPES

Schrammen based his description of this species upon three specimens from the Quadratenkreide of Oberg (1910, p. 234), one of which he figured (Pl. XXX, fig. 1; skeletal elements, Pl. XLIII, fig. 3, text plate XI, fig. 9). In the Museum Collection are four specimens which Schrammen either had at the time he wrote his description and which he overlooked or else he collected them subsequently and they are simply metatypes.

18364. **Leptophragma murchisoni** Goldfuss (p. 235). PLESIOTYPE

See No. 18532.

18365. **Leptophragma murchisoni** Goldfuss var. **minor** Schrammen. HOLOTYPE

One of the three specimens of *Leptophragma murchisoni* in the Museum Collection is labelled variety *minor*. This belongs to the group called by Schrammen cf. *Leptophragma murchisoni*, a designation which he used for certain small forms which he was in doubt whether to consider as a small variety of *L. murchisoni* or as young stages of the species. It is here proposed to put in print the name which Schrammen applied to the species in labelling the specimen. (This specimen, thus, is a chirotype which is now being raised to the rank of a holotype.) He figured one of these young forms twice enlarged on Pl. XXXII (figs. 1, 2) from the Quadratenkreide of Oberg.

18366. **Leptophragma pusillum** Schrammen (p. 236). PARATYPES OR HEAUTOTYPES

This species is one of the smallest Hexactinellas occurring in Hanover and was described by Schrammen in 1902 (p. 22) from the Quadratenkreide of Oberg and Misburg, the holotype, figured on Pl. III, fig. 6, being now in the Roemer Museum. In 1910 he figured two more specimens (Pl. XXXII, figs. 6, 7 and the skeletal elements, Pl. XLIII, fig. 1, text plate IX, fig. 2) and further described the species (p. 236). It is confined to the Quadratenkreide of Oberg. The three

specimens in the American Museum Collection are either paratypes if belonging to the original series, or heautotypes if from the material subsequently found by Schrammen and used in amplifying his description in 1910.

18367. **Leptophragma micropora** Schrammen (p. 237). COTYPE

This is a species of wide geological range occurring in the clays of the Granulatenkreide and up through the Mucronatenkreide. Schrammen lists its occurrence at Broitzem near Braunschweig, whence one of the figured cotypes came (1910, Pl. XXXII, fig. 5), from Misburg, Oberg (whence the second figured cotype, *loc. cit.*, Pl. XXXII, fig. 4) and Ahlten. He described the species in 1910 (Monograph, p. 237).

18368. **Pleurostoma radiata** Roemer (p. 238). PLESIOTYPE

From the Untere Kreide of Theidensen, near Peine, Hanover, Roemer described this species in 1841 (p. 5) and figured the holotype (Pl. I, fig. 11). Zittel listed it in the first of his 'Studies' (1878*b*, p. 48) and Hinde recorded the presence in T. Smith's collection of representatives of this species from the Upper Chalk of the South of England (1883, p. 103). Griepenkerl found in the Quadraten of Boimstorf, Braunschweig, one specimen which he identified with Roemer's species (1888-1889, p. 22). Schrammen has found this form in the Quadratenkreide of Misburg and Oberg, from the latter of which he has figured two specimens (1910, p. 238, Pl. XXXIII, figs. 1-3).

18369. **Pleurostoma dichotoma** Schrammen (p. 239). IDIOTYPE

In 1902 Schrammen described the genus *Typhlopleura* with *T. dichotoma* as the genoholotype and sole species (1902, p. 24). The holotype of the species was figured by Schrammen (Pl. I, fig. 3) and came from the Mucronatenkreide of Misburg. It is now in the Roemer Museum. In his Monograph Schrammen practically repeated the protolog (1910, p. 239) and he reproduced the protograph, placing the species in Roemer's genus *Pleurostoma* and thereby leaving *Typhlopleura* a *nomen nudum*. There is in the collection a specimen from a purchase made in 1903, and it is labelled *Typhlopleura dichotoma*. It is rather surprising that Schrammen made no record in print of the occurrence of the form in the Quadratenkreide and at Oberg, but he expressly states that he had examined only three specimens from the Quadratenkreide of Oberg. The single specimen in the collection is, therefore, to be regarded as an idiotype.

18370. **Guettardia stümpeli** Schrammen (p. 240). PARATYPES OR HEAUTOTYPES

The holotype of this species, now in the Roemer Museum, is a specimen from the Quadratenkreide of Oberg described by Schrammen in 1902 (p. 22) and figured on Plate IV, fig. 3. At that time he mentioned its occurrence at Misburg also in the Quadratenkreide. In his Monograph (1910, pp. 240-41), however, Schrammen failed to give Misburg among the localities for this species, but figured another much more complete specimen than the holotype from the Quadratenkreide of Oberg (Pl. XXX, fig. 9; skeletal elements, text plate IX, fig. 3). The specimens in the collection are paratypes if from the original series, heautotypes if from the subsequent collections by Schrammen.

18371. **Andreæa hexagonalis** Schrammen (p. 243). HEAUTOTYPES

This species is the genoholotype of, and sole species in the genus *Andreæa*[1] described by Schrammen in 1902 (p. 25). At that time he had a single specimen from the Quadratenkreide of Misburg which he figured (*loc. cit.*, Pl. I, fig. 4) and which is now in the Roemer Museum. By 1910 he had found three more specimens, one of which from Oberg, he figured (Pl. XXV, figs. 2 and 3; skeletal elements, text plate XI, fig. 7). The protograph is reproduced on Pl. XXV in fig. 4.

18372. **Callibrochis senonensis** Schrammen (p. 246). HEAUTOTYPE

In 1902 (p. 19) Schrammen erected the new family Eubrochidæ, under the tribe Hexasterophora, with the sole genus *Eubrochis* Schrammen containing the single species, the genoholotype, *E. senonica* Schrammen, which in turn was founded upon a single specimen from the Quadratenkreide of Oberg, now in the Roemer Museum. In 1910 (Monograph, p. 246) Schrammen, having found that the generic name *Eubrochis* had already been used, proposed *Callibrochis* and changed the family name Eubrochidæ to Callibrochidæ so that *senonica* became the genoholotype for *Callibrochis*. By 1910 he had examined two more specimens from the Quadratenkreide of Oberg, one of which he figures (Pl. XXVII, fig. 1; skeletal elements, Pl. XLI, fig. 6, text plate X, figs. 2 and 3). The specimen in the Museum Collection consists of two small fragments which are from a heautotype.

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[1]This generic name has been used for a genus of moss and the family name Andreæadæ proposed by Schrammen has been used for a family of mosses. Since the names are employed in groups so distinct as mosses and sponges it seems unnecessary to propose new generic and family names, although the strictest usage in nomenclature would require such a procedure.

18373. **Wollemannia araneosa** Schrammen (p. 247). PARATYPES

In 1910 Schrammen (p. 247) described the new genus *Wollemannia* with *araneosa* as the genoholotype and only species of the genus. He had examined three specimens from the Quadratenkreide of Oberg and had figured one of them (Pl. XXVII, fig. 2; skeletal elements, Pl. XLI, fig. 5, text plate x, figs. 4, 5, 6). There are two specimens in the Museum Collection, neither of which is figured, so that they are the two paratypes.

18374. **Pleurochorium schulzii** Schrammen (p. 251). COTYPE

This is the genoholotype and only species of *Pleurochorium* Schrammen, described in 1910 (p. 251) from seven specimens from the Quadratenkreide of Oberg, three of which are figured (*loc. cit.*, Pl. XXVII, figs. 3, 4, 5; skeletal elements, Pl. XLI, figs. 1, 2, text plate x, fig. 8).

18375. **Ptychodesia papillata** Schrammen (p. 252). PARATYPES

In 1910 Schrammen described the new family Ptychodesidæ for Cretacic and living forms, with the sole genus *Ptychodesia* and the genoholotype *P. papillata* (p. 252). The description was based upon four specimens examined by Schrammen from the Quadratenkreide of Oberg, one of which, the holotype, is figured (*loc. cit.*, Pl. XXX, fig. 4; skeletal elements, Pl. XLIII, fig. 5, text plate XI, fig. 2). The two specimens in the collection are paratypes.

18376. **Polystigmatium striato-punctatum** Schrammen (p. 254). METATYPES

This species is the genoholotype of *Polystigmatium* and the only species thus far known in it. It was described by Schrammen in 1910 (p. 254) from two specimens from the Quadratenkreide of Oberg, both of which are figured (*loc. cit.*, Pl. XXXII, figs. 8, 9; skeletal elements, Pl. XLII, fig. 2, text plate x, fig. 11). Strangely enough there are four specimens in the Museum Collection, some of which are as good as, if not better than, the figured ones, but none of them is figured, yet Schrammen states that he had examined only two specimens; therefore the four in the Museum are metatypes.

18377. **Stichmaptyx alatus** Schrammen (p. 255). METATYPE

This species is the genoholotype of, and sole species in, the genus *Stichmaptyx* described by Schrammen in 1910 (p. 255) from two specimens from the Quadratenkreide of Oberg, both of which he figured (Pl.

xxx, figs. 2, 3; skeletal elements, Pl. xliii, fig. 8, text plate ix, fig. 8). There is one specimen in the Museum Collection and, since it is not one of the two figured cotypes, it is a metatype.

18378. **Balantionella elegans** Schrammen (p. 261). COTYPE OR HEAUTOTYPE

In 1902 Schrammen (p. 23) erected the genus *Balantionella* for the single species and genoholotype *B. elegans* from the Quadratenkreide of Misburg and Oberg. Of the figured cotypes, one is from Misburg (Pl. iv, fig. 1*a*), two are from Oberg (1*b*, 1*c*). These cotypes are in the Roemer Museum. In 1910 Schrammen further described the species (p. 261) and figured the skeletal elements (Pl. xlii, fig. 6, text plate ix, fig. 7). He also reproduced the figures of the cotypes from Oberg. The four fragments in the collection are cotypes if belonging to the original series, but heautotypes if belonging to the supplementary material.

18379. **Ventriculites radiatus** Mantell. PLESIOTYPE

See No. 18191 for discussion of *V. radiatus*.

18380. **Ventriculites radiatus** Mantell mut. **posterus** Schrammen. CHIROTYPE

This mutation is represented by two exceptionally perfect specimens of stems and by three small fragments of the wall. The larger of the two stems is 15 cm. in length and 5 cm. in thickness. The ostia are arranged in strikingly unbroken linearity as shown in Fig. 1 on Plate xxxvi in Schrammen's Monograph. The ostia are, however, very much larger than are there indicated, reaching almost the maxima in dimensions given by Schrammen, for they are 5 mm. long and from 1.5 to 2 mm. wide.

The three small fragments show every detail of structure for the inner and outer surface of the wall, the position of the epirhyza and aporhyza and the form of the ostia and postica. In the thinness of wall, smaller size of the ostia and postica, and their arrangement, these fragments fit the description of *Ventriculites radiatus* Mantell var. *minor* Schrammen, described from three specimens from the Quadratenkreide of Oberg and Misburg (Schrammen, 1910, p. 266). It is to be regretted that Schrammen did not figure this variety. The large specimen of the stem labelled var. *posterus* does not fit the description of var. *minor*.

Here, as in the case of the other chirotypes, it seems best to retain Schrammen's manuscript name until future work on the spicules can be done or until more illustrations of Schrammen's holotypes appear in print.

18381. **Ventriculites stellatus** Schrammen (p. 267). HEAUTOTYPE

Schrammen described this species in 1902 (p. 11) from the Quadratenkreide of Misburg, figuring the holotype (Pl. III, fig. 5) which is now in the Roemer Museum. In 1910 he further described the species, reproducing the protograph (Pl. XXXVII, fig. 4), and gave in addition the figure of a specimen from Oberg (Pl. XXXVII, fig. 5) with which, however, the specimen in the American Museum Collection does not agree. It is, therefore, a heautotype.

18382. **Lepidospongia rugosa** Schlüter (p. 269). PLESIOTYPES

This species was named and briefly described by Schlüter, in 1870, when he gave a paper before the Niederrheinische Gesellschaft in Bonn (see Sitzungsberichte of same for 1870, p. 139), and was mentioned again two years later in his longer paper and there figured (1872, p. 27, Pl. I, figs. 1-4). This species has given the name of the zone of *L. rugosa* to the lower Mucronaten beds of Münsterland. Schlüter mentions, as localities where the species is abundant, Coesfeld and Osterwick.

In 1902 (p. 11) Schrammen described the species *Lepidospongia brandesi* for certain forms which he considered differed mainly from *L. rugosa* in their more delicate structure and "in the possession of finer ribs." Also, the two were found at different horizons, *L. brandesi* occurring in the older beds of the Quadratenkreide with *Micraster glyphus* and *Offaster pilula*, while it was unknown to Schrammen in the Mucronatenkreide. On the other hand, *L. rugosa* he thought appeared for the first time in the Hanover Chalk in the boundary beds between the Quadratenkreide and Mucronatenkreide of Adenstedt and extended upward into the Misburg Chalk. He corrected the statement which he had made in a foot-note in his first Roemer Museum paper (1899, p. 3) in which he had stated that he knew *L. rugosa* from the Quadratenkreide of Misburg, accounting for the error as due to a cursory identification of forms as *L. rugosa* which were really *L. brandesi*. The two cotypes of *L. brandesi* are figured (1902, Pl. III, figs. 1, 2) and come from the Quadratenkreide of Misburg. By the time Schrammen published his Monograph he had come to the conclusion that the features which he had previously considered of specific rank were not so in reality and he included *L. brandesi* in his synonymy of *L. rugosa*, stating that the former differed from the latter only "in the thinner walls, finer longitudinal ribs on the outside and smaller siliceous scales on the inside" (p. 269). In the Monograph, Schrammen has given a more complete description of *L. rugosa* and has figured two new specimens from the Quadraten-

kreide of Misburg (Pl. xxxv, figs. 7, 8; skeletal elements, text plate xiii, fig. 2). There are five specimens from the Quadratenkreide of Oberg in the Museum Collection.

18383. **Lepidospongia fragilis** Schrammen (p. 269). COTYPES OR HEAUTOTYPES

In 1902 Schrammen erected the genus *Plectodermatium* with the species *P. fragile* as the genoholotype (1902, pp. 12, 13). This he described from the Quadratenkreide of Misburg and Oberg and the Mucronatenkreide of Misburg, figuring the two cotypes on Pl. iv, figs. 4*a* and *b*, the first cotype being from the Quadratenkreide of Misburg, the second from the Mucronatenkreide of Misburg, both of which are now in the Roemer Museum. Without stating his reason, Schrammen, in 1910, placed this species under *Lepidospongia* (Monograph, p. 270), the genus *Plectodermatium, ipse facto*, becoming a *nomen nudum*. In further illustrating the species he figured only the skeletal elements (Pl. xlv, fig. 6; text plate xiii, fig. 1). The two specimens in the collection may be either cotypes, or heautotypes.

18384. **Rhizopterion solidum** Schrammen (p. 271). PARATYPES

This species was described by Schrammen in 1910 from eight specimens from the Quadratenkreide of Misburg and Oberg. The figured holotype is from the Quadratenkreide of Oberg (*loc. cit.*, Pl. xxxiv, fig. 6; skeletal elements, text plate xiii, fig. 8, text plate xiv, fig. 8).

18385. **Napæa striata** Schrammen (p. 273). PARATYPES OR HEAUTOTYPES

In 1902 Schrammen made the new genus *Eudictyon* and described from the Quadratenkreide of Misburg and Oberg two species *E. striatum*, the genoholotype and *E. diagonale* ('Hexactinelliden,' pp. 15, 16). The originals are in the Roemer Museum. The holotype of the first species is from the Quadratenkreide of Misburg (*loc. cit.*, Pl. ii, fig. 5), that of the second species also from the Quadratenkreide of Misburg (*loc. cit.*, Pl. i, fig. 5). By the time that he published his Monograph he had found that the name *Eudictyon* had already been preëmpted; he therefore proposed the new generic name *Napœa* and he furthermore placed both of the former species of *Eudictyon* under *N. striata*, although he fails to give his reasons (1910, p. 273). The holotype of *Eudictyon striatum* becomes the holotype of *Napœa striata*, and the protograph of *E. striatum* becomes the protograph of *N. striata*. The holotype of *E. diagonale* becomes a heautotype of *N. striata*. The five specimens in the collection

are paratypes. He figures two additional specimens coming from the Quadratenkreide of Oberg, Pl. XXXVI, figs. 11, 12, and refigures the holotype of *Eudictyon diagonale* which he states comes from the Quadratenkreide of Oberg, although in 1902 he had said that it came from Misburg.

18386. **Polyblastidium racemosum** (T. Smith) (p. 275). PLESIOTYPES

This species was described by Smith in 1848 as *Brachiolites racemosus* from the Upper Chalk of England. Smith, being more concerned with the classification of the Ventriculitidæ than with their stratigraphic position or geographic distribution, fails to give the locality whence the specimen which he figures and describes came. Roemer under the name *Cephalites ellipticus* in 1864 (p. 7, Pl. IV, fig. 6) described certain specimens from the Quadraten of Oberg. In 1878 Zittel, in the first of his 'Studien' (p. 52), erected the new genus *Polyblastidium* and gave as the genoholotype *P. luxurians* from Linden near Hanover. In describing *P. racemosum* in 1902, Schrammen includes all of the foregoing species under it (p. 275). It is found both at Oberg and Misburg from the Quadraten of the former and the Mucronaten of the latter, and Schrammen figures three specimens from the Quadratenkreide of Oberg (Pl. XXXVIII, figs. 8-10).

18387. **Actinocyclus alternans** (Roemer) (p. 277). PLESIOTYPE

In 1841 Roemer described from the Untere Kreide of Peine, Hanover, a sponge which he called *Cœloptychium alternans* (1841, p. 10, figured holotype Pl. IV, fig. 6). Zittel, in the first of his 'Studien,' erected the genus *Marshallia* with *Pleurostoma tortuosum* Roemer and *Cœloptychium alternans* Roemer as two representative species, the former being the genoholotype. This he did after examining Roemer's types of both species (1877, p. 58). Schrammen considered that Roemer's *C. alternans* is generically distinct from *Pleurostoma tortuosum*, for which reason he erected the genus *Actinocyclus* with *A. alternans* as the genoholotype (1910, p. 277) and for this genus he has founded the new family Actinocyclidæ (1910, p. 276). Schrammen's figured cotypes are all from the Quadratenkreide, one from Misburg (1910, Pl. XXIX, fig. 1), and two from Oberg (*loc. cit.*, Pl. XXIX, figs. 2, 3; skeletal elements, text plate XIV, fig. 14).

18388. **Microblastidium decurrens** Schrammen (p. 279). PARATYPE OR HEAUTOTYPE

Schrammen described this species in 1902 from two specimens from the Quadratenkreide, one from Oberg and one from Misburg (p. 15).

The holotype was a fragment of the wall of a specimen from Oberg (*loc. cit.*, Pl. IV, fig. 5). In his Monograph, Schrammen figured two nearly complete specimens from Oberg (Pl. XXX, fig. 11, Pl. XXXVII, fig. 9; skeletal elements, text plate XV, fig. 15). Since the only locality which he gave in 1910 was Oberg, it is evident that he had come to the conclusion that the specimen from Misburg was not to be placed in this species.

18389. **Sporadiscinia decheni** (Goldfuss) (p. 280).

This species was described by Goldfuss as *Scyphia decheni* from the Green Chalk of Coesfeld, Westphalia (1826, p. 219; protograph, Plate LXV, figs. 6*a*, *b*). D'Orbigny placed the species questionably in Lamarck's genus *Ocellaria* (1850, p. 284) and later Roemer called it *Cribrospongia decheni* (1864, p. 12). At this time he made the mistake of considering his former *Scyphia micrommata* a synonym of *Scyphia decheni* Goldfuss. As Schlüter first pointed out, the Goldfuss species was characterized by the diagonal arrangement of the smaller and more oval ostia in contradistinction to the larger indiscriminately situated ostia of *S. micrommata* (Schlüter, 1872, 'Spongitarienbänke,' p. 22). Schlüter accepted Roemer's generic revision and noted the occurrence of the species in the Quadraten Mergel in the zone of *Becksia soekelandi* in Münsterland. In 1877 Zittel emended Pomel's genus *Sporadiscinia* and included in it *Scyphia decheni* Goldfuss (1877, p. 362) and this revision was repeated the next year in the first of his 'Studies' (1878, p. 52). Both Hinde (1883, p. 116) and Schrammen (1910, p. 280) have accepted this generic standing for the species. Schrammen has figured two specimens from the Quadratenkreide of Misburg (*loc. cit.*, Pl. XXXVII, figs. 6, 7) showing clearly the internal and external surface characteristics. His description is the first adequate one which has appeared in print and the first one containing the necessary information about the skeletal elements. The specimens which he used in making his description and which came from the Quadratenkreide of Misburg must be looked upon as plesiotypes, but, since he did not mention Oberg in print in his further description, the specimens from that locality are not types. (See also discussion under *Sporadiscinia quenstedti* No. 18392.)

18390. **Sporadiscinia venosa** (Roemer) (p. 281). PLESIOTYPES

From the Untere Kreide of Peine, Hanover, Roemer described *Scyphia venosa* (1841, p. 8) and figured the holotype (Pl. III, fig. 4). Roemer later changed the generic name to *Cribrospongia* of D'Orbigny,

adding nothing, however, to the protolog (1864, p. 11). Wollemann gave a somewhat more complete description of the species, placing it in Pomel's genus *Sporadiscinia* (1902, p. 10), but did not figure any of the specimens which he had. His collections were from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg, Hanover. The description given by Schrammen in 1910 based upon Roemer's types and upon collections from the Quadratenkreide of Misburg and Oberg is the first strictly scientific description (1910, p. 281). A figure is given of a specimen from the Quadratenkreide of Misburg (Pl. XXXVIII, fig. 4) and the skeletal elements are illustrated (Pl. XIV, fig. 18).

