

PALAEONTOLOGY OF
HARRAR PROVINCE, ETHIOPIA

PART 4. JURASSIC CEPHALOPODA AND
A CRETACEOUS *NAUTILUS*

GAYLE SCOTT

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INTRODUCTION

THE CEPHALOPODS described in this paper are part of a collection of fossils assembled by Dr. Barnum Brown in Ethiopia while in charge of the Dudley Expedition to that region in 1921 and 1922. The fossils have remained in the American Museum for several years, and it is through the kindness of Dr. Harold E. Vokes that the writer has been given an opportunity to study and describe the cephalopods.

There are about 80 cephalopods in the collection. Of these four are *Aptychi*, and five belong to two genera of nautiloids. The 71 ammonites fall into 12 genera and 26 species. One genus and 19 species are new or not identifiable with known species.

The collection includes material from eight localities widely distributed over southern Ethiopia and two localities in western Somaliland. Most of the collection is, however, from

Dogou in Harrar Province, with a fair number of individuals from Ganame and Dirre Daua. The accompanying chart lists the species recognized, with their localities and approximate stratigraphic levels. A map of the localities and a general discussion of the geology of the region are in part 1 of this series of reports (Bull. Amer. Mus. Nat. Hist., vol. 82, art. 1, by Brown and Currie, 1943).

Small collections of cephalopods have been described from widely scattered localities in East Africa and Madagascar by a number of writers whose names and papers are listed in the bibliography, but little coordinated collecting or study of these fossils has been attempted. In most instances the collections have been so small or so poor, or the stratigraphic data accompanying them have been so inadequate that conclusions of only a general nature could be drawn from their study.

AGE OF THE ETHIOPIAN FAUNA

Spath, in his extensive revision of the Kachh ammonites (1933, pp. 810-825), has summarized what is known of the Jurassic cephalopod fauna of East Africa. In his report (p. 814) he mentions that there appears to be little affinity between the Kachh fauna and the known cephalopods from Ethiopia. He suggests that most of the Ethiopian fauna is probably from beds of upper Argovian (Oxfordian) and lower Kimmeridgian beds which are poorly represented in Kachh. His suggestion is well borne out by the study of the American Museum collections.

The specimens collected from Dogou, Ganame, and from Dirre Daua appear to be of approximately the same age. The assemblage from Dogou is the most extensive and is dominantly uppermost Oxfordian (Perisphinctean and Ringsteadian) in age, with possibly some specimens from beds of lowest Kimmeridgian. Genera such as *Perisphinctes*, *Ringsteadia*, *Aspidoceras*, and *Simaspidoceras* have been considered as Oxfordian in age, whereas *Lithacoceras* and a few others may indicate slightly younger beds. It may be that most of these genera actually extend across the border of the two stages.

An interesting feature of the Dogou locality is the extensive development of species of the genus *Physodoceras*. According to Spath (1930, p. 642), the range of this genus extends throughout the Kimmeridgian, but in Europe typical species, according to him, characterize the lower Kimmeridgian. In Ethiopia several species are closely associated with typical upper Oxfordian genera, and it may well be that the genus extends downward from the Kimmeridgian into the topmost Oxfordian.

The collections from Dirre Daua and Ganame are not so extensive as those from Dogou but appear to be of the same, or about the same, age. The presence of the lower Kimmeridgian genus *Idoceras* at Ganame suggests, however, the presence at that locality of beds that may be slightly younger.

Three species are recognized from the two neighboring localities at Mejasia east of Behan, British Somaliland. Two species of *Idoceras* are represented by large numbers of individuals, and there is an indeterminate species referred to *Virgatosimoceras*. The specimens retain fragments of the shell material and are preserved in a dark shaly

matrix differing considerably from the types of preservation found at Dogou, Dirre Daua, and Ganame. Age indications for strata at this locality are indefinite but suggest lower Kimmeridgian.

The age indication of a single Jurassic nautiloid from Kurtcha is indefinite.

The two nautiloids from Grau and Mt. Mummitchi are referred to *Heminautilus lallieri* (D'Orbigny) and are apparently Cretaceous specimens, although the label on the

larger individual mentions that it is from "limestone below ammonite zone." The presence in Ethiopia of *Heminautilus* is a further indication of the widespread occurrence of species of this group. Their age is everywhere uppermost Aptian or lower Albian. The presence of this species in beds immediately overlying strata of middle Upper Jurassic age suggests another area in which the widespread Aptian-Albian transgression manifests itself.

RELATIONSHIPS OF THE FAUNA

Little can be said concerning the affinities of the Ethiopian Jurassic ammonite faunas with those of surrounding areas. Collections and stratigraphic data throughout the vast

area of East Africa are so inadequate as to render statements of this nature little more than speculations.

It has been pointed out that the faunas

SPECIES	DOGOU	GANAME	DIRRE DAUA	MEJASIA	EAST BEHAN	KURTCHA	MT. MUMMITCHI	GRAU	PROBABLE AGE
<i>Ringsteadia africana</i>	*	*							Oxford. Ringsteadian
<i>Ringsteadia daua</i>			*						Oxford. Ringsteadian
<i>Perisphinctes vokesi</i>	*								Oxford. Ringsteadian or Perisphinctean
<i>Perisphinctes spathi</i>	*								Oxford. Ringsteadian or Perisphinctean
<i>Dichotomoceras</i> cfr. <i>predivisum</i>			*						Upper Oxford. or low. Kimmeridgian
<i>Dichotomosphinctes krapfi</i>	*		*						Upper Oxfordian
<i>Lithacoceras mombassanum</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Lithacoceras dogouense</i>	*								Upper Oxfordian
<i>Lithacoceras</i> sp. ind.		*							Upper Oxford. or low. Kimmeridgian
<i>Torquatisphinctes beyrichi</i>		*							Upper Oxfordian
<i>Torquatisphinctes</i> sp. ind.		*							Upper Oxfordian
<i>Idoceras rufanum</i>		*							Low. Kimmeridgian or upper Oxford.
<i>Idoceras behanense</i>				*	*				Low. Kimmeridgian
<i>Idoceras</i> sp. ind.				*					Low. Kimmeridgian
<i>Aspidoceras iphicerooides</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Aspidoceras evolutum</i>	*		*						Upper Oxfordian
<i>Physodoceras dogouense</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Physodoceras allenense</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Physodoceras gregoryi</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Physodoceras browni</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Glabrophysodoceras abyssinianum</i>	*		*						Upper Oxford. or low. Kimmeridgian
<i>Glabrophysodoceras ganamense</i>		*							Upper Oxford. or low. Kimmeridgian
<i>Simaspidoceras argobbae</i>		*							Upper Oxford. or low. Kimmeridgian
<i>Simaspidoceras harrarense</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Simaspidoceras ganamense</i>		*							Upper Oxford. or low. Kimmeridgian
<i>Virgatolimoceras</i> sp. ind.				*					Low. Kimmeridgian?
<i>Aptychi</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Paracenoceras</i> sp. ind.	*								Upper Oxford. or low. Kimmeridgian
<i>Paracenoceras costatum</i>	*								Upper Oxford. or low. Kimmeridgian
<i>Paracenoceras enmenianum</i>						*			Unknown
<i>Heminautilus lallieri</i>							*	*	Aptian or Albian, Cretaceous

from Ethiopia and Somaliland bear little apparent relationship to the classic Kachh fauna of India. As suggested by Spath (1933, p. 810), however, this may be explainable by a lack of absolute contemporaneity in the ammonite bearing beds of the two areas. The writer believes this suggestion is borne out by the study of the American Museum specimens. It is evident that the most extensive collections are from uppermost Oxfordian and lowermost Kimmeridgian which are poorly represented in Kachh.

In nearby areas such as Somaliland, Mom-basa, and Kenya small collections of approxi-

mately the same age and with a few species identical to those in Ethiopia have been found. Again, however, the collections are small, stratigraphic data insufficient, and absolute contemporaneity improbable.

The considerable numbers of cephalopods described from the Jurassic of Madagascar by Lemoine appear, for the most part, to be considerably older than the fauna described here.

The accompanying table gives a list of the species considered in the study, together with their distribution according to localities and probable age.

DESCRIPTION OF SPECIES

AMMONOIDEA

FAMILY PERISPHINCTIDAE HYATT

SUBFAMILY PROPLANULITINAE BUCKMAN,

EMEND. SPATH

GENUS RINGSTEADIA SALFELD

Ringsteadia SALFELD, 1913, p. 427; SALFELD, 1917, pp. 68-84, pls. 8-13; SPATH, 1931 (1927-1933), p. 445; ARKELL, 1935, p. 246; ROMAN, 1938, p. 266.

Adult species of this genus are discoid, with high, relatively thin, moderately evolute whorls. The venter is considerably narrowed and is rounded. Young specimens have perisphinctoid whorls, and the evolution is less marked than in adults.

The sculpture of young or internal whorls is also perisphinctoid, but with age this feature decreases in prominence. Specimens of medium size have rather prominent primary costae on the upper flanks. Near the middle of the flank these divide into two to six secondary costae which tend to disappear on the venter. The living chambers of old specimens are almost or completely smooth. Broad but shallow constrictions cross the whorls at intervals.

The suture line is perisphinctoid in character. The ventral lobe is broad; the first lateral is longer than the ventral. It is also narrow with a tendency to a trifid division, although this character varies considerably. All lobes are relatively narrow and separated by broad saddles.

Ringsteadia is very similar in appearance to *Proplanulites* and *Kinkelniceras*, but its whorl shape is different, its costae are less prominent on the umbilical area, and it occurs much higher in the stratigraphic section. The genus is also similar to *Pictonia*, to which it is probably closely related. *Pictonia*, however, has occasional abnormally prominent primary costae, a character not found in *Ringsteadia*.

Ringsteadia characterizes beds of highest Oxfordian and possibly lowest Kimmeridgian. It has generally been considered that *Ringsteadia* is restricted to northern Europe, but the African species here referred to the genus appear to fall well within the limits prescribed for it.

GENOTYPE: *Ammonites pseudocordatus* Blake.

Ringsteadia africana, new species

Plate 10, figures 1, 2; text figure 1

The American Museum collection contains three large specimens of this species. Two are almost complete with parts of the living chambers attached. One is a large whorl fragment which is only partly septate. All specimens are internal molds.

DESCRIPTION: The species is strongly evolute with high, laterally compressed whorls. Evolution increases with age. Flanks are flattened or gently bulged, tending to converge ventrally so that the ventral part of the whorl is thinner than the dorsal part. The venter is narrowly rounded. The umbilicus is broad and shallow with low, almost vertical walls. The umbilical margin is distinct but broadly rounded.

The following measurements are taken from the best specimens:

	I	II
	(holotype)	
Diameter	225 mm.	272 mm.
Greater radius	122	156
Lesser radius	103	116
Height of last whorl	66	76
Thickness of last whorl	44	48
Width of umbilicus	115	124
Suture taken at diameter of 196		

Sculpture consists of primary and secondary costae of the perisphinctid type. There are about three to four secondaries to every primary. On the ventral area of the whorl all costae are of about equal prominence. On approaching the venter they sweep gently forward and tend to disappear or become extremely weak. The secondary costae disappear on the middle part of the flank without anastomosing with the primaries. The primaries increase in strength dorsally and are strongest on the upper flank and near the umbilical margin. On the large outer whorls the flanks are smooth or marked only by broad undulations corresponding to the primary costae, while the finer primary and secondary costae on the ventral area are absent or only faintly discernible.

The suture line (fig. 1) has a broad and short ventral lobe, a first lateral lobe narrower and much longer than the ventral and asymmetrically trifold. All other lobes are rela-

suggesting a rather narrowly rectangular whorl section with narrowly rounded venter; umbilicus moderately broad and shallow with perpendicular wall and rounded margin.



FIG. 1. Suture line of *Ringsteadia africana*, new species.

tively short and narrow. The saddles are all broad except the second lateral which is narrow.

COMPARISON WITH OTHER SPECIES: *Ringsteadia africana* is very similar to species of the genus described by Salfeld (1917) from the topmost Oxfordian of England. In whorl shape and sculpture it corresponds to *R. evoluta* Salfeld, but is less evolute than that species. It is probably closest to *R. frequens* Salfeld, with which it is closely comparable in whorl section, coiling, and suture line. The sculpture is, however, more robust than on the British species.

OCCURRENCE: Two specimens are from strata exposed at Dogou, Harrar Province, Ethiopia. Specimen I (holotype, A.M.N.H. No. 25423) from an elevation of 7760 feet, specimen II (Texas Christian University Collection) from an elevation of 7550 feet. A large fragment (Texas Christian University Collection) referred to the species is from Ganame, Harrar Province.

Species of *Ringsteadia* abound in Europe in beds of uppermost Oxfordian age.

***Ringsteadia daua*, new species**

Plate 11, figures 1, 2; text figure 2

This species is represented in the collection by a single, entirely septate specimen (A.M.N.H. No. 25424) rather badly deformed by disturbance of the strata from which it was collected.

DESCRIPTION: Specimen strongly discoid, moderately evolute, each whorl embracing the latter to about half its height; flanks flat or only slightly inflated and almost parallel,

The following measurements are taken from the specimen:

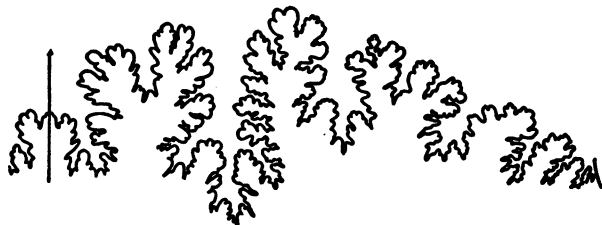
Diameter	180 mm.
Greater radius	113
Lesser radius	67
Height of last whorl	72
Height of penultimate whorl	38
Thickness of last whorl	36
Thickness of penultimate whorl	21
Width of umbilicus	56
Suture taken at diameter of	161

Sculpture consists of primary and secondary perisphinctoid ribs of striking regularity. Costae are of equal strength and prominence on the ventral area of the shell, but in crossing the narrowly rounded venter they sweep gently forward and are interrupted or strongly attenuated. The secondaries disappear dorsally by fading into the flat flanks and without anastomosing with the primaries. Primary ribs continue dorsally with some increased prominence to the umbilical margin. On the larger whorls the mid-flank becomes smooth or nearly so.

The perisphinctid suture line (fig. 2) consists of a short, broad, ventral lobe, a long, narrow, and almost symmetrically trifold first lateral lobe and several other short but narrow lateral lobes. All saddles except the second lateral are considerably broader than corresponding lobes.

COMPARISON WITH OTHER SPECIES: *Ringsteadia daua* belongs to the more involute group of *Ringsteadia* represented in England by such species as *R. pseudo-yo* and *R. brandesi* and is remarkably similar to the latter. Its whorl section, however, is a little thinner and higher than that of *R. brandesi*.

OCCURRENCE: The specimen which serves as the holotype of this new species is labeled as coming from the "ammonite zone 30 feet thick" 6 miles north of Dirre Daa, in Ethiopia. Similar species in Europe occur in beds of the uppermost Oxfordian.



Perisphinctes vokesi, new species
Plate 10, figures 3, 4; text figure 3

The American Museum collection contains a large internal mold to which a part of the living chamber is attached. The specimen (A.M.N.H. No. 25425) is rather badly bat-

FIG. 2. Suture line of *Ringsteadia daua*, new species.

SUBFAMILY **PERISPINCTINAE** HYATT,
EMEND. SPATH

GENUS **PERISPINCTES** WAAGEN, EMEND. SPATH

Perisphinctes WAAGEN, 1869, p. 248; WAAGEN, 1875, p. 143; SALFELD, 1914, p. 231; BUCKMAN, 1920, p. 27; SCHINDEWOLF, 1925, p. 500; SPATH, 1931, p. 397 and following (extensive discussion); ARKELL, 1935-1942, p. x and following (extensive discussion).

This genus, as now restricted, includes a relatively small number of ammonite species, and these are difficult to identify if material is poorly preserved or fragmentary.

Young individuals are evolute and characterized by what has become known as the perisphinctid type of sculpture in which strong primary costae cross the flanks and divide on the ventrolateral area into two or more secondaries. These cross the venter without interruption or attenuation. On the older, outer whorls secondary costae tend to disappear, and the primaries on the flanks expand into broad, widely spaced folds or disappear altogether.

Whorls are rounded to subquadrangular in cross section and increase slowly in both height and width.

It is difficult to recognize or correctly place many of the genera that have been separated from the originally and broadly conceived *Perisphinctes*. Among these is *Pachysphinctes*, and there is some doubt as to the validity of this division.

