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LVIII.—*On Upper Cretaceous (chiefly Maestrichtian) Ammonoidea from Palestine.* By Dr. LEO PICARD, Institute of Natural History, Hebrew University, Jerusalem.

[Plates IX. & X.]

INTRODUCTION.

During our investigation of the phosphate deposits of Palestine, under the direction of Dr. J. W. Evans, F.R.S., we collected a large number of fossils, of which only the ammonoids will be described in the following pages. These fossils were found in that part of the Jordan desert which lies between Wadi Kelt* in the north and Wadi Nar in the south, a region which is traversed by two main roads: the old and the new Jerusalem-Jericho road. Near the centre of this region lies the (Arabic) place of pilgrimage known as Nebi Nusa. The hills of this area present a steep escarpment towards the Jordan plain. A large part of this range of hills lies already below sea-level, having a mean height of -730 ft. at the border of the Jordan plain, not far from Jericho. In the south, at the north-western end of the Dead Sea, the edge of the hills is still more deeply buried, going down to -1000 to -1100 feet. In this area—*i. e.*, the land south of Wadi Kueiserah—the hard dolomites

* The names of the localities are taken from the map of the Palestine Exploration Fund.

and dolomitic limestones of Turonian-Cenomanian age form an impressive escarpment along the borders of the Dead Sea. Above this formation follow soft limestones and shales of Senonian age, intercalated occasionally with thick flint beds. Between Wadi Kueiserah and Wadi Kelt the Turonian and Cenomanian strata are no longer visible. The Senonian in this part has subsided to such an extent that the upper part of the Maestrichtian extends to near the border of the plain and there forms an escarpment of often only 100 feet in height*. It is this Maestrichtian that contains those very characteristic phosphate beds that occur also in Egypt and that are of such great economic importance. They are often underlying, overlying, and intercalated with beds of bituminous limestone. The phosphate deposits were discovered by Blanckenhorn in 1894 on the Jerusalem-Jericho road. The stratigraphical position of the phosphate beds has been frequently discussed in literature and they have been referred to the Danian or Campanian, but the age of these beds is now definitely fixed as Maestrichtian in view of the similarity of the ammonoidea to those of Egypt and other countries (see summary at end). Fossils other than ammonites have not yet been worked out in detail, but will be described in a later paper. The forms identified so far show intimate relations with those of the Maestrichtian (*overwegi* beds) of Egypt.

The Maestrichtian in the region here discussed is about 200 feet or more in thickness, and the lower main bituminous horizon seems to form the transition to the Campanian. In some parts the phosphate beds are overlain by an upper bituminous bed, from which so far no ammonites have been obtained. With the exception of a rare species of *Aptychus*, the Campanian has yielded only badly preserved ammonoids. These are not therefore here described.

The following ammonoids have been identified:—

- Campanian: *Spinaptychus* (*Aptychus*) *spinosus* (Cox).
 Maestrichtian: *Aptychus* sp.
 Ptychoceras sp.
 Bostrychoceras sp.
 — sp., aff. *punicum*, Perv.
 Baculites palestinensis, sp. n.
 — *asper*, Morton.
 — —, var *larteti*, Blanck.

* Oolitic limestone of probably Neogene age, but very limited distribution, has been found in several spots on the hills of this area.

- Baculites vertebralis*, Lam.
 ———, var. *syriacus*, Cour.
 ———?, var. *ovatus*, Say.
Libyoceras ismaeli, Zitt.
Sphenodiscus (?) *spathi*, sp. n.
 ——— sp.

Besides the Palestine Mining Syndicate for whom the exploration has been undertaken, I have to thank the Hebrew University for giving me permission and leave to carry out this investigation. My special thanks are due to Dr. Spath, who gave me much valuable help and kindly read through my manuscript. I wish also to thank Mr. L. R. Cox, who drew my attention to *Aptychus spinosus*, Cox, and to Dr. M. R. Sahni for help with the translation of the manuscript. My thanks are due to the Keeper of the Geological Department of the British Museum for allowing me to use some unworked material in that Department and for facilities to carry out my work.

DESCRIPTION.

Aptychus (*Spinaptychus*, Trauth*) *spinosus*, Cox.
 (Pl. IX. fig. 1.)

1926. *Aptychus spinosus*, L. R. Cox, Ann. & Mag. Nat. Hist. (9) xvii.
 p. 573, pl. xxiv.

Only the lower portion of the valve is preserved. The upper portion is missing, but the curved growth-lines can be clearly seen on the cast. On the preserved part of the valve there are very characteristic skittle-shaped protuberances having a pore with an elliptical aperture. The protuberances are about 1 mm. in height and are generally irregularly disposed, but occur occasionally in rows. The lower portion of the symphysis, which is gently curved, makes an angle (terminal angle) of 70° with the exterior-lateral margin and is very clearly visible. A real marginal angle ("Marginalecke" of Trauth), however, does not exist. According to Cox, the angle between the inner margin and the Symphysis (apical angle) is nearly a right angle. Consequently there would be only a very gentle "excision." The structure of the thin shell and other details, described by Cox, could not be observed on my specimen. The length

* In the description of the Aptychi referred to above, the terminology and classification adopted by Trauth are employed. According to him, *A. spinosus* should be placed in the *Spinaptychus* group.



1.



4a



4b



12.



2.



5.



3.



11.



10.



9.



6.



7.



8.

H.G. Herring photo.

PALESTINE SENONIAN AMMONOIDEA.

of the complete valve would be about 55 mm. The shape and size of the protuberances are very similar to those of the corresponding structures figured by Cox (pl. xxiv. fig. 2, Paratype). Up to the present *A. spinosus* has been recorded only from the *Micraster coranguinum* zone (Up. Santonian) of the South of England, but recently it was found also in the *Uintacrinus* band (Lower Campanian) of the south-east coast. This *Aptychus* was doubtfully referred to the genus *Mortoniceras*.

Locality.—Relict of Senonian formation at the foot of the hills in the Jordan plain, about 3 km. west of Jericho on the northern tributary of Wadi Kelt, near the junction of the ancient aqueduct, commencing at Ain el Kelt and Ain el Duk, about 700 metres west of Tellul Abu el Alek.

Horizon.—Along with *Spinaptychus* occur *Leda perditia*, Conr., *Crassatella falconeri*, Lartet, sp., var., *Dentalium octocostatum*, Fraas, *Nucula crebrilineata*, Conrad. The exact stratigraphical horizon of this specimen cannot be accurately determined owing to the disturbed nature of the strata, but, judging by the accompanying fauna, it should be referred to the Campanian.

Aptychus sp.

A small fragment of an *Aptychus* was obtained from a limestone full of *Baculites vertebralis* and *Turritella reyi*, Lartet. Unfortunately, only a portion of the *Aptychus* is preserved, and it is therefore extremely difficult to determine whether it belongs to *Rugaptychus* (which, according to Trauth, is referable to the genus *Baculites*) or to a species closely allied to *A. portlocki*, Sharpe*. The specimen shown in his fig. 6, according to Trauth, belongs to a *Striaptychus* which should be referred to the genus *Scaphites*.

Locality.—Hassauer Raai, 20 m. below the phosphate plateau on the footpath leading to Wadi Mukelik.

GENUS *PTYCHOCERAS*, d'Orbigny.

Ptychoceras sp. (Pl. IX. fig. 2.)