18391. **Sporadiscinia micrommata** (Roemer) (p. 281). PLESIOTYPES

Roemer described this species as *Scyphia micrommata* from the lower Kreidemergel of Coesfeld, Westphalia (1841, p. 7, protograph Pl. II, fig. 11). D'Orbigny included the species under his genus *Cupulospongia* (1850, p. 287). On account of an incorrect revision made by Roemer in 1864, when he considered his *Scyphia micrommata* as a synonym of *Scyphia decheni* Goldfuss, it is necessary to include the *S. micrommata* part of his *S. decheni* in the synonymy. Schlüter, as we have seen (No. 18390), restored *Scyphia micrommata* as a distinct species. He placed it in D'Orbigny's genus *Cribrospongia* and reported it from the zone of *Lepidospongia rugosa* of the Quadraten of Münsterland (Schlüter, 1872, p. 28). At the same time that Zittel revised *Scyphia decheni* he also included *S. micrommata* in Pomel's emended genus *Sporadiscinia* (1878*c*, p. 52; 1877, p. 362). Hinde (1883, p. 116) and Wollemann have accepted Zittel's generic revision. Wollemann reported the species from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneburg, Hanover (1902*a*, p. 10). Schrammen has added to the localities already known, Misburg, Oberg, Adenstedt, and Biewende, and has figured two specimens from the Quadratenkreide of Misburg (1910, p. 283, Pl. XXXVIII, figs. 5, 6). (See further Nos. 18390, 18392.)

18392. **Sporadiscinia quenstedti** Schrammen (p. 282). PARATYPES

From the Green Chalk of Coesfeld, Westphalia, Goldfuss described the species *Scyphia decheni* (1826, p. 29) figuring the holotype (Pl. LXV, figs. 6*a*, *b*). This species was subsequently placed under various genera, but is now called *Sporadiscinia decheni* (for details see that species). Quenstedt identified a fragment which he had obtained from the Chloritic Chalk of Ahlten as *Scyphia decheni* (1877, p. 454), and

figured his specimen (Pl. CXXXVII, fig. 2). A comparison of the protographs of *Scyphia decheni* Goldfuss and *Scyphia decheni* Goldfuss of Quenstedt reveals the very obvious fact that the ostia in the figure given by Goldfuss are irregular in arrangement and polygonal in outline, whereas those in the illustration given by Quenstedt are rectangular. Primarily on account of this distinction, Schrammen erected the new species *Sporadiscinia quenstedti* for the forms with the rectangular ostia, this being the only species of *Sporadiscinia* with ostia of that shape. Quenstedt's *Scyphia decheni* Goldfuss thus becomes a synonym of *Sporadiscinia quenstedti*, as does also Wollemann's *Sporadiscinia decheni* var. *quadrata* which was described from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg, Hanover (Wollemann, 1902*a*, p. 10). Wollemann's varietal name should not stand because the form is too distinct to be considered a variety of Goldfuss' *Scyphia decheni*. Wollemann ascribes the name *quadrata* to Quenstedt, but I have been unable to find it in that author's work.

Schrammen's protograph is of a specimen from the Quadratenkreide of Misburg (1910, Pl. XXXVII, fig. 8). The species occurs at Oberg and Ahlten, and in the Mucronatenkreide as well as in the Quadratenkreide. Schrammen has examined five specimens, one of which he has figured and three of which (paratypes) are in the American Museum Collection.

18393. **Leiostracosia brandesi** Schrammen (p. 288). PARATYPE

This species was described by Schrammen in 1910 from five specimens which he had examined from the Quadratenkreide of Oberg and Misburg, the figured holotype coming from the former locality (protograph: 1910, Pl. XXXV, fig. 3; skeletal elements, text plate XIII, fig. 11).

18394. **Marshallia tortuosa** (Roemer) (p. 291). HOMŒOTYPE

This species was described in 1864 by Roemer from the Quadratenkreide and was found on the Ihme near Hanover (p. 15, Pl. VI, fig. 1). The holotype is in the University Collection at Göttingen. In 1878 Zittel, in the first of his sponge studies (p. 58), described the genus *Marshallia* including under it *Pleurostoma tortuosum* Roemer. This revision Schrammen accepts (1910, p. 291) giving a full description of the species and one which is more complete than the protograph. He also figures the skeletal elements (text plate XV, fig. 12), since no illustration of them had previously appeared in the literature. Schrammen adds, as further occurrences, the Quadratenkreide and Mucronatenkreide of Misburg.

18395. **Coscinopora infundibuliformis** Goldfuss (p. 293). PLESIOTYPES

This species was described in 1826 by Goldfuss (pp. 30, 85) from the Cretaceous Marl of Coesfeld. (Cotypes figured: p. 30, Pl. IX, figs. 16*a*, *b*, *c*; Pl. XXX, fig. 10.) Schlüter (1872, p. 22) records that this species is abundant in the Mucronaten beds of Coesfeld, Münsterland. Quenstedt (1877, p. 461) notes its presence in abundance at Ahlten, while Hinde ('Catalogue,' p. 105) has listed it from the Upper Chalk of Croyden, Surrey and in the south of England. Gripenkerl speaks of its abundance in the upper Quadraten beds of Boimstorf and its lesser abundance in the same beds at Glentorf. Wollemann has found it well represented at Gr. and Kl. Biewende (1890, p. 7; 1901, p. 7; 1902*b*, p. 58). Schrammen in 1910 described the species from the Quadratenkreide and Mucronatenkreide and from Oberg and Misburg (pp. 293, 294) and he figured the skeletal elements (text plate XV, figs. 13 14). Since Schrammen's is the first detailed description appearing in the literature, containing, as it does, dimensions, minute morphological characterizations and having, in addition, the first illustration of the skeletal elements, the ten specimens upon which Schrammen based his description must be regarded as plesiotypes. Six of these are in the Museum Collection.

18396. **Becksia soekelandi** Schlüter (p. 297).

Schlüter described this species in 1868 (p. 93), naming it in honor of Becks and Soekeland. He referred to the species again in 1870 (pp. 140-141) but did not give any illustrations of it until 1872, when he figured two specimens and a diagram of the structure of the meshwork (1872, Pl. I, figs. 5, 6, 7), at which time he also gave a more complete description than he had yet published. Because of the restricted distribution of this species, Schlüter makes it one of the zonal fossils of the Quadratenkreide, using it instead of *Belemnitella quadrata* (*Actinocamax quadratus*), while he uses *Lepidospongia rugosa* instead of *Belemnitella mucronata* for the Upper Senonian (1870, p. 141). He records it from the Upper Quadratenkreide between Lette, Coesfeld, Holtwick and Legden, in none of which places is it to be considered a rare form, but in older or younger beds he states it is unknown. It is also found, according to Schlüter, in the subhercynian Kreide in the same horizon at Biewende a mile and a quarter northeast of Börsum. The beds at Biewende show a surprising similarity to those at Holtwick. Zittel, in his 'Studien' (1878*b*, p. 58), mentions the species without comment. Quenstedt (1877, p. 489) mentions the occurrence of the species at Coesfeld and reproduces on Pl. CXXXVIII, fig. 14 with a reduction of one-

half, the figures given by Schlüter in 1872 (*loc. cit.*). Hinde, in his 'Catalogue' (1883, p. 144), simply mentions the occurrence at Coesfeld, Westphalia.

Griepenkerl calls attention to the restricted occurrence of this species in Königslutter, Braunschweig, parallelling its restriction in Westphalia. It is found only in Göe's marl pit near Boimstorf (1889, p. 23).

Wollemann (1900, pp. 8, 9) reports that the species occurs only seldom and in fragments at Gr. Biewende, the only complete specimen which he knows of being in the collection of the Kaiserliche geologische Landesanstalt in Berlin.

Schrammen (1910, p. 297) states that the species does not occur in the Chalk Marl facies of the Quadratenkreide of Hanover, at least, he has never found it at Misburg and Oberg, but instead its place is taken by the nearly related *B. feuerwehri*. It is possible that it occurs also in the shaly Granulatenkreide around Braunschweig, but Schrammen is not positive on account of the poor preservation of the material therefrom

18397. **Becksia augustæ** Schrammen (p. 298). HEAUTOTYPES

Schrammen described this species in 1902 (p. 18) from the Quadratenkreide of Misburg whence came the holotype (figured Pl. II, fig. 2) now in the Roemer Museum. In 1910 Schrammen gave a fuller description of the species (p. 298), reproduced the protograph (Pl. XL, fig. 1; skeletal elements, text plate XIV, fig. 5), and noted the further occurrence from the Quadratenkreide of Oberg. The specimens in the American Museum Collection do not come from the locality of the type specimen, but have been identified by Schrammen and used in amplifying the protolog; they are, therefore, heautotypes.

18398. **Becksia feuerwehri** Schrammen (p. 298). PARATYPES

Schrammen described this species from four specimens from the Quadratenkreide of Oberg (1910, p. 298) figuring the holotype on Pl. XL, fig. 4. There are four specimens in the collection, none of which is figured, though two of them are far superior to the protograph. One specimen shows this species growing upon *Phymatella intumescens* (Roemer) (18398*a*).

18399. **Plocoscyphia centuncula** Schrammen (p. 301). PARATYPE

Schrammen described this species in 1910 from the Quadraten kreide and Mucronatenkreide, and from Misburg, Oberg, Ahlten, and

Glentorf. The figured holotype came from the Quadratenkreide of Oberg (Pl. XL, fig. 5; skeletal elements, text plate XIV, fig. 2). In his synonymy Schrammen includes, doubtfully, *Plocoscyphia annulata* as used by Griepenkerl 1889 (p. 23). Since Griepenkerl merely identified a fragment from Königslutter with Roemer's *Mœandrospongia annulata* giving no figure and only the briefest description, referring to Roemer's illustration (1864, p. 53, Pl. XVIII, fig. 9), it is difficult to understand why Schrammen did not include in his synonymy of *P. centuncula*, Roemer's *M. annulata* as well as Griepenkerl's *P. annulata*. Roemer's protograph is characteristically poor and the protolog is very brief. Schrammen nowhere refers to either except in his revision of Roemer's illustrations where he states that *M. annulata* is a Hexactinellid, leaving further taxonomic revision for future study (1910, p. 6).

18400. **Centrosia incrustans** Schrammen (p. 302). PARATYPES OR HEAUTOTYPES

In 1902 (p. 16) Schrammen described the new genus *Kentrosia* with the genoholotype and only species *K. incrustans* from the Quadratenkreide of Oberg and Misburg (p. 17). The figured holotype is from the Quadratenkreide of Oberg (Pl. IV, fig. 6) and is now in the Roemer Museum. In 1910 Schrammen (p. 302) gave Oberg as the only locality from which the species is known, and figured another specimen from the Quadratenkreide of Oberg (Pl. XXXIX, fig. 1; skeletal elements, text plate XIV, fig. 1). The two specimens in the collection are either paratypes, if belonging to the original series, or heautotypes, if belonging to the material used for the 1910 description.

18401. **Callicylix farreides** Schrammen (p. 302). COTYPES

In 1910 Schrammen erected the new genus *Callicylix* with the genoholotype and sole species *C. farreides* from the Quadratenkreide of Oberg (p. 302). There are two figured cotypes (*loc. cit.*, Pl. XL, figs. 7, 8). In American Museum Collection there are four of the eight specimens examined by Schrammen in describing the species, but none is figured.

18402. **Cyclostigma acinosa** Schrammen (p. 303). PARATYPES OR HEAUTOTYPES

In 1902 Schrammen (p. 17) described the new species *Plocoscyphia acinosa* from the Quadratenkreide of Oberg and figured the holotype (Pl. IV, fig. 2) now in the Roemer Museum. When he brought out his

Monograph he made a new genus *Cyclostigma*, with the genoholotype *Plocoscyphia acinosa*, without stating his reasons for making the generic revision (1910, p. 303). At this time he was able to record the species from the Mucronatenkreide as well, and also from Misburg. There are three good specimens in the Museum Collection and they are either paratypes or heautotypes.

18403. **Cyclostigma mæandrina** Schrammen (p. 304). PARATYPE

Schrammen described this species from two specimens examined by him from the Quadratenkreide of Oberg. The figured holotype (Pl. XL, fig. 6; skeletal elements, text plate XIV, fig. 4) is different from the specimen in the Museum Collection, which is thus a paratype.

18404. **Cystispongia monostoma** Schrammen (p. 316). PARATYPE

Schrammen in describing this species (1910, p. 316) gives no figure of an entire specimen, illustrating only the skeletal elements (1910, text plate XV, fig. 9). These are from the Quadratenkreide of Oberg and must be considered as constituting the holotype. Schrammen states that he had examined four specimens from the Quadratenkreide of Misburg and Oberg, one of which it is to be supposed is in the American Museum Collection.

18405. **Tremabolites megastoma** (Roemer) (p. 317). PLESIOTYPES

From the Untere Kreide of Peine, Roemer described a form which he called *Manon megastoma* (1841, p. 3), figuring the holotype (Pl. I, fig. 9). Schlüter twice cited the species from the zones of *Becksia soekelandi* and *Lepidospongia rugosa* in Münsterland referring it, however, to the genus *Camerospongia* (Schlüter, 1872, p. 19; 1876-1877, p. 244). Zittel, in 1877, erected the genus *Tremabolites* with Roemer's *Manon megastoma* as the genoholotype.

Since Roemer's protograph and protolog were very poor, and since the latter was not couched in modern terminology, we must look upon Schrammen's description in 1910, made from the type material and from specimens collected from the type locality, as the first really complete description, and the specimens in Schrammen's collection used in making the description must be considered plesiotypes. Schrammen figures two specimens from the Quadratenkreide of Oberg (1910, Pl. XXXIX, figs. 4, 5) and a single individual from the Mucronatenkreide of Misburg (Pl. XXXIX, fig. 3). The skeletal elements figured are from the former locality (*loc. cit.*, text plate, XV, figs. 7, 8).

18406. **Toulminia wollemanni** Schrammen (p. 319). PARATYPE

Schrammen described this species from the Quadratenkreide of Oberg in 1910 (p. 319), figuring the holotype (Pl. XXXIX, fig. 6; skeletal elements, text plate XV, fig. 6). He states that he had examined only two specimens, so that presumably the one in the Museum Collection is the second besides the figured one.

18407. **Phalacrus flosculus** Schrammen (p. 321). COTYPES

This species is the first described by Schrammen under his new genus *Phalacrus*, but he does not designate it as the genoholotype for which reason it simply becomes one of the genosyntypes (1910, p. 321). It is a rare genus known only from the Quadratenkreide of Oberg whence two cotypes are figured (Pl. XXXIX, figs. 7, 8; skeletal elements, text plate XV, figs. 3, 4).

18408. **Phalacrus decurrens** Schrammen (p. 323). METATYPE

Schrammen described this species from a single specimen ["Das Original ist Unikum"] which he did not figure. Since the dimensions of the specimen in the collection do not agree with those which he gives in the protolog, the specimen must either have been overlooked by him at the time of writing or else have been collected at some later date; in either case it is a metatype.

18409. **Cœloptychium deciminum** Roemer (p. 329). PLESIOTYPE

Roemer described this species in 1841 from the Untere Kreide of Peine, Hanover (p. 10) and figured the holotype (Pl. IV, fig. 3). In 1864 he gave a brief notice of it again, but did not figure it or add to the description or occurrences (1864, p. 3). Zittel has given by far the best description of this species that has yet appeared in print and his illustrations are in all respects superior to the protograph. In writing his description he had before him Roemer's types of this and related species, so that his characterization is particularly valuable (1876, pp. 62-65, Pl. I, figs. 6, 7; skeletal elements, Pl. III, fig. 2). He notes its occurrence in the Quadratenkreide at Vordorf near Braunschweig and at Schwiechelt near Peine, and in the Mucronatenkreide at Ahlten in Hanover.

Wollemann reports this species from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg (1902*a*, p. 11) and Schrammen lists it from Oberg, Biewende, and from Misburg (rare), but gives no figures (1910, p. 329).

18410. **Cœloptychium agaricoides** Goldfuss (p. 330). PLESIOTYPE

This species was described by Goldfuss from the marl of Coesfeld (1826-33, p. 31; protograph, Pl. IX, fig. 20 *a-e*). Roemer (1841, p. 10) gave an unusually good description of the same species, figuring an entire individual with the stem (Pl. IV, fig. 5), and noted its occurrence in the Lower Cretaceous of Peine and Theidessen and in the Upper Cretaceous marl of Lemförde and Coesfeld, to which localities he added Vordorf in 1864 (p. 3). The species has been reported by more recent writers from various parts of northwest Germany, namely, from the zones of *Becksia soekelandi* and *Lepidospongia rugosa* in the Quadraten and also from the Mucronaten of Münsterland (Schlüter, 1872, p. 16; 1876-1877, p. 244); from the Upper Quadraten of Boimstorf, Braunschweig, where it is absent in the Mucronaten zones (Griepenkerl, 1888-1889, p. 24); from the Senonian of Gr. and Kl. Biewende in Braunschweig (Wollemann, 1901, p. 9; 1902*b*, p. 58); and from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneberg, Hanover (Wollemann, 1902*a*, p. 11).

By far the most exhaustive discussion of the species is that given by Zittel in his paper *Ueber Cœloptychium*. He has carefully revised and amplified the protolog (1876*a*, pp. 59-61) and has figured numerous details of structure and of the skeletal network (Pl. III, figs. 1, 4, 5, 6, 10, 11, 13 and Pl. IV, fig. A).

From the Upper Senonian horizons Schrammen has collected many specimens at Misburg, Oberg, Linden, and Ahlten in the Kalkmergel of the Quadraten- and Mucronatenkreide and in the Sandmergel of the Mucronatenkreide (1912, p. 331). In the collection is a single specimen which is a plesiotype, since it was among those used by Schrammen in making his additional notes on the species.

18411. **Cœloptychium rude** von Seebach (p. 333).

There are in the Göttingen University Museum four specimens of sponges labelled by von Seebach *Cœloptychium rude*, but described only in manuscript by von Seebach. Zittel has described the species in his paper on *Cœloptychium* (1876, p. 71) and has figured one of Sebach's specimens (*loc. cit.*, Pl. I, figs. 1, 2), given to him for that purpose by Seebach, showing the top and side view slightly reduced. The specimens come from the Mucronatenkreide of Ahlten. Wollemann records the species from the *Heteroceras* zone of the Mucronatenkreide of Zeltberg, near Lüneburg, Hanover.

Schrammen, in 1910, noted the occurrence of this form from the Mucronatenkreide of Misburg and figured the skeletal elements (Pl. XLV, fig. 3, text plate XV, fig. 10). The specimen in the American Museum is not a type, but is included for the sake of having as complete a representation of species as possible.

SPECIES FROM THE QUADRATENKREIDE OF MISBURG, HANOVER

18412. **Theneopsis steinmanni** (von Zittel) (p. 55). PLESIOTYPE
See No. 18281.

18413. **Doryderma (Homalodora) ramosa** (Mantell) (p. 59). PLESIOTYPE
See No. 18284.

18414. **Doryderma capitata** Schrammen. CHIROTYPE

Schrammen, in his Monograph, records no species of *capitata* under *Doryderma*. The specimens of other species which he figures are all from Oberg and none agrees with the one which he has labelled *D. capitata*. This specimen therefore appears to constitute a chirotype, unless further study proves it to be the same as one of his new species described in the Monograph; if such were the case, it would mean that Schrammen had forgotten that he had already given a name to this form.

18415. **Amphilectella piriformis** Schrammen (p. 61). PARATYPE OR HEAUTOTYPE

See No. 18288 for a discussion of this species. The specimen in the collection is from the type locality, but whether belonging to the original series and so a paratype, or to material subsequently collected and so a heautotype, there is no way of knowing.

18416. **Pachypoterion koeneni** Schrammen (p. 63). PARATYPE
See No. 18259.

18417. **Pachinion scriptum** (Roemer) (p. 67). PLESIOTYPE
See No. 18204.

18418. **Pachinion cylindricum** Schrammen (p. 68). PARATYPE OR HEAUTOTYPE

See No. 18293. Since the holotype of this species came from the Quadratenkreide of Misburg, the specimen in the collection is either one of the paratypes or only a heautotype.

18419. **Phymatella bulbosa** von Zittel (p. 75). PLESIOTYPE
See No. 18207.

18420. **Phymatella tuberosa** (Quenstedt) (p. 76). PLESIOTYPE
See No. 18208.

18421. **Phymatella spæroides** Schrammen (p. 76). COTYPES
See No. 18241.

18422. **Aulaxinia sulcifera (typica)** (Roemer) (p. 78). PLESIOTYPE
See No. 18301.

18423. **Craterella tuberosa** Schrammen (p. 80). PARATYPES OR HEAUTOTYPES
See No. 18302. Since Misburg is the type locality for the species the two specimens in the collection are either paratypes or heautotypes.

18424. **Callopegma acaulis** von Zittel (p. 81). PLESIOTYPES
See No. 18304.

18425. **Turonia constricta** von Zittel (p. 87). PLESIOTYPE
See No. 18307.

18426. **Siphonia tubulosa** (Roemer) (p. 93). PLESIOTYPE
See No. 18311.

18427. **?Placoscytus jereæformis** Schrammen (p. 102).
See No. 18496.

18428. **Phymaraphinia infundibuliformis** Schrammen (p. 105). COTYPE OR HEAUTOTYPE
See No. 18320.

18429. **Cycloclema compressa** (Hinde) (p. 105). PLESIOTYPE
See No. 18321.

18430. **Ophiraphidites cylindricus** Schrammen (p. 121). COTYPE OR HEAUTOTYPE
See No. 18330.

18431. **Orphiraphidites infundibuliformis** Schrammen (p. 121).
See No. 18331.

18432. **Ophiraphidites tuberosus** Schrammen (p. 124). HEAUTOTYPE
See No. 18332.

18433. **Pachycothon giganteum** (Roemer) (p. 130). PLESIOTYPE

The representative of this species was labelled by Schrammen "*Pachycothon simplicissimus* Počta sp." and must have been so identified prior to the writing of the Monograph, for he there makes Počta's species a synonym of *P. giganteum* (Roemer) (1910, p. 130; see also for details No. 18183).