Species now commonly referred to *Perisphinctes* characterize strata of the highest Oxfordian.

GENOTYPE: *Ammonites biblex* Sowerby.

tered, but most of its features are well shown.

DESCRIPTION: Shell discoid, strongly evolute; umbilicus broad, moderately shallow; umbilical wall low and steep with rounded margin; whorls increase slowly in both height and thickness; whorl section subquadrate, slightly impressed by previous whorls. The specimen has the following dimensions:

Diameter	220 mm.
Greater radius	132
Lesser radius	88
Height of last whorl	62
Thickness of last whorl	51+
Height of penultimate whorl	42
Width of penultimate whorl	28
Width of umbilicus	122
Suture taken at diameter of	130

Sculpture consists of primary and secondary costae. On the inner whorls, sculpture is relatively fine, and the primary costae divide regularly into two secondaries at the ventrolateral margin. These are not interrupted on the venter but are faintly attenuated. On the outer whorls, costae are coarse, distantly spaced, and crested, and split into three or more secondaries. On the living chamber, the secondary costae become extremely weak or disappear altogether, while the primaries become broad, distantly spaced, irregular folds across the flanks but tend to disappear on the ventral region.

The suture line (fig. 3) is characterized by the shortness and complexity of its elements. The ventral lobe is short, broad, and much divided; first lateral lobe short, broad, and trifid; second and third lateral lobes short and

narrow. All the saddles are unusually broad, first lateral saddle short, extremely broad; and almost symmetrically divided; second lateral saddle also very broad and nearly symmetrically divided; third lateral saddle broad and unevenly divided. Umbilical elements of the suture are poorly shown.

evolute; umbilicus broad, shallow with low, steep, umbilical wall; umbilical margin rounded; whorls increase slowly in both height and thickness; whorl section subquadrate, slightly impressed, flanks and venter broadly rounded. The specimen has the following dimensions:



FIG. 3. Suture line of *Perisphinctes vokesi*, new species. $\times 2$.

COMPARISON WITH OTHER SPECIES: *P. vokesi* shows well the characters of the genus to which it is referred and is similar to other species of the group. It exhibits the same general type of costation as *P. martelli* Oppel, but the whorls are thinner in cross section, the shell is more evolute, and the large costae on the outer whorls are less pronounced.

OCCURRENCE: Dogou, Harrar Province of Ethiopia, at an elevation of 7735 feet. The age is probably uppermost Oxfordian, of the Ringsteadian or Perisphinctean zones.

***Perisphinctes spathi*, new species**

Plate 13, figures 2, 4; text figure 4

A large specimen from Dogou (A.M.N.H. No. 25426) is similar in many respects to *Perisphinctes vokesi*, but it shows such constant differences in the details of its structure that it cannot be placed in the same species. The inner whorls of the specimen are missing, and it is otherwise badly broken. The living chamber, however, of considerably more than half whorl length, is almost entirely intact. As is usual in species of this group, the young and fragmentary specimens are difficult or impossible of specific or even generic identification.

DESCRIPTION: Shell is discoid, strongly

Diameter	244 mm.
Greater radius	143
Lesser radius	101
Height of last whorl	64
Thickness of last whorl	54
Height of penultimate whorl	39
Width of umbilicus	140
Suture taken at diameter of	197

The sculpture consists of primary and secondary costae. Innermost whorls are not shown, but on earliest part of the shell that is preserved the primary costae are already quite coarse and sharp-topped. On the larger whorls, the costae increase in coarseness and spacing until, on the living chamber, they are only broad, distantly spaced, and indistinct swellings. These are shown only on the flanks, and the ventral area is entirely smooth. At the ventrolateral margin of the younger whorls, the primary costae are replaced by secondaries which cross the venter without interruption. The secondaries cannot be seen on the earliest whorls but appear to number two, three, or more for each primary. On a rather large fragment broken from an inner whorl, each primary rib is replaced on the venter by three to four secondaries. Some of these branch from the primaries, but others arise from the interspaces. Pronounced constrictions periodically cross the whorls.

The suture line (fig. 4) is characterized by long and, for the most part, relatively symmetrical elements. The ventral lobe is long, broad, and its ventral secondary saddle is short; first lateral lobe long, narrow, and almost symmetrically trifid; second lateral lobe short, narrow, and asymmetrical; third lateral strongly inclined ventrally. First lateral saddle long, broad, and almost symmetrically divided by a narrow and short secondary saddle; second lateral saddle long and relatively narrow.

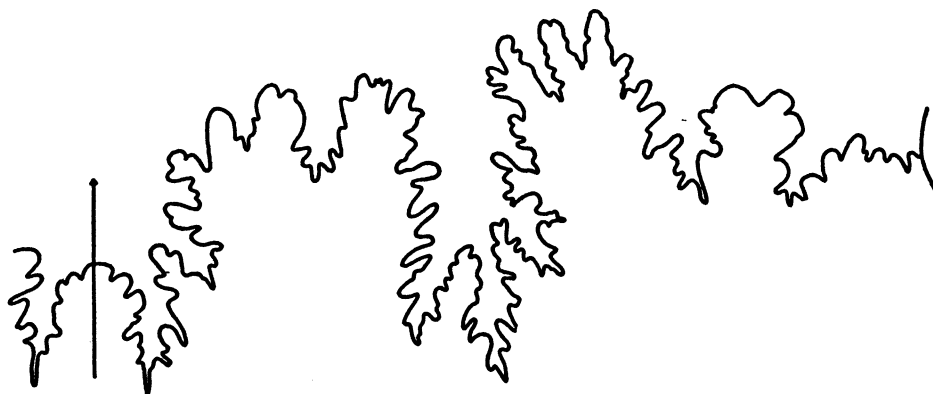


FIG. 4. Suture line of *Perisphinctes spathi*, new species. $\times 2$.

COMPARISON WITH OTHER SPECIES: *P. spathi* is very similar in general appearance to *P. vokesi* but differs from that species in several striking particulars. Its costation is everywhere coarser than in *P. vokesi*, and the secondaries may branch from the primaries or arise in the interspaces, whereas in *P. vokesi* they appear always to arise from the primaries and are less numerous. The flanks and venter of *P. spathi* are more rounded than in *P. vokesi*, and the fold-like swellings or costae on the living chamber are much less distinct and much more distantly spaced. In *P. vokesi* the sutural elements are short and broad, whereas in *P. spathi* they are long, and the first lateral lobe and second lateral saddle are distinctly narrower than the corresponding sutural elements in *P. vokesi*.

OCCURRENCE: Dogou, Harrar Province of Ethiopia. The age is probably uppermost Oxfordian of the Ringsteadian or Perisphinctean zones.

GENUS *DICHOTOMOCERAS* BUCKMAN

Dichotomoceras BUCKMAN, 1919, p. 27; SPATH, 1931 (1927-1933), pp. 401, 422; ROMAN, 1938, p. 278; ARKELL, 1935-1942, pt. 2, p. xxxvii.

According to Spath, who has carefully examined this genus, *Dichotomoceras* includes perisphinctids which retain the normal adolescent costation to the adult stage. Single ribs appear but are rare, and the body chamber is not modified. It might be added, also, that whorls are depressed in the young, circular at intermediate stages, and rather com-

pressed in the adult. A characteristic feature is the pronounced strength of the costae across the venter. Living chambers are about one whorl in length, and periodic constrictions are pronounced. Roman does not appear to believe its separation from *Perisphinctes* is justified, and Arkell includes it in *Biplices*.

GENOTYPE: *D. dichotomum* Buckman.

Dichotomoceras cfr. *predivisum* Spath

Plate 12, figures 2, 4

Dichotomoceras predivisum SPATH, 1931 (1927-1933), p. 422, pl. 88, fig. 4a, b, pl. 97, fig. 2, pl. 98, fig. 2, pl. 100, fig. 4.

DESCRIPTION: The single complete whorl is from a discoid, extremely evolute ammonite with a large, relatively deep umbilicus. The earlier part of the whorl has an almost circular cross section, but the outermost part is compressed and considerably higher than broad.

The following measurements give an idea of the dimensions of the specimen:

Diameter	111 mm.
Height of last whorl	32
Thickness of last whorl	24
Height of penultimate whorl	18
Thickness of penultimate whorl	18
Width of umbilicus	60

The sculpture is the most distinctive feature of the species. It consists of pronounced primary costae which rise on the umbilical wall, cross the flank with increasing strength while flexing slightly anteriorly. Each divides below the middle of the flank into two secondary ribs. These attain greatest prominence on the narrowly rounded venter. There are occasional undivided ribs, but these are rare. On the largest part of the whorl, the costae are flexed a little anteriorly at the umbilical suture, but this feature is not seen on the smaller parts of the whorl. Occasional constrictions are pronounced and directed anteriorly.

The specimen is broken at the last septum, and the suture line is not shown.

COMPARISON WITH OTHER SPECIES: This specimen is referred to Spath's species on the basis of comparison with his figure 4a, b of plate 88, to which it shows remarkable similarity. The Indian specimen, however, shows slightly more flexuous costae.

OCCURRENCE: Locality 6 miles north of Dirre Daua, Ethiopia, from an ammonite zone 30 feet thick, probably of lowest Kimmeridgian or topmost Oxfordian age. Spath's specimens are from the lower Katrol horizon of the Kimmeridgian of India.

GENUS *DICHOTOMOSPHINCTES* BUCKMAN

Dichotomosphinctes BUCKMAN, 1926, vol. 6, pl. 650; SPATH, 1930, p. 42; SPATH, 1931 (1927-1933), pp. 401-404 and following; ARKELL, 1936 (1935-1942), p. xlv.

Spath has pointed out (1931, p. 402) that it is extremely difficult to determine just what Buckman intended to include in this genus. Following Spath's interpretation, the genus should be reserved for the *D. wartae* (Bukowski) group. It is characterized by its strong, faintly sigmoidal ribbing on the flanks. Near the ventrolateral angle the costae bifurcate and bend slightly forward to

cross the venter. Whorls are broad and subquadrangular with broad, gently rounded venter; umbilicus is broad and moderately deep.

Suture line consists of a long and narrow ventral lobe, a slightly shorter tripartite lateral lobe, short and narrow second and third lateral lobes. The posterior swing of the umbilical sutural elements is markedly less than in many of the related genera. Saddles are broad and long and, except for the second lateral, are more or less symmetrically divided.

GENOTYPE: Buckman apparently intended to designate *D. antecedans* (Salfeld, 1914, p. 239, pl. 12, fig. 3) as genotype, but according to Spath the designation was based on misidentification. According to Spath, *Perisphinctes wartae* Bukowski may be taken as the genotype.

Dichotomosphinctes krapfi (Dacqué)

Plate 13, figures 1, 3; text figure 5

Perisphinctes (*Virgatosphinctes*) *krapfi* DACQUÉ, 1910, p. 13, pl. 3, fig. 3a, b.

Dichotomosphinctes krapfi SPATH, 1930, p. 45, pl. 3, fig. 7.

One fragmentary specimen from Dogou (A.M.N.H. No. 25428) showing parts of two whorls appears to belong to Dacqué's species. Another probable representative is from Dirre Daua.

DESCRIPTION: Shell evolute with broad, subquadrangular whorls broader than high; whorls increase slowly in both height and breadth; umbilicus broad, moderately deep, and bounded by smooth, perpendicular walls, the margins of which are broadly rounded; flanks gently rounded; venter broad and so broadly rounded that it gives the effect of being flattened when compared with many related species. The following measurements are taken from the specimen:

Diameter	102 mm.
Greater radius	59
Lesser radius	43
Height of last whorl	28
Height of penultimate whorl	31
Thickness of penultimate whorl	21
Thickness of last whorl	20
Width of umbilicus	55
Suture taken at diameter of	100

Sculpture consists of strong costation which varies seldom from the usual dichotomous arrangement. The strong, crested, faintly sigmoidal primary costae bifurcate at the point of their maximum strength on the ventrolateral margin to form the characteristic anastomosing arrangement of secondaries on the venter. Occasional undivided ribs are seen. Dacqué's text figure (text fig. 2, p. 13) shows a tripartite rib not seen on the specimen at hand. The writer agrees with Spath that this feature is not of specific rank. Secondary costae bend gently forward from the point of bifurcation to cross the broad venter. Costae are not interrupted on the venter but have a faint attenuation.

that its costae bifurcate at lower levels on the flanks and from greater prominences serve to distinguish it. In whorl section, the species is similar to *D. aff. luciae* (De Riaz) as figured by Spath (1931, p. 439, pl. 72, fig. 6a, b), but its costae are sharper, coarser, and more widely spaced. The specimen in the American Museum collection conforms well to Dacqué's figures, except that the venter appears to be more broadly rounded.

OCCURRENCE: Dogou, Harrar Province of Ethiopia, at an elevation of 7735 or 7450 feet. Another specimen is from 6 miles north of Dirre Daua. Both are probably topmost Oxfordian in age. Dacqué's specimens are listed as coming from "den gelbbraunen

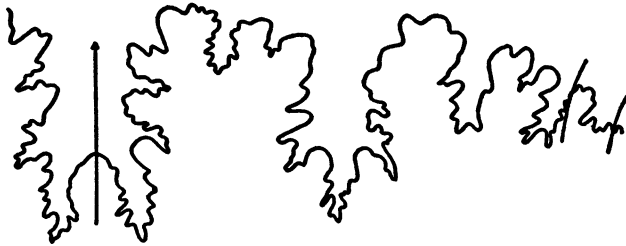


FIG. 5. Suture line of *Dichotomosphinctes krapfi* (Dacqué). $\times 2$.

The suture line (fig. 5) of this species has not been adequately described or figured, but is well shown on the specimen at hand. It consists of a long, narrow, deeply divided ventral lobe; a slightly shorter, narrow, almost symmetrically trifid first lateral lobe; pronounced but narrow second and third lateral lobes and numerous umbilical lobes. The first lateral saddle is broad, long, and equally divided by a pronounced secondary lobe. Second lateral saddle narrow and not deeply divided; third lateral saddle long, broad, and asymmetrically divided. The posterior sweep of the umbilical elements of the suture is not pronounced.

COMPARISON WITH OTHER SPECIES: The fact that the various perisphinctid genera and species are difficult to identify and interpret is well known. This is particularly true of African species where stratigraphic relationships are often uncertain and available specimens are few. Superficially, *D. krapfi* closely resembles such species as *Torquatisphinctes beyrichi* (Futterer) and *Lithacoceras mombasanum* (Dacqué), but its more quadrate whorls, broadly rounded venter, and the fact

Malmmergeln von kisaludini bei Mombasa," topmost Oxfordian. Various species described by Spath (1931) from India are topmost Argovian (Oxfordian) in age.

SUBFAMILY ATAXIOCERATINAE BUCKMAN,
EMEND. SPATH

GENUS LITHACOCERAS HYATT

Lithacoceras HYATT, 1900, p. 591; SPATH, 1931 (1927-1933), pp. 445-446, 450-463; ROMAN, 1938, p. 282; ARKELL, 1937 (1935-1942), p. li.

Hyatt's designation of *Lithacoceras* is without adequate diagnosis. As Spath has given this and related perisphinctid genera considerable study, his interpretation is followed here.

Species of the genus are essentially discoid, moderately evolute, but variable in this respect, and costation varies considerably from youth to adult. Young whorls show moderately straight primary costae, which divide low on the flanks into one or more secondary ribs. On outer whorls of older shells, the secondaries may be bundled to form large primaries.

The suture is similar to that of other peri-

sphinctids but is characterized by the marked posterior sweep of its umbilical elements and the ventral direction of these elements.

GENOTYPE: *Ammonites ulmensis* Oppel.

***Lithacoceras mombassanum* (Dacqué)**

Plate 14, figures 1, 2; text figure 6

Perisphinctes mombassanus DACQUÉ, 1910, p. 15, pl. 3, fig. 4, pl. 4, fig. 1.

Planites mombassanus (Dacqué) SPATH, 1925a, p. 122.

Lithacoceras mombassanum (Dacqué) SPATH, 1930, p. 48, pl. 4, fig. 1.