The shorter and broader arm (length : breadth = 12 mm. : 5 mm.) lies closer to the longer, thinner arm (40 : 3.5), but near the curved portion of the shell a small space (0.7 mm. wide) is left between the two arms. The shorter arm

* Ceph. of the Chalk, pl. xxiv. fig. 6.

narrows considerably near the curved portion and is continued into the longer arm without much modification. The entire cast is covered by fine annular ribs; the space between each pair of ribs being about the same breadth as the ribs themselves. The costæ of the two arms are slightly inclined, but no nodes or constrictions have been observed. The suture-line is unknown.

The example does not agree with any of the species of *Ptychoceras* which I have examined. The curved portion, however, resembles that of *Oxybeloceras meekianum*, Whitfield, sp.*. *O. mortoni*, Meek †, resembles it in the type of the ribs, but the intercostal spaces are much broader. Moreover, *O. mortoni* possesses a double row of nodes on the costæ. In *Metaptychoceras smithi*, Woods ‡, sp., the costæ are horizontal and the intercostal spaces are broader.

Locality.—Together with *Bostrychoceras* and *Libyoceras* from the phosphate plateau above the road-mark K. 33 on the new road Jerusalem—Jericho, at the foot of the hills bordering the Jordan plain on the northern flanks of Wadi Makarfet Kattum (Shab es Surveid).

Genus *BOSTRYCHOCERAS*, Hyatt.

Bostrychoceras sp., aff. *punicum*, Pervinquière.

(Pl. IX. fig. 3.)

Nearly a complete whorl is preserved, but the suture-line is absent and the example is weathered. It greatly resembles *B. punicum*, Pervinquière §, in shape and ornamentation, but, since all the species of the genus *Bostrychoceras* show great similarity in these respects and since the suture-line is missing, we cannot definitely refer it to *B. punicum*, the more so as the Tunisian species comes from the Upper Santonian. The example resembles *B. punicum* also in size, and the whorl shows nearly 30 ribs without nodes, the intercostal spaces being of uniform width; there are also two or three constrictions.

According to Pervinquière *B. punicum* is related to the group of *B. polyplacum*, Roemer.

Locality.—From the same locality and from the same phosphate bed as *Ptychoceras* sp., 5 km. from Jericho.

* Pal. Black Hills, 1880, pl. xvi. figs. 1, 2, U.S. Geogr. Geol. Surv., Rocky Mountains (Washington).

† Hayden's Rep. 1876, pl. xx. fig. 1, U.S. Geol. Surv. Territ. ix., Rep. Invert. Cret. Tertiary Foss. Upper Missouri, etc. (Washington).

‡ Quart. Journ. Geol. Soc. lii. 1896, pl. ii. fig. 1 (London).

§ Etud. Paléont. Tunis., Ceph. 1907, p. 105, pl. iv. figs. 20, 21 (Paris).

Bostrychoceras sp.

There are two incomplete specimens of another species of the genus *Bostrychoceras*. One is a small portion from about the middle of the shell, with a diameter of 25 mm.; it shows sharp thin ribs and wide intercostal spaces. The other is a larger portion from the latest part of the shell, with a diameter of the aperture measuring about 50–55 mm., and with correspondingly stronger ribs, but with intercostal spaces about double the width of the ribs. Both the specimens are devoid of nodes as well as of constrictions. The suture-line is not known.

So far as the material at my disposal permits of determination, the specimens appear to belong to the group of *B. polyplacum*, Roemer, in which we include also *B. indicum*, Stoliczka*.

Localities.—(1) (smaller specimen): Uppermost phosphate bed on the Derb-er-Rujaib (Pilgrim's Way), $\frac{1}{2}$ km. east of Nebi Nusa, together with a flattened, uniformly ribbed specimen of *Baculites* sp. (2) (larger specimen): From the collection of B. K. N. Wyllie, K. A. Campbell, and G. M. Lees (Turkish Petroleum Co. Ltd., 1924) (British Museum, Geol. Dept. no. C 25912; labelled "Nebi Nusa, Senonian"). It has an identical phosphate matrix and appears to have come from the same bed as the smaller specimen.

Genus *BACULITES*, Lamarck.*Baculites palestinensis*, sp. n.

(Pl. X. figs. 1–7; text-figs. 1 & 2.)

1852. *Baculites anceps*, Roemer, Kreidebild. v. Texas, p. 36, pl. ii. figs. 3 a, 3 d, non 3 b, c, f, g.

1920. *Baculites aspero-anceps*, Taubenhaus, Z. des deutsch. Palestina Ver. xliii. p. 10, pl. vi. fig. 3.

† 1867. *Baculites anceps*, Fraas, Aus dem Orient, i. pl. i. fig. 17.

† 1905. *Baculites furcillatus*, Blanckenhorn, Z. deutsch. Pal. Ver. xxviii. p. 114.

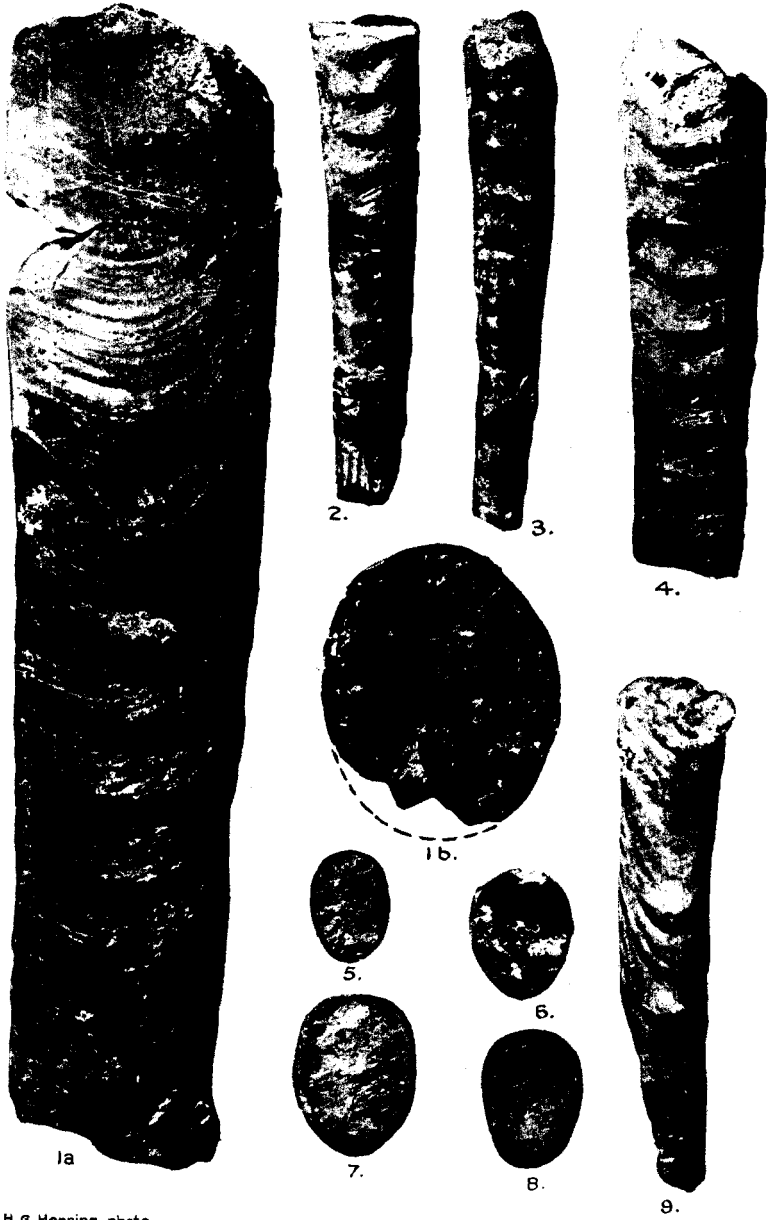
† 1920. *Baculites furcillatus*, Taubenhaus, Z. deutsch. Pal. Ver. xliiii. p. 10, pl. vi. fig. 2.