18434. **Verruculina macrommata** (Roemer) (p. 140). PLESIOTYPE

This species was described by Roemer (1864, p. 45, Pl. XVI, fig. 4) from the Mucronatenkreide of Ahlten, as *Verrucospongia macrommata*. Zittel ('Studien,' 1878*c*, II, p. 124), erecting the generic name *Amphithelion* for parts of several existing generic names, placed Roemer's species therein. Hinde, on the other hand (1883, p. 40), still retained the original generic assignation given by Roemer. Schrammen in his second Roemer Museum paper (1901, p. 21) accepts Zittel's revision, but by the time of the publication of the Monograph has decided to place *macrommata* under Zittel's *Verruculina*. He includes also as synonyms under this species *V. reussii* (M'Coy) as given by Hinde, and *V. papillata* Hinde. M'Coy's specific name (originally *Manon reussii*) would have priority, having been given in 1848, were it not for the fact that the species was inadequately described and not figured by M'Coy and because Hinde, claiming that M'Coy's species could be recognized, identified it as the same as *V. circumporosa* Quenstedt [= *V. crassa* (Roemer)] which latter is not, however, according to Schrammen, the same as the one described by Hinde as *V. reussii*. Hinde states that *V. reussii* and *V. papillata*, occurring in the Upper Chalk at Flamborough, are distinguished from *V. macrommata* by the papillose postica, but Schrammen states that these are not rare on *macrommata*. (The label on the specimen in the Museum has mutation ant. on it at the bottom. This designation probably refers to the fact that Schrammen's specimens are found in an earlier horizon than was Roemer's holotype.)

Schrammen listed the species from the Kalkmergel of the Quadratenkreide and Mucronatenkreide from Misburg, Oberg, Adenstedt and Ahlten, figuring some spicules from the last locality (1910, text plate VIII, fig. 6).

18435. **Verruculina seriatopora** (Roemer) (p. 141). PLESIOTYPE

See No. 18342.

18436. **Verruculina cupula** Schrammen (p. 142). COTYPE

See No. 18343.

18437. **Stichophyma multiformis** (Bronn) (p. 145). PLESIOTYPE

Bronn, in 1838, described this species as *Siphonia multiformis* ('Lethæa Geognostica,' Bd. II, p. 591, Pl. XXVII, fig. 20), noting its occurrence in the Glauconitic Marl Chalk of Vouziers in the Ardennes. The species is appropriately named *multiformis*, for it varies so greatly in size and form that these characteristics can hardly be used for identification. Schrammen states that the largest individual which he knows of is 55 cm. long, the smallest 3.5 cm. The largest in the American Museum Collection is over 20 cm. in length. Roemer (1864) revised the species, placing it under *Jerea* (p. 33) and recording its occurrence in the Quadratenkreide of Peine. Schrammen, accepting Zittel's revisional name *Jereica*, placed the species under that genus in 1901 (p. 21) and also in his second paper (1902, p. 3).

Previous to this, Hinde (1883, p. 41, Pl. v, figs. 3, 4) had described a new species *Stichophyma tumida* from the Upper Chalk of Flamborough, Yorkshire and Bromley, Kent. This species Schrammen, in his Monograph, considers the same as Bronn's *Siphonia multiformis* which he no longer leaves under the genus *Jereica* but changes to *Stichophyma*. Schrammen, remarking on the fact that the young stages of *Stichophyma multiformis* from the Senonian recall in the arrangement and size of ostia and postica those in the adult *S. verrucosa* from the Turonian, considers that it is quite likely that the former is simply a further development from the latter. Unfortunately, the beds of intermediate age in northwest Germany, where one would look for the transitional forms, are not developed in a facies suitable to sponges.

Schrammen lists the species from the Kalkmergel of the Quadratenkreide and Mucronatenkreide from Misburg, Oberg, Adenstedt and Biewende. He has given the best description that has yet appeared in the literature, but, unfortunately, has not figured any of the specimens from his collection, and since no other author has published illustrations of this species except the describer, we have only the protograph to refer to. This shows the external form and gives some idea of the surface characteristics, but the skeletal elements have never been figured.

18438. **Jereica polystoma** (Roemer) (p. 147). PLESIOTYPE

Roemer described this species (1864, p. 34, Pl. XII, fig. 5) from the Mucronatenkreide of Ahlten as *Jerea polystoma*. Zittel, in his 'Studies' (II, p. 126), erected the new genus *Jereica* ("like *Jerea*") for parts of *Jerea* and a number of other genera, stating that it was so like *Jerea* that it could only be distinguished therefrom by the microscopic structure.

Schrammen does not accept Griepenkerl's identification of a specimen from Sudmerberg as *Jereica punctata* (Münster), but considers that it likewise belongs under *J. polystoma*. Griepenkerl does not figure the single specimen which he had observed in Renzelmann's collection ('Königslutter,' 1888-1889, p. 17) and his description is so brief that it hardly seems possible that Schrammen had enough evidence to declare that Griepenkerl's identification was not valid, unless we assume that he had seen the specimen in question. Since Schrammen recognizes and accepts as of good standing the species *Jereica punctata* (Münster) Goldfuss which is known only from the sand marl of Sudmerberg, and since he does not list *J. polystoma* (in which he includes *J. punctata* as listed by Griepenkerl) from Sudmerberg or from an horizon lower than the Quadratenkreide, his synonymies are open to question, in so far as Griepenkerl's identification is concerned.

18439. **Jereica oligostoma** Schrammen (p. 148). COTYPE

This species is based upon eight specimens coming from the higher Senonian horizons and from Misburg, Oberg, and Adenstedt; it is not figured by Schrammen and no holotype is designated (Monograph, p. 148).

18440. **Scytalia terebrata** (Phillips) Hinde (p. 150). PLESIOTYPES

See No. 18189.

18441. **Scytalia radiciformis** (Phillips) (p. 151). PLESIOTYPE

See No. 18344.

18442. **Leiochonia cryptoporosa** Schrammen (p. 160). PARATYPE OR HEAUTOTYPE

See No. 18345.

18443. **Seliscothon planum** (Phillips) Hinde (p. 163). PLESIOTYPE

See No. 18224.

18444. **Hexactinella lævis** Schrammen (p. 224). IDIOTYPE

The holotype of this species was described and figured by Schrammen from the Quadratenkreide of Oberg (see No. 18360) and no mention was made of its occurrence at Misburg. The specimen in the collection therefore is an idiotype.

18445. **Leptophragma pusillum** Schrammen (p. 236). PARATYPE

The holotype was described and figured by Schrammen from the Quadratenkreide of Oberg (1902, p. 22, Pl. III, fig. 5), the species being recorded also from Misburg, though in his Monograph Schrammen lists it only from Oberg (see No. 18366) and seems thus to have overlooked the specimen now in The American Museum of Natural History which comes from Misburg, and is, therefore, a paratype. The species is of interest as being the smallest Hexactinellid from the Senonian of Hanover.

18446. **Guettardia stümpeli** Schrammen (p. 240). PARATYPE OR HEAUTOTYPE

This species was described by Schrammen in 1902 (p. 22), from the Quadratenkreide of Misburg and Oberg, the holotype being from the latter locality (protograph, Pl. IV, fig. 3). In 1910 Schrammen greatly amplified the protolog and figured another specimen from the Quadratenkreide of Oberg (Pl. XXX, fig. 9) and likewise the skeletal elements (text plate IX, fig. 3). He notes that the species may occur also in the lower Senonian of Adenstedt-Bühlten from which he has specimens which are, however, not to be identified with absolute certainty because the canal system is poorly preserved. In his Monograph he cites the species only from the Quadratenkreide of Oberg. This is clearly an oversight on his part, as the specimen in the collection labelled by him fully testifies.

18447. **Guettardia striata** Schrammen (p. 241). COTYPE

Schrammen described this species (1910, p. 241) from six specimens collected by him from Gleidingen, Misburg, and Oberg, the two figured cotypes coming from the Quadratenkreide of Oberg (*loc. cit.*, Pl. XXX, figs. 6, 7, 8; skeletal elements, text plate IX, fig. 5). The single specimen in the collection is only a "wing" of sponge.

18448. **Balantionella elegans** Schrammen (p. 261). COTYPES OR HEAUTOTYPES

See No. 18378.

18449. **Ventriculites radiatus** Mantell (p. 265). PLESIOTYPE

The specimen in the collection was labelled by Schrammen '*Ventriculites cribrosus* Phillips sp.' and was evidently identified by him some time before he wrote his Monograph, because he there recognizes that *V. cribrosus* (Phillips) is a synonym of *V. radiatus* Mantell (1910, p.

265). Thus, although it at first appeared that there was no representative of *V. radiatus* from the Quadratenkreide of Misburg in the collection, it is apparent that the specimen incorrectly labelled by Schrammen is a *radiatus*. It is a very fine specimen showing the typical umbrella form of this species. (For complete notes on the species see No. 18191.)

18450. **Ventriculites stellatus** Schrammen (p. 267). PARATYPES OR HEAUTOTYPES

Misburg is the type locality for this species, the figured holotype having come from the Quadratenkreide (Schrammen, 1902, p. 11; see further No. 18381).

18451. **Lepidospongia fragilis** Schrammen (p. 269). COTYPES OR HEAUTOTYPES

See No. 18383.

18452. **Napæa striata** Schrammen (p. 273). PARATYPE OR HEAUTOTYPE

See No. 18385.

18453. **Polyblastidium racemosum** (T. Smith) (p. 275). PLESIOTYPE

See No. 18386.

18454. **Sporadiscinia decheni** (Goldfuss) (p. 280). PLESIOTYPE

See No. 18389.

18455. **Sporadiscinia venosa** (Roemer) (p. 281). PLESIOTYPE

See No. 18390.

18456. **Sporadiscinia micrommata** (Roemer) (p. 281). PLESIOTYPE

See No. 18391.

18457. **Sporadiscinia stirps** Schrammen (p. 282). COTYPE

This is a rare species found by Schrammen in the Kalkmergel of the Quadratenkreide of Misburg and Oberg and described from three specimens (1910, p. 282). The one figured specimen comes from the Quadratenkreide of Misburg (*loc. cit.*, Pl. XXXVIII, fig. 7); the skeletal elements figured are from the Quadratenkreide of Oberg. The specimen in the collection is almost like the figured one, but the ostia do not show so distinctly.

18458. **Sporadiscinia quenstedti** Schrammen (p. 282). PARATYPE

See No. 18392.

18459. **Becksia augustæ** Schrammen (p. 298). PARATYPE OR HEAUTOTYPE

The specimen in the collection comes from the type locality and horizon and is either a paratype, if from the original material, or a heautotype, if from subsequently collected material.

18460. **Cystispongia monostoma** Schrammen (p. 316). PARATYPE

See No. 18404.

18461. **Tremabolites megastoma** (Roemer) (p. 317). PLESIOTYPE

See No. 18405.

The Mucronatenkreide (Zone 4 of Stolley; Zones 2 and 3 of the Obersenon of Schlüter)

SPECIES FROM MISBURG

18462. **Stolleya ornatissima** Schrammen (p. 51). HEAUTOTYPE

See No. 18278.

18463. **Stolleya microtulipa** Schrammen (p. 51). HEAUTOTYPES

See No. 18279.

18464. **Theneopsis steinmanni** von Zittel (p. 55). PLESIOTYPE

See No. 18281.

18465. **Doryderma (Brochodora) roemeri** (Hinde) (p. 58). PLESIOTYPE

See No. 18180.

18466. **Doryderma (Brochodora) ramusculus** Schrammen (p. 59). PARATYPES

See No. 18283.

18467. **Doryderma (Homalodora) ramosa** (Mantell) (p. 59). PLESIOTYPE

See No. 18284.

18468. **Doryderma (Homalodora) tuberosa** Schrammen (p. 60). COTYPES

See No. 18286.

18469. **Doryderma (Homalodora) ficus** Schrammen (p. 60). PARATYPE

See No. 18287.

18470. **Amphilectella piriformis** Schrammen (p. 61). PARATYPES OR HEAUTOTYPES

See No. 18203.

18471. **Heterostinia immanis** Schrammen (p. 63). PARATYPE

The holotype and figured specimen of this species comes from the Mucronatenkreide of Misburg where the form is confined, according to Schrammen (1910, p. 63, Pl. XVII, fig. 1). He states that he has examined only two specimens so that the one in the American Museum Collection is a paratype. (For further occurrence of this species at Oberg see No. 18290.)

It is evident that the specimen which Schrammen describes on page 63 as having a height of about 20 cm. without the stem is the one in the collection. In his description of the species he speaks of the similarity between this and *Pachypoterion auritum* and of the possibility of distinguishing the two by the surface features. In *Heterostinia immanis* "the supporting skeleton on the outside is thick and smooth and is only broken through by numerous round ostia which are several millimeters apart" (Schrammen, 1910, p. 64). In *Pachypoterion auritum*, on the other hand, the water enters through the holes (0.5 -1 mm. in width) of the skeleton mesh which covers the surface in a net-like manner. A comparison of figures 1 and 4 on Pl. XVI, shows clearly the differences between *Heterostinia immanis* and *Pachypoterion auritum*.

18472. **Heterostinia depressa** Schrammen (p. 61). METATYPE

A single specimen from the Mucronatenkreide of Misburg was used by Schrammen in describing this species (1910, p. 63, Pl. XV, fig. 5). The surface and canal system are the same as in *H. immanis* from which *H. depressa* differs mainly in the external form. In the Museum Collection is a bottle containing two fragments of the sponge wall and some skeletal elements. If these fragments and spicules are from the original specimen they are parts of the holotype, but if subsequently collected by Schrammen they constitute metatypes.

18473. **Pachypoterion auritum** Schrammen (p. 64). METATYPE

This species was described by Schrammen in 1910 from a single specimen from the Kalkmergel of the Mucronatenkreide of Misburg (p. 64; protograph, Pl. XVI, fig. 4; skeletal elements, text plate II, fig. 5). In the collection is a very poor specimen in which all of the surface features are obscured. Since Schrammen did not use it in his protograph, but since he did identify the specimen, it is a metatype.

18474. **Pachinion scriptum** (Roemer) (p. 67). PLESIOTYPES

See No. 18204.

18475. **Procorallistes polymorphus** Schrammen (p. 69). COTYPES OR HEAUTOTYPES

This species is one of the two genosyntypes of Schrammen's genus *Procorallistes* erected in 1901 (p. 15). *P. polymorphus* was described from the Quadratenkreide of Oberg and Misburg and the Mucronatenkreide of Misburg. Schrammen figured an entire specimen from the Quadratenkreide of Oberg (*loc. cit.*, Pl. I, fig. 10) and several spicules from the Mucronatenkreide of Misburg (Pl. V, fig. 8). The three specimens in the collection are thus cotypes, if belonging to the original series, or heautotypes, if a part of that used for supplementing the protograph and protolog.

The second genosyntype described by Schrammen was *P. tuberosus* from the Quadratenkreide of Oberg (1901, p. 15, holotype figured, Pl. I, fig. 11). The original of this and of the first species are in the Roemer Museum. In his Monograph, Schrammen made this species a synonym of *P. polymorphus* (1910, p. 69) and figured two new specimens (heautotypes), one from the Cuvieri Pläner of Heere (*loc. cit.*, Pl. XX, fig. 1), the other from the Mucronatenkreide of Misburg (idem, fig. 2).

18476. **Phalangium cylindratum** Schrammen (p. 70). IDIOTYPE

See No. 18205.

In the notes on the specimens from Nettlingen, attention was called to the fact that this species was recorded by Schrammen only from the Cuvieri Pläner of Heere despite the fact that he himself had identified and labelled a large specimen from the Scaphites Pläner of Nettlingen. It is somewhat unusual, though not unique, that a species found in the lowest Turonian should occur also in the upper Senonian. There is one well-preserved specimen in the collection from the Mucronatenkreide of Misburg.

18477. **Phalangium scytaliforme** Schrammen (p. 70). PARATYPE (Spicules)

See No. 18238.

18478. **Propachastrella primæva** (von Zittel) (p. 71). PLESIOTYPES

See No. 18295.

18479. **Phymatella bulbosa** von Zittel mut. **postera** Schrammen (p. 75). CHIROTYPES

See No. 18297.

18480. **Phymatella tuberosa** (Quenstedt) (p. 76). PLESIOTYPE

See No. 18298.

18481. **Aulaxinia sulcifera (typica)** (Roemer) (p. 78). PLESIOTYPE
See No. 18301.

18482. **Aulaxinia sulcifera maliformis** Schrammen (p. 78). METATYPE
Schrammen described this species from a single specimen from the Mucronatenkreide of Misburg, but he did not figure it. In the description he stated that the original example was 5 cm. high without the stem. The specimen in the collection, however, is 11 cm. high with the stem or at least 8 cm. without it. It is thus not the holotype, but only a metatype.

18483. **Aulaxinia fallax** Schrammen (p. 78). IDIOTYPE
The holotype of this species is from the Quadratenkreide of Oberg (Schrammen, 1910, pp. 78, 79, protograph, Pl. I, fig. 4). Schrammen does not mention its occurrence in the Mucronatenkreide nor yet at Misburg, but the specimen in the Museum Collection is labelled by Schrammen himself. It is, therefore, an idiotype.

18484. **Craterella auricula** Schrammen (p. 80). COTYPE
This species was described by Schrammen from Misburg and Oberg from the Quadratenkreide and Mucronatenkreide (1910, p. 80, Pl. XI, figs. 6, 7). He suggests that it is possible that *Craterella auricula* and Zittel's *Callopegma schloenbachi*, which is one of the species which Schrammen has not found and which Zittel has only briefly described without figuring, may be identical. *Craterella auricula* is the only species in the Senonian of northwest Germany which Zittel's description of *Callopegma schloenbachi* would fit and which at the same time resembles the genoholotype of *Callopegma*, namely *C. acaulis* Zittel, in the structure and arrangement of the supporting skeleton (Schrammen, 1910, p. 80). The two figured cotypes are from Misburg, but the specimen in the American Museum Collection does not correspond with either illustration.

18485. **Craterella tuberosa** Schrammen (p. 80). IDIOTYPES
See No. 18302 for a discussion of this species. Schrammen has noted is occurrence only in the Quadratenkreide so that the four specimens in the collection, though from the type locality, are only idiotypes, because from an unrecorded horizon.

18486. **Callopegma acaulis** von Zittel (p. 81). PLESIOTYPE
See No. 18304.

18487. **Turonia variabilis** Michelin (p. 86). PLESIOTYPES
See No. 18306.

18488. **Turonia constricta** von Zittel (p. 87). PLESIOTYPE
See No. 18307.

18489. **Turonia induta** von Zittel (p. 87). PLESIOTYPES
Zittel, in 1878 ('Studien,' II, p. 150, Pl. IX, fig. 2), gave a brief description of this species which occurs in the Quadratenkreide of Linden. *Turonia induta* is the smallest of the species of that genus, being usually about the size of a walnut, or smaller. Though Schrammen has figured three specimens from the Mucronatenkreide of Misburg (1910, Pl. XI, figs. 4, 5, Pl. XV, fig. 3), none corresponds with the specimens in the Museum of which there are five.

18490. **Turonia cerebriformis** Schrammen (p. 88). IDIOTYPES
See No. 18308 for notes on this species. Since Schrammen states that this species is confined to the Quadratenkreide of Oberg, it is interesting to note that there are in the Museum Collection three poorly preserved specimens from the Mucronatenkreide of Misburg labelled by Schrammen, which are thus idiotypes.

18491. **Siphonia tubulosa** (Roemer) (p. 93). PLESIOTYPE
See No. 18311.

18492. **Siphonia maliformis** Schrammen (p. 93). COTYPE
Six specimens were examined by Schrammen in describing this species which occurs at Misburg and Oberg (1910, p. 93). He does not figure any specimens so that all six are cotypes and one of them is in the American Museum Collection. This specimen, while showing the form and the stem, fails to exhibit the characteristic deep paragaster which is one of the chief points of distinction between this and other species of *Siphonia*.

18493. **Discodermia antiqua** Schrammen (p. 97). COTYPES OR HEAUTOTYPES
See No. 18315.

18494. **Discodermia colossea** Schrammen (p. 98). COTYPE
Schrammen described this species from two specimens, the dimensions of which he gives in the text (1910, p. 98). The specimen in the Museum Collection is not quite so large as the measurements which he records for the smaller of the two cotypes. The maximum thickness is

8 cm., not 10 cm., and the length is only 17.5 cm., not 20 cm., unless measured on the curvature. Either the specimen in the Museum is the smaller of the two he describes or else it is another one and would increase the number of examined specimens to three.

18495. **Rhagadinia rimosa** (Roemer) (p. 100). PLESIOTYPES

See No. 18316.

18496. **Placoscytus jereæformis** Schrammen (p. 102). PARATYPES OR HEAUTOTYPES

In 1901 Schrammen described a new genus *Sollasella* for the single species *jereæformis* from the Mucronatenkreide of Misburg (p. 6, holotypes figured, Pl. II, fig. 4). He subsequently found that that generic name had already been used for a modern genus by von Lendenfeld and on that account proposed *Placoscytus* in his Monograph (p. 101). By that time, too, he had found the species at Oberg also. The holotype is in the Roemer Museum.

18497. **Phymaraphinia infundibuliformis** Schrammen (p. 105). COTYPE OR HEAUTOTYPE

See No. 18320.

18498. **Phymaraphinia infundibuliformis** mut. **postera** Schrammen. CHIROTYPE

Schrammen, in his description of *P. infundibuliformis*, has noted that the specimens from the Quadratenkreide, even when full grown, are smaller than those from the Mucronatenkreide ('Kieselspongien,' 1910-1912, p. 105.) Thus, in the lower horizon, an adult individual has a wall 0.5 cm. in thickness, is about 8 cm. high, and is from 6 to 8 cm. in width at the basal end. But in the Mucronatenkreide have been found specimens measuring 30 cm. in diameter, with walls 3 cm. thick and with ostia a millimeter broad. Schrammen has not given these large individuals at a higher horizon a particular mutation name in print, but it is one of these which he has labelled mut. *postera*. The wall is 1.72 cm. thick, the basal end 3.9 cm. by 4.15 cm. in thickness, and the ostia measure up to a millimeter in diameter. The specimen, though broken, has a diameter of over 19 cm., being thus not so large as the maximum mentioned by Schrammen, but yet far exceeding in dimensions the forms from the Quadratenkreide.