DESCRIPTION: Shell discoid, moderately evolute; umbilicus moderately broad, shallow, bounded by low, sloping walls which grade imperceptibly into the flanks; whorls moderately high, thin in cross section, with flat to slightly rounded flanks and broadly rounded venter. The following measurements are taken from the completely septate specimen (A.M.N.H. No. 25429):

Diameter	122 mm.
Greater radius	71
Lesser radius	51
Height of last whorl	39
Thickness of last whorl	32
Width of umbilicus	54
Suture taken at diameter of	110

Sculpture consists of about 58 narrow and crested, almost straight primary costae which usually bifurcate into secondaries half way from the middle of the flank to the ventrolateral margin. Although some of the primaries on the larger whorls may divide into three secondaries, occasional ones do not di-

The suture line (fig. 6) consists of a long, moderately narrow ventral lobe divided into two slender branches, a long first lateral lobe, and additional slender lateral and umbilical lobes and corresponding saddles. The suture is characterized by its first lateral lobe which is broadly and symmetrically trifid, and by the marked posterior sweep and ventral direction of its umbilical elements.

COMPARISON WITH OTHER SPECIES: The specimen considered here corresponds closely to specimens figured by Dacqué. All its dimensions, its whorl section, number and disposition of costae are almost identical with the specimen figured by Spath (pl. 4, fig. 1).

OCCURRENCE: Dacqué listed his specimens as coming from the upper Oxfordian near Mombasa. Spath's specimens are from "north and south of Makupa Bridge" in the region of Mombasa, and considered lower Kimmeridgian. The Ethiopian specimen is from Dogou, Harrar Province. It is probably uppermost Oxfordian in age, or lowest Kimmeridgian.

***Lithacoceras dogouense*, new species**

Plate 19, figures 1, 4; text figure 7

A single specimen (A.M.N.H. No. 25430) from Dogou presents striking features. A part of the living chamber is attached, and all the whorls except the youngest are partially shown in the umbilical area.

DESCRIPTION: Internal mold discoid, evolute; umbilicus shallow; umbilical wall low, steep, with rounded, costate margin; whorls increase slowly in both height and thickness;

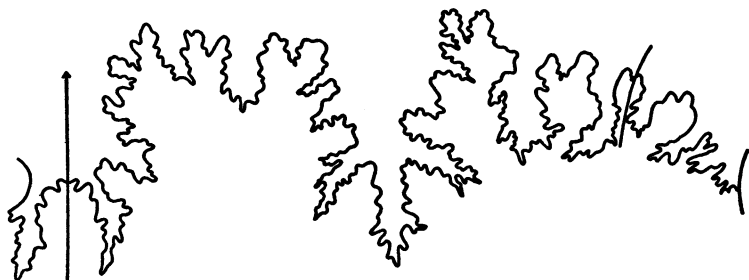


FIG. 6. Suture line of *Lithacoceras mombassanum* (Dacqué). $\times 2$.

vide at all. On parts of the whorl, secondary costae appear to bend sharply forward from the point of bifurcation, but this is probably due to the slightly crushed condition of the whorls.

whorl section subtrigonal, slightly impressed by preceding whorls; thickest part of whorl near umbilicus; flanks and venter broadly rounded. The holotype has the following dimensions:

Diameter	134 mm.
Greater radius	71
Lesser radius	63
Height of last whorl	39
Thickness of last whorl	40 (on costae)
Width of umbilicus	66
Suture taken at diameter of	108

Sculpture consists of primary and secondary costae which change markedly in appearance from youth to adulthood. On the younger, inner whorls, the sculpture consists of about 40 to 45 narrow and crested, almost straight primary costae. These usually bifurcate into secondaries a little more than half way from the flank to the ventrolateral area. Some of the primaries divide into three or more secondaries. On the older, outer whorls the secondaries become indistinct, while the primaries gain in strength so that on the last whorl they are widely spaced, rounded umbilical folds.

smaller than the Kenya form, and the adult sculpture is manifest at a much earlier age.

OCCURRENCE: Dogou, Harrar Province of Ethiopia, at an elevation of 7470 feet. The age is probably uppermost Oxfordian.

***Lithacoceras* ? sp. ind.**

Plate 14, figures 3, 5; text figure 8

One short and badly corroded fragment (A.M.N.H. No. 25431) of a large whorl collected at Ganame is doubtfully referred to *Lithacoceras*, although it may be a *Perisphinctes* related to some such species as *P. elisabethae* Müller (1900, p. 524, pl. 15, figs. 2, 3). The fragment appears to be from the part of the shell just at the point where the coarse adult sculpture begins to develop. The fragment has the following dimensions:

Length of fragment	57 mm.
Height of whorl	40
Thickness of whorl	43

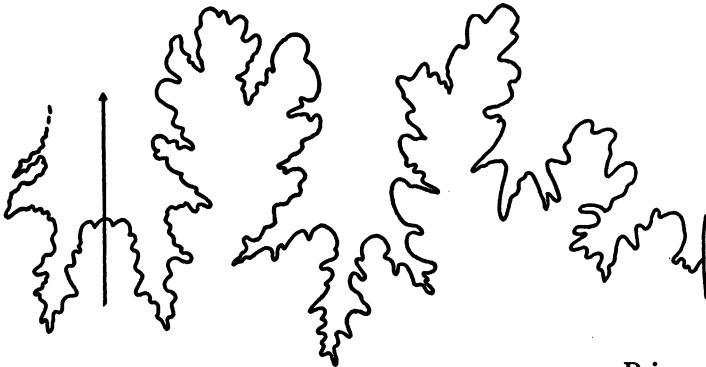


FIG. 7. Suture line of *Lithacoceras dogouense*, new species. $\times 2$.

The suture line (fig. 7) consists of a long, moderately narrow, ventral lobe divided into two slender branches; a long, narrow, tripartite first lateral lobe; a short, straight, second lateral lobe; a long and ventrally directed third lateral lobe on the umbilical margin, and corresponding saddles.

COMPARISON WITH OTHER SPECIES: The inner whorls of *L. dogouense* show some resemblance to *L. mombassanum* (Dacqué), but the costae are coarser and less numerous, and the adult sculpture is manifest at an earlier age. The species shows remarkable resemblance to *Lithacoceras kenyaense* Spath. The whorl sections are the same. The broad, fold-like, umbilical costae are also similar, but the shell of the Ethiopian species is considerably

Primary costae strong and distant but not fold-like. Near the ventrolateral margin, each splits into two or three secondaries. The ventral area of the shell is marked by a slightly eccentrically placed groove. This may, however, be a result of erosion of the specimen, as the impressed area of the shell shows the typical lithacocerid sculpture, and there is no suggestion of a ventral groove.

Both the external and internal suture lines (fig. 8) are especially well shown. The ventral lobe is moderately short and broad; first lateral lobe long, expanding posteriorly, and is tripartite; second, third, fourth, and fifth lateral lobes long, narrow, and ventrally directed. The dorsal lobe is long and narrow; internal lateral lobes long, narrow, and dorsally directed.

OCCURRENCE: The specimen here described was collected at Ganame, Harrar Province, near the base of what was termed "Oxfordian." The specimen was associated with other upper Oxfordian and lower Kimmeridgian species.

One incomplete and poorly preserved specimen from Ganame (A.M.N.H. No. 25432) appears referable to Futterer's species, although it is difficult to be certain of the generic assignment because the adult whorls are not present.



FIG. 8. Suture line of *Lithacoceras* ? sp. ind.

SUBFAMILY VIRGATOSPHINCTINAE SPATH

GENUS TORQUATISPHINCTES SPATH

Torquatisphinctes SPATH, 1923, p. 302; SPATH, 1931 (1927-1933), p. 465 and following; ROMAN, 1938, p. 283.

This perisphinctid genus is difficult to recognize except when complete shells are available. Young whorls might with reason be referred to a number of the perisphinctid genera now known. On younger whorls, ribs are typically dichotomous, but on older, outer whorls, single ribs become frequent and tripartite ribs occur.

Species of the genus are often very similar to *Biplices*, but in the latter genus the extreme length of some of the umbilical elements of the suture appears to be a distinctive feature. Imlay (1939, pp. 23, 34) assigns *Torquatisphinctes* to the upper Kimmeridgian, but common species in Europe, Asia, and Africa are referable to topmost Oxfordian or lowest Kimmeridgian.

GENOTYPE: *Ammonites torquatus* Sowerby.

Torquatisphinctes beyrichi (Futterer)

Plate 15, figures 1, 4; text figure 9

Perisphinctes beyrichi FUTTERER, 1894, p. 9, pl. 2, fig. 2.

Perisphinctes beyrichi Futterer, SIEMIRADZKI, 1898, p. 173; DACQUÉ, 1910, p. 14, pl. 4, fig. 2; SPATH, 1925a, p. 125.

Torquatisphinctes beyrichi (Futterer) SPATH, 1930, p. 55, pl. 3, fig. 6.

DESCRIPTION: Shell discoid, evolute, with subquadrate whorls almost as wide as high; umbilicus broad, shallow, with perpendicular walls and narrowly rounded margin. The specimen shows the following principal dimensions:

Diameter	91 mm.
Greater radius	53
Lesser radius	38
Height of last whorl	25
Width of last whorl	23
Width of umbilicus	50
Suture at diameter of	66

Sculpture consists of the usual dichotomous ribbing, with rather prominent points of bifurcation, especially on the younger whorls. Occasional single costae, however, are found, and these tend to be more numerous on the larger whorls. Secondary costae sweep markedly forward in crossing the venter.

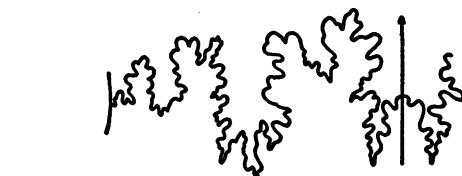


FIG. 9. Suture line of *Torquatisphinctes beyrichi* (Futterer). X 2.

Suture line (fig. 9) consists of a broadly divided ventral lobe, a massive, symmetrical

cally trifold, first lateral lobe, a short, narrow, second lateral lobe, and several ventrally directed umbilical lobes; first lateral saddle broad, second lateral saddle narrow and quite long.

COMPARISON WITH OTHER SPECIES: The specimen belonging to the American Museum conforms well to the figures given by Dacqué and Spath. It is, of course, closely similar in general appearance to many species of perisphinctids. Except for its suture it might well be assigned to *Biplices*.

to the ventrolateral margin where they normally bifurcate. Occasional ribs do not divide into secondaries or divide into three. Secondaries sweep across the venter in a broad but shallow, anteriorly directed sinus. Primary costae are nearly straight, but all are directed slightly forward along the flanks.

The suture line (fig. 10) consists of a broad, deeply and widely divided ventral lobe; a long, massive, symmetrically trifold first lateral; a short and narrow second lateral lobe, and several ventrally directed umbilical lobes



FIG. 10. Suture line of *Torquatisphinctes* sp. ind. $\times 2$.

OCCURRENCE: Specimen is labeled as coming from Ganame, Harrar Province, "Oxfordian," 40 feet above base. The other fossils with which the specimen is possibly associated appear to be lowest Kimmeridgian or uppermost Oxfordian in age. Dacqué assigned an upper Oxfordian age to his species.

Torquatisphinctes sp. ind.

Plate 12, figures 1, 3; text figure 10

One fragmentary, badly corroded, partially septate specimen from Ganame (A.M.N.H. No. 25433) is not definitely determinable.

DESCRIPTION: Shell discoid, moderately evolute, with ovate whorl section somewhat higher than broad; umbilicus broad, shallow, and bounded by low steep wall with broadly rounded margin. The following measurements give an idea of the size of the fragment:

Length of fragment (outer whorl)	134 mm.
Height of last whorl	38
Thickness of last whorl	35
Height of penultimate whorl	23
Thickness of penultimate whorl	20

Primary costae arise at the umbilical margin and gradually increase across the flanks

which lie in a posteriorly directed line along the umbilical wall; a broad, symmetrically divided, first lateral saddle, and a very long and narrow second lateral saddle. The suture is distinctive on account of the abnormally long and massive first lateral lobe as long as, or longer than, the ventral, and the long, but extremely narrow, second lateral saddle.

COMPARISON WITH OTHER SPECIES: As noted elsewhere, species of the various perisphinctid genera are often difficult to distinguish, but this species appears to be fairly distinctive on account of the peculiarities of costation and the suture. In general appearance, it is similar to *Biplices africanus* (Dacqué), but its suture is entirely different. On the other hand, it does not have the single and trifold costae characteristic of species of the genus *Torquatisphinctes*.

OCCURRENCE: Ganame, Harrar Province. The age appears to be topmost Oxfordian.

SUBFAMILY IDOCERATINAE SPATH

GENUS IDOCERAS BURCKHARDT

Idoceras BURCKHARDT, 1906, p. 36; BURCKHARDT, 1912, p. 101; SPATH, 1925a, p. 129; SPATH, 1930, p. 56; ROMAN, 1938, p. 242.

Idoceras was created by Burckhardt for the groups of *Ammonites planula* (Hill), Zieten, and *A. balderus* Oppel. At the same time (p. 82) he also created *Nebroditites*. Spath (1925a, p. 130) restricted *Nebroditites* to the group of *N. agrigentinus* (Gemmellaro), and *Idoceras* (p. 129) to the group of *A. balderus*. He then separated the species of the *A. planula* group from *Idoceras* and placed them in his new genus *Subnebroditites*. Spath's classification is followed here.

DESCRIPTION: Shell discoid, moderately evolute, with large umbilicus, bounded by low walls with rounded margin. Whorls are flattened, subrectangular, with rounded venter; whorls grow slowly in both height and width.

On young whorls, sculpture consists of numerous closely spaced primary costae which normally bifurcate near the ventrolateral margin. Sometimes, however, they divide into three or more secondaries, or are simple. Costae may be entire, gently attenuated, or even narrowly interrupted on the venter. On the older, outer whorls, the costae are more widely spaced and are irregularly branched. Outer whorls are almost smooth or marked by broad swellings on which there may be smaller costae. Costae lean strongly forward, especially on older whorls.

Strong, forwardly inclined constrictions cross the whorls at frequent intervals.

The suture line is relatively simple; external lobe a little shorter than the first lateral; second and third lateral lobes short and narrow; first lateral saddle broad, long, symmetrically divided; second lateral saddle long and narrow.

Idoceras, *Subnebroditites*, and *Nebroditites* were considered by Spath as probable derivatives of *Biplices* and placed in the family *Idoceratidae*. Spath in his Somaliland paper (1935, p. 213) seems to have revised his ideas of this group to a certain extent, when he considered it of subfamily rank. Finally in his revision of the Kachh ammonites (1931, p. 643), he gave the group subfamily rank but removed *Nebroditites* from it.

GENOTYPE: *Ammonites balderus* Oppel.

Idoceras rufanum Dacqué

Plate 14, figures 4, 6

Perisphinctes planula (Hehl), var. *laxevoluta*

Fontannes, Dacqué, 1905b, p. 147, pl. 14, fig. 15a, b, c.

Idoceras rufanum Dacqué, 1914, p. 3.

The American Museum collection contains one specimen (A.M.N.H. No. 25434) from the Ganame area which agrees closely with the specimen described and figured by Dacqué from Somaliland and which he later reported from Ethiopia.

DESCRIPTION: Shell discoid, markedly evolute, with broad umbilicus bounded by low, smooth, broadly rounded walls; whorls are subquadrangular in section, slightly higher than wide, and increase slowly in both height and width. The following measurements are taken from the plesiotype:

Diameter	76 mm.
Greater radius	43
Lesser radius	33
Height of last whorl	20
Thickness of last whorl	16
Width of umbilicus	39

Sculpture is perisphinctoid, consisting of narrow-crested and regularly spaced primary costae which bifurcate into secondaries low on the ventrolateral area. From the point of bifurcation the secondary ribs sweep sharply forward to approach the venter where they are interrupted by a narrow, smooth area. Occasional costae do not bifurcate, or they may divide into three secondaries. Strongly inclined constrictions cross the whorls at intervals. Dacqué did not figure nor describe the suture line of the species, and none is shown on the specimen at hand.

COMPARISON WITH OTHER SPECIES: Dacqué included *Perisphinctes planula* (Hehl) var. *laxevoluta* Fontannes as described and figured by Choffat (1893, p. 52, pl. 11, fig. 2a-c) in his *Idoceras montejuuntense*. At the same time the species from Somaliland formerly referred to *P. planula* var. *laxevoluta* by him was referred to his new species *Idoceras rufanum* (Dacqué, 1905b, p. 147, pl. 14, fig. 15a, b, c). It seems doubtful to the writer that either of the African species is very closely related to Choffat's variety. They are, however, very closely related to each other. *I. rufanum* appears to have somewhat coarser and sparser costae, and the whorl section is considerably lower than in *I. montejuuntense*. *I. sauteri* (Fontannes), as figured by Burckhardt (1912, p.

