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Larger Foraminifera from Aintab, Turkish Syria.

By **F. R. S. Henson,** Kirkuk ('Iraq).

With 5 plates (II—VI) and 5 text figures.

Introduction.

Certain foraminiferal limestones (**3**; p. 156, § 3)[1]) found at Aintab have been the subject of discussion in the literature of the area and various opinions have been expressed as to their ages. Prof. M. BLANCKENHORN attributed them first to the Lower Eocene (**1**; pp. 339—342) and later to the Upper Eocene (**3**; pp. 156—157). L. R. COX suggested that Miocene rocks might be present (**6**; p. 43). Subsequently both BLANCKENHORN (**2**; pp. 20, 21) and COX (**7**; pp. 338—341) noted resemblances between a molluscan fauna from Aintab and that of the Upper Oligocene at Ramleh in Palestine. COX concludes: " It is thus quite possible that the Oligocene is developed at Aintab itself and to the South of the town " (**7**; p. 341). This opinion was supported later by COX and H. D. THOMAS (**8**; p. 431) after examination of specimens from Aintab. L. DUBERTRET in his 'Carte Géologique de la Syrie et du Liban' 1933, shows " Miocène présumé " at Aintab.

It is clear from BLANCKENHORN's descriptions (**3**; pp. 154—158) that rocks of several ages outcrop in this district and that further field survey is required to determine their relationships and exact localities.

The present paper makes no contribution in this respect but records observations on larger foraminifera contained in BLANCKENHORN's original collections from Aintab which were lent to the writer by the authorities of the Hebrew University, Jerusalem. The results of the investigation are given in Plate II [2]).

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[1]) Numerals in Clarendon type in bibliographical references apply to the list of works at the end.

[2]) Registration numbers (Reg. No.) refer to specimens in the collections at the Hebrew University, Jerusalem.

It is shown that the foraminiferal limestones referred to above (Plate II, Nos. 27, 28, 39, 40, 514) are from three different sources, Upper Eocene to Miocene in age. Among them are specimens of a *Spiroclypeus* Limestone which is considered to be Lower Miocene on the evidence of larger foraminifera which are described in detail.

The remaining samples in the collection are inadequate for complete study of microfaunas but they are discussed briefly to confirm the existence of Lutetian and Oligocene outcrops in the vicinity of Aintab (**3**; pp. 154—158, etc.); it is also suggested that Vindobonian rocks may occur.

Notes on Specimens Described in Plate II.

Lutetian. Nos. 46 and 47.

Owing to silicification of the rock, complete determination of species is not possible but the general character of the fauna is comparable with that of the widespread Lutetian Limestone of surrounding areas.

Upper Eocene. No. 27(b).

Sample No. 27 contains two types of material. (a) Freshly broken fragments of Lower Miocene *Spiroclypeus* Limestone (see below); (b) Worn and soil-stained casts of macrofossils which are evidently derived fragments; since the matrix in each consists of the same limestone of Upper Eocene age with *Nummulites variolarius*, it is assumed that outcrops of the rock occur in the vicinity of Aintab.

Oligocene? No. 44.

Oligocene *Nummulites* are numerous and well preserved in this sample but the detrital character of the rock calls for caution in deducing its age without examination of a larger quantity of material than that available to the author. Even if the *Nummulites* are derived, their abundance and good preservation point to the presence of Oligocene outcrops near Aintab.

Miocene, Lower Miocene, *Spiroclypeus* Limestone. Nos. 27(a), 28.

Both samples are of identical type and contain abundant fairly well preserved foraminifera which were examined in detail.

A count of 300 recognisable foraminifera in 8 rock sections gave the following frequencies:—

Spiroclypeus	30%	*Heterostegina*	20%
Rotalia viennoti .	20%	*Amphistegina*	15%
Miogypsina	10%	*Operculina*	2%
Textularia	2%	*Cycloclypeus*	1%

The stratigraphical distribution of the species listed in Plate II is not sufficiently well known to serve as a definite index of age. Existing records of the generic ranges only limit the beds between Upper Eocene and Miocene, the former being most unlikely.

An abundance of *Spiroclypeus* and *Miogypsina* is most characteristic of Miocene rocks while the absence of *Nummulites* and *Lepidocyclina* may perhaps be noted as evidence against an earlier date in a region where Oligocene limestones of similar facies usually abound in species of these genera. Nevertheless the assemblage has at least five species in common with that of the Upper Oligocene in Palestine (**13**), suggesting that the difference between their ages is not very great.

For these reasons it is considered that the Aintab *Spiroclypeus* Limestone may be referred to the Lower Miocene.

Vindobonian? No. 495(a).