18499. **Astrocladia subramosa** (Roemer) (p. 111). PLESIOTYPES

See No. 18324.

18500. **Microdendron ramulosum** Schrammen (p. 112). PARATYPES

The holotype and figured specimen of this species was described by Schrammen in 1901 (p. 10, Pl. II, fig. 3, Pl. IV, fig .7) from the Mucronatenkreide of Misburg, and is now in the Roemer Museum. It is one of the smallest of sponges, the largest specimen known to Schrammen being only 2 cm. high (1910, p. 112). It is a species of rare occurrence known only from the type locality whence Schrammen has examined four specimens; two are in the Museum Collection.

18501. **Chenendopora fungiformis** Lamouroux (p. 113). PLESIOTYPE

This species was described by Lamouroux from Caen ('Exp. Méthod. des Polypes,' 1821, p. 77, Pl. CXXV, figs. 9, 10). Zittel figured the skeletal elements and noted the occurrence of this form in the Senonian of Evreux near Rouen and of Chatellerault in Touraine ('Studien,' II, 1878, p. 55, Pl. III, figs. 13, 14). Hinde has recorded it from the Upper Greensand of Warminster, Wiltshire, which is interesting in view of the fact that on the Continent it is characteristic of the much higher Senonian beds. Schrammen states that in northwest Germany it is confined to the lower part of the Mucronatenkreide and that even there it is rare.

18502. **Plinthosella squamosa** von Zittel (p. 114). PLESIOTYPE

See No. 18325.

18503. **Dactylotus micropelta** Schrammen (p. 115). COTYPE

See No. 18326.

18504. **Ophiraphidites** cf. **tuberosus** Schrammen (p. 124).

See No. 18333 for notes on *O. tuberosus*. The specimen in the collection is very poor, being only a mass of spicules, and none of the morphological characteristics of the sponge are retained.

18505. **Pachycothon giganteum** Roemer (p. 130). PLESIOTYPE

See No. 18183.

18506. **Verruculina tenuis** (Roemer) (p. 136). PLESIOTYPES

See No. 18217.

18507. **Verruculina convoluta** (Quenstedt) (p. 138). PLESIOTYPES

See No. 18219.

18508. **Verruculina macrommata** (Roemer) (p. 140). PLESIOTYPES
See No. 18434.

18509. **Verruculina seriatopora** (Roemer) (p. 141). PLESIOTYPES
See No. 18342.

18510. **Verruculina cupula** Schrammen (p. 142). COTYPES
See No. 18343.

18511. **Verruculina astræa** Hinde (p. 142). PLESIOTYPE

From the Upper Chalk of Flamborough, Yorkshire, Hinde described *Verruculina astræa* in 1883 (p. 37, protograph, Pl. III, figs. 5, 5*a*). The form is distinctive and easily recognized by the anastomosing canals which radiate from the postica. Schrammen added a little to the protograph by giving additional dimensions, especially of the ostia and postica (1910, p. 142). He had examined three specimens from the Mucronatenkreide of Misburg, one of which is in the collection.

18512. **Stichophyma multiformis** (Bronn) (p. 145). PLESIOTYPES
See No. 18437.

18513. **Jereica polystoma** (Roemer) (p. 147). PLESIOTYPES

18514. **Jereica tuberculosa** (Roemer) (p. 147). PLESIOTYPE

This species was described by Roemer in 1864 (p. 35, Pl. XIII, fig. 3) as *Jerea tuberculosa* from the Mucronatenkreide of Ahlten, and not as *Jereica tuberculosa* as Schrammen says in his synonymy (p. 147). It was not placed under *Jereica* until Zittel made his revision in 1880 when he erected that name (see No. 18438). Schrammen includes Wollemann's species *Jereica polystoma* var. *tuberculosa* in this species (Wollemann, 1902, p. 8; Schrammen, 1910, p. 147).

18515. **Jereica oligostoma** Schrammen (p. 148). COTYPES

This species is described from eight specimens examined by Schrammen coming from Misburg, Oberg, and Adenstedt from the Quadraten and Mucronatenkreide. Since no holotype is mentioned or figured all specimens of his original series are cotypes. In the Museum Collection are three from the Mucronatenkreide of Misburg.

18516. **Scytalia terebrata** (Phillips) Hinde (p. 150). PLESIOTYPE
See No. 18189.

18517. **Scytalia cylindrata** Schrammen Ms. CHIROTYPE

No sponge of this name is described by Schrammen in his Monograph. The specimen is, therefore, a chirotype. It is a slightly flattened, cylindrical form, measuring 19 cm. in height and a little over 5 cm. in its greatest diameter. A small, depressed, circular paragaster about 1 cm. deep is visible at the top. The spicules have not been studied, so that a complete description of the species cannot at this time be given.

18518. **Scytalia radiciformis** (Phillips) (p. 151). PLESIOTYPES

See No. 18344.

18519. **Pachysalax processifer** Schrammen (p. 157). METATYPE

This species was described by Schrammen from a single specimen from the Kalkmergel of the Mucronatenkreide of Misburg (1910, p. 157, protograph, Pl. XXII, fig. 2), and constitutes the genoholotype of the monotypic genus *Pachysalax*. Since the specimen in the American Museum Collection is not the figured holotype and was not used by Schrammen in the writing of the protolog, where he distinctly says that he has examined only a single specimen, then it is a metatype, for it was identified by the nomenclator and comes from the type locality and horizon.

18520. **Plinthodermatium exile** Schrammen (p. 158). PARATYPE

This species is rare in the Mucronatenkreide of Misburg, Schrammen having collected only two specimens, one of which he figures (1910, Pl. XXIII, fig. 1) the other of which is in The American Museum of Natural History.

18521. **Leiochonia robusta** Schrammen (p. 160). COTYPE

This species was founded by Schrammen for forms which are very similar to *L. cryptoporosa* Schrammen, but which differ chiefly in having a much thicker wall than that species ever acquires. Even in the largest specimens of *L. cryptoporosa* the wall is never more than about 1 cm. thick, while in *L. robusta* it may be as thick as 4 cm. That Schrammen did not originally distinguish these as two separate species is apparent from the fact that he had labelled as *L. robusta* one of the specimens upon the surface of which he has previously printed *L. cryptoporosa*. Yet this is not to be accounted for as a misplaced label; the specimen agrees with his description of *L. robusta* (unfortunately he gives no figure) and the wall is 1.7 cm. thick. He has examined three specimens and one is in the American Museum Collection.

18522. **Chonella tenuis** Roemer(p. 161). PLESIOTYPES
See No. 18346.

18523. **Chonella auriformis** Roemer (p. 161). PLESIOTYPE
See No. 18223.

18524. **Coscinostoma fragilis** Schrammen (p. 162). PARATYPE

This is a rare species in the chalk marl of the Mucronatenkreide and has been found by Schrammen only at Misburg, Oberg, and Adenstedt; he has examined only five specimens. It is easy to confuse this species with *Chonella tenuis* which, however, lacks the characteristic grouping of the postica on the inner surface into star-groups. From *Coscinostoma auricula* the species is to be distinguished by its thinner wall and the small and more closely crowded ostia.

The species is the first of the two genosyntypes described by Schrammen under *Coscinostoma*. The protograph is of a specimen from the Quadratenkreide of Oberg (1910, Pl. XXI, fig. 7).

18525. **Coscinostoma auricula** Schrammen (p. 163). PARATYPE

This is one of the rare species in the Mucronatenkreide of Misburg. The specimen which Schrammen speaks of in the text as "the largest in his collection" and which is 7 cm. high, without stem, and 17 cm. across, is the one in the Museum Collection (Schrammen, 1910, p. 163). Since it has been specially pointed out by Schrammen and described, it must be considered a paratype. He points out that this species may be confused with *Chonella auriformis* and that the most readily recognizable distinction lies in the grouping of the postica in *Coscinostoma auricula* and absence of grouping in Chonella. The figured holotype is from the Mucronatenkreide of Misburg (*loc. cit.*, Pl. XXI, fig. 8).

18526. **Seliscothon planum** (Phillips) (p. 163). PLESIOTYPE
See No. 18224.

18527. **Seliscothon mantelli** (Goldfuss) (p. 165). PLESIOTYPES
See No. 18350.

18528. **Chalaropegma cerebriformis** Schrammen. HOLOTYPE OR METATYPE (Spicules)

Schrammen had only a single specimen from which to describe this species which is the genoholotype and sole species in the genus *Chalaropegma* (1910, p. 168). The holotype came from the Kalkmergel of the

Mucronatenkreide of Misburg and was figured (*loc. cit.*, Pl. XIX, fig. 2; skeletal elements, text plate VIII, fig. 8). In the Museum is a bottle containing spicules and a label with the species name, the locality, Misburg, but no horizon. Either the spicules came from the holotype or else were collected subsequently to the publication of the Monograph and are only part of a metatype.

18529. **Pachytrachelus exspectatus** Schrammen (p. 174). PARATYPES

This species is rare in the Mucronatenkreide of Misburg, Schrammen having examined only six specimens. The material which he sent to The American Museum of Natural History consists of a bottle of skeletal elements and small fragments, and one specimen which is larger than the figure which he gives and shows the surface features quite as well except that the portion rimming the paragaster has been broken off.

18530. **Aphrocallistes cylindrodactylus** Schrammen (p. 220). PARATYPE

See No. 18358.

18531. **Hexactinella angustata** Schrammen (p. 223). HEAUTOTYPE

See No. 18359. The type locality for this species is Oberg. At the time of the writing of the protolog, Schrammen described *Polyopesia radiciformis* from the Mucronatenkreide of Misburg, a species which he later included in his synonymy of *Hexactinella angustata*. Thus all of the specimens from Misburg are heautotypes.

18532. **Leptophragma murchisoni** (Goldfuss) (p. 235). PLESIOTYPE

This species was described in 1826 by Goldfuss as *Scyphia murchisoni* (p. 219, Pl. LXV, fig. 8). D'Orbigny, in listing the sponges in his 'Prodrome,' placed the species under the genus *Coscinopora* (1850, tome II, p. 284), where by an error he refers to the species as *Scythia murchisoni*' Goldfuss instead of as *Scyphia*. Schlüter records that it is abundant in the Upper Quadratenkreide of Münsterland, but that if it occurs at all in the Mucronatenkreide it is very rare and that he had obtained only one doubtful specimen (1872, p. 14). As *Cribrospongia murchisoni*, A. Roemer records the presence of this species in the Mucronatenkreide at Coesfeld and Lemförde and in the Quadratenkreide of Ilsenburg and Peine. In 1878 Zittel ('Studien,' I, p. 48) created the generic name *Leptophragma* for parts of *Scyphia* of authors, including herein *Scyphia murchisoni* Goldfuss the original specimens of which he had seen. Hinde reports specimens in the British Museum from the Upper Green Sand (?) near Folkstone and the Lower Chalk of the South of

England ('Catalogue,' 1883, p. 102). Griepenkerl states that this species is very abundant in the Quadratenkreide of Boimstorf ('Königslutter,' p. 22). It has been found sparingly at Grosse and Kleine Biewende near Wolfenbüttel (Wollemann, 1901, p. 7). Schrammen lists Misburg, Oberg, Ahlten, Biewende, Münsterland and Glentorf at which the species occurs either in the Quadraten or Mucronatenkreide (1910, p. 235) and he figures a specimen from Quadratenkreide of Oberg (apparently Pl. XXXII, fig. 3 not fig. 1; skeletal elements, text plate IX, fig. 6).

18533. **Leptophragma micropora** Schrammen (p. 237). COTYPE
See No. 18367.

18534. **Pleurostoma dichtoma** Schrammen (p. 239). PARATYPES AND METATYPES
See No. 18369. Schrammen states, in his Monograph, that he had examined only three specimens, yet there are four in the American Museum Collection, no one of which corresponds to the protograph.

18535. Aff. **Pleurostoma radiata** (Roemer).
See No. 18368.

18536. **Lepidospongia rugosa** Schlüter (p. 269). PLESIOTYPE
See No. 18382.

18537. **Rhizopoterion tubiforme** Schrammen (p. 272). COTYPES
This species is of rare occurrence, being known only from Misburg. In the text Schrammen states that it is known only from the Mucronatenkreide (1910, p. 273), but he figures a specimen from the Quadratenkreide as well. He said that he had only two specimens, but he figures at least three (Pl. XXXIV, figs. 1-5), and there are the two in the Museum Collection which do not fit in with any of the figures.

18538. **Napæa striata** Schrammen (p. 273). IDIOTYPE
See No. 18385. The holotype of this species came from the Quadratenkreide of Misburg; therefore the specimen in the Collection is an idiotype.

18539. **Polyblastidium racemosum** (T. Smith) (p. 275). PLESIOTYPE
See No. 18386.

18540. **Sporadiscinia micrommata** (Roemer) (p. 281). PLESIOTYPE
See No. 18391.

18541. **Sporadiscinia teutoniæ** Schrammen (p. 283). FIGURED COTYPE AND COTYPES

This species is very similar to *S. venosa* and, indeed, in labelling his material Schrammen originally referred certain of the specimens to *venosa*. In his Monograph he has figured one of these (formerly named *S. venosa*) among his cotypes of *teutoniæ*. He states that there are only three specimens, but he must have overlooked some since there are five in the Museum Collection including one figured one (see Pl. XXXVIII, fig. 2 in the Monograph). The species is known only from the Mucronatenkreide of Misburg.

18542. **Pleurope lacunosa** (Roemer) (p. 290). PLESIOTYPE

Roemer described this species as *Pleurostoma lacunosa* from the Lower Cretaceous of Peine and Lindner Berg near Hanover (1841, p. 5; protograph, Pl. I, fig. 12). Zittel made Roemer's species the genoholotype of a new genus *Pleurope* (1877, p. 58), without describing or figuring the species, which was the only one which he placed in the genus. Since he had not seen Roemer's type his description of the skeletal elements must have been based upon material collected by himself and identified with Roemer's species. Zittel records no horizons or localities.

Schrammen amplified the original description of the species and Zittel's generic description, noting the occurrence of the species in the Kalkmergel of the Quadraten and Mucronatenkreide at Misburg and Oberg. From the Quadraten of Oberg Schrammen figures one specimen (1910, Pl. XXXIII, fig. 4) and the dermal covering of the inside of a specimen showing the lychnisks (text plate XIV, fig. 16).

18543. **Coscinopora infundibuliformis** Goldfuss (p. 293). PLESIOTYPE

See No. 18395.

18544. **Cystispongia monostoma** Schrammen (p. 316). IDIOTYPE

See No. 18404.

Schrammen has recorded this species only from the Quadratenkreide so that the specimen in the collection from the Mucronatenkreide of Misburg is an idiotype.

18545. **Tremabolites megastoma** (Roemer) (p. 317). PLESIOTYPE

See No. 18405.

18546. **Cœloptychium deciminum** Roemer (p. 329). PLESIOTYPES

See No. 18409.

18547. **Cœloptychium agaricoides** Goldfuss (p. 330). PLESIOTYPES
See No. 18410.

18548. **Cœloptychium seebachi** von Zittel (p. 331). PLESIOTYPE
This species was described by Zittel in his paper on *Cœloptychium* (1876, p. 68, Pl. II, figs. 5, 6, 7, Pl. III, figs. 8, 9, Pl. V, fig. 4) for four specimens from the Mucronatenkreide of Haldem and Lemförde in Westphalia and Lüneburg in Hanover.

SPECIES FROM HALDEM, HANOVER

18549. **Cœloptychium seebachi** von Zittel (p. 331). PLESIOTYPES
The holotype of this species was described and figured by Zittel in 1876 ('Cœloptychium,' p. 68, Pl. II, figs. 5, 6, 7; skeletal elements, Pl. III, figs. 8, 9, Pl. V, fig. A). It came from the Mucronatenkreide of Haldem in Hanover, for which reason the two specimens in the Museum Collection, which come from the same locality and horizon, are plesiotypes of unusual value.

SPECIES FROM SASSNITZ ON RÜGEN

18550. **Aulaxinia** aff. **sulcifera** (**typica**) (Roemer) (p. 78).
See No. 18301 for a description of this species.

18551. **Phymatella sphæroides** Schrammen (p.76). IDIOTYPE
See No. 18241.

SPECIES FROM AHLTEN, HANOVER

18552. **Rhagadinia rimosa** (Roemer) (p. 100). PLESIOTYPES
See No. 18316.

18553. **Sporadiscinia micrommata** (Roemer) (p. 281). HOMŒOTYPE
See No. 18391.

18554. **Sporadiscinia quenstedti** Schrammen (p. 282). PARATYPE
See No. 18392.

18555. **Cœloptychium rude** von Seebach (p. 332). PLESIOTYPE
See No. 18411.
The specimen in the collection comes from the same horizon and locality as did von Seebach's holotype and type material and, since Schrammen used it for further illustration of the species, it is a plesiotype, but one of greater value than most plesiotypes.

Alphabetical Index to the Types[1] in the Schrammen Collection of Silicispongiæ

[1]Seventeen specimens which are not types are included in the collection in order to give as complete a zoological representation as possible. The specimens in most cases are identified *confer* or *affine*. In other cases, when types of a species were lacking from any locality, specimens identified by Schrammen have been included whenever available.

Abbreviations for Names of Periodicals used in the Biblography

Abh.d. könig. böhm. Gesell. d. Wiss.—Abhandlungen der königlichen böhmischen Gesellschaft der Wissenschaften.

Abh. d. könig.-preuss. geol. Landesanst.—Abhandlungen der königlich-preussischen geologischen Landesanstalt.

Abh. d. math.-naturwiss. Cl. d. könig. böhm. Gesell. d. Wiss.—Abhandlungen der mathematisch-naturwissenschaftlichen Classe der königlichen böhmischen Gesellschaft der Wissenschaften.

Abh. d. math.-phys. Cl. d. könig.-bayer. Akad. d. Wiss.—Abhandlungen der mathematisch-physicalischen Classe der königlich-bayerischen Akademie der Wissenschaften.

Ann. and Mag. Nat. Hist.—Annals and Magazine of Natural History.

Archiv der naturw. Landesdurchforschung von Böhmen.—Archiv der naturwissenschaftlichen Landesdurchforschung von Böhmen.

Bull. Acad. Imp. Sci. de St. Péters.—Bulletin de l'Académie Impérial des Sciences de St. Pétersbourg.

Bull. Soc. Belge de Géol.—Bulletin de la Société Belge de Géologie de Paléontologie et d'Hydrologie.

Bull. Soc. Imp. d. Nat. de Mosc.—Bulletin de la Société Impérial des Naturalistes de Moscou.

Centralbl. f. Min., Geol., u. Pal.—Centralblatt für Mineralogie, Geologie und Palaeontologie.

Jahr. d. k. k. geol. Reichsanstalt.—Jahrbuch der kaiserlich-königlichen geologischen Reichsanstalt.

Mag. Nat. Hist.—Magazine of Natural History.

Mém. de l'Acad. imp. d. Sci. de St. Pétersb.—Mémoires de l'Academie impériale des Sciences de St. Pétersbourg.

Mém. de la Soc. Géol. de France.—Mémoires de la Société géologique de France.

Neues Jahrb. f. Min.—Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefakten-Kunde, in recent years, Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie.

Q. J. G. S.—Quarterly Journal of the Geological Society of London.

Sitz. d. math. naturw. Cl. d. kaiser. Akad. d. Wiss.—Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der kaiserlichen Akademie der Wissenschaften.

Sitz. d. niederrh. Gesell. in Bonn.—Sitzungsberichte der niederrheinischen Gesellschaft in Bonn, in Verhandlungen der naturhistorischen Vereines der preussischen Rheinlande und Westphalens.

Sitz. d. niederrh. Gesell. f. Natur-u. Heilk. in Bonn.—Sitzungsberichte der niederrheinischen Gesellschaft für Natur-und Heilkunde in Bonn.

Sitz. kön. böhm. Ges. Wiss.—Sitzungsberichte der königlichen böhmischen Gesellschaft zu Wissenschaft.

Trans. Geol. Soc. London.—Transactions of the Geological Society of London.

Verhand. d. naturhist. Ver. d. preuss. Rhein. und Westph.—Verhandlungen des naturhistorischen Vereines der preussischen Rheinlande und Westphalens.

Zeit. f. wissensch. Zool.—Zeitschrift für wissenschaftliche Zoologie.

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[1]This bibliography contains references to the literature on Cretaceous Silicispongiæ and on European Cretaceous stratigraphy. Papers on the Calcispongiæ and on sponges of periods other than the Cretaceous have not been included unless they contained general discussions on classification or structure and have been used by the author in writing this paper. References preceded by an asterisk (*) have not been consulted, because not available. Only the more important stratigraphic references have been included, because the present paper deals only incidentally with the stratigraphy.

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*1786*a*. Sur plusieurs Corps marins fossiles de la classe des Coraux; ou Supplément aux Mémoires du second et du troisième volume des Mémoires sur les Sciences et les Arts, dans lesquels il a été question de fossiles semblables. Nouvelle Collection des Mémoires sur différentes parties interessants des Sciences et Arts. Paris, chez Lamy. I, faisant le IV*e* de la Collection, pp. 1–75, Pls. I-XXIX.

*1786*b*. Mémoire sur les Fossiles comparés aux Éponges. Nouv. Coll. de Mém. sur différ. parties interess. des Sciences et Arts. Paris. II, faisant de V*e* de la Collection, pp. 457–469, Pls. LXXV-LXXVII.

GÜMBEL, C. W. *1868. Geognostische Beschreibung des Königreichs Bayern. Abth. 2: Geognostische Beschreibung des Ostbayerischen Grenzgebirges oder des Bayerischen und Oberpfälzer Waldgebirges. Gotha. (Pages 761, 771).

1880. Spongien-Nadeln im Flysch (in den Rossfeldschichten und im Alpinen Lias). Verhandlungen der königlich-kaiserlichen geologischen Reichsanstalt. Wien, Jahrgang 1880, pp. 213–215. (No species described.)