103, pl. 25, figs. 1-4), has the same coiling and about the same whorl section, but the ribs are coarser and more rounded than in either of the African species. *I. aguilarae* Burckhardt (1912, p. 105, pl. 25, figs. 5, 7-9) is also similar, but its whorls are higher, ribs coarser, and the smooth ventral area is not pronounced.

OCCURRENCE: Ganame, Harrar Province of Ethiopia. The label with the specimen bears the designation "Oxfordian—30 feet above base." Dacqué's Somaliland specimen came from what he called the "Gelbbrauner kalk" at Harro Rufa, and he assigned it a lower Kimmeridgian age. In his Ethiopian paper he refers the species to topmost Oxfordian. The American Museum specimen is believed to be from strata of the lowest Kimmeridgian or possibly topmost Oxfordian.

***Idoceras behanense*, new species**

Plate 15, figures 2, 3, 5; text figure 11

A suite of several specimens from one to two miles east of Behan at Mejasia, British Somaliland, appear to be referable to this species. All specimens in the American Museum collection show parts of the shell considerably altered, and some of the specimens retain large portions of the living chambers.

DESCRIPTION: Shells discoidal, evolute, with large umbilicus; umbilical wall low, perpendicular, with rounded margin; whorl section trapezoidal, with gently rounded venter; flanks flattened, converging gently toward the venter; whorls increase slowly in both height and width. The following measurements are taken from the two best individuals:

	I (A.M.N.H. No. 25435)	II (A.M.N.H. No. 25436)
Diameter	156 mm.	81 mm.
Greater radius	94	50
Lesser radius	62	31
Height of last whorl	56	25
Thickness of last whorl	28	19
Height of penultimate whorl	31	20
Thickness of penultimate whorl	12	12
Width of umbilicus	81	40
Suture taken at diameter of		64

Sculpture consists, in the young, of numerous costae which normally bifurcate at about one-third the whorl height. On the young, the costae are briefly interrupted on the mid-ventral line, but the interruption disappears with age. With increasing age the primary costae break into numbers of secondaries, and on the large outer whorls, strength, length, number, and distribution of secondary costae are extremely irregular, often resulting in great bulges. Costae flex gently backward on leaving the umbilicus, then turn forward. Strongly inclined constrictions cross the whorls at intervals.



FIG. 11. Suture line of *Idoceras behanense*, new species. $\times 2$.

The suture line (fig. 11) is relatively simple. A distinctive feature is the narrow and extremely long second lateral saddle.

COMPARISON WITH OTHER SPECIES: Superficially the outer whorls of this species closely resemble *Pseudovirgatites anavirgatoides* Spath (1925a, pl. 16, fig. 5), but the inner whorls are much more coarsely costate than in that species. It also shows some resemblance to *Lithacoceras capillaceum* (Fontannes), as figured by Spath (1930, pl. 6, fig. 3), but the umbilicus is wider and the costation coarser than in that species. It is, no doubt, closely related to *Idoceras balderum* (Oppel), as figured by Spath (1925a, pl. 16, fig. 3), but the ribs are more strongly inclined.

OCCURRENCE: Mejasia, 2 miles east of Behan, British Somaliland, upper ammonite zone, 2 feet thick, 100 feet below highest limestone "B," and (large specimen) 1 mile east of Behan 100 feet below layer "C," but thought to be layer "B" faulted. The level is probably lower Kimmeridgian.

***Idoceras* sp. ind.**

Plate 20, figures 3, 4

One fragment of *Idoceras* from Mejasia (A.M.N.H. No. 25437), appears to differ con-

siderably from the numerous specimens referable to *I. behanense*.

DESCRIPTION: Shell moderately evolute; whorls high and subrectangular in cross section; umbilicus shallow and bounded by a low vertical wall. The measurements of the fragment are as follows:

Length of fragment	34 mm.
Height of whorl	13
Thickness of whorl	9

Sculpture consists of primary and secondary costae. The primaries are relatively coarse and widely spaced. Just ventral of the mid-flank, each primary rib normally bifurcates into two secondaries which in turn are interrupted along a narrow, smooth, ventral area. Occasional primary costae do not divide, or they bifurcate abnormally high on the flank. Periodic constrictions cross the whorls.

OCCURRENCE: Mejasia, 2 miles east of Behan, British Somaliland. The age is believed to be lower Kimmeridgian.

FAMILY ASPIDOCERATIDAE ZITTEL

SUBFAMILY ASPIDOCERATINAE SPATH

GENUS ASPIDOCERAS ZITTEL

Aspidoceras ZITTEL, 1868, p. 58; ZITTEL, 1870, p. 79; WAAGEN, 1875, pp. 75-88; SPATH, 1931 (1927-1933), pp. 551, 617-620 (exhaustive discussion); ARKELL, 1940 (1935-1942), p. lxvi.

This large and important group of Jurassic ammonites has been somewhat restricted in recent years. As now interpreted, the genus includes moderately evolute, massive species characterized by two rows of tubercles on the flanks. Whorls are subquadrate to rounded in section, with flattened or broadly rounded venters; umbilicus moderately large and deep; suture complex and characterized by relatively broad, short lobes and saddles.

GENOTYPE: *Aspidoceras rogoznicense* (Zeu-schner).

Aspidoceras iphiceroides Waagen

Plate 16, figures 1, 3; text figure 12

Aspidoceras iphicerum (Oppel) WAAGEN, 1871, p. 92.

Aspidoceras iphiceroides WAAGEN, 1875, p. 102, pl. 23, figs. 1, 2; BEYRICH, 1877, p. 100; FUTTERER, 1894, p. 5 (in part); MÜLLER, G., in Bornhardt, 1900, p. 524; TOULA, 1907, p. 66; DACQUÉ, 1910, p. 24, fig. 13, pl. 4, fig. 4; SPATH, 1931 (1927-1933), p. 635, pl. 123, fig. 8a, b.

Physodoceras iphiceroides (Waagen) DIETRICH, 1925, p. 15.

Acanthosphaerites aff. *iphiceroides* (Waagen) SPATH, 1930, p. 60 (in part).

Spath, in his study of the Kachh Cephalopoda, considered this species in great detail and pointed out the difficulties involved in accurate determination. One large internal mold in the American Museum collection (A.M.N.H. No. 25456) appears to conform well to his analysis.

DESCRIPTION: Shell globose, involute, with broadly rounded flanks and highly arched venter; umbilicus deep, moderately narrow; umbilical wall slopes steeply and has broadly rounded margins; whorls increase rapidly in both height and thickness; whorl section sub-circular. The specimen, which is slightly crushed, has the following dimensions:

Diameter	120 mm.
Greater radius	68
Lesser radius	62
Height of last whorl	54
Thickness of last whorl	63
Width of umbilicus	26
Suture taken at diameter of	88



FIG. 12. Suture line of *Aspidoceras iphiceroides* Waagen.

The umbilical area is damaged so that the tuberculation is not well shown. It is possible, however, to make out two rows of tubercles. The rows are very close together, but individual tubercles in the rows are distantly spaced. The inner row is on the umbilical margin, and the tubercles are much larger than those of the other row just ventral to them. Other sculpture consists of indistinct, broad, irregular swellings and constrictions crossing the whorls.

The suture line (fig. 12) is typically aspido-

cerid; ventral lobe long, relatively narrow, and much divided; first lateral lobe long, narrow, and tripartite, with many divisions; second and third lateral lobes are lacking in distinctive features. The first lateral saddle is long, broad, and strongly asymmetrical; second lateral saddle is short, narrow, and symmetrically divided.

COMPARISON WITH OTHER SPECIES: Little can be added to what Spath has already said concerning the comparison of this species with others of the genus. The distinctive features are the globosity of the shell, the highly arched ventral area, and the closeness of the two rows of tubercles.

OCCURRENCE: Dogou, Harrar Province of Ethiopia, at elevation of 7550 feet. In India the species occurs in the middle Katrol beds of the middle and lower Kimmeridgian, but the specimen here described occurs with an upper Oxfordian-lower Kimmeridgian fauna.

***Aspidoceras evolutum*, new species**

Plate 17, figures 1, 4; text figure 13

Three internal molds, two of which have parts of the living chamber attached, are referred to this new species.

DESCRIPTION: Shell subglobose, evolute with broad, relatively deep umbilicus; umbilical wall steep and rounded at the margin; whorls increase slowly in both height and thickness; flanks subflattened to rounded; ventral area highly arched; whorl cross section subcircular. The three specimens in the collection have the following dimensions:

	I (A.M.N.H. No. 25438)	II	III
Diameter	166 mm.	146 mm.	121 mm.
Greater radius	91	86	70
Lesser radius	75	60	51
Height of last whorl	55	53	45
Thickness of last whorl	49	49	37 ±
Height of penultimate whorl	34	31	24
Thickness of penultimate whorl	31	30	22
Width of umbilicus	68	57	47
Suture taken at diameter of	135	125	81

Sculpture consists of two rows of prominent tubercles on each flank and broad, obscure bulges running transversely to the axis of the whorls. The outer row of tubercles is

stronger than the inner row, and each has about 17 tubercles per whorl. The outer row is just ventral of the middle flank, while the inner row is on the umbilical margin.

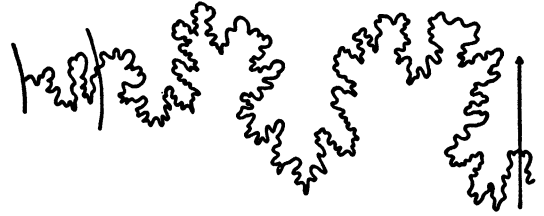


FIG. 13. Suture line of *Aspidoceras evolutum*, new species.

The suture (fig. 13) is characterized by the near symmetry of the first lateral saddle. Ventral lobe short, broad, and strongly divided; first lateral lobe short, broad, tripartite, and strongly divided; second lateral lobe also short, broad, tripartite, and strongly divided; umbilical lobes and saddles asymmetrical; second lateral saddle short, broad, and strongly divided.

COMPARISON WITH OTHER SPECIES: *Aspidoceras evolutum* is strikingly like *A. lerense* Spath (1931, p. 633, pl. 122, fig. 1a, b) but is slightly more evolute than that species. Its whorls are distinctly thinner, its venter more highly arched, and its flanks more strongly rounded. The young of the species also show some similarity to *A. somalicum* Dacqué (1905b, pl. 17, fig. 1a, b) but Dacqué's species is more globose and less evolute than the Ethiopian specimens.

I (A.M.N.H.

No. 25438)

II

III

166 mm.

146 mm.

121 mm.

91

86

70

75

60

51

55

53

45

49

49

37 ±

34

31

24

31

30

22

68

57

47

135

125

81

OCCURRENCE: Two specimens (I, A.M.N.H. No. 25438, and II, Texas Christian University Collection) are from Dogou, Harrar Province of Ethiopia, at elevations of 7760

feet (No. I) and 7730 feet (No. II), respectively. Both are preserved in gray to yellow arenaceous limestone. The other individual (Texas Christian University Collection) is from 6 miles north of Dirre Daa, Ethiopia, in the ammonite zone. It is preserved in dark argillaceous limestone.

The age is believed to be highest Oxfordian.

GENUS *PHYSODOCERAS* HYATT

Physodoceras HYATT, 1900, p. 582; SCHINDEWOLF, 1923, p. 370; SPATH, 1925a, p. 117; SPATH, 1931 (1927-1933), p. 618 (extensive discussion); ROMAN, 1938, p. 307; IMLAY, 1942, p. 1447.

Hyatt proposed this genus for ammonites of the group of *Ammonites circumspinosum* Oppel. According to Spath, such forms as *Physodoceras altenense* (D'Orbigny), *P. diastrophum* (Fontannes), *P. supraspinosum* (Dacqué), *P. cyclotum* (Oppel), *P. pipini* (Oppel), and others belong to it.

Physodoceras includes globose, involute forms similar to *Aspidoceras*, except that there is one row of tubercles on the flanks instead of two, as in *Aspidoceras*, and these are on the umbilical margin.

The suture is complex, consisting of broad and long elements. Ventral lobe is long, deeply divided; first lateral lobe tends to be asymmetrically tripartite; first lateral saddle long, broad, and asymmetrically divided. Second lateral lobe tripartite; umbilical sutural elements strongly directed ventrally.

Physodoceras is widespread in its occurrence, although Spath reports only a doubtful specimen from the Kachh Indian fauna. Dacqué has recorded at least two species (*P. supraspinosum* and *P. altenense*) from East Africa, and species of the European Jurassic are well developed. The stratigraphic range, also, appears to be considerable and, according to Spath, extends throughout the Kimmeridgian. He states, however (1930, p. 642), that typical species in Europe characterize the lower Kimmeridgian.

It appears to the writer that the genus may well extend down into the Oxfordian. The several entirely typical species described here are closely associated with an uppermost Oxfordian and lowermost Kimmeridgian fauna.

GENOTYPE: *Physodoceras circumspinosum* (Oppel).

Physodoceras dogouense, new species

Plate 18, figures 1, 2; text figure 14

Two very large and completely septate internal molds of *Physodoceras* do not appear to be referable to any known species of the genus.

DESCRIPTION: Shell extremely globose, involute, with deep, relatively narrow umbilicus; umbilical wall perpendicular at base but broadly rounded to meet the flank. Whorls increase with great rapidity in both width and height; whorl section subcircular to depressed-lunate. Venter and flanks broadly rounded. The two specimens have the following dimensions:

	I (A.M.N.H. No. 25439)	II
Diameter	177 mm.	195 mm.
Greater radius	117	120
Lesser radius	60	75
Height of last whorl	86	98
Width of last whorl	100	138
Height of penultimate whorl	47	48
Width of penultimate whorl	54	68
Width of umbilicus	52	53
Suture taken at diameter of	170	180

The only sculpture shown on the specimens at hand are strong, bullate tubercles to the number of about 12 per whorl on the umbilical margin.

The suture line (fig. 14) is extremely complex. The principal elements are a divided ventral lobe, tripartite first and second lateral lobes, broad and long first and second lateral saddles, and ventrally inclined umbilical elements.

COMPARISON WITH OTHER SPECIES: This species bears some resemblance to *Physodoceras supraspinosum* described by Dacqué (1905b, p. 150, pl. 16, fig. 2), but is much more globose, and the umbilical tubercles are much larger and fewer. It does not appear that the species would be easily confused with any other.

OCCURRENCE: Dogou, Harrar Province, at an elevation of 7750-7760 feet. The other ammonites with which the species is associated are upper Oxfordian or lower Kimmeridgian in age.

FIG. 14. Suture line of *Physodoceras dogouense*, new species.***Physodoceras altenense* (D'Orbigny)**

Plate 17, figures 2, 3; text figure 15

Ammonites altenensis D'ORBIGNY, 1847, p. 537, pl. 204; OPPEL, 1863, p. 181.*Aspidoceras altenense* NEUMAYR, 1873, p. 199 pl. 42, fig. 2; FAVRE, 1877, p. 16, pl. 7, fig. 5; DE LORIO, 1877, p. 116, pl. 17, fig. 4; DACQUÉ, 1905b, p. 150, pl. 17, figs. 2a, b.*Physodoceras altenense* SPATH, 1931 (1927-1933), p. 618.

One small and poorly preserved specimen (A.M.N.H. No. 25440) appears to be referable to this species, as described and illustrated by Daqué. Probably none of the African specimens, however, should be assigned to the D'Orbigny species. Although the specimen is small, a part of the living chamber is shown.

DESCRIPTION: Internal mold of shell discoid, globose, moderately evolute, with broad and deep umbilicus bounded by a steep, perpendicular wall. Whorls grow rapidly in both height and width; whorl section sub-circular; flanks rounded and converging toward the broadly rounded venter. The specimen has the following dimensions:

Diameter	45 mm.
Greater radius	29
Lesser radius	16
Height of last whorl	21
Thickness of last whorl	22
Width of umbilicus	14
Suture taken at diameter of	41

The principal sculptural feature consists of a single row of about 10 to 12 tubercles situ-

ated on the umbilical margin. These have a tendency to extend in rib-like fashion on the flanks. Fine striae or costae and occasional fold-like ribs cross the flanks and venter in broad forward sweeps.

FIG. 15. Suture line of *Physodoceras altenense* (D'Orbigny). $\times 2$.

The suture line (fig. 15) consists of a broad, relatively short, ventral lobe divided by a short, V-shaped, ventral, secondary saddle, a tripartite and much divided, narrow, first lateral lobe, a moderately long and divided second lateral lobe, a broad, but short and asymmetrically divided, first lateral saddle, a much narrower second saddle, and umbilical lobes and saddles.