From a single block we obtained about twenty specimens of different sizes.

Ornamentation.—The ribs and the lines of growth compare with those of *B. anceps*, d'Orbigny †, but occasionally there

* Ceph. Cret. S. India, Pal. Indica, i. 1865, pl. lxxxvi.

† Pal. franç. Terr. Crét. T. 139, figs. 1–7. According to Schlueter (Ceph. d. ob. deutsch. Kreide, Palæontographica, xxiv. p. 145) the species *B. anceps* of Lamarck may be both smooth and ribbed, but the name should be confined to the ribbed form first figured by d'Orbigny.



H. G. Herring. photo.

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are slight differences. In some cases the growth-lines appear as slight thread-like elevations on the siphonal end. In the larger specimens only convex elevations may be observed, parallel with the growth-lines, which can be considered to be insufficiently developed continuations of the lateral ribs. In the smaller specimens the surface of the antisiphonal end is smooth. In certain forms the half-moon shaped ribs are particularly accentuated, whereas in the majority of the specimens they are uniformly rounded.

The growth-lines are much more sharply curved on the venter than on the antisiphonal side. The ribs can also be recognized on the cast. They are most pronounced at the middle of the flanks, and follow each other at regular and short intervals. Unlike *B. asper* the present species shows close ribs with the intervals of similar width.

In two examples, after a series of regularly formed ribs, we find that a rib on one side is only feebly developed or even missing, whereas the corresponding rib on the opposite flank is quite prominent. This must be regarded as an abnormal feature.

Form.—The true *B. anceps* has a wedge-shaped transverse section, because there is always a sharp keel at the siphonal end. Nowak*, who discussed the *B. anceps* group, showed that there was a great deal of variation in the different transverse sections of these *Baculites*, but that the section was always more or less elliptical in the young form and wedge-shaped in the adult. The transverse section of the young *B. palestinensis*, on the other hand, is ovate, narrowing towards the siphuncle, but there is no keel. A similar section of the adult *B. palestinensis* is, however, broadly elliptical; so that there is no difference between the siphonal and the antisiphonal ends, and the position of the siphuncle, when the latter is not externally visible, is only determined by the growth-lines. The largest specimen measures 150 mm. in length (Pl. X. fig. 1).

Another distinguishing character, particularly in young forms, is that *B. palestinensis* always shows a slightly concave curvature of the antisiphonal side, whereas *B. anceps* is quite straight. This is another feature which enables us to determine the position of the siphuncle. In *B. palestinensis* the earlier part of the shell increases relatively more quickly in thickness than the later.

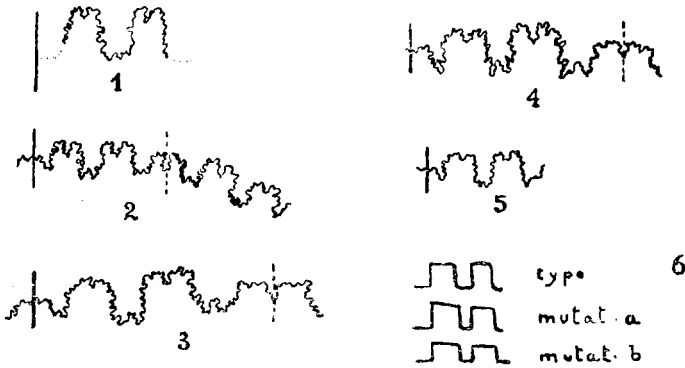
Suture.—The suture-line of *B. palestinensis* differs from that of the allied forms in having the three lobes of different depth. The denticulated external lobe is inclined at an

* Bull. Acad. Sci. Cracovie, 1913, iii. p. 380.

acute angle, the first lateral lobe is broader and deeper than the other two, the second lateral lobe on the other hand is shorter and narrower. All the three saddles possess well-developed incisions, of which that in the lateral saddle is the deepest. The external saddle is lower and somewhat narrower than the first saddle. The latter is the largest and broadest.

Identical or nearly related Forms.—(a) From Palestine: Some of the forms described from Palestine may be included here. These were either imperfectly preserved or incompletely described and figured, so that comparison with *B. palestinensis* is very difficult. Fraas* figured a small portion of a Baculite showing wavy nodular ribs, from bituminous rocks of the Kidron valley.

Text-figs. 1-6.

Suture-lines of *Baculites*.

Text-figs. 1-2. *B. palestinensis*, nov.

Text-figs. 3-5. *B. vertebralis*, Lamarck.

Text-fig. 6. Scheme of mutations in suture-line of *B. vertebralis*.

. Unfortunately, the *B. aspero-anceps*, Lasswitz, of Taubenhaus †, is insufficiently described and referred to the "Emscher" on slender evidence. The original *B. aspero-anceps*, Lasswitz ‡, is a true *B. anceps*, having costæ that follow one another at regular and narrow intervals, and a prominent siphonal keel. Taubenhaus's specimen is oval-elliptical in cross-section like *B. palestinensis*, and has the same ornamentation.

* Aus dem Orient. i. pl. i. fig. 17.

† Pl. vi. fig. 3.

‡ Kreide v. Texas, Palæont. Abhandl., N.F. vi. 1904, p. 16, pl. iii. fig. 1.

B. furcillatus, Blanckenhorn, Taubenhaus (p. 10, pl. vi. fig. 2), from the Jerusalem region (Mount of Olives), differs from *B. aspero-anceps*, Taubenhaus, only in its very prominent ("starkskulpturiert") ribs. It would appear therefore that *B. furcillatus* is only a strongly ribbed form of *B. palestinensis* as above described, and it has the same cross-section*.

(b) From other countries: *B. anceps*, Roemer †, possesses all the characteristics of *B. palestinensis*.

A closely related form is *B. anceps*, var. *obtusus*, Meek ‡, which resembles *B. palestinensis* in all respects, but the suture-line shows a very broad second lateral saddle. Meek himself had some doubt about referring his form to *B. anceps*, because the specimens had the siphonal side more obtusely rounded than was generally shown in the figures of European forms.

Related Forms.—*B. aspero-anceps*, Spath §, is probably only a strongly ribbed variety of *B. palestinensis* (like *B. furcillatus*).

B. subanceps, Haughton ||, closely resembles *B. palestinensis*. But the second lobe is extraordinarily broad, the three lobes are of about the same depth, and there are almost no incisions in the saddles. The form, like our specimens, is curved, but it has two characteristic grooves along the siphonal side, which shows that it may be more closely related to *B. vagina* (= *Eubaculites*, Spath) than to *B. anceps*.

The suture-lines of *B. anceps* and *B. vertebralis* [in Schlueter] are similar, but the large second lateral saddle in both species constitutes an important difference.

Localities.—(1) Tubk es Summarah (N.E. flanks of Wadi Nar), 30 m. below the top, 20 m. below the main phosphate beds. Together with *Libyoceras ismaeli*, Zitt.

(2) Old Jerusalem—Jericho road, near Police Station, at the crossing-point of the old and the new Jericho roads.

(3) Between Wadi Ekteif and Wadi Kueiserah, on the slopes, at the border of the Jordan plain.