HAGENOW, FRIEDRICH VON. 1839. Monographie der Rügen'schen Kreide-Versteinerungen. Abtheilung I: Phytolithen und Polyparien. Neues Jahrb. für Min., Stuttgart, pp. 253–296. (19 species listed or described, two figured.)

HARDMANN, EDWARD T. 1887. Note on Professor Hull's Paper on Dr. G. J. Hinde's 'On Beds of Sponge-Remains, etc.' Proc. Roy. Soc. London, XLII, pp. 308–310. (Impossibility of sponge theory of chert insisted upon.)

HEIM, ARNOLD. 1909–1912. Sur les Zones paléontologiques et lithologiques du Crétacique moyen dans les Alpes suisses. Bull. Soc. Géol. France, Paris, (4) IX, pp. 101–127. (Stratigraphic; sponges not mentioned.)

HAUG, ÉMILE. 1908–1911. Traité de Geologie. Paris. II. Les Périodes geologiques. Fascicule 2.

HILL, WILLIAM. 1886. On the Beds between the Upper and Lower Chalk of Dover, and their comparison with the Middle Chalk of Cambridgeshire. Q. J. G. S., London, XLII, pp. 232–248. (Sponges listed, pp. 238, 239, 240, 241.)

HILL, W. AND JUKES-BROWNE, A. J. 1886. The Melbourn Rock and the Zone of *Belemnitella plena* from Cambridge to the Chiltern Hills. Q. J. G. S., London, XLII, pp. 216–231.

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1886. On beds of Sponge-Remains in the Lower and Upper Greensand of the South of England. Phil. Trans. Royal Soc. London, CLXXVI, (1885), part 2, pp. 403–453, Pls. XL-XLV. (It is shown that certain formations in England are made up to a large extent of siliceous sponge spicules; in some beds spicules entirely replaced by calcite; microscopic sections.)

1887. A Monograph of the British Fossil Sponges. Part I, Palæontographical Society, London, issued for 1886, XL, 92 pp., 8 plates. (Deals with Palæozoic sponges of Great Britain, but is preceded by general discussion of sponges and of literature thereon. Part II appeared in 1888, but was devoted entirely to descriptions of Palæozoic species.)

1889. On the Nature of some Fragments of Siliceous Rock from the Boulder-clay of the "Roode Klif" (Red Cliff) on the southern border of the province of Friesland. Bull. Soc. Belge de Géol. de Paléont. et d'Hydrol., III. PP. 254–258, Pl. VIII. (Generic determinations of spicules found in glacial boulder given; age seems to be Upper Cretaceous; came perhaps from Denmark.)

HULL, EDWARD. 1887. Note on Dr. G. J. Hinde's paper "On Beds of Sponge remains in the Lower and Upper Greensand of the South of England." Proc. Roy. Soc London, XLII, pp. 304–308. (Contains objections to Hinde's theory that cherts were formed from sponge spicules.)

JAHN, JAROSLAV. 1891. Ueber die in den nordböhmischen Pyropensanden vorkommenden Versteinerungen der Teplitzer und Priesener Schichten. Annalen der k. k. Hofmuseums in Wien. Wien. VI, pp. 467–486. (Nine species of sponges identified, p. 482, 4 indeterminate species; nature of occurrence, p. 471.)

JUKES-BROWNE, A. J. 1900. The Cretaceous Rocks of Britain, Vol. I. The Gault and Upper Greensand of England. Memoirs of the Geological Survey of the United Kingdom. London. (Geologic map; 35 species of siliceous sponges listed, pp. 480, 481; no descriptions; no new species.)

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1904. The Cretaceous Rocks of Britain. Vol. III. The Upper Chalk of England. Mem. Geol. Surv. United Kingdom. London. (131 species of siliceous sponges from Lower, Middle and Upper Chalk listed, pp. 505–510.)

JUKES-BROWNE, A. J. AND HILL, W. 1887. On the Lower Part of the Upper Cretaceous Series in West Suffolk and Norfolk. Q. J. G. S., London, XLIII, pp. 544-598. (Stratigraphic paper; 5 species of sponges listed from Chalk-marl, p. 575; no species described.)

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KILIAN, W. 1907. Lethæa geognostica. Teil II. Das Mesozoicum. Stuttgart. (In continuation of Fritz Frech's 'Lethæa geognostica.')

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LAMOUROUX, J. 1821. Exposition méthodique des Genres de l'Ordre des Polypiers, des Zoophytes D'Ellis et Solander, Paris. (8 species of recent sponges listed, pp. 29–31; species of fossil sponges described: 2 sp. p. 72, 3 sp. p. 77, 1 sp. p. 79, 7 sp. pp. 87–89; p. 72, *Hallirhoa costata, H. lycoperdoides,* p. 77, *Chenendopora fungiformis, Hippalimus fungoides, Lymnorea mamillosa,* p. 79, *Jerea piriformis;* pp. 87–89, Pl. CXXXIV, figs. 1–15, *Spongia helvelloides, S. lagenaria, S. pistilliformis, S. clavarioides, S. mamillifera, S. stellata.*)

1824. Encyclopédie Méthodique. Histoire Naturelle des Zoophytes, ou Animaux Rayonnés, II, Paris. (Sponges on pp. 344, 345, 350, 453, 454, 502, 503; no new species described, same ones as in 'Exp. Meth.,' 1821.)

LEE, JOHN EDWARD. 1839. Notice of undescribed Zoophytes from the Yorkshire Chalk. Mag. Nat. Hist., London, New Ser., III, pp. 10–17. (Eight new species described and figured: *Siphonia clava, S. anguilla, S. catablastes, S. fastigiata, S. spinosa, S. sepiaformis, S. ampulla, Udotea cancellata.*)

LENDENFELD, R. VON. 1891. Das System der Spongien. Abhandlungen herausgegeben von der Senckenbirgischen Naturforschenden Gesellschaft, Frankfurt a.M., XVI, Heft 2, pp. 361–418, Pl. v. (Classification of recent sponges, family tree, bibliography of 121 references, for recent sponges, definitions of technical terms descriptive of spicules, pp. 419–427.)

LEONHARD, RICHARD. 1897. Die Fauna der Kreideformation in Oberschlesien. Palæontographica, Cassel, XLIV, pp. 11–70, Pls. III-VI.

LEPSIUS, RICHARD. 1892. Geologie von Deutschland und den angrenzenden Gebieten. Erster Teil: Das westliche und südliche Deutschland. Leipzig. 800 pp., geol. map, 1 colored plate, 136 text figures.

1910. Geologie von Deutschland und den angrenzenden Gebieten. Zweiter Teil: Das nördliche und östliche Deutschland. Leipzig. 548 pp., 88 text figures, 2 colored plates.

LEYMERIE, A. 1841. Mémoire sur le Terrain Crétacé du Departement de l'Aube. Mém. Soc. Géol. de France, Paris, IV, part 2, pp. 297, 298, 321.

1842. Suite du Mémoire sur le Terrain Crétacé du Departement de l'Aube. Second Partie (Pal.). Mém. de la Soc. Géol. de France, Paris, V, part 1, pp. 1–34. (3 species described and figured: *Spongus? ovatus, S? meandrinoides, Scyphia os-ranæ* (p. 1). Complete faunal list for Cretacic of Aube.)

LINNÆUS, CARL. 1735. Systema Naturæ, sive Regna tria naturæ systematice proposita per classes, ordines, genera, et species. Lugduni Batavorum apud Theodorum Haak. (Genus *Spongia* placed under Cryptogamia in the group of the Lithophyta.)

1792. Systema Naturæ, I, pars VI. (Sponges under Alcyonium and Spongia, pp. 3810–3826; 78 species briefly described; all recent forms.)

LORIOL, P. DE. 1861–1863. Description des animaux invertébrés fossiles contenus dans l'étage néocomien moyen du Mont Salève. Genève and Bâle, 214 pages, 22 plates. (Sponges, pp. 180–207, Pls. XX-XXII; external characters alone used in descriptions.)

*1868. Monographie des couches de l'Étage Valangien des carrières d'Arzier (Vaud). Matériaux pour la Paléontologie Suisse, par Pictet. Ser. 4, Mém. 2.

LORIOL, P. DE, AND GILLIÉRON V. 1869. Monographie Paléontologique et Stratigraphique de l'Étage Urgonien inférieur du Landeron (Canton de Neuchâtel). Mémoires de la Societe helvétique des Sciences naturelles, Bâle et Genève, XXIII, 123 pages, 8 plates. (Sponges described, pp. 61–87, 89–90; Pl. IV, figs. 9–21, Pl. V, Pl. VI, figs. 3–19, Pl. VII; thirty species described, 18 new; Fromentel's classification and nomenclature used.)

LUIDIUS (LHWYD), E. *1699. Lithophylacii Britannici Ichnographica. (Pls. II, III; Pl. XVIII, fig. 1522.)

LUNDGREN, B. *1888. List of the Fossil Faunas of Sweden. (Edited by the Palæontological Dept. of the Swedish State Mus., Stockholm.) III, Mesozoic, p. 7.

MACKIE, S. J. *1866. An Illustrated Catalogue of British Fossil Sponges. Part 2, 32 pages with 4 plates.

MANTELL, GIDEON ALGERNON. 1815. Description of a Fossil Alcyonium, from the Chalk Strata near Lewes, in a letter to A. B. Lambert, Esq. Transactions of the Linnean Society of London, XI, pp. 401–407, Pls. XXVII-XXX. (Description of *Alcyonium chonoides.*)

1822. The Fossils of the South Downs; or illustrations of the Geology of Sussex. London; 4to. (11 species listed; 37 figures; descriptions very general; several forms included under some of the species; all species from the Chalk of South Downs of England.)

1829. A Tabular Arrangement of the Organic Remains of the County of Sussex. Trans. Geol. Soc. London, III, part 1, pp. 201–216. (Sponges listed, pp. 205, 208, 210.)

*1833. The Geology of the South-East of England. London. PP. 96–109, with 9 text figures; pp. 371–372, 379, 383–84.

1839. The Wonders of Geology; or, a familiar exposition of Geological Phenomena. London. 2 vols. Third edit. (No new species described; 2 species figured, a third listed, II, pp. 560–562.)

1854. The Medals of Creation; or, First Lessons in Geology. London, 2nd edition, entirely rewritten. (Sponges, I, on pp. 242–250, figs. 80–83; no species described.)

MARCOU, JULES. 1848. Recherches Géologiques sur la Jura Salinois. Mém. Soc. Géol. de France. Paris, (2) III, part 1, pp. 1–122; second part, pp. 123–151 on Cretaceous; sponges listed, pp. 137, 140, 147.

MARTIN, P. I. 1828. A Geological Memoir on a part of Western Sussex; with some observations upon Chalk-Basins, the Weald-Denudation, and outliers-by-protrusion. London, 4to, pp., x+100, 3 plates and geol. map. (Mentions *Ventriculites* from the Chalk, *Choanites* from the Malm, pp. 17, 18; no species given or figures.)

MEUNIER, STANISLAS. 1904. Sur des concrétions Quartzeuses renfermées dans la Craie blanch de Marguy (Oise). Bull. Soc. Géol. France, Paris, (4) IV, pp. 218–222. (Origin of concretions held to be organic; sponge spicules identified some seeming to be those of *Hallirhoa costata* Lamouroux; of little value in palæospongiologie.)

MICHELIN, HARDOUIN. 1840–1847. Iconographie Zoophytologique. Paris, 4to. (One species described, p. 6; six species (three new) described, pp. 113–115, figured on Pl. XXVI, figs. 3–8; 51 species described, pp. 120–147, 42 of these new species; 11 species (ten new) described, pp. 214–217.)

MORREN, CHARLES F. A. 1828. Descriptio Coralliorum fossilium in Belgio repertorum. Annales Academiæ Groninganæ, (1827–1828). (Pages 15-18, not p. 19, figs. 1 and 2.)

MORRIS, JOHN. 1843. A Catalogue of British Fossils. Comprising all the Genera and Species hitherto described; with references to their geological distribution and to the localities in which they have been found London, 8vo. (Genera and species listed; no new forms described; no figures, no descriptions; pp. 30–46, *pars.*)

1851. Palæontological Notes. Ann. Mag. Nat. Hist., London, (2) VIII, pp. 85–90. (Sponges, pp. 87–89, Pl. IV, figs. 8–11.)

1854. A Catalogue of British Fossils, etc. Second edition. London, 8vo. (Sponges separated from corals as Amorphozoa, pp. 26–32; no figures or descriptions.)

MÜNSTER, G. GRAF ZU. *1843. Ueber einige fossile mikroskopische Körper aus der Kreideformation. Beiträge zu Petrefactenkunde, Bayreuth, 6 Heft, pp. 89–91, Pl. IV, figs. 1–8.

MUNIER-CHALMAS. 1882. Ueber die Gattung Barroisia, M. Ch. Bull. Soc. Géol. de France, Paris, (3) X, p. 425.

PARFITT, E. *1870. Fossil sponge spicules in the Greensand of Haldon and Blackdown. Transactions of the Devonshire Association for the Advancement of Science, IV, pp. 138–144, one plate.

PARKINSON, JAMES. 1808. Organic Remains of a Former World. An Examination of the Mineralized Remains of the Vegetables and Animals of the Antediluvian World; generally termed Extraneous Fossils. II. London, 4to. (Contains inadequate descriptions and poor figures of species from Chalk of England.)

1822. Outlines of Oryctology. An Introduction to the Study of Fossil Organic Remains.

1830. Outlines of Oryctology. An Introduction to the Study of Fossil Organic Remains. Second edition (revised). London, 8vo, 1830. (Sponges, pp. 34–66, fossil species, pp. 48–66.)

PASSY, M. ANTOINE. 1832. Description Géologique du Départment de la Seine-Inférieure. Rouen, 4to, pp. xvi+371, 20 plates. (15 species from Lower and Upper Cretaceous of France, listed on p. 339; *Chaonites pyriformis* revised, figured, Pl. XVI, fig. 9; no descriptions.)

PERON, M. A. 1905. Note Stratigraphique sur l'Étage Aptien dans l'Est du Bassin Parisien. Bull. Soc. Géol. France, Paris, (4) V, pp. 359–378. (Stratigraphic; three species of sponges mentioned, p. 366, three on p. 369.)

PHILLIPS, JOHN. 1829. Illustrations of the Geology of Yorkshire; or, a description of the strata and organic remains of the Yorkshire coast: accompanied by a geological map, sections, and plates of the fossil plants and animals. (First edition.) Yorkshire. 8vo. 192 pp., 14 plates of fossils + 7 plates of sections and a geological map. (16 species listed, 10 new; no descriptions, 9 of the new species figured; all from White Chalk of Danes' Dike, Yorkshire, England.)

1830. On the Geology of Havre. The Philosophical Magazine and Annals of Philosophy, London, New Ser., VII, pp. 195–198. (Stratigraphical; comparison of succession and faunas in France and England; genera alone noted.)

1835. Illustrations of the Geology of Yorkshire. Part I, the Yorkshire Coast. London. Second edit. (Sponges listed, but not described on pp. 90, 91, figured on Pl. I, figs. 1–10.)

1871. Geology of Oxford and of the Valley of the Thames, Oxford.

1875. Illustrations of the Geology of Yorkshire; or a description of the Strata and Organic Remains. London, 4to. Third edition, edited by R. Etheridge. (16 species listed; 13 figured; no descriptions; all from Upper Chalk of Yorkshire, pp. 234, 322; Pl. I.)

PICTET, F. J. 1857. Traité de Paléontologie. Paris, 4to, IV, 2nd edition. (Sponges, pp. 530–557. In vol. of plates, Pl. XC, figs. 3–25.)

PLOT, R. 1705. The Natural History of Oxfordshire, being an essay towards the Natural History of England. Second edition. Oxford and London. (Chapter V, Pls. VI and VIII.)

POČTA, PHILLIPPE. 1883*a*. Einige Bemerkungen über das Gitterskelet der fossilen Hexactinelliden. Sitz. kön. böhm. Gesell. Wiss., Jahrgang 1882, Prag, 1883, Vorträge, pp. 378–390, one plate.

1883*b*. Beiträge zur Kenntniss der Spongien der böhmischen Kreideformation. I Abth. Hexactinellidæ, Abh. d. könig. böhm. Gesell. d. Wissen., Prag, (6) XII, (1885), pp. 1–42, Pls. I–III.

1884*a*. Ueber isolirte Kieselspongiennadeln aus der böhmischen Kreideformation. I. Sitz. kön. böhm. Ges. Wiss., Jahrgang 1883, Prag, Vorträge, pp. 371–384, with one plate.

1884*b*. Beiträge zur Kenntniss der Spongien der böhmischen Kreideformation. II Abth. Lithistidæ. Abh. d. math.-naturwiss. Cl. d. königl. böhm. Gesell. d. Wiss., Prag, (6) XII, (1885), pp. 1–42, Pls. I–II.

1884*c*. Beiträge zur Kenntniss der Spongien der böhmischen Kreideformation. III Abth. Tetractinellidæ, Monactinellidæ, etc. Abh. d. math.-naturwiss. Cl. d. königl. böhm. Gesell. d. Wiss. vom Jahre 1885–1886, Prag, (7) I, (1886), 1 Pl., 26 text figures, pp. 1–40.

1885*a*. Ueber isolirte Kieselspongiennadeln aus der böhmischen Kreideformation. II. Sitz. kön. böhm. Ges. Wiss., Jahrgang 1884, Prag, Vorträge, pp. 1–14 with one plate.

1885*b*. Ueber Spongiennadeln des Brüsauer Hornsteines. Sitz. kön. böhm. Ges. Wiss., Jahrgang 1884, Prag, Vorträge, pp. 243–254, two plates. (Ten species of sponges described, nine only generically identified.)

1886. Ueber zwei neue Spongien aus der böhmischen Kreideformation. Sitz. kön. böhm. Ges. Wiss., Jahrgang 1885, Prag, Vorträge, pp. 587–592, one plate. (Species described: *Casearia cretacea; Verrucocœlia uvæformis.*)

1890. Ueber einige Spongien aus dem Cuvieri-Pläner von Paderborn. Zeit. d. d. geol. Gesell., Berlin, XLII, pp. 217–232, Pls. VI–VIII.

1892. Ueber Spongien aus der oberen Kreide Frankreichs in dem k. mineralogischen Museum in Dresden. Mit Vorwort von H. B. Geinitz. Mittheilungen aus dem koeniglichen mineralogisch-geologischen und Praehistorischen Museum in Dresden, Cassel, Heft 11, 26 pages, 4 plates. (34 species (11 new) described from the Senonian of Meaulne in the department of Maine-et-Loire, France.)

1907. Sur Quelques Éponges du Sénonien de Nice. Bull. Soc. Géol. France, Paris, (4) VII, pp. 163–173, Pl. III. (Eleven species described, 5 new: *Scytalia laghetensis, Verruculina cazioti, Chonella andreensis, Thamnospongia pauciramea, Pachycornea erecta.*)

POMEL, A. *1872. Paléontologie, ou description des animaux fossiles de la Province D'Oran. Zoophytes, 5*e* fascicule, Spongiaires.

PRICE, F. G. H. 1877. On the Beds between the Gault and Upper Chalk near Folkestone. Q. J. G. S., London, XXXIII, pp. 341–448. (7 species listed from Chalk, p. 442, no sponges described. Species: *Stauronema carteri* Sollas, *S. lobata* Sollas, *Hylospongia* sp. Sollas; *Ventriculites, Brachiolites quadrangularis* Smith, *Plocoscyphia mœandrina* Leym., *Dendrospongia fenestralis.*)

PUGGAARD, CH. *1852. Geologie der Insel Möen. Eine Untersuchung über die Umwälzungen der Kreide und der Glacialbildung, sowie über die quaternären Ablagerungen und die erratischen Blöcke dieser Insel. Leipzig. PP. 10–13, figs. 3–7.

PUSCH, G. G. *1837. Polens Paläontologie. Stuttgart. (Pages 6, 7, Pl. II, figs. 3–5.)

QUENSTEDT, FRIEDRICH AUGUST. 1876–1878. Petrefactenkunde Deutschlands. Leipzig, 8vo. Abth. 1. Die Schwämme, 612 pp. Atlas, 28 plates.

RAMOND, L. *1801. Voyages au Mont-Perdu et dans la partie adjacente des Hautes Pyrénées. Paris. (Pages 127–129, 345–346, Pl. II, figs. 1, 2.)

RAUFF, HERMANN. 1893–1894. Palæospongiologie. Erster Theil und Zweiter Theil, erste Hälfte, Palæontographica, Stuttgart. (Contains a bibliography of 650 references for sponges of all geological periods; best historical discussion and criticism of literature that there is in print, pp. 46–114; morphology of sponges, pp. 115–185; systematic part deals only with Palæozoic sponges; classification of sponges, p. 188, division into two classes, Silicea and Calcarea, used.)

REUSS, AUGUST EMANUEL VON. 1840. Geognostische Skizzen aus Böhmen. Bd. I. Die Umgebung von Teplitz und Bilin in Beziehung auf ihre geognostischen Verhältnisse. Ein Betrag zur Physiographie des Böhmischen Mittlegebirges, pp. xx, 298, 9 plates (1 colored), 1 map colored.

1844. Geognostische Skizzen aus Böhmen. Bd. II. Die Kreidegebirge des westlichen Böhmens, ein monographischer Versuch, nebst Bemerkungen über die Braunkohlenlager jenseits der Elbe und eine Uebersicht der fossilen Fischreste Böhmens. PP. vi, 304, 3 plates.

1845–1846. Die Versteinerungen der böhmischen Kreideformation. Stuttgart. 4to. 148 pp. [IV.] 51 plates. (Sponges described, pp. 70–80.)

ROEMER, FERDINAND. 1854*a*. Die Kreidebildungen Westphalens. Eine geognostische Monographie. Verh. d. naturhist. Ver. preuss. Rhein. und Westph. Bonn. Jahrgang 11, pp. 29–39, geological map.