COMPARISON WITH OTHER SPECIES: Spath and others have called attention to the great difficulty of specific identification and of proper generic assignment of this group of aspidocerids. The specimen here considered, however, agrees well with Daqué's figures in whorl section, sculpture, and especially its suture. There can be little question of the identity of the Somaliland and Ethiopian individuals. They are probably not, however, referable to *P. altenense* (D'Orbigny), but the

material at hand is insufficient to undertake a revision of the species.

OCCURRENCE: Dogou, Harrar Province, Ethiopia. The level is probably highest Oxfordian or lowest Kimmeridgian.

***Physodoceras gregoryi* (Spath)**

Plate 16, figures 2, 4; text figure 16

Acanthosphaerites aff. *longispinus* (Sowerby) SPATH, 1930, p. 58, pl. 7, fig. 6.

Aspidoceras gregoryi (Crick M. S.) SPATH, 1931 (1927-1933), p. 631.

One rather badly broken internal mold (A.M.N.H. No. 25441) is doubtfully referred to this species, which has been described with considerable thoroughness by Spath. The specimen is really too poorly preserved for accurate assignment.

DESCRIPTION: Shell globose, evolute, with broad, deep umbilicus; umbilical area badly broken, but apparently the umbilical wall is high and almost perpendicular, with rounded margin; whorls increase rapidly in both height and width; whorl section subcircular to ovate in the young with a tendency to become subquadrate in the large whorl; flanks and venter broadly rounded; ventrolateral margins indistinct. The following measurements taken from the specimen are only approximate:

Diameter	110 mm.
Greater radius	72
Lesser radius	38
Height of last whorl	47
Thickness of last whorl	44
Width of umbilicus	37
Suture taken at diameter of	96



FIG. 16. Suture line of *Physodoceras gregoryi* (Spath).

In the early stages the flanks are marked by two rows of moderately closely spaced tubercles, but on the older and larger whorl the

outer row disappears. The umbilical tubercles become larger, more bullate, and more widely spaced on the outer whorl of the entirely septate shell.

All sutural elements (fig. 16) are relatively long; ventral lobe long, narrow, and divided by a narrow ventral saddle into long, slender branches, and long, slender, secondary lobes extend from the sides of the primary. First lateral lobe long and asymmetrically trifid; second lateral lobe broad and moderately long. First lateral saddle long and asymmetrically divided, the ventral division being the longer and broader. Second lateral saddle relatively narrow. Umbilical elements of the suture are directed a little ventrally.

COMPARISON WITH OTHER SPECIES: Spath has pointed out the differences between this species and *Ammonites longispinus* (Sowerby) to which he originally referred his Somaliland form. The specimen considered here agrees with Spath's description and figure, except that the outer row of tubercles disappears more quickly, a factor which may be accounted for by the poor state of preservation of the Ethiopian specimen.

OCCURRENCE: Dogou, Harrar Province, Ethiopia, at an elevation of 7550 feet. The age is probably lower Kimmeridgian. Spath assigns his Mombasa specimen to the *tenuilabatus* zone of the lower Kimmeridgian, but some of the species with which *P. gregoryi* are associated in Ethiopia suggest an upper Oxfordian age.

***Physodoceras browni*, new species**

Plate 22, figures 2, 3; text figure 17

One large, entirely septate, internal mold (A.M.N.H. No. 25442), badly eroded on one side, is not referable to any known species.

DESCRIPTION: Shell subglobose, moderately involute, but increasing rapidly in evolution with age; umbilicus moderately narrow and deep; umbilical wall slopes steeply and has broadly rounded margin; whorl section ovate; flanks and venter broadly rounded. The holotype has the following dimensions:

Diameter	151 mm.
Greater radius	91
Lesser radius	60
Height of last whorl	65
Height of penultimate whorl	38

Thickness of last whorl	58
Thickness of penultimate whorl	34
Width of umbilicus	33
Suture taken at diameter of	96

Sculpture consists of a row of about 12 strong, bulla-like tubercles per whorl on the umbilical margin.



FIG. 17. Suture line of *Physodoceras browni*, new species. $\times 2$.

The suture line (fig. 17) is complex; ventral lobe extremely long and much divided; first lateral lobe relatively short, broad, and roughly quadrifid; second lateral lobe broad and strongly inclined ventrally; first lateral saddle long, broad, and asymmetrically divided, the ventral portion being considerably longer than the dorsal; second lateral saddle short, constricted posteriorly and much divided.

COMPARISON WITH OTHER SPECIES: *Physodoceras browni* is readily distinguished from common aspidocerids by its single row of prominent tubercles on the umbilical margin. It is considerably less globose than *Phy. dogouense*, and its umbilicus is narrower and deeper.

OCCURRENCE: Dogou, Harrar Province of Ethiopia, elevation 7750 feet. The age is probably topmost Oxfordian or lowest Kimmeridgian.

GENUS GLABROPHYSODOCERAS, NEW GENUS

Two physodocerids in the American Museum collections are sufficiently distinct to merit separate generic designation. They possess the characters of *Physodoceras* but in such an obscure fashion as to be easily overlooked. Superficially they show considerable resemblance to *Haploceras* and related genera with which, according to Spath (1928,

Kachh, p. 154), relatively smooth physodocerids have probably been confused.

Glabrophysodoceras may be described as a smooth *Physodoceras*. The shell is semiglobose involute, with whorls that are ovate in cross section. The flanks are broadly rounded and merge imperceptibly into the rounded venter. Around the umbilical border are rounded, indistinct tubercles, and broad, indistinct, irregular, and distantly spaced costae cross the flanks. Occasional costae are preceded by constrictions across the whorls.

The sutures are similar to those of other physodocerids.

GENOTYPE: *Glabrophysodoceras abyssinianum*, new species.

Glabrophysodoceras abyssinianum, new species

Plate 21, figures 1, 4; text figure 18

An almost smooth internal mold from Dirre Daa (A.M.N.H. No. 25443) retains a part of the living chamber and is the holotype of this new species. A second and smaller specimen from Dogou is referred to it.

DESCRIPTION: Shell discoid to semiglobose, involute; umbilicus narrow, moderately deep; umbilical walls steep, with broadly rounded margin; whorls ovate in cross section, increasing rapidly in height, slowly in thickness; flanks broadly rounded to flattened, merging imperceptibly with the much more narrowly rounded venter. The following measurements are taken from the holotype:

Diameter	87 mm.
Greater radius	54
Lesser radius	33
Height of last whorl	46
Thickness of last whorl	28
Height of penultimate whorl	23
Thickness of penultimate whorl	18
Width of umbilicus	13
Suture taken at diameter of	60

The sculpture of this species is so faint as to give a first appearance of complete smoothness. Careful examination, however, reveals low, broad, distantly spaced, fold-like costae on the flanks and sparse, low, broad, and relatively indistinct tubercles on the umbilical margin. Occasional broad and shallow constrictions cross the flanks but are traced across the venter with some difficulty.

The suture line (fig. 18) is especially well shown, and its features are distinctive. All elements are long and relatively narrow. The ventral lobe is as long as the first lateral and is narrow, with many branches. The terminal secondary lobes are long and narrow; first

ovate in cross section, increase rapidly in height, more slowly in thickness; flanks are broadly rounded and merge imperceptibly into the more narrowly rounded venter. The following measurements are taken from the holotype:



FIG. 18. Suture line of *Glabrophysodoceras abyssinianum*, new species. $\times 2$.

lateral saddle long, expanded posteriorly, and asymmetrically bifid so that the ventral branch is perceptibly longer and broader than the dorsal. All other saddles are long, narrow, and divided.

COMPARISON WITH OTHER SPECIES: The indistinct sculpture of this species might easily go unnoticed, in which case, except for the long ventral lobe of its suture, it would probably be referred to *Haploceras*. *G. abyssinianum* is also very similar in appearance to *G. ganamense*, but it is distinctly more involute than the Ganame species, its whorls are thinner, its sculpture much less pronounced, and the details of its suture line are markedly different.

OCCURRENCE: Holotype from an "ammonite zone" about 30 feet thick at Dirre Daa, Ethiopia. A second small specimen from Dogou, Harrar Province, is referred to the species. The age is probably uppermost Oxfordian or lowest Kimmeridgian.

***Glabrophysodoceras ganamense*, new species**

Plate 19, figures 2, 3; text figure 19

One internal mold retaining a part of the living chamber is made the holotype of this new species (A.M.N.H. No. 25444). The specimen is deeply weathered but shows the essential shell and sutural features.

DESCRIPTION: Shell semiglobose, involute; umbilicus narrow, moderately deep, and bounded by a high steep wall which is narrowly rounded into the flanks; whorls are

Diameter	89 mm.
Greater radius	52
Lesser radius	37
Height of last whorl	40
Thickness of last whorl	35
Width of umbilicus	20
Suture taken at diameter of	75

Sculpture consists of umbilical tubercles and broad, irregular, and distantly spaced costae. There are about seven tubercles per whorl. They are broad, but not high. Costae arise to the number of two or three from each umbilical tubercle, are distantly spaced, broadly rounded, and indistinct except on the outer whorl. They cross the flanks and venter without interruption or attenuation. Occasional ones are preceded by faint constrictions.

The suture line (fig. 19) is characterized by the largeness of its saddles and the smallness of its lobes, and by the circuitous line of its trace across the flanks. The ventral lobe is the most prominent lobal element of the suture and is relatively long and broad. The end secondary lobes are, however, short and thin; first lateral lobe short, narrow, and trifid. All other lobes are extremely short and narrow. First lateral saddle extremely broad and asymmetrical, and divided on its dorsal side by a long, narrow, and trifid secondary lobe which might be considered a part of the first lateral lobe. All other lateral saddles are short and broad and variously divided.

COMPARISON WITH OTHER SPECIES: *G.*



FIG. 19. Suture line of *Glabrophysodoceras ganamense*, new species. $\times 2$.

ganamense and *G. abyssinianum* are undoubtedly physodocerids, as shown by their umbilical tubercles, asymmetrical first lateral saddles, and other features. As mentioned in the generic description, these species show considerable superficial resemblance to *Haploceras* and related genera, with which, according to Spath (1928, Kachh, p. 154), some physodocerids have probably been confused. In *Haploceras*, however, there are no umbilical tubercles, and the ventral lobe of the suture line is much shorter than the first lateral lobe. In *Physodoceras* and *Glabrophysodoceras*, the ventral and first lateral lobes are approximately the same length.

OCCURRENCE: The holotype of *G. ganamense* and the only specimen in the collection is from Ganame near the base of the section exposed there. The age is probably uppermost Oxfordian or lowest Kimmeridgian.

GENUS SIMASPIDOCERAS SPATH

Simaspidoceras SPATH, 1925a, p. 119; SPATH, 1931 (1927-1933), pp. 552, 617, 619, 815.

Spath named this genus for *Aspidoceras argobbae* Dacqu  without giving further diagnosis. At the same time he described a fragment from British Somaliland which he thinks may be referable to Dacqu 's species.

Simaspidoceras may be characterized as a strongly ribbed aspidocerid. Shells are often large, with heavy whorls that have quadrate to subquadrate sections; whorls grow rapidly in both height and thickness; umbilicus is deep and bounded by steep sides; flanks converge slightly to meet the broad, flattened, or broadly rounded venter at abruptly rounded ventrolateral angles. Costae are broad and rounded, ending on the ventrolateral region. They become increasingly prominent with age.

Suture line consists of long and broad ele-

ments. Ventral lobe long, deeply divided; first lateral tripartite and strongly digitate; third lateral lobe also tripartite; first and second lateral lobes broad and strongly divided.

GENOTYPE: *Simaspidoceras argobbae* (Dacqu ).

Simaspidoceras argobbae (Dacqu )

Plate 21, figure 2, plate 23, figure 1; text figure 20

Aspidoceras argobbae DACQU , 1905b, p. 151 (33), pl. 18, fig. 1a, b, c.

One entirely septate specimen from Ganame (A.M.N.H. No. 25445) appears to belong to Dacqu 's species.

DESCRIPTION: Shell moderately involute, globose, heavy bodied; whorls massive, subquadrate, growing rapidly in both height and thickness; umbilicus deep, moderately broad, with steep walls and narrowly rounded margin; flanks flattened, gently converging toward the distinct ventrolateral margins; venter in small younger whorls broadly rounded, in older, outer whorls broad and distinctly flattened. The specimen shows the following measurements:

Diameter	143 mm.
Greater radius	83
Lesser radius	60
Height of last whorl	64
Thickness of last whorl	70
Width of umbilicus	41
Suture taken at diameter of	112

Sculpture consists of alternating primary and secondary costae and tubercles. Costae are broad and rounded and are all of about equal strength, but primaries arise as radially elongate tubercles on the umbilical margin, fade to relative insignificance on the middle of the flanks to become again prominent toward the ventrolateral margins where they end in prominent, radially elongate tubercles.

Secondary costae arise near the middle of the flanks, attain the prominence of primaries, and end in a similar manner. No costae cross the venter. Umbilical tubercles appear earlier than those on the ventrolateral margin and remain more prominent during the entire life of the individual but do not appear to become spinose.



Simaspidoceras harrarensense, new species

Plate 21, figure 3, plate 23, figure 3; text figure 21

A very large specimen (A.M.N.H. No. 25446), badly broken on one side, conforms to the characters outlined for *Simaspidoceras*. A large part of the living chamber, about one-half whorl in length, is attached.

FIG. 20. Suture line of *Simaspidoceras argobbae* (Dacqué).

The suture line (fig. 20) is complex. Ventral and first lateral lobes of about equal length; ventral lobe deeply divided, with prominent lateral branches; first lateral broad, long, strongly and symmetrically tripartite; second lateral long, broad, and tripartite. First lateral saddle broad and a little asymmetrically divided; second lateral strikingly long, narrow, and deeply divided asymmetrically.

COMPARISON WITH OTHER SPECIES: The individual here described is somewhat larger than Dacqué's specimen but agrees with it in every feature of shell shape and sculpture. The general features of the suture line are also the same.

Spath thought his large fragment (1925a, p. 119, pl. 16, fig. 10) might belong to this species, but the section of the extremely large whorl is not the same, and it appears to be spinose.

OCCURRENCE: Ganame, Harrar Province, at 30 feet above the base of the section. The age is believed to be topmost Oxfordian or lowest Kimmeridgian. In 1925 Spath considered that his fragment of *Simaspidoceras* from Bihendula, British Somaliland, was probably upper Kimmeridgian in age, but in 1933 (p. 815) he suggests that these forms may be upper Argovian (Oxfordian) or lower Kimmeridgian. Dacqué assigned his specimens to the Kimmeridgian.

DESCRIPTION: Shell globose, heavy bodied, moderately involute, but evolution increases with age; umbilicus moderately deep and broad, with steep wall; umbilical wall broadly rounded; whorls massive, subquadrate in cross section, increasing rapidly in both height and thickness; flanks broadly rounded, converging gently toward the venter; ventrolateral areas and venter broadly rounded. The specimen has the following dimensions.

Diameter	262 mm.
Greater radius	151
Lesser radius	111
Height of last whorl	92
Thickness of last whorl	86
Thickness of penultimate whorl	58
Height of penultimate whorl	55
Width of umbilicus	88
Suture taken at diameter of	130

The sculpture consists of alternating primary and secondary costae and tubercles. Costae are broad, rounded, and distantly spaced. Primaries arise from bulla-like, slightly radially elongate tubercles on the umbilical margin, fade perceptibly on the flanks, and then again become prominent on the ventrolateral margins where they end in prominent, radially elongate tubercles. Two costae frequently arise from the same umbilical tubercles, but usually secondary ribs begin on the middle of the flanks between the

primaries, attain the prominence of primaries, and end in a similar manner. All costae are strongly inclined forward. None are seen to cross the venter. Umbilical tubercles appear much earlier than those on the ventrolateral margins and remain more prominent on the largest whorls.

sists of a fragment showing parts of only two whorls. The left side of each is missing, and the ventral area is only partly shown on the outer whorl. The outer whorl is a living chamber, but the inner whorl shows all the external suture line except the ventral lobe.

DESCRIPTION: Shell is globose, heavy



FIG. 21. Suture line of *Simaspidoceras harrarense*, new species.

The suture line (fig. 21) has a long, broad, and strongly branched ventral lobe, a long, many-branched, asymmetrally trifold, first lateral lobe; long, club-shaped, asymmetrally divided, second lateral lobe; a short, trifold lobe on the umbilical margin, and a relatively long and trifold umbilical lobe. The first lateral saddle is broad and deeply divided by two long secondary lobes and smaller lobes; second lateral saddle long, narrow, and unevenly divided by a long secondary lobe; other saddles are short, broad, and divided.