No foraminifera of general stratigraphical value were found in this specimen, but, according to the author's present experience, the association of abundant *Amphistegina lessonii* with *Elphidium crispum* is exclusively characteristic of Vindobonian or later rocks in adjoining regions of 'Iraq, Syria and Palestine. It is possible that the limestone belongs to the transgressive Vindobonian formation which is well developed further South, and that the conglomeratic limestone No. 495(b) containing derived (?) *Nummulites* and orbitoids, is its basal member.

Unidentified. Nos. 39, 40, 514.

According to Dr. L. PICARD[3]), Nos. 29 and 40 are of the material in which COX and H. D. THOMAS observed several specimens of *Lepidocyclina* (**8**; p. 431).

The present writer found no orbitoids but the samples contain probable small *Nummulites* and involute *Operculina* sp. which recall similar forms in the Upper Oligocene of Ramleh, Palestine (**7**; p. 352; **13**). A single fragment of *Spiroclypeus* was found in No. 514, but the rock is quite different from that of samples 27(a) and 28.

No. 58.—This silicified limestone yielded no fossils of determinative value.

The writer is indebted to The 'Iraq Petroleum Company, Limited, for permission to publish this paper; to the authorities of the Hebrew University, Jerusalem, for the loan of all the samples described; to Dr. L. PICARD, Prof. MAX BLANCKENHORN and Mr. L. R. COX for helpful correspondence on the subject in question, and to Dr. W. A. MACFADYEN for valuable criticisms of the manuscript.

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[3]) Personal communication.

Prof. BLANKENHORN's collection has been returned to the Hebrew University, Jerusalem, together with the specimens referred to and illustrated in this paper.

Description of Foraminifera.

Genus **Operculina** D'ORBIGNY, 1826.

Operculina complanata (DEFRANCE).

1826. *Operculina complanata* DEFRANCE; **15**, p. 281, figs. 7—10. Model No. 80.
1907. *O. complanata*, DEFRANCE; **17**, p. 29, et syn.
1933. *O. complanata* DEFRANCE; **11**, p. 121, pl. viii, fig. 3b.

Description.—See Plate III, *I*.

Remarks.—Several specimens of this well known species were obtained, which agree closely with EL. DAVID's fig. 3b (op. cit.) showing an example from the Miocene of Syria; and with forms occurring in the Upper Oligocene of Palestine (**13**).

In a few cases the surface of the test is granulated as in the var. *granulosa* LEYM. One specimen with relatively straight septa resembles the var. *zitteli* SILVESTRI (**17**; p. 38, pl. ii, fig. 1; **11**; p. 122, pl. viii, fig. 1).

Material.—Samples 27, 28. About ten specimens, mainly fragments. Reg. No. 2793-XXVII.

Genus **Heterostegina** D'ORBIGNY, 1826.

Heterostegina assilinoides BLANCKENHORN.

Pl. IV, Figs. 1—5; Text-Figs. 1 and 2 [4]).

1890. *Heterostegina assilinoides* BLANCKENHORN, **1**, p. 342, pl. xlii, fig. 5, non figs. 4 and 6.

Description.—Plate III, *II*.

Remarks.—A comparison of BLANCKENHORN's original figures 4a and b with his fig. 5 suggests that two distinct species have been included under the same name. Figure 5 shows a small form only 3·1 mm. in maximum diameter for 1—2 whorls, whereas figure 4a represents an individual five to six times as large for an equivalent number of coils. The secondary chambers in figure 5 are nearly square, so far as can be judged from such a small scale drawing, while figure 4b shows secondary chambers more elongated in form.

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[4]) All text figures are based on camera lucida drawings.

No holotype is designated but several fragments exposed on the broken rock faces are ringed. All but one of these resemble figure 5. The single ringed specimen agreeing with figure 4a is probably the individual illustrated since the dimensions are the same, but this belongs to the genus *Spiroclypeus*, because definite traces of polygonal lateral chambers are visible where the natural section is not truly equatorial.

Morphologically *H. assilinoides* belongs to the group of involute *Heterosteginae* including *H. suborbicularis* D'ORBIGNY, *H. antillarum* D'ORBIGNY and *H. depressa* D'ORBIGNY, the latter as figured by BRADY (**9**; pl. xx, figs. 7a, b); exact comparison with these species