1854*b*. Die Kreidebildungen Westphalens. Eine geognostische Monographie. Zeit. d. d. geol. Gesell., Berlin, VI, pp. 99–236, geol. map Pl. I. (Important stratigraphic contribution; historical sketch; sponge faunas listed, pp. 134, 135, 200, 204; subdivisions of Cretaceous of Westphalia, p. 235. Same paper as 1854*a*.)

1870. Geologie von Oberschlesien. Eine Erläuterung zu der im Auftrage des Königlichen Preussischen Handelsministeriums von dem Verfasser bearbeiteten geologischen Karte von Oberschlesien in 12 Sektionen. Breslau, pp. xxiv+587. Atlas with 50 plates, 8to.

ROEMER, FRIEDRICH ADOLPH. 1841. Die Versteinerungen des norddeutschen Kreidegebirges. Hannover, 4to, pp. iv+145, 16 plates. (78 species described and figured, pp. 2–11, Pls. I-IV. Figures poor, descriptions incomplete.)

1864*a*. Die Spongitarien des norddeutschen Kreidegebirges. Palæontographica, Cassel, XIII, (1864–1866), pp. 1-64. (47 genera including 261 species briefly described; 208 figures on 19 plates. Complete list of species described with occurrences; partial synonymy, p. 61.)

1864*b*. Die Quadraten-Kreide des Sudmerberges bei Goslar. Palæontographica, Cassel, XIII, (1864-1866), pp. 193–199, Pl. XXXII, figs. 1, 2. (8 species listed and 4 new ones described: *Cribrospongia scripta, Siphonocœlia imbricata, Amorphospongia conifera, A. siliqua.*)

ROSE, C. B. 1829. On the Anatomy of the *Ventriculites* of Mantell. Mag. Nat. Hist., London, II, pp. 332-341, figs. 93–101. (Anatomical discussion of genus; no species cited.)

SCHLÜTER, CLEMENS AUGUST. 1868. Ueber die jüngsten Schichten der unteren Senon-Bildungen und deren Verbreitung. Sitz. d. niederrh. Gesell. in Bonn. Jahrgang 25, (3) V, pp. 92, 93. (*Becksia soekelandi* described; named after the Westphalian geologists Becks and Soekeland.)

1870. Über die Spongitarien-Bänke der unteren Mukronaten und obern Quadraten-Schichten und über *Lepidospongia rugosa* insbesondere. Sitz. d. niederrh. Gesell. f. Natur-u. Heilk. in Bonn. (3) Jahrgang 7, pp. 139–141.

1872. Ueber die Spongitarien-Bänke der oberen Quadraten- und unteren Mukronaten-schichten des Münsterlandes. 38 pp., 1 plate.

1874. Der Emscher Mergel. Vorläufige Notiz über ein zwischen Cuvieri Pläner und Quadraten-Kreide lagerndes mächtiges Gebirgsglied. Zeit. d. d. geol. Gesell., Berlin, XXVI, pp. 775–782. (Stratigraphic paper; sponges mentioned incidentally.)

1876*a*. Cephalopoden der oberen Kreide. Palæontographica, Cassel, XXIV, Lieferungen, 1, 2, 3, 4, pp. 1–144. (Stratigraphic discussion in Theil II, pp. i-vii, 88-134.)

1876*b*. Verbreitung der Cephalopoden in der oberen Kreide Norddeutschlands. Zeit. d. d. geol. Gesell., Berlin, XXVIII, pp. 457–518. (Stratigraphic paper giving detailed zonal classification of Upper Cretaceous on basis of ammonites; other fossils also given; sponges on pp. 506, 508, 510.)

1876*c*. Verbreitung der Cephalopoden in der oberen Kreide Norddeutschlands. Verhand. d. naturhist. Ver. d. preuss. Rhein. und Westph., Bonn, Jahrgang 33, pp. 330–406. (Practically a reprint of the paper of same title, see above 1876*b*. Some generic revision.)

1877. Ueber das Vorkommen der Gattung Cœloptychium im südlichen Europa. Sitz. d. niederrh. Gesell. f. Natur.-u. Heilk. in Bonn, in Verhandl. d. naturhist. Ver., Jahrgang, 34 p. 191. (Occurrence of specimens of *Cœloptychium deciminum* noted.)

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1903*a*. Zur Systematik der Kieselspongien. Mittheilungen aus dem Roemer Museum, Hildesheim, No. 19. 21 pp.

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SINZOW, J. 1872. Ueber Jura und Kreideversteinerungen im Gouvernement Saratow. Materialy dlä Geologii Rosii, IV, pp. 1–129. (Sponges, pp. 49–61, Pls. VII-XII; 14 species described; three new species, i.e., *Cœloptychium subagaricoides, Ventriculites spinosus, Pleurostoma multilobatum.* (Paper in Russian.)

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1887*b*. Beitrag zur Kenntniss der Phymatellen der böhmischen Kreideformation. Bull. Acad. Imp. Sci. St. Péters., XXXI, No. 4, pp. 464–473, one plate. (*Phymatella intumescens* (Roemer) described from Raudnitz, *P. tuberosa* (Roemer) from Lovosic.)

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Plate I

Types of Spicules in the Silicispongiæ

Fig. 1. Oxytriod (×50). (After Rauff, 'Palæospongiologie,' Fig. 5a.)

Fig. 2. Tripod (×40). (After Rauff, 'Palæospongiologie,' Fig. 5k.)

Fig. 3. Caltrop from *Propachastrella primæva* (von Zittel) (×16). (After Schrammen, 'Kieselspongien,' Text Plate I, fig. 4.) *a*. Oxycaltrops. *b*. Caltrop with globular arms.

Fig. 4. Criccaltrop (×80). (After Rauff, 'Palæospongiologie,' Fig. 6b.)

Fig. 5. Protriæne from *Tetillopsis longitridens* Schrammen (×16). (After Schrammen, 'Kieselpongien,' Text Plate I, fig. 7a.)

Fig. 6. Orthotriæne from *Theneopsis steinmanni* (von Zittel) (×16). (After Schrammen, 'Kieselpongien,' Text Plate I, fig. 5a.)

Fig. 7. Anatriæne from *Theneopsis steinmanni* (von Zittel) (×16). (After Schrammen, 'Kieselspongien,' Text Plate I, fig. 5b.)

Fig. 8. Dichotriæne from epiderm of *Phymatella bulbosa* (von Zittel) (×30). (After Schrammen, 'Kieselspongien,' Text Plate IV, fig. 8c.)

Fig. 9. Didichotriæne (×25). (After Rauff, 'Palæospongiologie,' Fig. 7i.)

Fig. 10. Trichotriæne (×100). (After Rauff, 'Palæospongiologie,' Fig. 7g.)

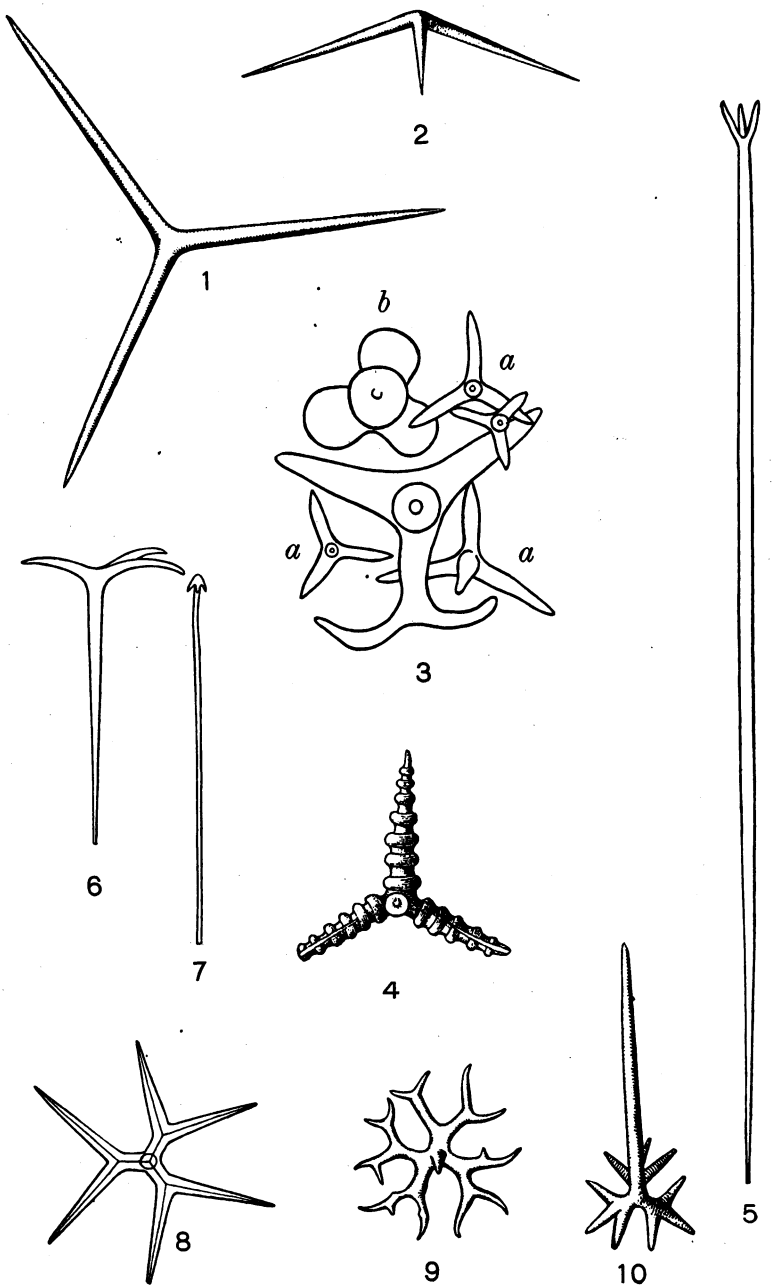
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PLATE II

Types of Spicules in the Silicispongiæ

Fig. 1. Phyllotriæne from *Rhagadinia rimosa* (Roemer) (×30). (After Schrammen, 'Kieselspongien,' Text Plate v, fig. 3c.)

Fig. 2. Symphyllotriæne (×95). (After Rauff, 'Palæospongiologie,' Fig. 8b.)

Fig. 3. Pinakid (×100). (After Rauff, 'Palæospongiologie,' Fig. 9b.)

Fig. 4. Amphitriæne (×800). (After Rauff, 'Palæospongiologie,' Fig. 10a.)

Fig. 5. Candelaber (×1000). (After Rauff, 'Palæospongiologie,' Fig. 13.)

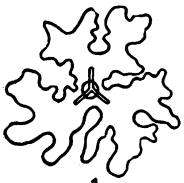
Fig. 6. Tetraclone from *Jerea quenstedti* von Zittel (×30). (After Schrammen, 'Kieselspongien,' Text Plate IV, fig. 2a.)

Fig. 7. Dichotrider (×65). (After Rauff, 'Palæospongiologie,' Fig. 19.)

Fig. 8. Ennomoclone (×120). (After Rauff, 'Palæospongiologie,' Fig. 20.)

Fig. 9. Didymoclone (×120). (After Rauff, 'Palæospongiologie,' Fig. 22.)

Fig. 10. Dicranoclone from *Pachinion cylindricum* Schrammen (×30). (After Schrammen, 'Kieselspongien,' Text Plate III, fig. 4a.)



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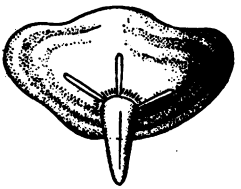

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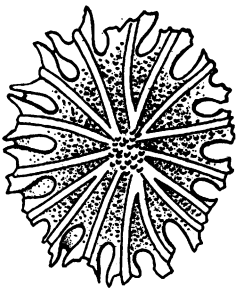

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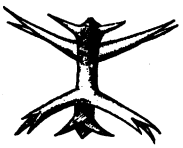

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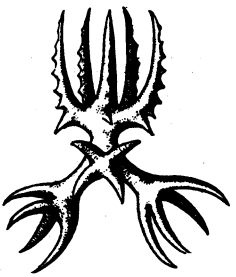

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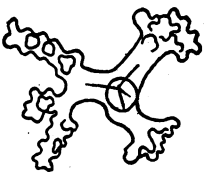

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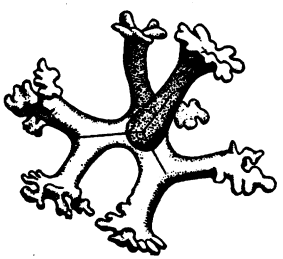

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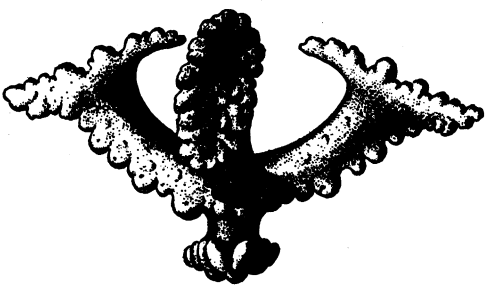

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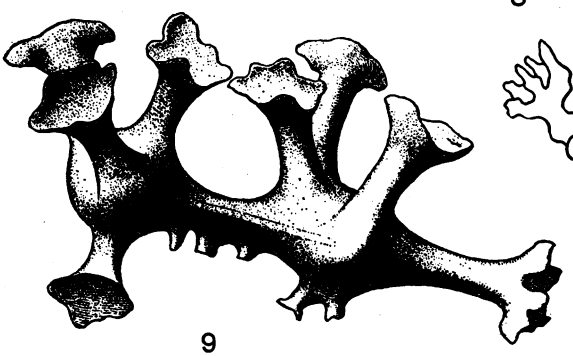

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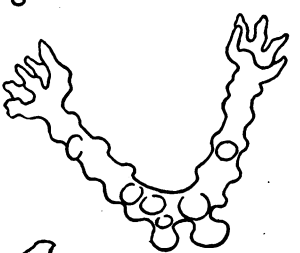

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Plate III

Types of Spicules in the Silicispongiæ

Fig. 1. Rhabdoclone (×75). (After Rauff, 'Palæospongiologie,' Fig. 23.)

Fig. 2. Megaclone from *Heterostinia obliqua* (Benett) (×16). (After Schrammen, 'Kieselspongien,' Text Plate II, fig. 4a.)

Fig. 3. Rhizoclone from *Verruculina macrommata* (Roemer) (×20). (After Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 6.)

Fig. 4. Megarhizoclone from *Chalaropegma cerebriformis* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 8.)

Fig. 5. Megarhizoclonid from *Phalangium scytaliforme* Schrammen (×30). (After Schrammen, 'Kieselspongien,' Text Plate III, fig. 2b.)

Fig. 6. Sphæroclone from *Pachytrachelus exspectatus* Schrammen (×50). (After Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 1f)

Fig. 7. Heloclone from *Pachycothon giganteum* (Roemer) (×16). (After Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 3a.)

Fig. 8. Hexactine (dictyonal hexactines) from *Stereochlamis pilosa* Schrammen (×45). (After Schrammen, 'Kieselspongien,' Text Plate IX, fig. 9.)

Fig. 9. Oxyhexactine (×100). (After Rauff, 'Palæospongiologie,' Fig. 28a.)

Fig. 10. Strongylhexactine (×100). (After Rauff, 'Palæospongiologie,' Fig. 28c.)

Fig. 11. Tylhexactine (×100), with sixth arm nearly aborted, approaching Tylpentactine. (After Rauff, 'Palæospongiologie,' Fig. 28 l.)

Fig. 12. Discohexactine (×300). (After Rauff, 'Palæospongiologie,' Fig. 29a.)

Fig. 13. Pinule (Pinulhexactine) (×100). (After Rauff, 'Palæospongiologie,' Fig. 31b.)

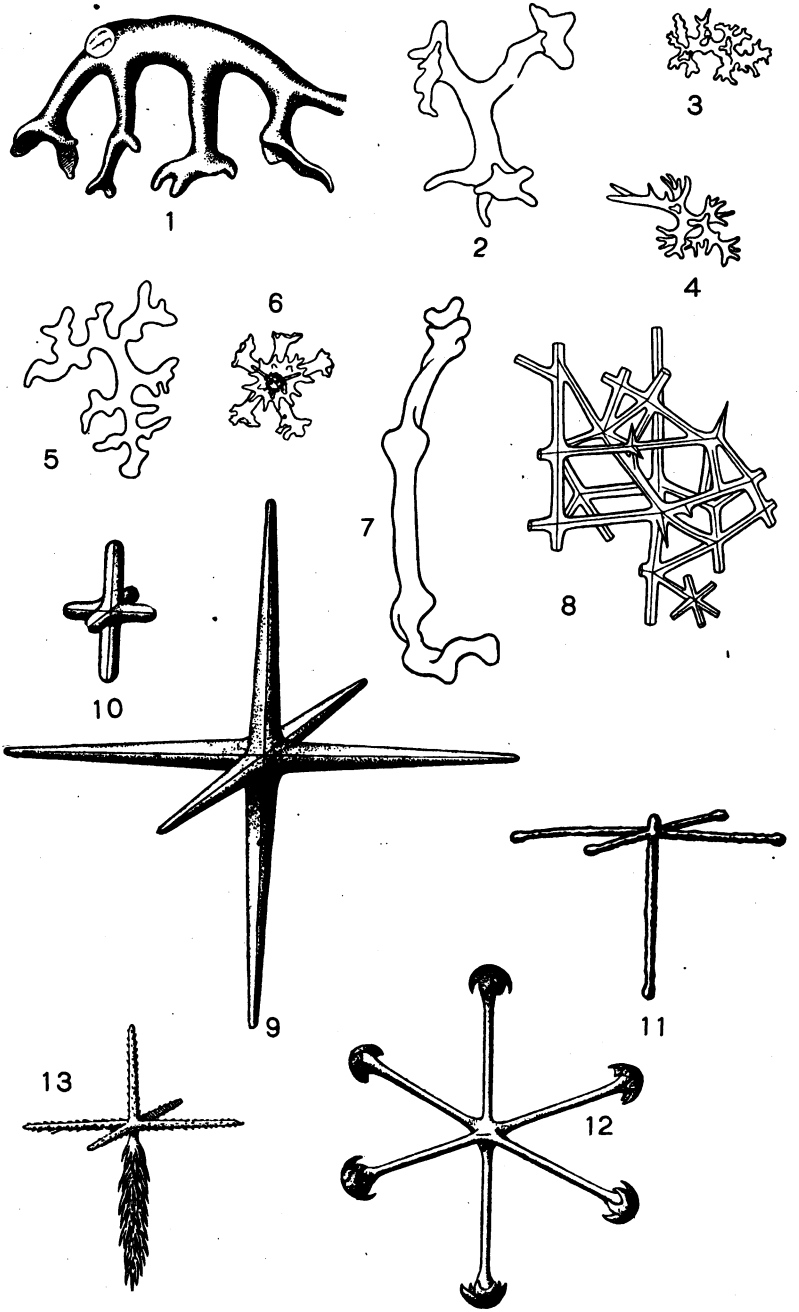
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PLATE IV

Types of Spicules in the Silicispongiæ

Fig. 1. Tylhexaster (×300). (After Rauff, 'Palæospongiologie,' Fig. 29c.)
Fig. 2. Graphihexaster (×300). (After Rauff, 'Palæospongiologie,' Fig. 29f.)
Fig. 3. Discohexaster (×450). (After Rauff, 'Palæospongiologie,' Fig. 30.)
Fig. 4. Floricom (×300). (After Rauff, 'Palæospongiologie,' Fig. 29g.)
Fig. 5. Plumicom (×300). (After Rauff, 'Palæospongiologie,' Fig. 28x.)
Fig. 6. Lychnisks from *Toulminia wollemanni* Schrammen (×45). (After Schrammen, 'Kieselspongien,' Text Plate xv, fig. 6.)
Fig. 7. Pentactine (×1). (After Rauff, 'Palæospongiologie,' Fig. 28m.)
Fig. 8. Pinule (Pinulpentactine (×300). (After Rauff, 'Palæospongiologie,' Fig. 31a.)
Fig. 9. Tetractine (Stauractine) (×100). (After Rauff, 'Palæospongiologie,' Fig. 29 l.)
Fig. 10. Amphidisc (×10). (After Rauff, 'Palæospongiologie,' Fig. 32.)
Fig. 11. Amphiaster (×250). (After Rauff, 'Palæospongiologie,' Fig. 29i.)
Fig. 12. Uncin (×300). (After Rauff, 'Palæospongiologie,' Fig. 31h.)
Fig. 13. Scopula (×450). (After Rauff, 'Palæospongiologie,' Fig. 31d.)
Fig. 14. Clavula (×450). (After Rauff, 'Palæospongiologie,' Fig. 31f.)