COMPARISON WITH OTHER SPECIES: *S. harrarense* is very similar to *S. argobbae* in general appearance, but its whorls are more rounded in cross section, and its venter is less flattened. Its umbilicus is larger, its sculpture throughout is distinctly more robust, and the details of its suture are very different. *S. harrarense* is also similar to *S. ganamense*, but that species has crested instead of rounded ribs, the ventrolateral tubercles are indistinct, the umbilicus is larger, and the whorls distinctly less massive. The first lateral lobe of the suture is also much less symmetrical.

OCCURRENCE: Dogou, Harrar Province of Ethiopia, at an elevation of 7750 feet. The age is probably uppermost Oxfordian or lowest Kimmeridgian.

Simaspidoceras ganamense, new species

Plate 20, figures 1, 2, 5; text figure 22

The single individual (A.M.N.H. No. 25447) upon which this species is based con-

bodied, evolute, increasing in evolution with age; umbilicus only moderately deep, with sloping, rounded wall; whorls slightly subquadrate to rounded in cross section, increasing rapidly in both height and thickness; flanks and venter broadly rounded; ventrolateral areas indistinct. The specimen has the following approximate dimensions:

Diameter	223 mm.
Greater radius	220
Lesser radius	103
Height of last whorl	75
Width of umbilicus	87

Sculpture consists of tubercles, primary and secondary costae, and occasional faint constrictions. On the inner whorl, umbilical tubercles are prominent and bulla-like, and there are eight or nine on the half whorl. Costae arise from these, are strongly inclined forward but became indistinct on the ventrolateral area. On the large whorl, primary costae occasionally arise in pairs at the large umbilical tubercles, cross the flanks in great, crested, widely separated ridges, attain their greatest prominence near the ventrolateral area, and then fade out toward the venter. None appear to cross that area of the shell. Secondary costae are irregular in occurrence and are indistinguishable from the primaries except that they arise on the flanks.

The suture line (fig. 22) is not particularly distinctive. The ventral lobe is not shown; first lateral lobe long, relatively slender, much divided, and ends posteriorly in three asym-

metrical secondary lobes; second lateral lobe asymmetrically trifold. A third lateral lobe lies on the umbilical wall. First lateral saddle broad and deeply divided; second lateral saddle narrow and much divided.



FIG. 22. Suture line of *Simaspidoceras ganamense*, new species.

COMPARISON WITH OTHER SPECIES: The characters shown by the fragment upon which this species is founded are not very similar to other known species of *Simaspidoceras*. The species is much more evolute than either *S. argobbae* or *S. harrarensis*. Its costae are more crested and more prominent on the flanks, and its whorl section is more circular, than in either of those species.

OCCURRENCE: Ganame, Harrar Province of Ethiopia, at about 30 feet above the base of the section. The age is probably topmost Oxfordian or lowest Kimmeridgian.

FAMILY SIMOCERATIDAE SPATH

GENUS VIRGATOSIMOCERAS SPATH

Virgatosimoceras SPATH, 1925a, p. 131; ROMAN, 1938, p. 313; IMLAY, 1942, p. 1446.

This genus was established by Spath for the group of *Simoceras rothpletzi* Schneid, but no very accurate diagnosis has yet been given, and material for that purpose is not available to the writer. Spath referred two Somaliland specimens (one from Bihendula and one from Bihen) to the genus without specific identification, and remarked that they might not belong to the same species. The writer suggests that they may not belong to the same genus. His specimen (pl. 16, fig. 2a, b) appears close to *Virgatosimo-*

ceras rothpletzi, but the Bihen individual (pl. 16, fig. 1) seems to be entirely different and may possibly be a new genus. The American Museum collection contains two poor specimens which are very similar to, or identical with, Spath's Bihen specimen. Until better material is available it seems wise to follow Spath's generic grouping.

GENOTYPE: *Virgatosimoceras rothpletzi* (Schneid).

***Virgatosimoceras* sp. ind.**

Plate 22, figure 1

Virgatosimoceras sp. nov. SPATH, 1925a, p. 132, pl. 16, fig. 1 (not fig. 2a, b).

In the collections from 2 miles east of Behan in British Somaliland are two broken and crushed fragments of ammonites which appear to be identical with the specimen figured by Spath. The writer is of the opinion these three specimens belong to a new species and a new genus. Unfortunately they are all so poorly preserved as to render accurate assignment or diagnosis impossible.

DESCRIPTION: Shell discoid, moderately evolute, with broad umbilicus; umbilical wall low, perpendicular, with rounded margin; whorls badly crushed, but apparently subrectangular in cross section, growing slowly in both height and thickness; venter flattened or only broadly rounded. The following indefinite measurements are taken from the best specimen (A.M.N.H. No. 25448):

Diameter	115 mm.
Greater radius	60
Height of last whorl	35
Thickness of last whorl	12
Width of umbilicus	62

Sculpture on the flanks of the young whorls consists of moderately fine, narrowly spaced, primary costae. These are divided into secondaries on the ventrolateral area, but the number of divisions is imperfectly shown. On older and larger whorls, costae are prominent at the umbilical margin and divide along the flanks into bundles of secondaries. Living chamber becomes smooth except for low, broad, broadly rounded costae which end at the ventrolateral angle in broad, indistinct swellings to either side of the almost flat venter. Prominent but narrow constrictions cross the flanks and venter at intervals, are

bounded posteriorly and anteriorly by narrow, prominent ribs or ridges, and are strongly flexuous and inclined anteriorly.

No suture is apparent on the specimens at hand.

COMPARISON WITH OTHER SPECIES: With the exception of Spath's specimen already mentioned, the fossils described here are not closely similar to any other species of ammonite known to the writer.

OCCURRENCE: Label reads "two miles east of Behan, British Somaliland, layer 'C,' 50 feet below 'B'." Spath assigned his Bihen specimen to the *palmatus* zone? of the upper Kimmeridgian. The specimen before the writer is closely associated with a species of *Idoceras*, and a lower Kimmeridgian age is suggested.

Aptychi

Aptychi SPATH, 1925a, p. 153; SPATH, 1928, p. 152.

Laevaptychi SPATH, 1930, p. 61.

The American Museum collection contains three specimens of *Aptychi* (A.M.N.H. Nos. 25449-25451) from the ammonite zone at Dogou. All are too fragmentary and too badly worn to be of any systematic or stratigraphic value. All appear to be of the cellulose type, although one of the specimens is badly worn and shows the punctations only along one margin. A fourth specimen is so embedded in crystalline limestone that it is impossible to be certain that it is *Aptychus*.

Spath has pointed out in his papers that the *Cellulosi* are likely to be numerous in the upper Argovian and lower Kimmeridgian beds, whereas the *Imbricati* are rare. In the middle and upper Kimmeridgian the opposite is likely to be the case.

NAUTILOIDEA

FAMILY PARACENOCERATIDAE SPATH

GENUS PARACENOCERAS SPATH

Paracenoceras SPATH, 1927, p. 22; SPATH, 1935, p. 224, text fig. 4.

This family and genus were established by Spath in 1927. He points out that the genera in the family "are characterized by differentiation of the periphery, generally associated with increased sinuosity of the suture-line, and a ventral lobe." According to Spath, the

ventral area of *Paracenoceras* becomes sulcate in the more specialized forms. It appears to the writer, however, that in many cases the venter may be described as broad and flattened.

Spath mentions no sculpture in his generic discussion, but he doubtfully refers the ribbed *Paracenoceras* ? *jumarense* (Waagen) to the genus. He doubts the accuracy of Waagen's restoration of the *Cymatoceras* type of sculpture and suggests that the apparent costae or tubercles described and illustrated may be the result of corrosion.

An African species before the writer shows, however, this type of costation clearly. It is possible that a new genus should be created for Waagen's species and the new African form. The other characters of the species conform so well to the characters of *Paracenoceras* that such a step does not appear to be justified at the present.

GENOTYPE: *Nautilus hexagonus* (J. de C. Sowerby).

Paracenoceras sp. ind.

A broken and badly worn fragment of a nautiloid is here referred to *Paracenoceras*, but it is not specifically determinable. The faintly sulcate venter is clearly discernible, both on the large outer whorl and on the cross section of the crushed inner whorl. The specimen shows marked similarity to *P. hexagonoides* Spath (1927, p. 28, pl. 4, fig. 4a, b). The species is also similar to *P. prohexagonum* Spath (1935, p. 224, text fig. 4), but specific determination is impossible. Spath's species is Tithonian in age.

OCCURRENCE: Dogou, Harrar Province, Ethiopia, at an elevation of 7550 feet. The specimen (A.M.N.H. No. 25452) was associated with species believed to be upper Oxfordian or lower Kimmeridgian in age.

Paracenoceras costatum, new species

Plate 24, figures 1, 3

One large but slightly crushed specimen (A.M.N.H. No. 25453) serves as the holotype of this new species.

DESCRIPTION: Shell massive, involute, with umbilicus practically closed; whorls quadrangular in cross section, growing rapidly in both height and thickness; flanks flat to

slightly bulged; venter flat; ventrolateral angle distinct and narrowly rounded. The specimen has the following dimensions:

Diameter	138 mm.
Height of last whorl	84
Thickness of last whorl	
Near umbilicus	74
At ventrolateral angles	56

Sculpture consists of strongly sigmoidal costae which arise near the umbilicus as faint ridges, often branch several times, describe a broad saddle near the umbilicus, a broad lobe on the middle of the flanks, and another broad saddle near the ventrolateral area. Costae increase in strength ventrad to where they end at the ventrolateral angle. None can be seen to cross the venter. The costae are easily seen in the shell material and on the internal mold. Costae and interspaces, although slightly irregular, are about of equal width.

The sutures are typical of the genus, and, although not very well shown on the specimen at hand, there are broad lateral and ventral lobes and narrower saddles on the ventrolateral angles.

COMPARISON WITH OTHER SPECIES: On account of its sculpture, the only species to which *P. costatum* shows any considerable similarity is *P. jumarensis*. In that species the costae are more distantly spaced, and the venter is considerably narrower.

OCCURRENCE: Dogou, Harrar Province of Ethiopia. The specimen occurs with other fossils believed to be of lower Kimmeridgian and upper Oxfordian age. *P. jumarensis* (Waagen) appears to be considerably older.

***Paracenoceras ennenianum* (Dacqué)**

Plate 24, figure 2, plate 25, figure 1

Nautilus ennenianus DACQUÉ, 1905b, p. 144, pl. 17, fig. 5.

Paracenoceras ennenianum SPATH, 1927, p. 29.

One badly battered specimen (A.M.N.H. No. 25454) from the limestone beds at Kurtcha, Harrar Province, appears referable to Dacqué's species.

DESCRIPTION: Shell thin discoid with flattened flanks that converge ventrally; venter flattened, subsulcate, bicarinate; whorls involute, subquadrangular in cross section and increasing rapidly in height, slowly in thick-

ness; umbilicus moderately narrow; umbilical wall rounded. The specimen has the following dimensions:

Diameter	146 mm.
Greater radius	81
Lesser radius	65
Height of last whorl	74
Width of umbilicus	27
Suture taken at diameter of	110

The specimen is so badly corroded that no sculptural features are preserved, except that faint irregular crenulations are shown about the margin of the aperture.

Only fragmentary portions of the suture are preserved, but they do not appear to differ from the outlines shown on Dacqué's figures.

COMPARISON WITH OTHER SPECIES: As noted by Spath, *P. ennenianum* is considerably less inflated than any of the other species of the genus yet described. In fact in the thinness of its whorls, it strongly resembles *Heminautilus* of the Cretaceous. The Cretaceous forms, however, have a closed, or nearly closed, umbilicus, and their suture line is markedly sinuous.

OCCURRENCE: Kurtcha, Harrar Province of Ethiopia, at an elevation of about 8500 feet and about 500 feet from the base of the section. It is the only cephalopod in the collection from this locality. The age is unknown.

GENUS *HEMINAUTILUS* SPATH

? *Heminautilus* SPATH, 1927, p. 22.

Vorticoceras SCOTT, 1940, p. 1074.

This genus was named without description by Spath in his tabular summary of Jurassic and Cretaceous nautiloids worked out in connection with his study of the Kachh Jurassic cephalopods. He named as genotype *Nautilus saxbii* Morris (1848) which he considers the equivalent of *Nautilus lallierianus* D'Orbigny (1841).

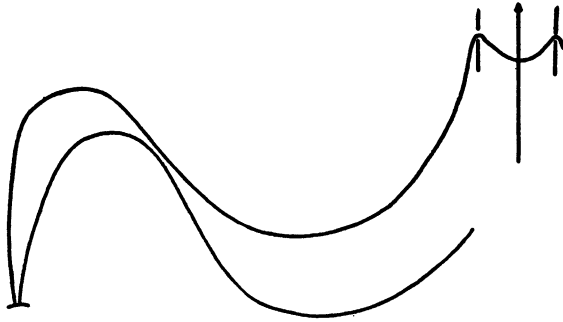
In 1940 the writer overlooked Spath's designation of a new name and erected the genus *Vorticoceras* for this group, with *V. stantoni* Scott from the Trinity of Arkansas as genotype. While there are certain differences in the sculpture of the Eastern and Western Hemisphere species, there can be little doubt that they belong to the same generic group. *Vorticoceras*, therefore, falls into synonymy with *Heminautilus*. Because *N.*

lallierianus D'Orbigny antedates *N. saxbii*, the former becomes the genotype.

DESCRIPTION: Shell involute, discoid, with high, thin whorls that increase rapidly in height, slowly in width; flanks are flat and converge gently toward the venter; venter narrow, flattened, or depressed and bicarinate; umbilicus about closed. Sculpture is wanting or consists of broad, widely spaced, flexuous, and indistinct costae. The suture is the most distinctive feature and consists of a broadly curved line forming a narrow, short, ventral lobe to either side of which is a short, narrow, and almost pointed saddle with apex on the ventrolateral angle or keel. On the ventral area of the flank there is a broad short lobe, followed by a narrow and more sharply rounded saddle. A broad short lobe lies at the umbilical suture.

The genus appears to be widely distributed in Cretaceous beds of Aptian and Albian age in Europe, Asia, and Africa, and one species is known from the Trinity of Arkansas.

GENOTYPE: *Nautilus lallierianus* D'Orbigny.



Heminautilus lallieri (D'Orbigny)

Plate 23, figure 2, plate 25, figure 2; text figure 23

Nautilus lallierianus D'ORBIGNY, 1840, p. 620; D'ORBIGNY, 1841, p. 318; D'ORBIGNY, 1850, p. 112; PICTET AND CAMPICHE, 1858, p. 148, pl. 19, fig. 6.

Nautilus saxbianus FITTON, 1847, p. 289.

Nautilus saxbii MORRIS, 1848a, p. 193; MORRIS, 1848b, p. 106 (woodcut).

Nautilus lallieri H. DOUVILLÉ, 1916, p. 129, pl. 17, figs. 2-6.

Two specimens from neighboring localities appear to be referable to this species. Both are badly corroded internal molds. The smaller one retains most of the living chamber.

DESCRIPTION: Shell thinly discoid, with

high, thin whorls that increase rapidly in height, slowly in thickness; umbilicus almost closed and without pronounced wall; flanks moderately flat but bulged at about one-fourth the distance from umbilicus to venter and converging ventrally; venter broadly depressed and strongly bicarinate. The two specimens in the collection have the following dimensions:

	I	II
Diameter	146 mm.	129 mm.
Greater radius	92	74
Lesser radius	54	55
Height of last whorl	93	73
Height of penultimate whorl	28	26
Thickness of last whorl	57	46
Thickness of penultimate whorl	21	21
Width of umbilicus	5	5

No sculpture is shown on the badly corroded molds.

The suture line (fig. 23) is well shown and is strongly flexuous. On the venter is a short, narrow, rounded lobe occupying the ventral flattened or gently depressed area. On

FIG. 23. Suture line of *Heminautilus lallieri* (D'Orbigny).

the ventrolateral keels are short, narrowly rounded saddles followed on the broad flat flanks by broad, rounded, first lateral lobes. These lobes in turn are followed by narrower and deeper saddles. Second lateral lobes reach their apex along the line of involution.

The state of preservation of the material prevents adequate preparation of the siphuncle, but that structure is relatively narrow in cross section and dorsal of the axial line of the whorl.