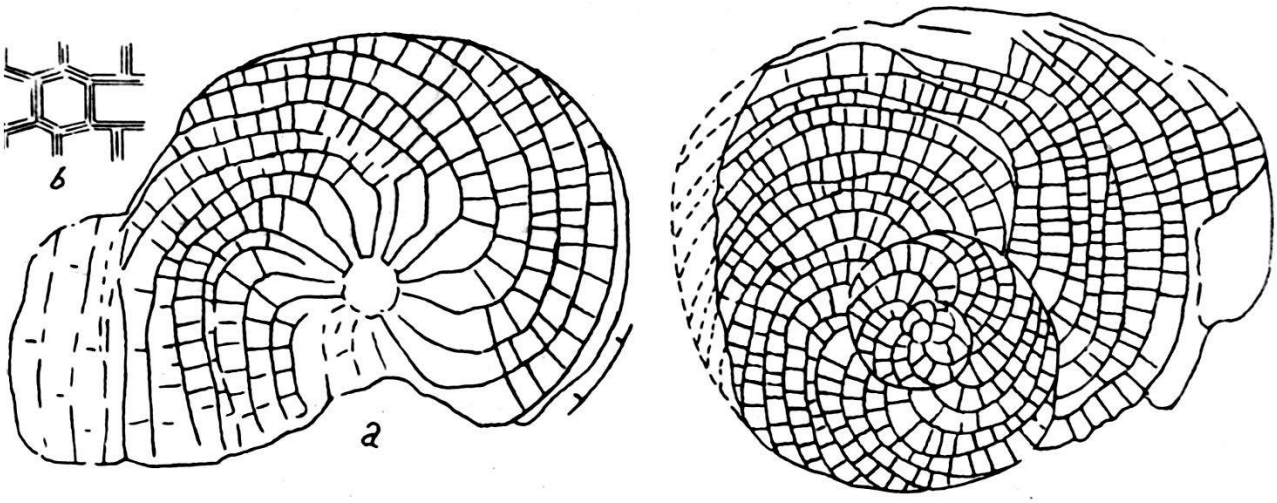

Fig. 1. Fig. 2.

Heterostegina assilinoides BLANCK.

1: (*a*) External view of specimen ringed by BLANCKENHORN; Lectotype; x 17.0.
(*b*) Enlargement; showing detail of secondary chambers; Reg. No. 2793-VI.
2: Equatorial section of megalospheric specimen; Plesiotype; x 14.0; Reg. No. 2793-VIII.

is not possible without reference to details of internal structure which are not at present available. *H. ruida* SCHWAGER, with which BLANCKENHORN compares his species, is complanate and evolute while the primary septa are more numerous and much less curved.

The most closely related form occurs in the Burdigalian of Syria and is referred by EL. DAVID to *H. praecursor* TAN (**11**; p. 123, pl. viii, figs. 5, 7, 8). This is an evolute *Heterostegina* with pillars terminating at the surface in granules, but the details of the equatorial chamber layer are practically those of *H. assilinoides* and the two species are connected by intermediate forms in the Upper Oligocene of Palestine where they appear together (**13**). *H. assilinoides* occurs also at Anah on the Euphrates (**4**; p. 65) in Upper Oligocene

and Lower Miocene limestones with *Lepidocyclina* cf. *raulini* LEM. and DOUV. and *Miogypsina complanata* SCHLUMB. respectively[5]). Thus the range of the species, as at present known, is from Upper Oligocene to Lower Miocene.

Material and Types.—Samples 27, 28. About thirty specimens were examined, mostly fragments.

The writer was unable to identify the original of BLANCKENHORN's fig. 5, but a specimen ringed by him has been designated as the lectotype (text fig. 1), Reg. No. 2793-VI.

Plesiotypes.—Reg. Nos. 2793-II(3 and 4), 2793-III(1), 2793-VII, 2793-VIII, 2793-IX (microspheric individual), 2793-XI, 2793-XII.

Other Specimens.—Reg. Nos. 2793-X, 2793-XIII.

Genus **Spiroclypeus** H. DOUVILLÉ, 1905.

Spiroclypeus blanckenhorni sp. nov.

Pl. IV, Fig. 7; Pl. V, Figs. 1—3.

Description.—Plate III, *III*.

Remarks.—An individual (Reg. No. 2793-XV) ringed by BLANCKENHORN and figured by him as *Heterostegina assilinoides* (**1**; p. 342, pl. xiil, fig. 4a) is probably an exceptionally large (microspheric?) example of *Spiroclypeus blanckenhorni*. An interesting feature of the specimen is the presence over the nucleoconch, where the natural section is not truly equatorial, of short, radial prolongations of primary septa only (Pl. IV, fig. 7). In axial sections of the species the shell lamina of the first whorl is sometimes undivided and is separated from the enveloping lamina by simple alar prolongations of the equatorial chambers. In such cases, therefore, the earliest whorl of *S. blanckenhorni* is comparable in structure with that of an involute *Heterostegina*. Other specimens show the development of lateral chambers even in the first coil. The initial *Heterostegina* stage may be of special significance in the present instance, since there is a marked similarity between equatorial sections of the first whorl in *S. blanckenhorni* and *H. assilinoides* respectively. This resemblance may be due to the fact that variation in detail of the equatorial chamber layer is often not very pronounced among small, loosely coiled species of the two genera. In the author's opinion, however, it is probable that *H. assilinoides* is the immediate ancestor of the associated *Spiroclypei*. For this reason the specimens with an initial *Heterostegina* stage are regarded as intermediate forms and are not separated as the product of a distinct line of specialisation.