(4) Locality of *Aptychus* sp. The regularly ribbed specimen has been compressed and shows a sharp edge on the

* The species *B. asper*, Lartet, is quite distinct and cannot be referred to *B. aspero-anceps* as Taubenhaus maintains.

† Kreidebildg. v. Texas, pl. ii. figs. 3 a, 3 d (non 3 b, 3 c, 3 f, 3 d).

‡ Hayden's Rep. U.S. Geol. Surv. Territ. ix. 1874, p. 106, text-figs. 57-60.

§ Ann. S. Afr. Mus. xii. part vii. 1921, p. 259, pl. xxiv. fig. 7.

|| *Op. cit.* xxii. 1925, p. 278, pl. xiv. figs. 6, 6 a.

siphonal end, so it is impossible to distinguish whether it belongs to *B. palestinensis* or to *B. anceps*.

Baculites asper, Morton. (Pl. X. fig. 8.)

1834. *Baculites asper*, Morton, Synopsis Organ. Rem. Cret. Group, U.S. pl. i. figs. 12, 13, pl. xiii. fig. 2.

1852. *Baculites asper*, Roemer, Kreidebild. v. Texas, p. 36, pl. ii. fig. 2.

? 1867. *Baculites asper*, Fraas, Aus dem Orient, i. pl. i. fig. 17.

There are eight specimens from different localities.

Ornamentation.—The sinuous growth-lines are developed as in *B. palestinensis*, and sometimes show a slight thread-like elevation. The ribs and nodules are irregularly disposed on the flanks, and in the younger part of the shell the distance between two ribs may be as much as 2 to 4 times the width of the whorl. This is a very typical character of the species, but unfortunately it cannot be applied to the older part of the shell, for the intercostal spaces here are mostly very narrow and resemble those of *B. palestinensis* or *B. anceps*. The ribs are developed mostly in the form of strong nodes and lie nearer the antisiphonal side.

Form.—All the specimens are straight and the characters described by Roemer (Pl. X. figs. 2 *a-d*) may be recognized. These are:—(1) oval cross-section, with the antisiphonal side broad and flattened; (2) narrower and well-rounded siphonal side (Pl. X. fig. 8).

Suture.—The only existing figure of the suture-line is by Gabb* and agrees with that of our specimens. All the three saddles possess incisions of which that in the second lateral saddle is the smallest. The deepest and the broadest lobe is the first lateral lobe. The second lateral saddle is the broadest and also has the largest incision. The suture-line is more denticulate than that of *B. palestinensis*.

The *B. anceps* collected and figured by Fraas (pl. i. fig. 17), from the shore of the Dead Sea, is too fragmentary; and in the absence of the cross-section we are not able to say whether it belongs to *B. asper* or to *B. palestinensis*.

Van Ingen † figured as *B. asper* three completely smooth *Baculites*, which therefore cannot belong to *B. asper*, Morton.

Related Forms.—Woods ‡ and later Spath § have already

* Proc. Acad. Nat. Sci. Philad. xiii. 1861, p. 394, p. iii. fig. 4.

† In Libbey and Hoskins, 'The Jordan Valley and Petra,' Appendix, p. 364. no. 5385, pl. A. fig. A, pl. B. fig. 3, pl. C. fig. 11 (1905) (London and New York).

‡ Cretac. Fauna of Pondoland, p. 342, pl. xlv., Ann. S. Afr. Mus. iv. (1908).

§ Ann. S. Afr. Mus. xii. p. 257, pl. xxiv. figs. 6, 7; Ann. Durban Mus. 1921, Tabular List.

drawn attention to the affinities between *B. asper* and *B. capensis*, Woods. *B. capensis* differs from the former in its more prominent nodes, which follow one another at regular distances, in its large second lateral lobe, and in its elongate elliptical cross-section.

Other forms which appear to be related to the species here described are *B. incurvatus*, Dujardin (and Schlüter), and *B. brevicosta*, Schlüter*. Schlüter's figures show an identical type of cross-section, but the nodes are regularly disposed.

The suture-line, with its very large second lateral saddle, shows that *B. asper* is also related to *B. anceps* and *B. vertebralis*.

Localities.—(1) Upper part of Wadi el Hazim, above the 34-Km. stone on the new Jericho road and immediately below the phosphate beds. (2) Wadi Muhavat, in a flint-bearing chalk stratum above the asphalt-veined dolomite.

Baculites asper, var. *larteti*, Blanckenhorn.

(Pl. X. fig. 9.)

1872. *Baculites asper*, Lartet, Essai Géol. Palest., Ann. Sci. Géol. ii. pl. i. fig. 2.
 1877. *Baculites asper*, Lartet, Explor. Géol. de la Mer Morte, pl. xi. fig. 25, non *aspero-anceps*, Taubenhaus (1920).
 1905. *Baculites larteti*, Blanckenhorn, Z. deutsch. Palest. Ver. xxviii. p. 111.

One of my specimens possesses ribs without nodes, and the ribs lie near the middle of the flanks. This agrees with Lartet's specimen, and both, like *B. palestinensis*, are slightly curved. In my specimen especially the curvature near the body-chamber is strong. The flattened character of the antisiphonal side of the true *B. asper* cannot be observed, and as this is well-rounded the cross-section is more or less elliptical.

Lartet's *B. asper* from Wadi Arabah does not, as Taubenhaus thinks, belong to the narrow-ribbed and keeled *B. aspero-anceps*, Lasswitz. It seems to be only a ribbed variety of *B. asper*, like the specimen here described. Blanckenhorn (1905) gave a list of fossils from the neighbourhood of Jerusalem, in which he recorded *B. asper*, Lartet, as a new species under the name of *Baculites larteti*.

Locality.—From the *Libyoceras ismaeli* and *Baculites palestinensis* beds of Tubk es Summarah (Eastern Flank).

* 'Palæontographica,' xxiv. 1876, pl. xxxix., Cephalop. d. ob. deutsch. Kreide.

Baculites vertebralis, Lamarck.

(Pl. IX. figs. 5-8 ; text-figs. 3-6.)

1867. *Baculites anceps*, Fraas, Aus dem Orient, i. pl. i. fig. 16 *a*, *b*, pp. 108, 61.
 1876. *Baculites vertebralis*, Schlueter, Ceph. d. ob. deutsch. Kreide, Palæontographica, xxiv. pl. xxxix. figs. 11-13, pl. xl. figs. 4, 5, 8.
 1905. *Baculites asper*, van Ingen, in Libbey-Heskin, The Jordan Valley and Petra, ii., Appendix, p. 364. no. 5365, pl. A. fig. A, pl. B. fig. 3, pl. C. fig. 1.
 1920. *Baculites vertebralis* (?), Taubehaus, Z. deutsch. Palestina Ver. xliii. p. 11.

This is the commonest form of *Baculites* in the Senonian of Palestine. There are over a hundred isolated specimens, and a much larger number embedded in the matrix. *B. vertebralis* is so common in certain beds that one may call these the "main Baculite horizon." A large number of these specimens have suffered compression, but several silicified forms from the Wadi Kumran region are perfectly preserved and very clearly show the form, suture-line, and the ornamentation.

Ornamentation (Pl. IX. fig. 5).—Shell smooth ; growth-lines sometimes slightly elevated. The orientation of the growth-lines is the same as in the species of *Baculites* described above.

Form.—The increase in thickness is much more gradual than in *Baculites palestinesis*. The cross-section is nearly elliptical. It shows only a slight narrowing towards the siphonal side (Pl. IX. figs. 7, 8). The compressed specimens simulate the form of the species *B. compressus*, Say*. *B. vertebralis* is always straight.