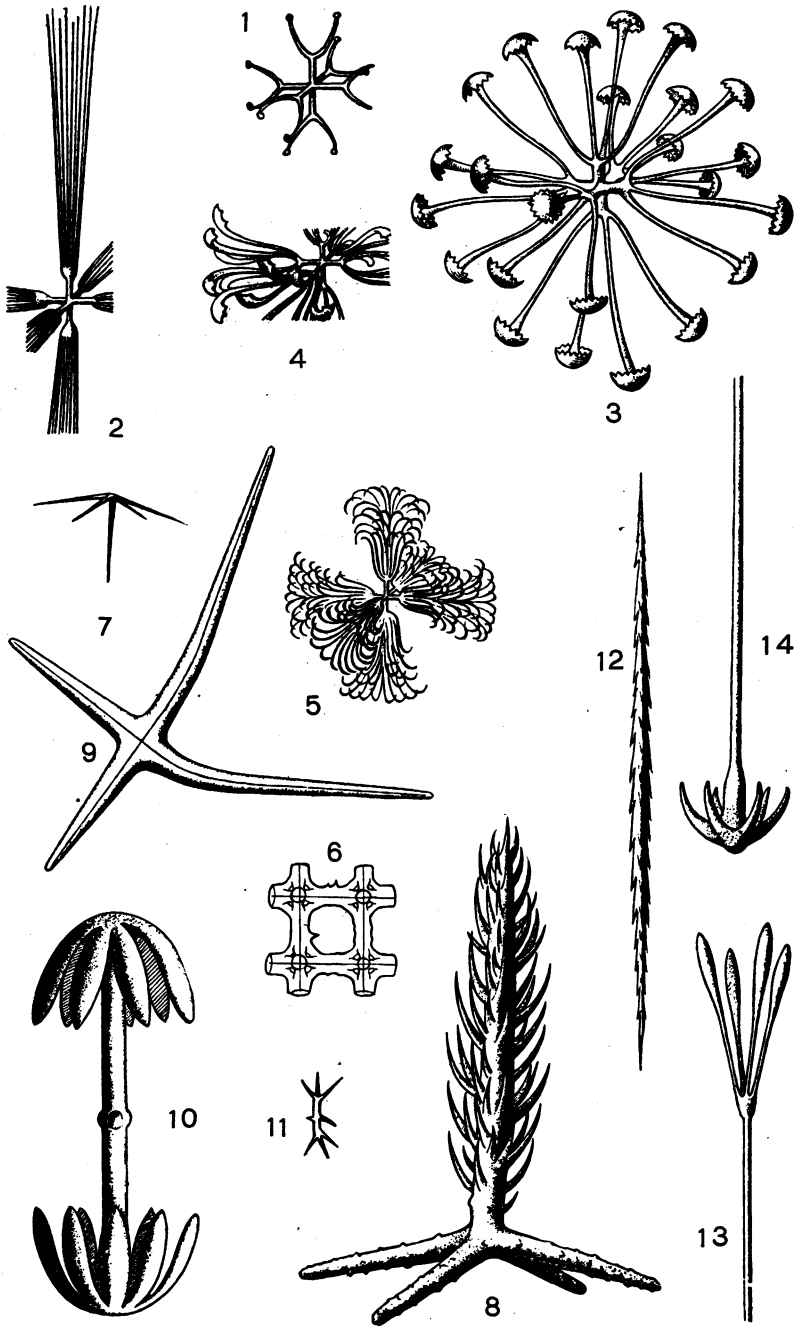
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Plate V

Types of Spicules in the Silicispongiæ

Fig. 1. Amphiox from *Ophiraphidites infundibuliformis* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VII, fig. 5c.)

Fig. 2. Amphitorn (×100). (After Rauff, 'Palæospongiologie,' Fig. 34f.)

Fig. 3. Dor (×300). (After Rauff, 'Palæospongiologie,' Fig. 34g.)

Fig. 4. Amphistrongyle from *Alloioraphium spongiosum* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VII, fig. 4d.)

Fig. 5. Style from *Cephaloraphidites milleporatus* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VII, fig. 3b.)

Fig. 6. Tylostyle from *Alloioraphium spongiosum* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VII, fig. 4b.)

Fig. 7. Amphityle from *Alloioraphium spongiosum* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VII, fig. 4c.)

Fig. 8. Ophirhabd from *Megaloraphium auriforme* Schrammen (×16). (After Schrammen, 'Kieselspongien,' Text Plate VII, fig. 7a.)

Fig. 9. Cricamphityle (×80). (After Rauff, 'Palæospongiologie,' Fig. 35b.)

Fig. 10. Spirule (×300). (After Rauff, 'Palæospongiologie,' Fig. 35m.)

Fig. 11. Sigmaspire (×290). (After Rauff, 'Palæospongiologie,' Fig. 35n.)

Fig. 12. Diancistra (×180). (After Rauff, 'Palæospongiologie,' Fig. 35f.)

Fig. 13. Anisochela (×360). (After Rauff, 'Palæospongiologie,' Fig. 35c.)

Fig. 14. Isochela (×100). (After Rauff, 'Palæospongiologie,' Fig. 35d.)

Fig. 15. Diaspid (×1350). (After Rauff, 'Palæospongiologie,' Fig. 35e.)

Fig. 16. Sanidaster (×100). (After Rauff, 'Palæospongiologie,' Fig. 35 o.)

Fig. 17. Spiraster (×500). (After Rauff, 'Palæospongiologie,' Fig. 36a.)

Fig. 18. Discorhabd (×280). (After Rauff, 'Palæospongiologie,' Fig. 35h.)

Fig. 19. Sphær (×430). (After Rauff, 'Palæospongiologie,' Fig. 36b.)

Fig. 20. Euaster (Oxyaster) (×100). (After Rauff, 'Palæospongiologie,' Fig. 36c.)

Fig. 21. Sphæraster (×300). (After Rauff, 'Palæospongiologie,' Fig. 36f.)

Fig. 22. Pycnaster (×600). (After Rauff, 'Palæospongiologie,' Fig. 36g.)

Fig. 23. Sterraster (×290). (After Rauff, 'Palæospongiologie,' Fig. 36h.)

Fig. 24. Rhax (×200). (After Rauff, 'Palæospongiologie,' Fig. 36i.)

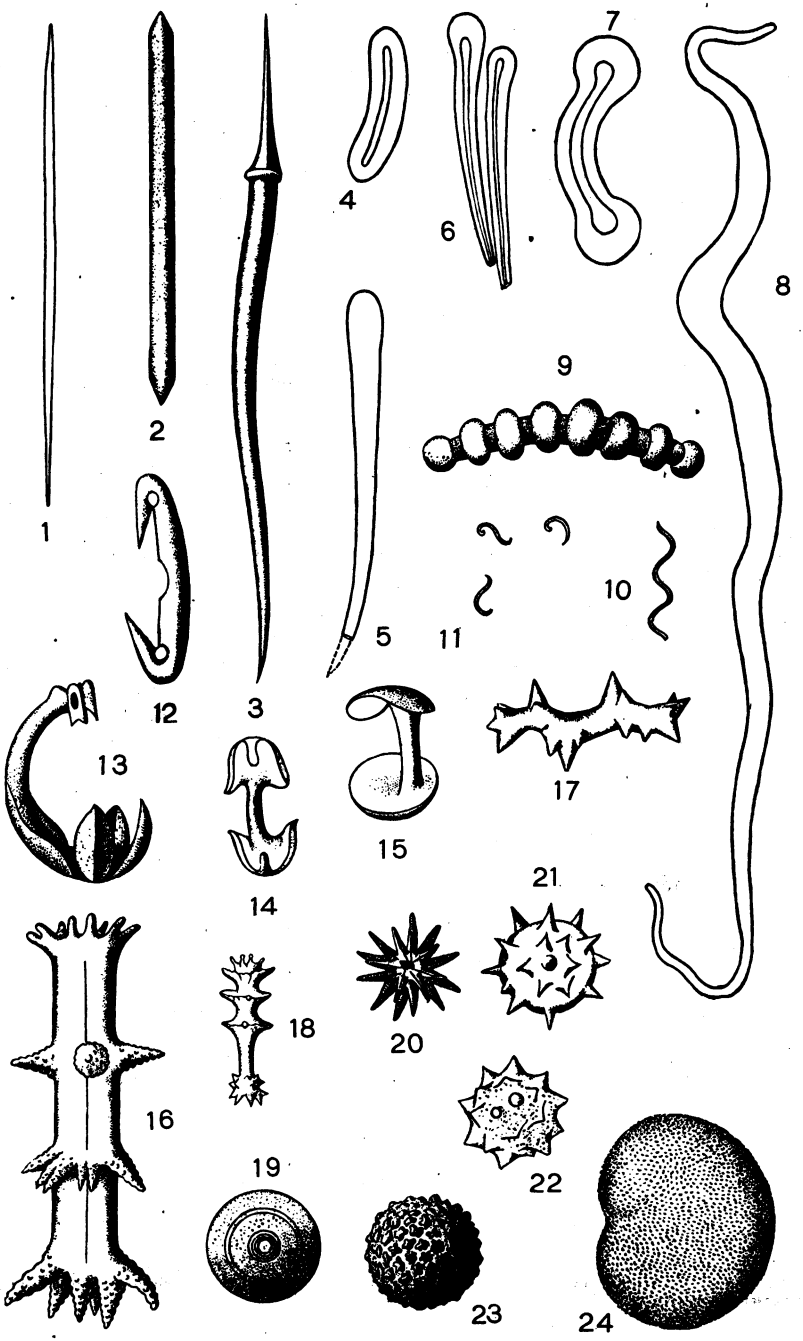
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PLATE VI

Representative Associations of Skeletal Spicules in the Silicispongiæ

(After Schrammen)

Order Tetraxonia[1] Schulze

Family Tetillidæ Sollas

Fig. 1. *Tetillopsis longitridens* Schrammen. (*a*) Protriæne. (*b*) Amphiox. (×16) (Schrammen, 'Kieselspongien,' Text Plate I, fig. 7.) Quadratenkreide. Oberg. A. M. N. H. No. 18277.

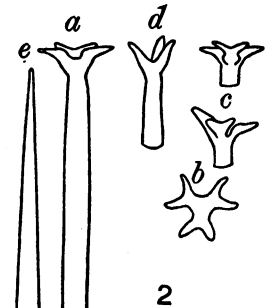
Family Stellettidæ Sollas emend. v. Lendenfeld

Fig. 2. *Stolleya ornatissima* Schrammen. (*a*) Dichotriæne. (*b*) Dichotriæne seen from above. (*c*) Front part of a dichotriæne. (*d*) Front part of a protriæne. (*e*) Half of an amphiox. (×16) (Schrammen, 'Kieselspongien,' Text Plate I, fig. 1.) Quadratenkreide. Oberg. A. M N. H. No. 18278.

Family Megamorinidæ v. Zittel

Fig. 3. *Doryderma* (*Brochodora*) *roemeri* Hinde. (*a*) Megaclones. (*b*) Dermal dichotriænes. (*c*) Amphioxes. (×16) (Schrammen, 'Kieselspongien,' Text Plate II, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18282.

[1]All illustrations of skeletal elements from species of this order show the individual spicules and not the skeleton as a whole.



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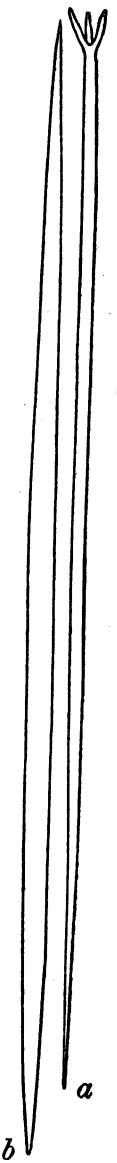

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Plate VII

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Family Corallistidæ Sollas emend. Schrammen

Fig. 1. *Pachinion scriptum* (Roemer). (*a*) Dicranoclones. (*b*) Megarhizoclonids. (*c*) Siliceous bodies from the epiderm. (*d*) Dermal dichotriænes. (*e*) Rod-like needles from the epiderm. (×30) (Schrammen, 'Kieselspongien,' Text Plate III, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18292.

Family Pachastrellidæ Sollas emend. v. Lendenfeld

Fig. 2. *Propachastrella primæva* (Zittel). (*a*) Caltrop. (*b*) Caltrop with globular arms. (*c*) Dermal dichotriæne seen from below. (×16) (Schrammen, 'Kieselspongien,' Text Plate I, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18295.

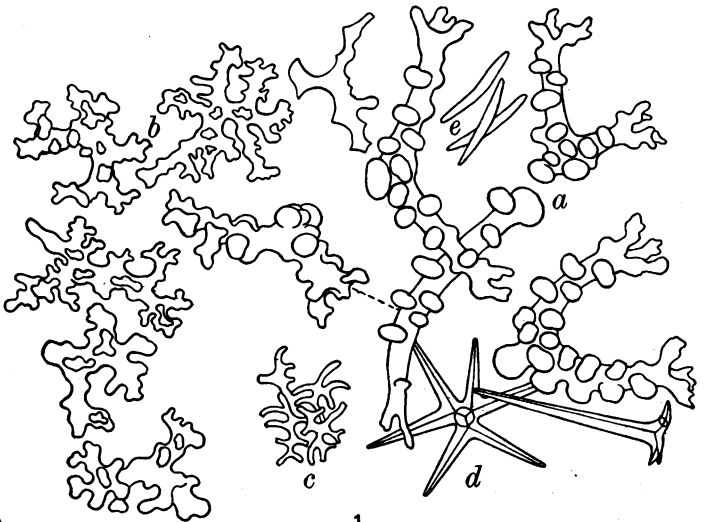
Family Tetraclinidæ v. Zittel

Subfamily Phymatellinæ Schrammen

Fig. 3. *Phymatella bulbosa* Zittel. (*a*) A tetraclone. (*b*) A young tetraclone. (*c*) Dichotriæne from the blanket layer or epiderm. (*d*; upper *a* misprint for *d*) Irregularly shaped siliceous bodies from the epiderm. (×30) (Schrammen, 'Kieselspongien, Text Plate IV, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18297.

Fig. 4. *Thecosiphonia postumus* Schrammen. (*a*) Tetraclones. (*b*) Irregularly shaped siliceous bodies from the epiderm. (*c*) Amphioxes from the epiderm. (×30) (Schrammen, 'Kieselspongien,' Text Plate IV, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18305.

Fig. 5. *Siphonia tubulosa* (Roemer). (*a*) Tetraclones. (*b*) Siliceous bodies from the epiderm. (*c*) Dermal dichotriænes. (×30) (Schrammen, 'Kieselspongien,' Text Plate IV, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18311.



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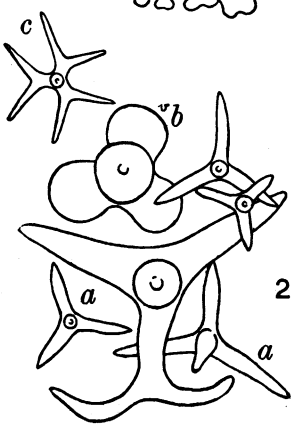

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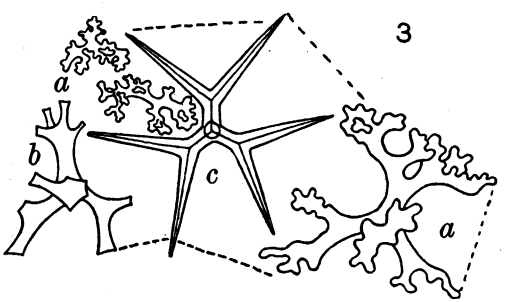

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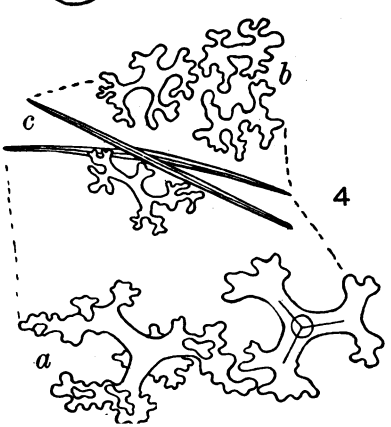

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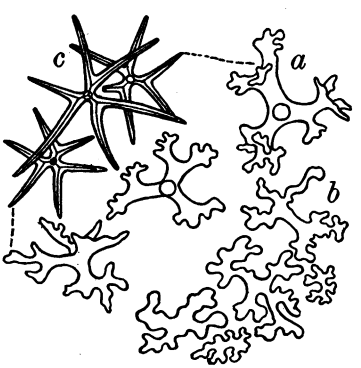


Plate VIII

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Subfamily Acrochordoniæ Schrammen

Fig. 1. *Acrochordonia ramosa* Schrammen. (*a*) Tetraclones. (*b*) Dermal dichotriænes (×30) (Schrammen, 'Kieselspongien,' Text Plate VI, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18313.

Subfamily Discoderminæ Schrammen

Fig. 2. *Discordermia antiqua* Schrammen. (*a*) Tetraclones with smooth arms. (*b*) A tetraclone with warty arms. (*c*) Lobate phyllotriæne from the epiderm. (×30) (Schrammen, 'Kieselspongien,' Text Plate V, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18315.

Fig. 3. *Rhagadinia rimosa* (Roemer). (*a*) Tetraclones with warty arms. (*b*) A tetraclone with smooth arms. (*c*) A phyllotriæne from the epiderm. (×30) (Schrammen, 'Kieselspongien,' Text Plate V, fig. 3.) Quadratenkreide. Oberg. A. M. N. H. No. 18316.

Subfamily Phymaraphininæ Schrammen

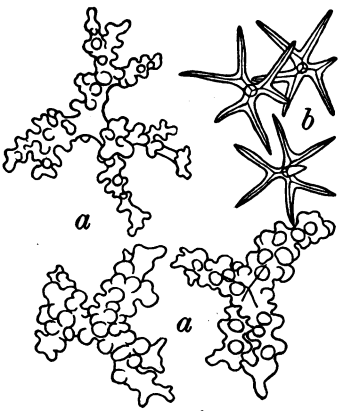
Fig. 4. *Procaliapsis cretacea* Schrammen. (*a*) Tetraclones. (*b*) Dermal phyllotriænes. (×30) (Schrammen, 'Kieselspongien,' Text Plate VI, fig. 2.) Quadratenkreide. Oberg. A. M. N. H. No. 18323.

Subfamily Astrocladinæ Schrammen

Fig. 5. *Astrocladia subramosa* (Roemer). Tetraclones (×30). (Schrammen, 'Kieselspongien,' Text Plate VI, fig. 9.) Quadratenkreide. Oberg. A. M. N. H. No. 18324.

Subfamily Plinthosellinæ Schrammen

Fig. 6. *Dactylotus micropelta* Schrammen. (*a*) Tetraclones. (*b*) Young tetraclones. (×30) (Schrammen, 'Kieselspongien,' Text Plate VI, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18326.



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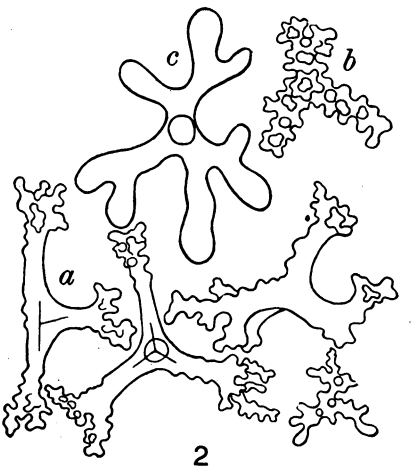

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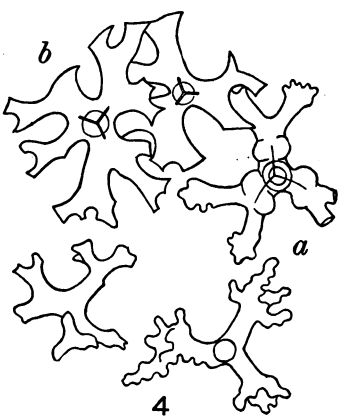

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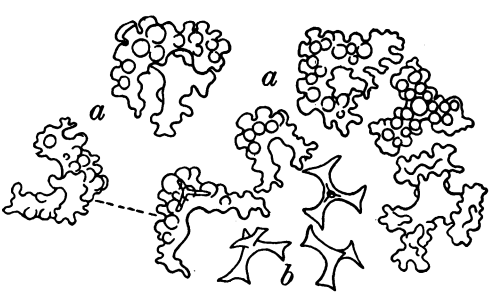

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Plate IX

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Family Geodiidæ Sollas

Fig. 1. *Geodeopsis microthrinax* Schrammen. (*a*) A protriæne. (*b*) An amphiox. (×16) (Schrammen, 'Kieselspongien,' Text Plate I, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18327.

Family Ophiraphididæ Schrammen

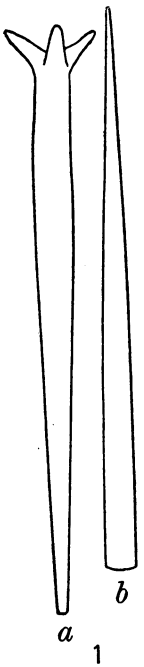
Fig. 2. *Alloioraphium spongiosum* Schrammen. (*a*) Ophirhabds. (*b*) Tylostyles. (*c;* just above *b;* the letter was omitted on the plate) An amphistyle. (*d*) An amphistrongyle. (*e*) An amphiox. (×16) (Schrammen, 'Kieselspongien,' Text Plate VII, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18325.

Family Helobrachiidæ Schrammen

Fig. 3. *Helobrachium consecatum* Schrammen. (*a*) Triactines. (*b*) Central part of a triactine (seen from the side, and showing the short axial canal of the fourth ray which is reduced to a globular swelling. (×16) (Schrammen, 'Kieselspongien,' Text Plate VII, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No. 18338.

Family Helomorinidæ Schrammen

Fig. 4. *Pachycothon giganteum* (Roemer). (*a*) Heloclones. (*b*) A dichotriæne from the surface. (*c*) An amphiox. (×16) (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 3.) Quadratenkreide. Oberg. A. M. N. H. No. 18339.



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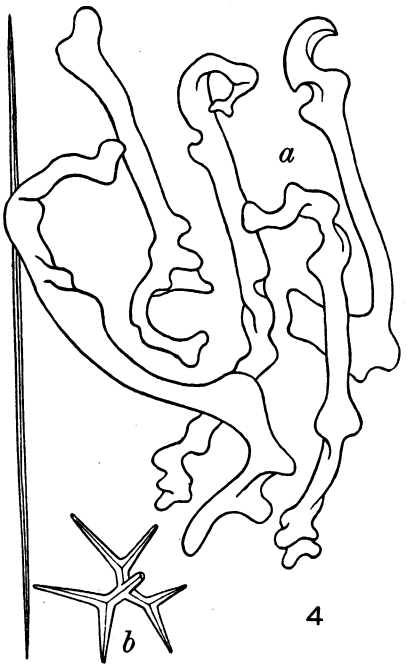

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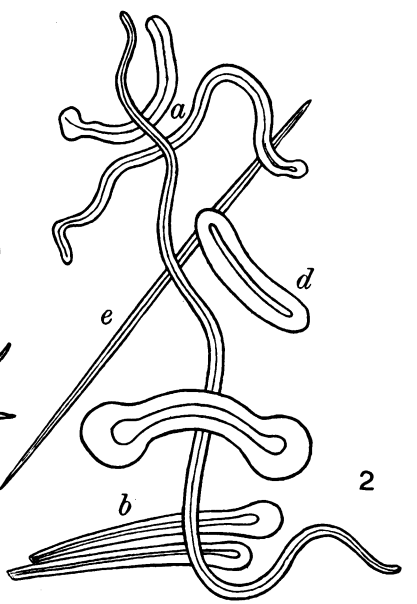

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PLATE X

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Family Desmacidonidæ Ridley and Dendy

Fig. 1. *Rhizopsis horrida* Schrammen. Megascleres (×10). (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18340.