COMPARISON WITH OTHER SPECIES: The two specimens here discussed agree well with figures and descriptions given by Douvillé, except that the African individuals are too

poorly preserved to show details of the sculpture. According to Douvillé, the species is extremely variable. The two specimens before the writer exhibit many differences, but as they are from neighboring localities and are identical in lithology, they are retained in the same species, at least until more material is available. The completely septate specimen has flatter flanks, a more pronounced ventral depression, and more flexuous suture lines than the smaller individual, but these differences are presumed to be due to the difference in age of the specimens.

Heminautilus lallieri is very similar to *H. stantoni* but is thicker in whorl section, its sculpture is more pronounced, and its sutures less flexuous than in the American species.

OCCURRENCE: The large, entirely septate specimen is from Barsalas, south side of Mt. Mummitchi, Dakgon, Harrar Province (A.M.N.H. No. 25455). A notation on the label is to the effect that the elevation was 6775 feet, "limestone below ammonite zone." The smaller individual is from Grau, Harrar Province, "top of white lime—end of Mesozoic series." The collector suggests the age as Cretaceous, Aptian (?).

Nautiloids of this type are known from the Aptian or Albian of Europe, Asia, and America. The mention, however, of an ammonite zone above the point where the large specimen was collected leaves the specific identification and stratigraphic occurrence of that individual very much in doubt.

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PLATES 10-25

PLATE 10

1. *Ringsteadia africana*, new species p. 64
A.M.N.H. No. 25423. Ventral view of holotype, $\times\frac{1}{2}$; uppermost Oxfordian
at elevation of 7760 feet. Dogou.
2. *Ringsteadia africana*, new species p. 64
A.M.N.H. No. 25423. Lateral view of holotype, $\times\frac{1}{2}$; uppermost Oxfordian
at elevation of 7760 feet. Dogou.
3. *Perisphinctes vokesi*, new species p. 66
A.M.N.H. No. 25425. Lateral view of holotype, $\times\frac{1}{2}$; uppermost Oxfordian
at elevation of 7735 feet. Dogou.
4. *Perisphinctes vokesi*, new species p. 66
A.M.N.H. No. 25425. Ventral view of holotype, $\times\frac{1}{2}$; uppermost Oxfordian
at elevation of 7735 feet. Dogou.





PLATE 11

1. *Ringsteadia daua*, new species p. 65
A.M.N.H. No. 25424. Ventral view of holotype, $\times 1$; uppermost Oxfordian,
"ammonite zone," 6 miles north of Dirre Daua.
2. *Ringsteadia daua*, new species p. 65
A.M.N.H. No. 25424. Lateral view of holotype, $\times 1$; uppermost Oxfordian,
"ammonite zone," 6 miles north of Dirre Daua.

PLATE 12

1. *Torquatisphinctes* sp. ind. p. 74
A.M.N.H. No. 25433. Ventral view, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian at elevation of 7550 feet. Dogou.
2. *Dichotomoceras* cfr. *predivisum* Spath p. 68
A.M.N.H. No. 25427. Lateral view of specimen, $\times 1$.
3. *Torquatisphinctes* sp. ind. p. 74
A.M.N.H. No. 25433. Lateral view, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian at elevation of 7550 feet. Dogou.
4. *Dichotomoceras* cfr. *predivisum* Spath p. 68
A.M.N.H. No. 25427. Ventral view of specimen referred to Spath's species, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian, "ammonite zone," 6 miles north of Dirre Daua.



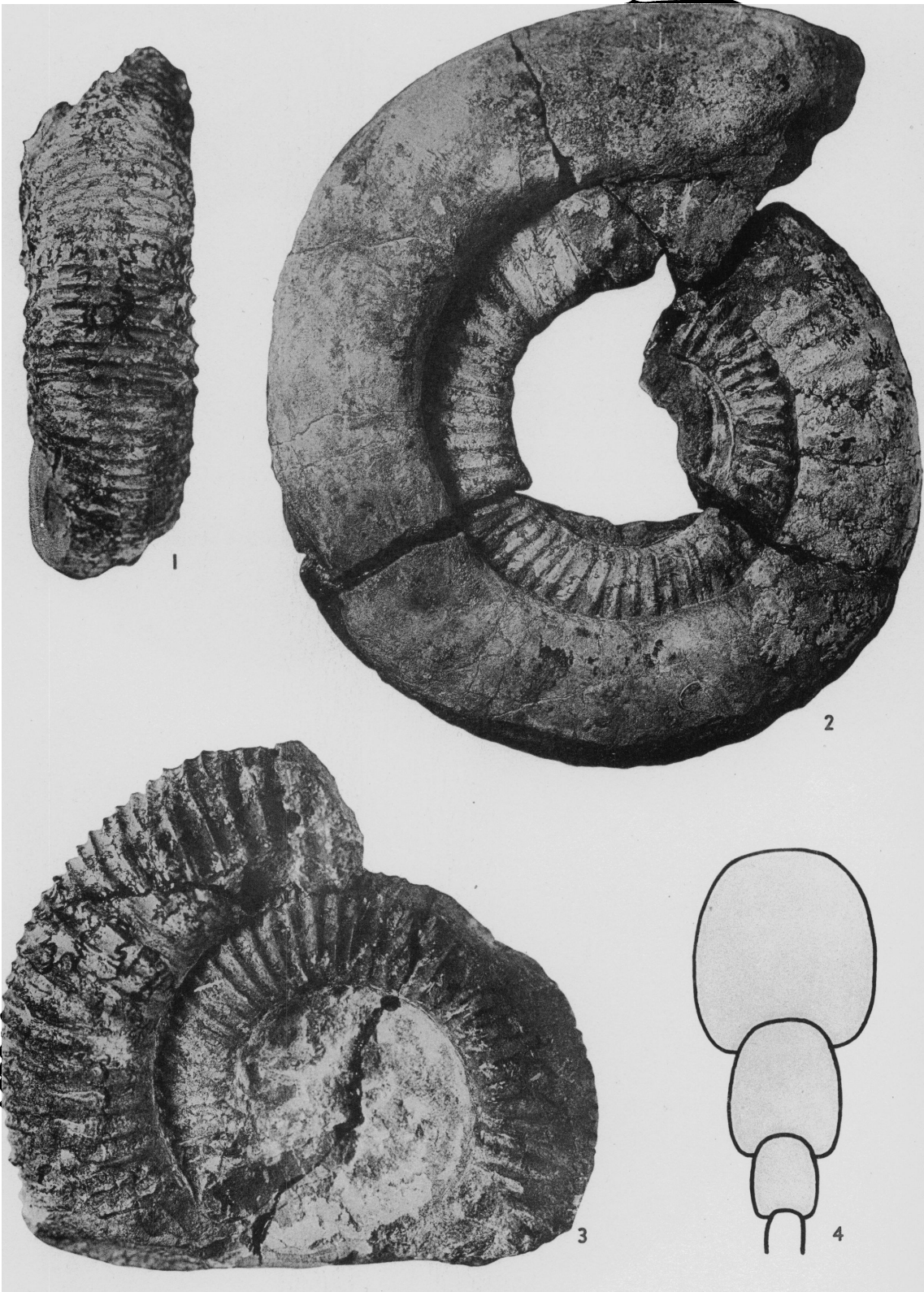
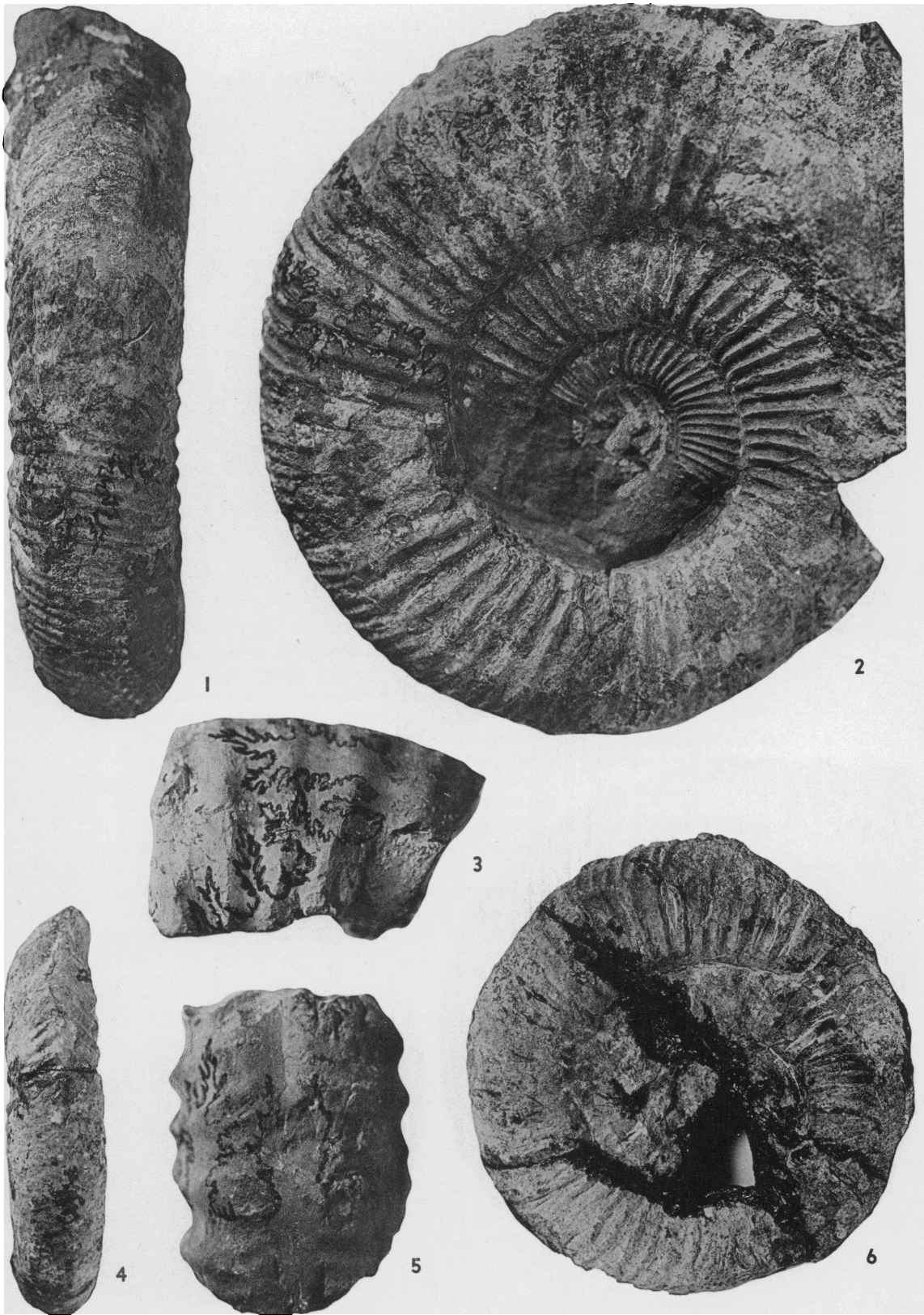


PLATE 13

1. *Dichotomosphinctes krapfi* (Dacqué) p. 69
A.M.N.H. No. 25428. Ventral view, $\times 1$; uppermost Oxfordian at elevation
of 7735 feet or 7450 feet. Dogou.
2. *Perisphinctes spathi*, new species p. 67
A.M.N.H. No. 25426. Lateral view of holotype, $\times \frac{1}{2}$; uppermost Oxfordian.
Dogou.
3. *Dichotomosphinctes krapfi* (Dacqué) p. 69
A.M.N.H. No. 25428. Lateral view, $\times 1$; uppermost Oxfordian at elevation
of 7735 feet or 7450 feet. Dogou.
4. *Perisphinctes spathi*, new species p. 67
A.M.N.H. No. 25426. Cross section of whorls of holotype, $\times \frac{1}{2}$.

PLATE 14

1. *Lithacoceras mombassanum* (Dacqué) p. 71
A.M.N.H. No. 25429. Ventral view, $\times 1$; uppermost Oxfordian or lowest
Kimmeridgian. Dogou.
2. *Lithacoceras mombassanum* (Dacqué) p. 71
A.M.N.H. No. 25429. Lateral view, $\times 1$; uppermost Oxfordian or lowest
Kimmeridgian. Dogou.
3. *Lithacoceras* ? sp. ind. p. 72
A.M.N.H. No. 25431. Lateral view of fragment, $\times 1$; upper Oxfordian or
lower Kimmeridgian at Ganame.
4. *Idoceras rufanum* Dacqué p. 75
A.M.N.H. No. 25434. Ventral view, $\times 1$; uppermost Oxfordian or lowest
Kimmeridgian. Ganame.
5. *Lithacoceras* ? sp. ind. p. 72
A.M.N.H. No. 25431. Ventral view of fragment, $\times 1$; upper Oxfordian or
lower Kimmeridgian at Ganame.
6. *Idoceras rufanum* Dacqué p. 75
A.M.N.H. No. 25434. Lateral view, $\times 1$; uppermost Oxfordian or lowest
Kimmeridgian. Ganame.



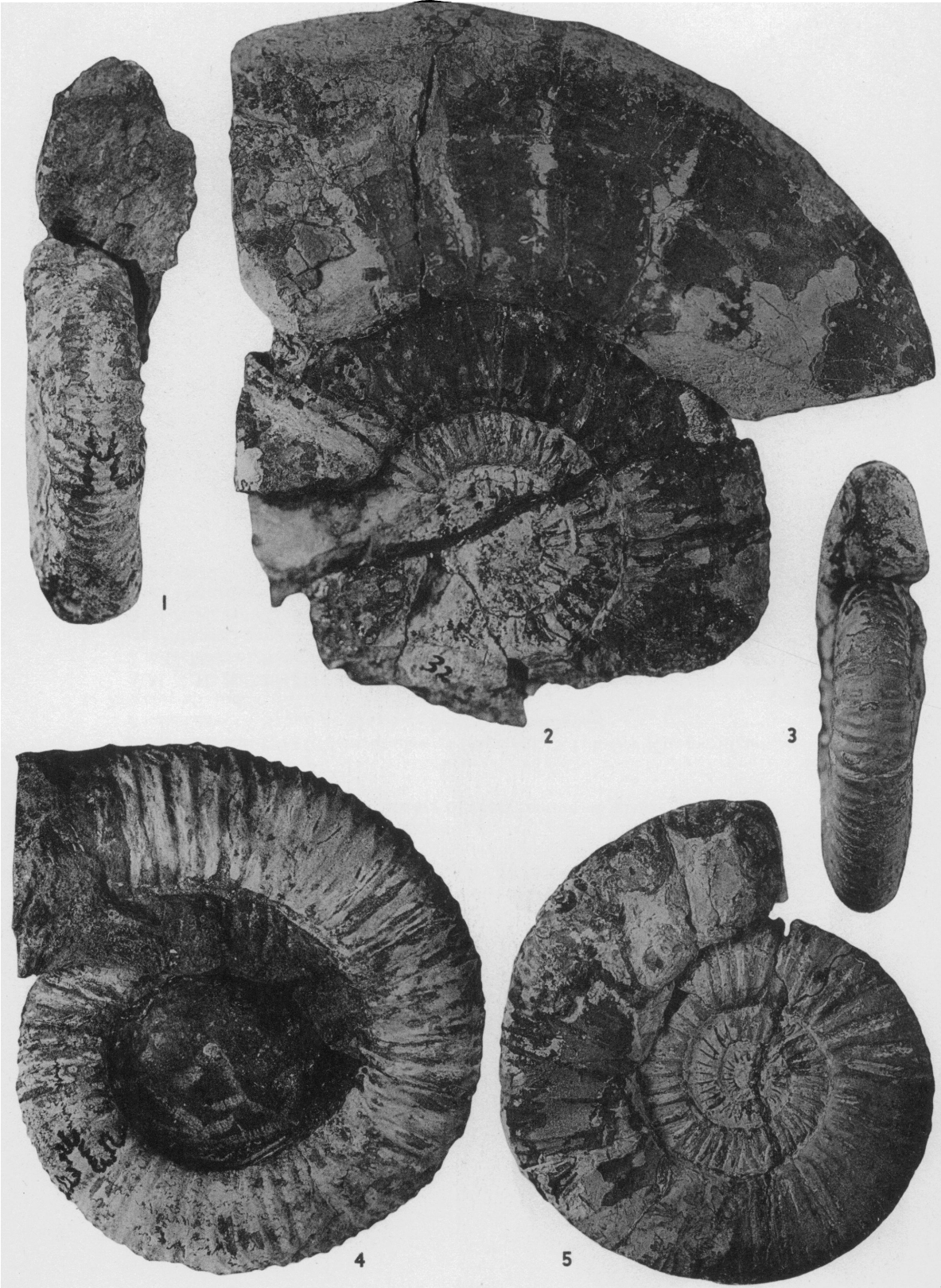


PLATE 15

1. *Torquatisphinctes beyrichi* (Futterer). p. 73
A.M.N.H. No. 25432. Ventral view, $\times 1$; uppermost Oxfordian, 40 feet
above base of section at Ganame.
2. *Idoceras behanense*, new species p. 76
A.M.N.H. No. 25435. Lateral view of large cotype with living chamber,
 $\times 1$; lower Kimmeridgian, 1 mile east of Behan, British Somaliland.
3. *Idoceras behanense*, new species p. 76
A.M.N.H. No. 25436. Ventral view of small cotype, $\times 1$; lower Kimme-
ridgian at Mejasia, 2 miles east of Behan, British Somaliland.
4. *Torquatisphinctes beyrichi* (Futterer). p. 73
A.M.N.H. No. 25432. Lateral view, $\times 1$; uppermost Oxfordian, 40 feet
above base of section at Ganame.
5. *Idoceras behanense*, new species p. 76
A.M.N.H. No. 25436. Lateral view of small cotype, $\times 1$; lower Kimmeridg-
ian at Mejasia, 2 miles east of Behan, British Somaliland.