Suture-line.—Only some of our specimens show a character mentioned by Schlueter, namely, that "the lobes and saddles on the flanks are nearly equal in size." The majority of the specimens, however, possess larger saddles than lobes, and in this respect they compare with *B. anceps*. But the latter has saddles and lobes which are trapezoidal, whereas in our specimens they are rectangular.

It does not appear to be justified to give new names to forms which show such variation (as *a* and *b* in text-fig. 6) of the suture-line, because the character of the suture-line in all the species of the genus *Baculites* is often variable. Even one of Schlueter's own specimens (pl. lx. fig. 4) shows similar variation, although he ascribes it also to *B. vertebralis*.

* Morton, Synopsis etc. pl. ix. fig. 1.

B. faujasi, Sowerby *, and *B. faujasi*, Binkhorst †, show the same preservation, and have been correctly referred by authors to *B. vertebralis*. Pervinquière ‡ figures a similar suture-line.

My specimens, however, agree with *B. vertebralis* in all other respects.

Identical forms (from Palestine to Egypt): *B. anceps*, Fraas (pp. 108 and 61, pl. i. fig. 16 a, b), which was said to occur in "great quantity" in "bituminous strata," is probably from the main baculite horizon. Fraas erroneously referred the beds in which *B. anceps* occurred to the Cenomanian.

It is worth noting that Taubenhaus (1920), who had described some isolated and imperfectly preserved species of *Baculites*, mentioned that there was a great deal of material of the Upper Senonian *B. vertebralis* (?).

Van Ingen (1905) figured three smooth *Baculites* from the Senonian Chert of Kerak in Transjordania; but only one of these (pl. c. fig. 11) is well preserved, and agrees with our *B. vertebralis* from the Wadi Kumran. In the absence of a cross-section I am unable to say whether Van Ingen's specimens belong to the typical *B. vertebralis* or to one of its varieties (or mutations).

Koert § discovered *B. vertebralis*, together with *Leda leia*, Wanner, in the phosphate beds near the railway-station of Amman in Transjordania ||.

B. vertebralis has been recorded by Greco ¶ from the Maestrichtian of Egypt.

Baculites vertebralis, var. *syriacus*, Conrad.

(Pl. IX. figs. 9, 10.)

1852. *Baculites syriacus*, Conrad, in Lynch, Off. Rep. to explore the Dead Sea, pl. xx. fig. 121, p. 227 (Baltimore).

Conrad was the first to describe a *Baculites* from Palestine, under the name of *B. syriacus*. From the meagre illustrations it appears that the shell is smooth and has an ovate cross-section. Dr. Spath kindly showed me some rather imperfectly preserved phosphate-casts of *B. syriacus* from

* Min. Conchology, vi. p. 186, pl. 592. fig. 1.

† Gaster. Céph. Limbourg, pl. v. d. fig. 1, p. 40.

‡ Étud. Paléont. Tunis. Céph. 1907, p. 93, text-fig. 23 (Paris).

§ 1924, Zeitschr. d. deutsch. geol. Ges. p. 40.

|| Koert has also written (p. 40) on the Maestrichtian age of these formations, but refers erroneously to the Danian, in which Ammonites do not exist (see Summary).

¶ Pal. Ital. xxii. p. 114, pl. xv. figs. 2, 3.

Egypt* which have a similar cross-section. We have, moreover, in our own collection similar specimens from Tubk el Kuneitrah (Wadi Jofet Zeben) with the more or less ovate cross-section and a suture-line which agrees with that of our mutation *a* or *b* of *B. vertebralis*.

From the same bed we obtained the typical elliptical *B. vertebralis* and forms that are intermediate between *B. vertebralis* and *B. syriacus*. It appears, therefore, quite justified to regard *B. syriacus* merely as a variety of *B. vertebralis*. Blanckenhorn in his list mentions † *B. syriacus* from the neighbourhood of Jerusalem.

Other *Baculites* referred to as *B. angustus*, Möberg, *B. cfr. anceps*, Paulcke, *B. ovatus*, Say, etc., should also be referred to *B. vertebralis* or one of its varieties.

Localities.—(1) Eastern slope of Tubk el Kuneitrah (upper part of Wadi Jofet Zeben), about 60 m. below the Phosphate plateau.

(2) Lower Phosphate bed, below Murrad Hani. Mouth of Wadi Kueiserah in the Jordan Plain. Main *Baculite* horizon.

(3) The *Turritella reyi* zone of Hassan er Raai, and also strata 60 m. below this zone.

(4) Below the Phosphate plateau, between Wadi Kueiserah and Wadi Ekteif on the eastern slope of the mountains. *Turritella reyi* also occurs here. Height about 465 feet.

(5) Lower Phosphate zone, New Jericho road, between Km. 24 and Km. 25, at a height of about 400 feet (together with *T. reyi*).

(6) Below the Phosphate plateau, near Km. 24, Old Jericho road, at a height of 865 feet, about 1.5 km. below the Police Station.

(7) Tubk es Summarah, in the *Libyoceras* and *Baculites palestinensis* beds.

(8) Collection H. St. J. B. Philby, British Museum Geol. Dept., C. 25701. "Phosphate hill between Suwailik and Es Salt, Transjordania."

Baculites vertebralis, Lam. (?), var. *ovatus*, Say.

(Pl. IX. fig. 11.)

1834. *Baculites ovatus*, Morton, Synopsis Organ. Rem. Cret. Group, U.S., p. 42, pl. i. figs. 6-8, pl. v. figs. 5, 6 (Philadelphia).

1920. *Baculites ovatus*, Taubenhaus, Zeitschr. deutsch. Palest. Ver. xliii. p. 11, pl. vi. fig. 1.

Some of our smooth *Baculites* casts show a more or less

* Ann. S. Afr. Mus. xii. 1921, p. 251.

† Zeitschr. deutsch. Palest. Ver. xxviii. p. 111,

broad elliptical cross-section, similar to that of *B. ovatus* from America. Meek's figures* show an ovate cross-section, but according to certain authors this is elliptical †. The elliptical character of the transverse section is also seen in a specimen in the British Museum Collection (no. C. 5415) from South Dakota, U.S.A., from the Foxhill group (Upper Cretaceous), figured and described by G. C. Crick ‡. The suture-line of this specimen, as well as that of the specimen figured by the American authors, mentioned above, agrees with that of *B. vertebralis*. *B. ovatus* should, therefore, be placed with *B. vertebralis*. The American specimens are distinguished only by their enormous size.

B. ovatus (Faubenhaus), from the bituminous limestone of the Dead Sea region, also shows the closest relations with *B. vertebralis*.

Localities.—(1) Phosphate beds on the New Jericho road (Km. 32), 0.5 kilometre before the road reaches the Jordan plain.

(2) In Lower and Middle Bituminous layers at Tubk el Kuneitrah (Wadi Jofet Zeben).

(3) Old Jericho road 400 m. from the Police Station, Lower Phosphate bed.

GENUS LIBYOCERAS, Hyatt.

Libycoceras ismaeli, Zitt.

(Pl. IX. fig. 12; text-figs. 7-9.)

1902. *Libycoceras ismaeli*, Zittel, Fauna Kreidebildg. libysch. Wüste, Palæontographica, xxx. p. 303, pl. xxix. figs. 3-7, pl. xxx. fig. 1.