Family Homoraphidæ Ridley and Dendy

Fig. 2. *Halichondria vosmaeri* Schrammen. Amphioxes from the surface (×10). (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 10). Scaphites Pläner. Nettlingen. A. M. N. H. No. 18214.

Family Rhizomorinidæ v. Zittel

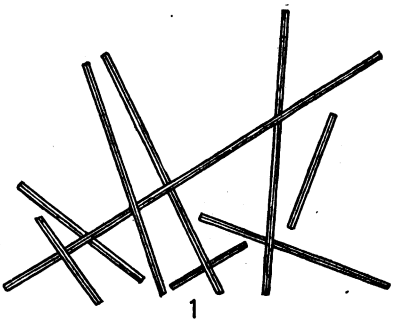
Fig. 3. *Seliscothon mantelli* (Goldfuss). Rhizoclones (×20). (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 4.) Mucronatenkreide. Misburg. A. M. N. H. No. 18527.

Family Megarhizidæ Schrammen

Fig. 4. *Chalaropegma cerebriformis* Schrammen Me garhizoclones enlarged 16 times. For comparison, showing the difference in size, (4*a*) is a megaclone (4*b*) a rhizoclone, both enlarged 16 times. (Schrammen, 'Kieselspongien,' Text Plate VIII, fig. 8.) Mucronatenkreide. Misburg. A. M. N. H. No. 18528.

Family Sphærocladinidæ Schrammen

Fig. 5. *Pachytrachelus exspectatus* Schrammen. (*a*) Sphæroclones with from 1 to 5 clones (×50). (*b*) Two sphæroclones in juxtaposition (×50). (*c*) and (*d*) Indefinite six-armed siliceous bodies (×50). (*e*) Dermalia (×60). (*f*) A sphæroclone with the ends of the axial canals seen from above and below (×50). (*g*) Central part of another sphæroclone with part of the axial canals (×100). (Dotted lines are parts restored.) (Schrammen, 'Kieselspongien,Text Plate VIII, fig. 1.) Mucronatenkreide. Misburg. A. M. N. H. No. 18529.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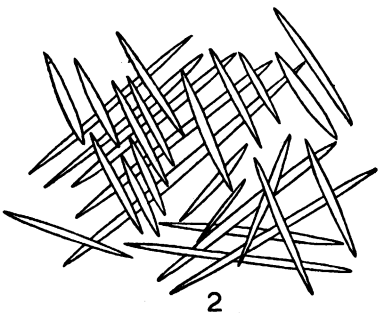
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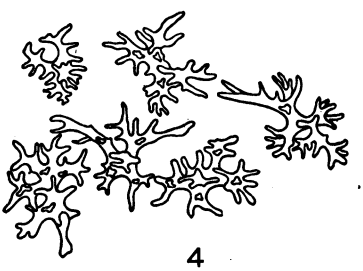
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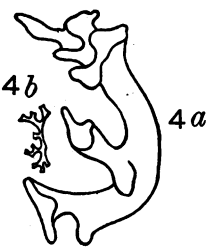
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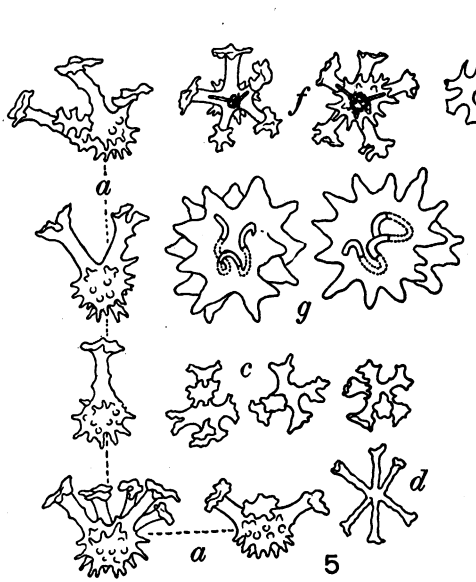
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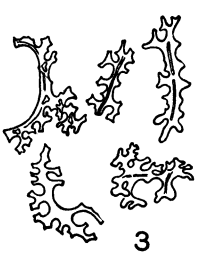
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Plate XI

Representative Associations of Skeletal Spicules in the Silicispongiæ

(After Schrammen)

Order Triaxonia[1] Schulze

Family Euplectellidæ Ijima

Fig. 1. *Regadrella petri-jacobi* Schrammen. Principalia with the long, thin needles of the comitalia lying thereon (×45). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 4.) Quadratenkreide. Oberg A. M. N. H. No. 18351.

Family Euritidæ F. E. Schulze

Fig. 2. *Farrea halli* Schrammen. Portion of skeleton showing lattice-like arrangement of spicules (×45). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18353.

Family Chonelasmatidæ Schrammen

Fig. 3. *Chonelasma hindii* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate xii, fig. 1.) Quadratenkreide. Oberg. A. M. N. H. No 18356.

Family Aphrocallistidæ F. E Schulze

Fig. 4. *Aphrocallistes cylindrodactylus* Schrammen. Surface of the outside of the skeleton seen from below (×45). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 6.) Quadratenkreide. Oberg. A. M. N. H. No. 18358.

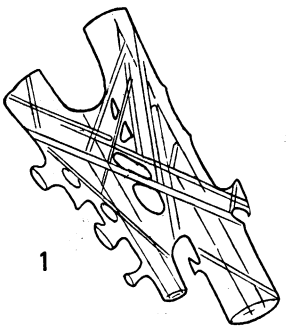
Family Tretocalycidæ F. E. Schulze

Fig. 5. *Hexactinella angustata* Schrammen. Skeletal arrangement into a dictyonal lattice or net-work (×45). (Schrammen, 'Kieselspongien,' Text Plate xi, fig. 8). Quadratenkreide. Oberg. A. M. N. H. No. 18359.

Family Auloplacidæ Schrammen

Fig. 6. *Auloplax spongiosus* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate ix, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18361.

[1]All illustrations of spicules from this order show the exact arrangement of the elements as they appear in the skeleton of the sponges.



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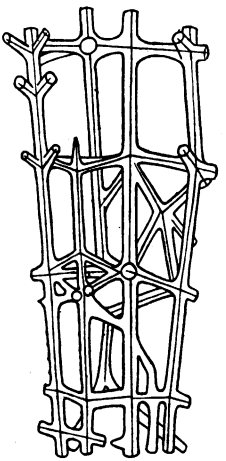

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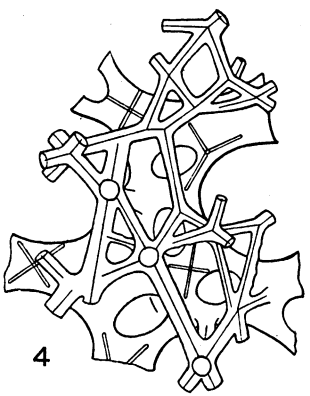

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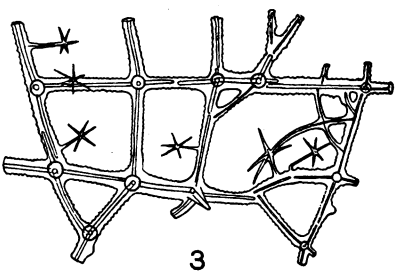

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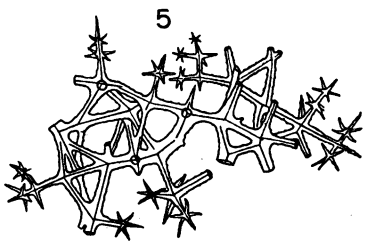

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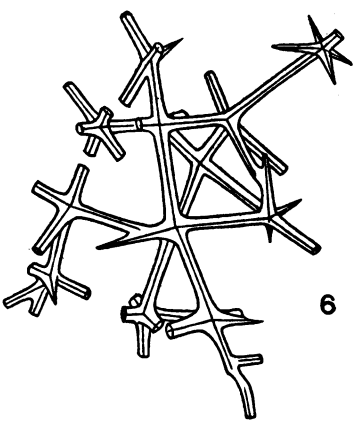

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PLATE XII

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Family Craticularidæ Rauff

Fig. 1. *Craticularia virgatula* Schrammen. Dictyonal skeleton (×45). (Schrammen, 'Kieselspongien,' Text Plate XI, fig. 9.) Quadratenkreide. Oberg. A. M. N. H. No. 18363.

Family Leptophragmidæ Schrammen

Fig. 2. *Pleurostoma radiata* Roemer. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate IX, fig. 4.) Quadratenkreide. Oberg. A. M. N. H. No. 18368.

Fig. 3. *Guettardia stümpeli* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate IX, fig. 3.) Quadratenkreide. Oberg. A. M. N. H. No. 18370.

Family Callibrochidæ Schrammen

Fig. 4. *Wollemannia araneosa* Schrammen. Skeletal network (*Gerüst*) (×45). (Schrammen, 'Kieselspongien,' Text Plate X, fig. 4.) Quadratenkreide. Oberg A. M. N. H. No. 18373.

Fig. 5. *Wollemannia araneosa* Schrammen. Surface of the inside of the skeleton seen from below (×45). (Schrammen, 'Kieselspongien,' Text Plate X, fig. 5.) Quadratenkreide. Oberg. A. M. N. H. No. 18373.

Fig. 6. *Wollemannia araneosa* Schrammen. Surface of the outside of the skeleton seen from below (×45). (Schrammen, 'Kieselspongien,' Text Plate X, fig. 6.) Quadratenkreide. Oberg. A. M. N. H. No. 18373.

Family Pleurothyrisidæ Schrammen

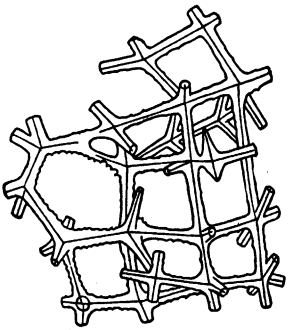
Fig. 7. *Pleurochorium schulzii* Schrammen. (*a*) Dictyonal hexactines. (*b*) Dictyoderm (*Deckgespinst*). (×45) (Schrammen, 'Kieselspongien, Text Plate X, fig. 8). Quadratenkreide. Oberg. A. M. N. H. No. 18374.

Family Ptychodesidæ Schrammen

Fig. 8. *Ptychodesia papillata* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate XI, fig. 2.) Quadratenkreide. Oberg. A. M. N. H. No. 18375.

Family Polystigmatidæ Schrammen

Fig. 9. *Polystigmatium striato-punctatum* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate X, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18376.



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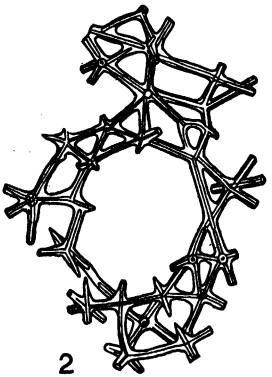

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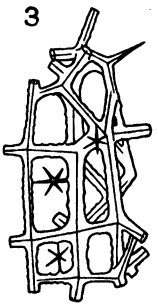

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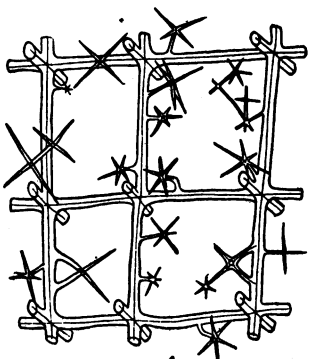

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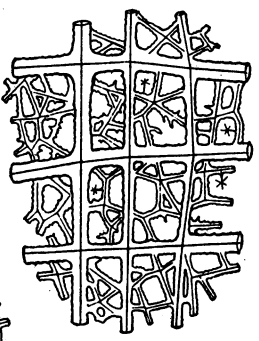

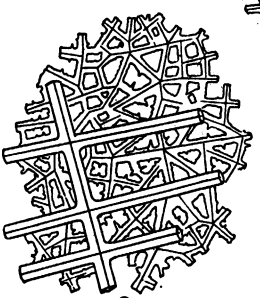

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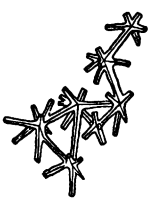

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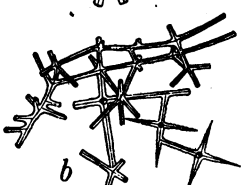

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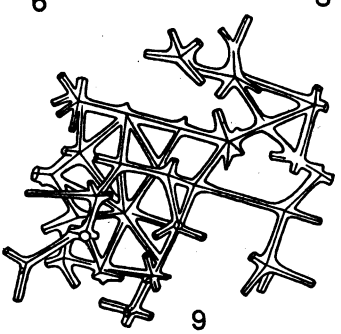

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Plate XIII

Representative Associations of Skeletal Spicules in the Silicispongiæ

(After Schrammen)

Family Stichmaptycidæ Schrammen

Fig. 1. *Stichmaptyx alatus* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate IX, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18377.

Family Botryosellidæ Schrammen

Fig. 2. *Botryosella labyrinthica* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate IX, fig. 11.) Cuvieri Pläner. Grosse Heere. A. M. N. H. No. 18251.

Family Balantionellidæ Schrammen

Fig. 3. *Balantionella elegans* Schrammen. Dictyonal hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate IX, fig. 7.) Quadratenkreide. Oberg. A. M. N. H. No. 18378.

Family Ventriculitidæ v. Zittel

Fig. 4. *Ventriculites radiatus* Mantell. Dictyoderm of the upper side of the skeleton (×45). (Schrammen, 'Kieselspongien,' Text Plate XIII, fig. 5.) Cuvieri Pläner. Grosse Heere. A. M. N. H. No. 18252.

Fig. 5. *Lepidospongia fragilis* Schrammen. Dictyoderm of the inner side of the skeleton (×45). (Schrammen, 'Kieselspongien,' Text Plate XIII, fig. 1.) Quadratenkreide. Oberg. A. M N. H. No. 18383.

Fig. 6. *Napœa striata* Schrammen. Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate XIV, fig. 11.) Quadratenkreide. Oberg. A. M. N. H. No. 18385.

Family Polyblastididæ Schrammen

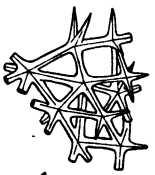
Fig. 7. *Polyblastidium racœmosum* (T. Smith). Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate XIII, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18386.

Family Actinocyclidæ Schrammen

Fig. 8. *Actinocyclus alternans* (Roemer). Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate XIV, fig. 14.) Quadratenkreide. Oberg. A. M. N. H. No. 18387.

Family Microblastididæ Schrammen

Fig. 9. *Microblastidium decurrens* Schrammen. Lychnisks (×45). (Schrammen, 'Kieselspongien.' Text Plate XV, fig. 15.) Quadratenkreide. Oberg. A. M. N. H. No. 18388.



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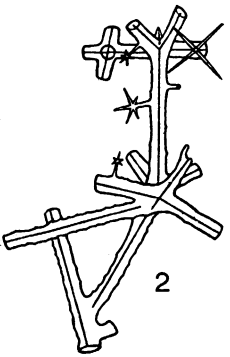

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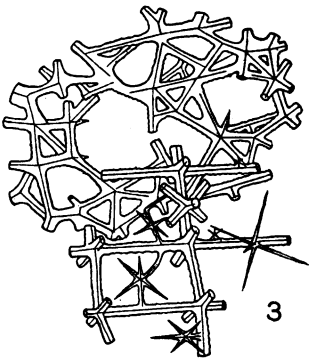

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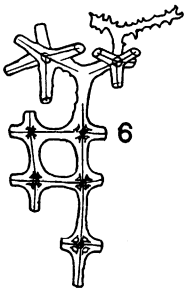

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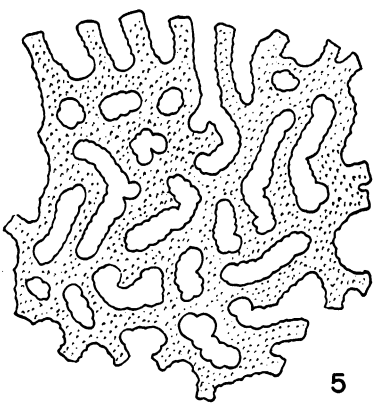

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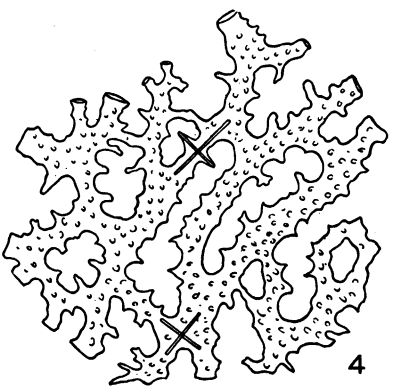

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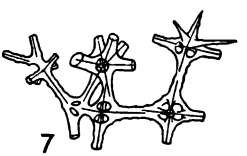

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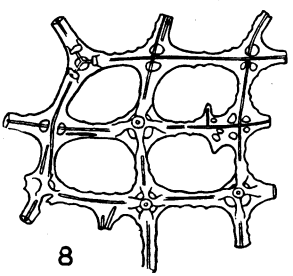

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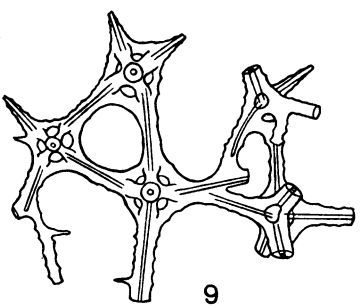

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Plate XIV

Representative Associations of Skeletal Spicules in the Silicispongiæ
(After Schrammen)

Family Sporadoscinidæ Schrammen

Fig. 1. *Sporadoscinia venosa* (Roemer). Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 18). Quadratenkreide. Misburg. A. M. N. H. No. 18455.

Family Callodictyonidæ v. Zittel

Fig. 2. *Pleuroţe lacunosa* (Roemer). Epiderm of the inside and lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 16.) Quadratenkreide. Oberg.[1]

Family Coscinoporidæ Schrammen

Fig. 3 *Coscinopora infundibuliformis* Goldfuss. Epiderm of the outside seen from below and lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 13.) Quadratenkreide. Oberg. A. M. N. H. No. 18395.

Family Becksidæ Schrammen

Fig. 4. *Cyclostigma mæandrina* Schrammen. Lychnisks and hexactines (×45) (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 4.). Quadratenkreide. Oberg A. M. N. H. No. 18403.

Family Oncotœchidæ Schrammen

Fig. 5. *Oncotœchus subrutus* (Quenstedt). Lychnisks (×45.) (Schrammen, 'Kieselspongien,' Text Plate xiv, fig. 7.) Cuvieri Pläner. Oberg. A. M. N. H. No. 18256.

Family Camerospongidæ Schrammen

Fig. 6. *Cystispongia monostoma* Schrammen. Lychnisks and hexactines (×45). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 9.) Quadratenkreide. Oberg. A. M. N. H. No. 18404.

Fig. 7. *Tremabolites megastoma* (Roemer). Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 8.) Quadratenkreide. Oberg. A. M. N. H. No. 18405.

Family Cœloptychidæ v. Zittel

Fig. 8. *Cœloptychium rude* von Seebach. Lychnisks (×45). (Schrammen, 'Kieselspongien,' Text Plate xv, fig. 10.) Quadratenkreide. Oberg. A. M. N. H. No. 18411.

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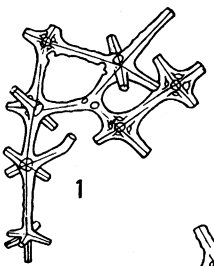
[1]The only representative of this species in the collection comes from the Mucronatenkreide of Misburg. (See No. 18542.)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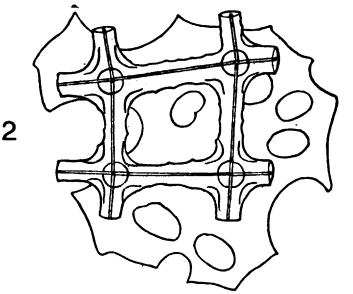
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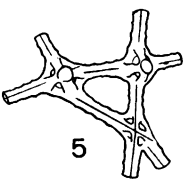
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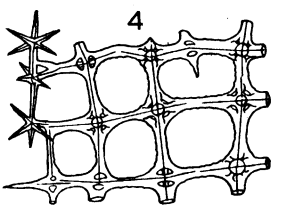
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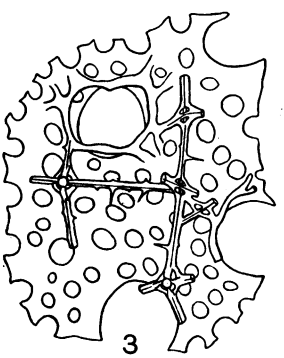
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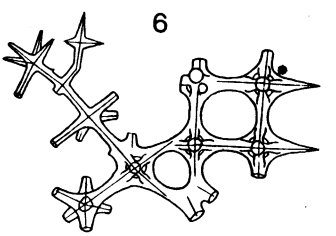
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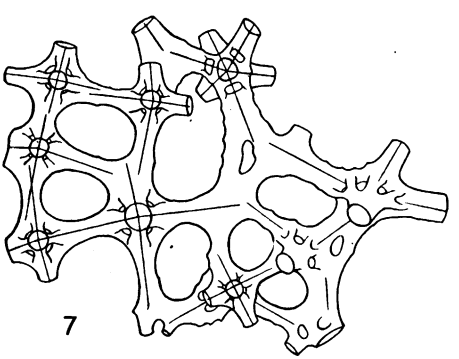
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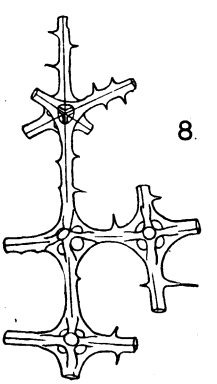
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