PLATE 16

1. *Aspidoceras iphicerooides* Waagen p. 77
A.M.N.H. No. 25456. Lateral view, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian at elevation of 7550 feet. Dogou.
2. *Physodoceras gregoryi* (Spath) p. 81
A.M.N.H. No. 25441. Ventral view, $\times 1$; upper Oxfordian or possibly lowest Kimmeridgian at elevation of 7550 feet. Dogou.
3. *Aspidoceras iphicerooides* Waagen p. 77
A.M.N.H. No. 25456. Ventral view, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian at elevation of 7550 feet. Dogou.
4. *Physodoceras gregoryi* (Spath) p. 81
A.M.N.H. No. 25441. Lateral view, $\times 1$; upper Oxfordian or possibly lowest Kimmeridgian at elevation of 7550 feet. Dogou.





PLATE 17

1. *Aspidoceras evolutum*, new species. p. 78
A.M.N.H. No. 25438. Ventral view of holotype, $\times 1$; uppermost Oxfordian
at elevation of 7760 feet. Dogou.
2. *Physodoceras allenense* (D'Orbigny) p. 80
A.M.N.H. No. 25440. Lateral view, $\times 1$; uppermost Oxfordian or lowest
Kimmeridgian. Dogou.
3. *Physodoceras allenense* (D'Orbigny) p. 80
A.M.N.H. No. 25440. Ventral view, $\times 1$; uppermost Oxfordian or lowest
Kimmeridgian. Dogou.
4. *Aspidoceras evolutum*, new species p. 78
A.M.N.H. No. 25438. Lateral view of holotype, $\times 1$; uppermost Oxfordian
at elevation of 7760 feet. Dogou.

PLATE 18

1. *Physodoceras dogouense*, new species. p. 79
A.M.N.H. No. 25439. Ventral view of holotype, X1; upper Oxfordian or
lowest Kimmeridgian at elevation of 7750-7760 feet. Dogou.
2. *Physodoceras dogouense*, new species. p. 79
A.M.N.H. No. 25439. Lateral view of holotype, X1; upper Oxfordian or
lower Kimmeridgian at elevation of 7750-7760 feet. Dogou.





PLATE 19

1. *Lithacoceras dogouense*, new species p. 71
A.M.N.H. No. 25430. Ventral view, $\times 1$; uppermost Oxfordian at elevation
of 7470 feet. Dogou.
2. *Glabrophysodoceras ganamense*, new species p. 83
A.M.N.H. No. 25444. Lateral view of holotype, $\times 1$; uppermost Oxfordian
or lowest Kimmeridgian near base of section at Ganame.
3. *Glabrophysodoceras ganamense*, new species p. 83
A.M.N.H. No. 25444. Ventral view of holotype, $\times 1$; uppermost Oxfordian
or lowest Kimmeridgian near base of section at Ganame.
4. *Lithacoceras dogouense*, new species p. 71
A.M.N.H. No. 25430. Lateral view, $\times 1$; uppermost Oxfordian at elevation
of 7470 feet. Dogou.

PLATE 20

1. *Simaspidoceras ganamense*, new species p. 86
A.M.N.H. No. 25447. Lateral view of inner whorl of holotype, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian, 30 feet above base of section at Ganame.
2. *Simaspidoceras ganamense*, new species p. 86
A.M.N.H. No. 25447. Line drawing of cross section of whorls of holotype, $\times 1$.
3. *Idoceras* sp. ind. p. 76
A.M.N.H. No. 25437. Ventral view of fragment, $\times 1$; lower Kimmeridgian, 2 miles east of Behan at Mejasia, British Somaliland.
4. *Idoceras* sp. ind. p. 76
A.M.N.H. No. 25437. Lateral view of fragment, $\times 1$; lower Kimmeridgian, 2 miles east of Behan at Mejasia, British Somaliland.
5. *Simaspidoceras ganamense*, new species p. 86
A.M.N.H. No. 25447. Lateral view of outer whorl of holotype, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian, 30 feet above base of section at Ganame.

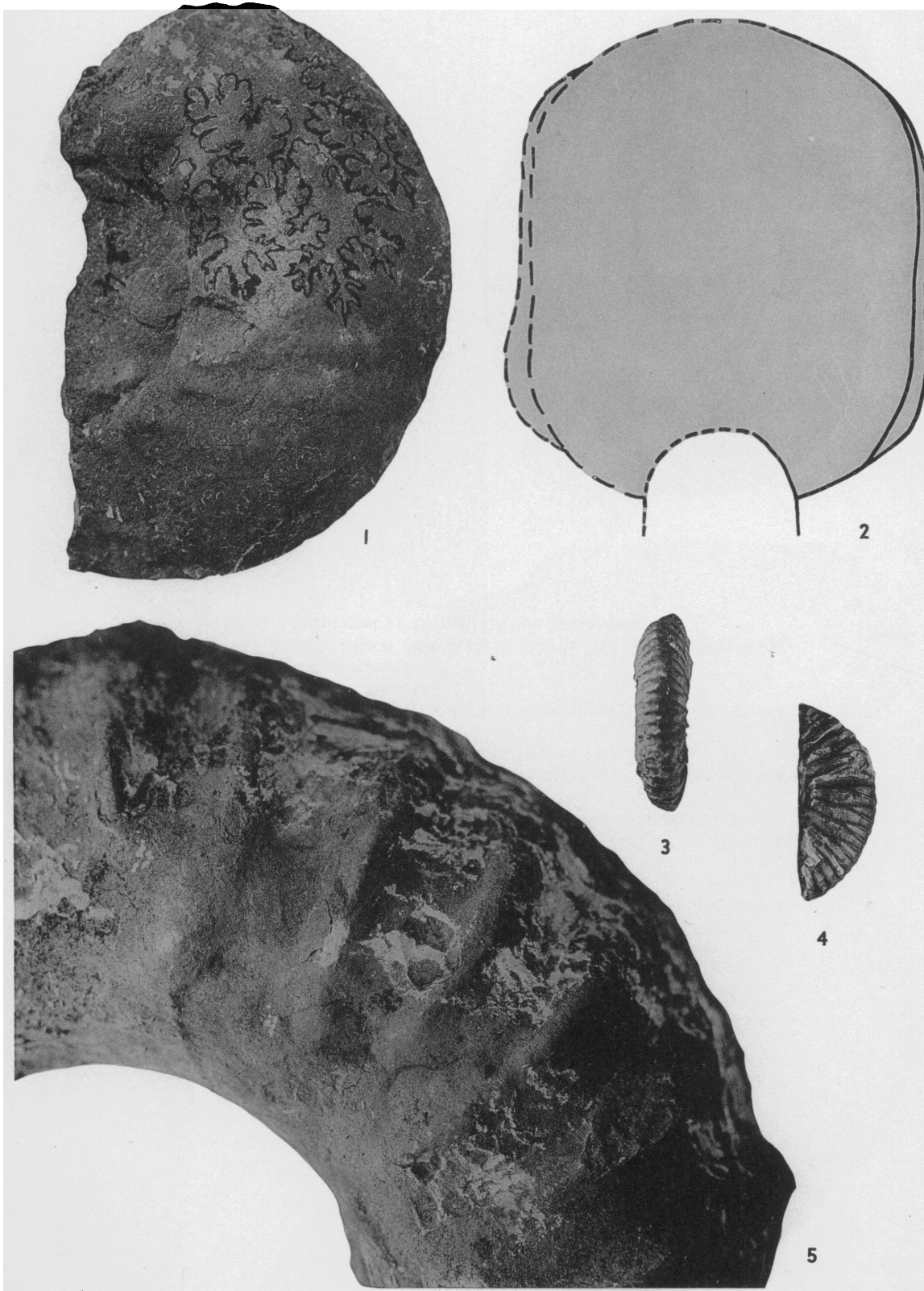




PLATE 21

1. *Glabrophysodoceras abyssinianum*, new genus, new species p. 82
A.M.N.H. No. 25443. Lateral view of geno-holotype, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian, "ammonite zone." Dirre Daua.
2. *Simaspidoceras argobbae* (Dacqué). p. 84
A.M.N.H. No. 25445. Ventral view, $\times 1$ (lateral view, pl. 23, fig. 1); uppermost Oxfordian or lowest Kimmeridgian from 30 feet above base of section at Ganame.
3. *Simaspidoceras harrarense*, new species. p. 85
A.M.N.H. No. 25446. Lateral view of holotype, $\times \frac{1}{2}$ (line drawing of whorl section, pl. 23, fig. 3); uppermost Oxfordian or lowest Kimmeridgian at elevation of 7750 feet. Dogou.
4. *Glabrophysodoceras abyssinianum*, new genus, new species p. 82
A.M.N.H. No. 25443. Ventral view of geno-holotype, $\times 1$; uppermost Oxfordian or lowest Kimmeridgian, "ammonite zone." Dirre Daua.

PLATE 22

1. *Virgatolimoceras* sp. ind.. p. 87
 A.M.N.H. No. 25448. Lateral view of crushed fragmentary specimen, $\times 1$;
 lower Kimmeridgian, 2 miles east of Behan, British Somaliland.
2. *Physodoceras browni*, new species p. 81
 A.M.N.H. No. 25442. Lateral view of holotype, $\times 1$; uppermost Oxfordian
 or lowest Kimmeridgian at elevation of 7750 feet. Dogou.
3. *Physodoceras browni*, new species p. 81
 A.M.N.H. No. 25442. Ventral view of holotype, $\times 1$; uppermost Oxfordian
 or lowest Kimmeridgian at elevation of 7750 feet. Dogou.





PLATE 23

1. *Simaspidoceras argobbae* (Dacqué). p. 84
A.M.N.H. No. 25445. Lateral view $\times 1$ (ventral view, pl. 21, fig. 2); uppermost Oxfordian or lowest Kimmeridgian from 30 feet above base of section. Ganame.
2. *Heminautilus lallieri* (D'Orbigny). p. 90
A.M.N.H. No. 25455. Ventral view, $\times 1$ (lateral view, pl. 25, fig. 2); Cretaceous (Aptian?), Barsalis, south side of Mt. Mummitchi near Dakgon.
3. *Simaspidoceras harrarensense*, new species. p. 85
A.M.N.H. No. 25446. Line drawing of whorl section, $\times \frac{1}{2}$ (lateral view, pl. 21, fig. 3); Oxfordian or lowest Kimmeridgian at elevation of 7750 feet. Dogou.

PLATE 24

1. *Paracenoceras costatum*, new species p. 88
A.M.N.H. No. 25453. Lateral view of holotype, $\times 1$; upper Oxfordian or lower Kimmeridgian. Dogou.
2. *Paracenoceras ennenianum* (Dacqu ) p. 89
A.M.N.H. No. 25454. Line drawing of whorl section, $\times 1$. (Lateral view, pl. 25, fig. 1).
3. *Paracenoceras costatum*, new species p. 88
A.M.N.H. No. 25453. Ventral view of holotype, $\times 1$; upper Oxfordian or lower Kimmeridgian. Dogou.

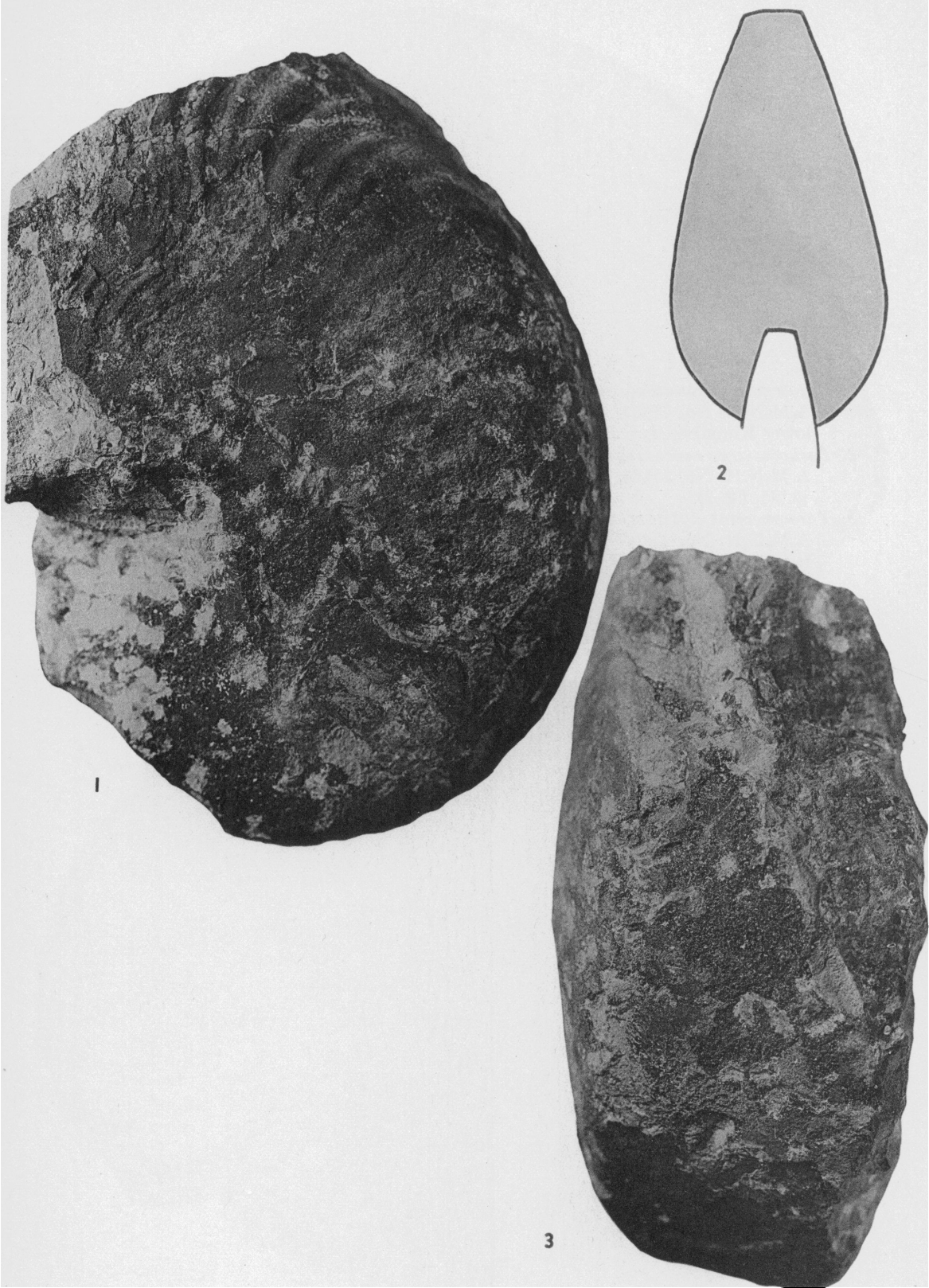




PLATE 25

1. *Paracenoceras ennenianum* (Dacqu ) p. 89
A.M.N.H. No. 25454. Lateral view, $\times 1$ (line drawing of cross section, pl. 24,
fig. 2); age unknown; 500 feet above base of section at Kurtcha.
2. *Heminautilus lalieri* (D'Orbigny) p. 90
A.M.N.H. No. 25455. (Ventral view, pl. 23, fig. 2); Cretaceous (Aptian?),
Barsalas, south side of Mt. Mummitchi near Dakgon.