The adult as well as the young specimens are always tuberculated near the keel. The inner row of tubercles is not situated exactly in the middle of the flanks (as in the specimens of Quaas), but lies somewhat nearer to the umbilicus.

In the larger specimens (diameter 145 mm.) this inner row of tubercles always lies on the second lateral saddle; in medium-sized specimens (diameter 90 mm.) upon the second lateral lobe, *i. e.*, between the first and second saddle; and

* Hayden's Rep. U.S. Geol. Rep. Terr. ix. 1876, pl. xx. fig. 1 (non 2), p. 394.

† Morton, 1834, Synopsis etc.; and Whitfield, 1892, Monogr. U.S. Geol. Surv. xviii., Washington, pl. xlvi. figs. 3, 4, p. 275 (Gastrop. & Ceph. of New Jersey).

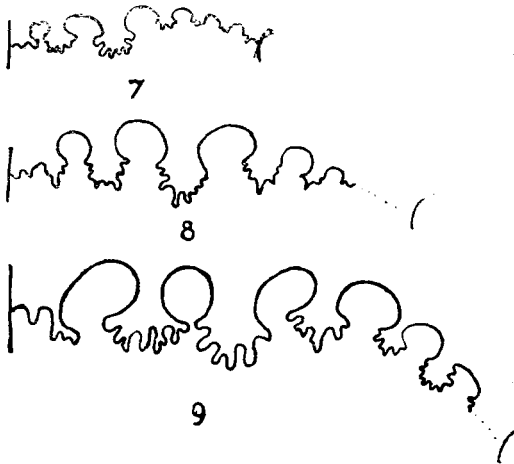
‡ Trans. Linn. Soc. (2) vii. no. 4, p. 77, pl. xvii. figs. 1-4.

in the young forms (diameter 70 mm.) on the first lateral saddle.

In the large and medium sized specimens the keel is sharp along the entire shell; in the smaller specimens it is somewhat flattened near the body-chamber. The development of the suture-line at different stages is shown in text-figures 7-9.

The shape of the ribs, tubercles, keel, growth-lines, and the cross-section of the shell, as well as the suture-line, agree entirely with the *Libycoceras ismaeli* from the Maestrichtian of Egypt, first referred to by Zittel and later described in great detail by Quaas*.

Text-figs. 7-9.



Suture-lines of *Libycoceras ismaeli* (Zittel).

Young (fig. 7), medium-sized (fig. 8), and adult (fig. 9) types.

This species has not previously been described from Palestine. Haughton † described a species *L. angolense* from Angola, and this agrees with *L. ismaeli* in all characters except that the inner row of tubercles lies near the umbilicus. Since, however, the position of the tubercles is very variable (in Quaas's specimen they lie along the middle of the flanks,

* The figures in Zittel's Text-books of Palæontology, *e. g.*, Handbuch, 1884, p. 451, fig. 631; Grundzüge, 5th German ed., 1921, p. 575, text-fig. 1251, however, do not well show the type of ornamentation found in *Libycoceras*.

† 1925, Ann. S. Afr. Mus. xxii. pt. i. 4, p. 269, pl. xiv, figs. 1-5.

in my specimens between the middle of the flanks and the umbilicus), Haughton's species may perhaps also be considered as a variety of *L. ismaeli*.

Localities.—(1) Tubk es Summarah, near Wadi en Nar, in the beds of *Baculites palestinensis*.

(2) Wadi Makarfett Kattum, in the phosphate beds, together with *Ptychoceras* sp. and *Bostrychoceras*, aff. *punicum*.

(3) Specimens C. 25895–25901 in the British Museum, Geol. Dept. Collected: B. K. N. Wyllie, K. A. Campbell, and G. M. Lees. Presented: Turkish Petroleum Co., Ltd., 1924. Maestrichtian, south of Jisr ed Dabba, west of el Katrain, Transjordanian.

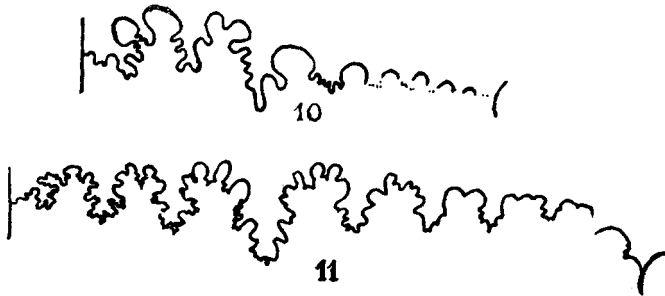
Genus SPHENODISCUS, Meek.

Sphenodiscus? spathi, sp. n. (Text-fig. 10.)

1922. *Sphenodiscus*, sp. nov., aff. *acutodorsatus*, Noetl., Spath, Trans. Roy. Soc. S. Afr. x. pt. iii. p. 140.

The specimen is completely silicified and, since a great

Text-figs. 10–11.



Suture-lines of *Sphenodiscus* (?) *spathi*, sp. n. (fig. 10), and *Sphenodiscus*, sp. n., aff. *stantoni*, Hyatt (fig. 11).

deal of the shell is broken away, the inner whorls are clearly visible. The following characters may be recognized:—

Ornamentation.—Shell entirely smooth.

Form.—Umbilicus very narrow. The sides are slightly convex and show a wedge-like sharpening towards the keel. The cross-section is therefore lancet-shaped; the periphery very acute throughout.

Suture-line.—Serial, straight; external lobe narrow and

not deep, shorter than the first lateral lobe. First lateral lobe deep and with a broad indentation. Second lateral lobe not much developed, fairly denticulated. Four to five inconspicuous auxiliary lobes.

The very broad external saddle has two large adventitious lobes of different size. The outer branch is inclined at an angle of 45° to the keel and contracted near its base. The second phylloid branch is broader and showed originally a small incision, which, curiously enough, does not appear on the suture-line of the surface. This incision, however, can be seen on the suture-line in the third, and larger, inner branch.

The first lateral saddle is much lower and, like the second lateral and auxiliary saddles, is not divided.

Related Forms.—A closely related form is *S. acutodorsatus*, Noetling*, which differs from *S. spathi* in the constricted external saddle and first lateral lobe. *S. spathi*, moreover, has one or two subdivided adventitious saddles and a third independent branch; also different proportions. Both the adventitious lobes are broader and more denticulated than those of *S. acutodorsatus*. The meagre development of the first adventitious lobe in *S. spathi* may, however, be due to the smaller size of our specimen (diameter 65 mm.). Douvillé † described a small form of *S. acutodorsatus* from Persia with a similar variation of the first adventitious lobe. In *S. acutodorsatus* the first lateral lobe is much larger and more denticulated.

Closely related to *S. spathi* is the North African form *S. cossoni*, Peron et Thomas ‡, in which the incisions forming the branches of the external saddle are feeble. According to Pervinquière §, this Tunisian specimen “paraît avoir possédé de vagues côtes,” but Peron (p. 14) holds a contrary view, “aucune trace de côtes ni de tubercules ombilicaux ou dorsaux; flancs lisses.”

In *Coahuilites cavinsi*, Boese, and *Coahuilites orynskii*, Boese ||, the first branch of the external saddle is also

* “Fauna of Baluchistan,” Pal. Ind. (xvi.) vol. i. pt. 3, 1902, p. 76, pl. xxi. fig. 3 (Mem. Geol. Surv. India).

† In Morgan, Mission Scient. Perse, T. iii. pt. iv. p. 255.

‡ Explor. scient. Moll. foss. terr. cré. haut plat de la Tunisie, 1890, p. 14, pl. xvi. figs. 1, 2; Peron, Mém. Soc. géol. France, Paléont., no. 17, 1897, p. 73.

§ Étud. Paléont. Tunis. i., Ceph. 1907, p. 386, text-fig. 148.

|| Cret. Amm. Texas a. North Mexico, Univ. Texas, no. 2748, 1927, p. 188 ff, Bureau of Econ. Geol. University Publications (Austin).

divided by a secondary lobe and, like that of *S. spathi*, inclined towards the keel. But this Mexican form of Maestrichtian age differs from the form here described in the numerous incisions on the external and lateral saddles, which look as if resting on short stalks. Moreover, the genus *Coahuilites* has a characteristic ornamentation, similar to that of *Libycoceras*.

Having seen only one specimen of *S. spathi* and no specimens of the related forms mentioned above, I have referred it doubtfully to *Sphenodiscus*, but I have no doubt that it belongs to the same group to which *S. acutodorsatus* is referred (see Summary).

Locality.—Uppermost flint-bearing chalk; Mount of Olives, Jerusalem, near Auguste-Victoria Sanatorium (formerly Government House). Collection British Museum, Geol. Dept., no. C. 22136.

Sphenodiscus, sp. n., aff. *stantoni*, Hyatt. (Text-fig. 11.)

In the specimen before me only the body-chamber and the last few air-chambers are preserved.

Ornamentation.—It is very doubtful whether certain elevations on the flanks are of the nature of true ribs or not. There is no other ornamentation.

Form.—Discoidal, with a lanceolate cross-section and a slightly flattened keel.

Suture-line.—The suture-line of the last whorl is about 140 mm. long and is straight across the side, but curved near the umbilicus. The external lobe has a characteristic large indentation.

The external saddle is more than one-third of the entire length of the suture-line. It is divided by two adventitious lobes, which are strongly denticulated and are broad both at the mouth and at the base. Of the three branches of the saddle, the first is the smallest and the third the largest; they all have a broad base and are palmate, with secondary denticulated incisions. The first lateral lobe is broad and deep, and narrower at the base than at the mouth. It is not so strongly denticulated as the adventitious lobes of the external saddle, but shows the characteristic teeth (indentations) on both sides. The first lateral saddle has five or six divisions and is larger than the other saddles. The second lateral saddle possesses five divisions. The second lateral lobe is similar to the first, but much smaller. The other auxiliary lobes are small and indistinctly denticulated.

The auxiliary saddles are not much divided, there being only one or two incisions.

Affinity.—The only species of *Sphenodiscus* closely related to the present form in its suture-line is *S. stantoni* Hyatt*.

The proportions of their external and first lateral saddles are very similar. But there are differences in the very strong denticulation of the adventitious saddles and lobes, and in the totally different shape of the second lateral saddles.

In *S. stantoni* the auxiliary saddles are also much more numerous and are undivided and phylloid (pl. v. fig. 4).

It therefore appears that our specimen belongs to a distinct species of *Sphenodiscus*, with some affinity to *S. stantoni*. Unfortunately, only part of the outer whorl is preserved and no new name can be given.

From the Senonian Chert beds of Kerak in Transjordania Van Ingen † describes two specimens as *Sphenodiscus*? sp.? The original of his pl. C. fig. 8 is compressed and not determinable. Only the presence of a keel and of a narrow umbilicus suggests that this specimen may belong to one of the allied genera, *Sphenodiscus*, *Libyoceras*, *Coahuilites*. The example figured in Van Ingen's pl. C. fig. 9 is an ammonite nucleus with a very large umbilicus that does not belong to *Sphenodiscus*.

Locality ‡.—South of Jisr ed Dabba, west of el Katrani, Transjordania. Collection Wyllie, Campbell, and Lees; British Museum, Geol. Dept., no. C. 25902. In the body-chamber of the specimen was embedded a medium-sized *Libyoceras ismaeli*, Zitt.

SUMMARY.

It appears desirable to show the inter-relations of the genus *Sphenodiscus* and the allied groups in the following table. The principal characters utilised for comparison are form, suture-line, and ornamentation. The genera are arranged according to their suture-lines, but *Coahuilites* could also have been placed next to *Libyoceras*. This

* "Pseudoceratites of the Cretaceous," Monogr. U.S. Geol. Surv. Washington, xlv. 1903, p. 70, pl. v. fig. 4, pl. vi. fig. 5.

† In Libbey-Hoskin, "Jordan Valley and Petra," 1905, nr. 5366.

‡ Mr. Lees informs me (in letter dated 8 Aug., 1928) that this Ammonite has been found "about 210 m. above the chert-coprolite horizon."

order would, of course, be altered if other characters, such as ornamentation or form, were accorded priority :—

Genus.	Form.	Suture-line.	Ornamentation.
<i>Libyceras</i> , Hyatt.	Disc-shaped keel generally sharp, lancet-shaped cross-section.	External saddle divided by one adventitious lobe, lateral and auxiliary saddles entire.	Row of tubercles near the keel*. Row of tubercles on the flanks or near the umbilicus. Slightly S-shaped ribs.
<i>Indoceras</i> (Noetling).	Disc-shaped, back well - rounded without keel, parabolic cross-section.	Shell smooth †.
Group of <i>Sphenodiscus</i> <i>acutodorsatus</i> .	Disc-shaped, keel sharp, lancet-shaped cross-section.	External saddle broad, divided by two adventitious lobes, lateral and auxiliary saddles entire.	Shell smooth †.
<i>Coahuilites</i> (Boese).	Disc-shaped, keel generally sharp, lancet-shaped cross-section.	External saddle divided by two adventitious lobes ‡, lateral saddle with incisions. Only auxiliary saddles entire.	Row of tubercles near the keel. Row of tubercles on the flanks. Slightly S-shaped ribs.
<i>Sphenodiscus</i> (Meek).	Disc-shaped, keel more or less developed, lancet-shaped cross-section.	External saddle divided by two adventitious lobes, lateral saddle with incisions. Auxiliary saddles generally entire.	Shell smooth (rarely slightly ribbed).

* In the literature of *L. charginse*, Blanckenhorn (Zeitschr. deutsch. Geol. Ges. 1900, p. 32), from Egypt, has often been referred to as a smooth *Libyceras*, but it has never been described or figured.

† Noetling described some young specimens of *Indoceras baluchistanense* (Koken, Palaeont. Abhandl. 1906, lxxv.) with slightly sickle-shaped ribs. But, according to him, embryonal forms of the true *Indoceras* (p. 75) do not possess ribs.

‡ According to Peron [see our remarks, p. 450], *S. cossoni* has no ribs, but Pervinquière believes the species to be perhaps slightly ribbed.

§ *Coahuilites cavinsi*, Boese, and *C. orynskii*, Boese [see our remarks, p. 450], the last Ammonites of the Mexican Cretaceous have a bifid external saddle. The ventral branch, like that in *Sphenodiscus acutodorsatus*, is inclined towards the keel.

As Boese has again emphasised in a recent paper* the genera *Sphenodiscus*, *Libyoceras*, *Indoceras*, and *Coahuilites* occur only in the Maestrichtian of the different countries, *i. e.*, the Sphenodiscan Age of Spath †. The Cenomanian and Santonian species from Madagascar ascribed to *Sphenodiscus* by Boule, Lemoine, Thévenin ‡ do not belong to this genus §.

The occurrence of *S. spathi*, which is a form closely related to the Indian *S. acutodorsatus*, proves more than any other species of the Maestrichtian fauna of Palestine the close affinity between the Indian and Palestinian forms of that age. Similar Maestrichtian forms have been described from Tunis (*S. cossoni*) and even from Mexico (*Coahuilites cavinsi* and *C. orynskii*). It therefore appears that there was a marine connection between the Indo-Pacific and the Atlantic seas, covering part of Arabia and the African continent. Blanckenhorn || and Pervinquierè ¶ have already mentioned the existence of a probable connection between the Indian and African seas.

Libyoceras ismaeli, which occurs in the *overwegi* beds in Egypt, was originally referred by Blanckenhorn to the Lower Danian (= Maestrichtian of Blanckenhorn)**. In his more recent publication †† he refers it to a lower horizon, the Campanian. The Geological Survey of Egypt ‡‡ and also Krenkel §§ refer the beds in which the phosphate layers occur to the same age. But there is no doubt that, according to the evidence recently obtained, *Libyoceras* and related forms are some of the most reliable Maestrichtian zonal indices. *Libyoceras* is also one of the last ammonites of the Cretaceous formation, and cannot therefore be referred to the Danian, where ammonites do not occur.

It is, furthermore, important to note that *Libyoceras ismaeli* occurs also in Palestine in the phosphate beds, which even show the same petrological characteristics as those of Egypt. Blanckenhorn notes that the phosphate beds of

* University of Texas, no. 2748 (1927).

† "New Ammonites from the English Chalk," Geol. Mag. 1926, table to p. 80.

‡ Céph. créat. Diego-Suarez, Ann. Paléont. ii. pp. 49, 50 (Paris, 1907).

§ See Spath, Ann. S. Afr. Mus. xii. pt. vii. p. 284.

|| Zeitschr. deutsch. geol. Ges. 1900, p. 42.

¶ Etud. géol. de la Tunisie, Carte géol. de la Tunisie (Paris, 1903), p. 149.

** Zeitschr. deutsch. geol. Ges. 1900, p. 44.

†† Hdb. reg. Geol. vii., Ägypten, 1921, p. 60.

‡‡ Hume, 'Phosphate Deposits in Egypt,' 1927, Carte of Safaga District, Survey of Egypt, paper no. 41.

§§ Geol. von Africa, Berlin, 1925, pp. 147, 158.

both Palestine and Egypt are of the same age*. In this paper he described for the first time the phosphate deposits on the Jericho road, but later referred them (like those of Egypt) to the Campanian †. According to my investigations the phosphate beds of Palestine with *Libycoceras ismaeli* and its associated fauna must be referred to the Maestrichtian.

In this ammonite fauna *Baculites vertebralis* is another characteristic Maestrichtian fossil and is well known from various European Maestrichtian deposits. With its varieties *syriacus* and *ovatus* it is the most common ammonoid of the uppermost Cretaceous of Palestine, and this horizon I therefore call the *Baculite*-horizon.

The genera *Ptychoceras* and *Bostrychoceras* occur in the phosphate beds of Egypt and Palestine. This shows that these ammonoids lived in shallow water ‡ and possibly crawled on the sea-bottom. In the recent fossil catalogue (cf. Diener §), these genera (and also *Libycoceras*) ought to have been referred to the Maestrichtian.

It is almost certain that *Sphenodiscus? spathi*, which is so closely related to *S. acutodorsatus*, Noetling, belongs, like the latter, to the Maestrichtian. It occurs in the uppermost flint beds of the Mount of Olives, near Jerusalem, from which Blanckenhorn has mentioned the occurrence of *Baculites* of the *asper (larteti)* and *palestinensis (furcillatus)* group.

It is interesting to note that *Aptychus spinosus*, Cox, which has only been recorded from the English Chalk, has now also been found in Palestine. *Aptychi* and the genera *Ptychoceras*, *Bostrychoceras*, *Libycoceras*, and *Sphenodiscus* || have not so far been recorded from Palestine.

EXPLANATION OF THE PLATES.

(All the figures are of natural size.)

PLATE IX.

Fig. 1. *Aptychus (Spinaptychus) spinosus*, Cox.

Fig. 2. *Ptychoceras* sp.

Fig. 3. *Bostrychoceras* sp., aff. *punicum*, Pervinquière.

* Zeitschr. f. prakt. Geol. 1903, xi. 8.

† Zeitschr. deutsch. geol. Ges. 1915, Monatsber. p. 18; and Hdb. reg. Geol. vii. 1921, p. 59.

‡ Krusch has especially emphasised the shallow-water nature of the phosphate deposits, and calls them Phosphate breccias ("Phosphat-truemmerkalk," Zeitschr. f. prakt. Geol. 1911, Jhg. xix. Hft. 12, p. 398, Phosphatlagerstätten von Es Salt).

§ 'Fossilium Catalogus,' 1925, pars 29, p. 236 ff.

|| Excepting the very badly preserved *Sphenodiscus? sp.?* of Van Ingen from Transjordanian [see our remarks, p. 450].

Fig. 4. *Baculites vertebralis*, Lamarck. (a) Lateral view. (b) Septal surface.

Fig. 5. Ditto. Lateral view showing the growth-lines slightly elevated.

Figs. 6, 7, 8. Ditto. Cross-section of different sizes.

Figs. 9, 10. *Baculites vertebralis*, var. *syriacus*, Conrad. Cross-sections.

Fig. 11. *Baculites vertebralis*, var. *ovatus*, Say (P). Cross-section.

Fig. 12. *Libycoceras ismaeli*, Zittel. Lateral view.

PLATE X.

Fig. 1. *Baculites palestinensis*, sp. n. (a) Lateral view. (b) Cross-section.

Figs. 2, 3, 4. Ditto. Lateral views of different smaller specimens.

Figs. 5, 6, 7. Ditto. Cross-sections of different smaller specimens.

Fig. 8. *Baculites asper*, Morton. Cross-section.

Fig. 9. *Baculites asper*, var. *larteti*, Blanckenhorn. Lateral view.

LIX. — On the Avonian Coral *Caninophyllum*, gen. nov., and *C. archiaci* (Edwards & Haime). By HERBERT P. LEWIS, M.A., F.G.S.

[Plates XI. & XII.]

I.

The name *Caninophyllum* is here given to certain Lower Carboniferous Corals which exhibit cyatho-caninoid features. Hitherto they have been referred to the "gens" of *Caninia patula*, Michelin, but some palæontologists have expressed the opinion that *C. patula* and its varieties show definite characters which distinguish them generically from *Caninia*. It was the opinion of A. Vaughan* that the "marked peculiarities" of *C. patula* "warranted the creation of a new genus," and Vaughan's view later received support from Dr. L. M. Parsons †.

Dr. A. Salée ‡ recognised, in his memoir 'Le Genre *Caninia*,' the essential differences between *C. patula*, Mich., and *Caninia cornucopiæ*, Mich. (the genotype of *Caninia*), namely, the broader dissepimental zone and the absence of an amplexoid septal phase in *C. patula*. On other grounds, of minor importance, however, he decided to group the two

* "The Avonian of Burrington Combe," Q. J. G. S. vol. lxxvii. p. 375 (1911), by S. H. Reynolds and A. Vaughan.

† "The Carboniferous Limestone bordering the Leicestershire Coal-field," Q. J. G. S. vol. lxxiii. p. 92 (1918), by L. M. Parsons.

‡ "Le Genre *Caninia*," Bruxelles, 1910, p. 46, Mém. Soc. Belge de Géologie, etc.