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[5]) Author's own observations.

Although *S. blanckenhorni* is typically a non-granulated form, a few small, rounded ' pillars ' appeared sporadically at vertices of lateral chambers when cutting tangential sections through the specimen shown on Plate V, fig. 1; the ' pillars ' are impersistent since they disappeared on further grinding.

This species is distinguished from *S. leupoldi* VAN DER VLERK (= *S. globulus* NUTTALL, *S. binteotensis* ZUFF.-COM., *S. wolfgangi* VAN DER VLERK—**14**; pp. 86, 87, 90, 91) by its less inflated form, fewer lateral chamber layers and absence of undivided primary chambers in Form A; the marginal flange is very thin and the equatorial chambers are often visible externally.

S. orbitoideus DOUVILLÉ (**10**; pl. xiv, figs. 1—6) is considerably larger, while axial sections show more numerous lateral chamber layers for individuals of comparable size; the wall structures seem to be more delicate than those of the Aintab forms in which the lateral chambers are often almost obscured by relative thickening of shell material.

The species is named after Professor MAX BLANCKENHORN in recognition of his pioneer work in the Middle East.

Material and Types.—Samples 27, 28. About fifteen specimens were examined.

Syntypes.—Reg. Nos. 2793-II(1), 2793-XIV, 2793-XVI, 2793-XVII.

Other specimens.—Reg. Nos. 2793-XV, 2793-XVIII.

Spiroclypeus blanckenhorni sp. nov. var. **ornata** var. nov.

Pl. V, Figs. 4—7; Text-figs. 3 and 4.

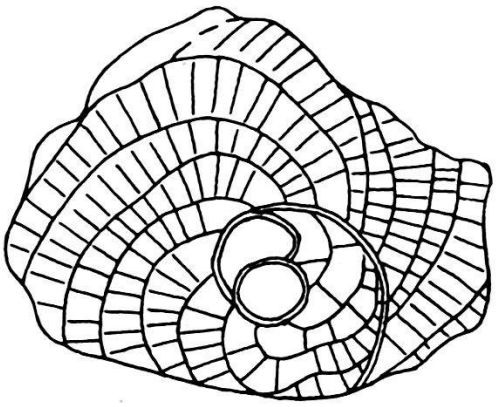

Fig. 3.

Fig. 4.

Spiroclypeus blanckenhorni sp. nov. var. *ornata* var. nov.

3: Fragment of natural equatorial section of megalospheric specimen; x 24; Reg. No. 2793-XXIII.

4: Axial section showing early *Heterostegina* stage; x 44.5.

Description.—Plate III, *IV*.

Remarks.—The variety *ornata* differs from *S. blanckenhorni* mainly in having numerous pillar-granules; the average diameter is less with greater relative inflation at the umbo; the embryon is generally somewhat larger and the spire more open (Plate VI).

In all these characters, however, there is a gradation from one form to the other. Occasional rudimentary ' pillars ' are observed in *S. blanckenhorni* (p. 51), while parts of the lateral chamber structure in the var. *ornata* are sometimes devoid of pillars; for this reason the development of pillars is here considered to be of varietal significance only.

Equatorial sections of the two forms are often indistinguishable and specimens of the var. *ornata* have been found with an initial *Heterostegina* stage (text-fig. 4).

The pillar-granules in *S. blanckenhorni* var. *ornata* are rarely conspicuous though occasionally large polar pillars are present as in *S. margaritatus* (SCHLUMBERGER) var. *umbonata* KRIJNEN (**14**; pl. i, fig. 5).

Granules are exceptional on the marginal flange, whereas they cover the whole surface of the test in *S. margaritatus* (SCHLUMB.), *S. pustulosus* DOUVILLÉ, *S. granulosus* BOUSSAC, *S. pleurocentralis* (CARTER) and *S. yabei* VAN DER VLERK.

S. tidoenganensis VAN DER VLERK, which has a smooth flange according to the original description (**20**; p. 16), is distinguished by the peculiarity of its embryonic apparatus.

In equatorial sections the Aintab forms are very similar to *S. margaritatus* and *S. pleurocentralis* but these species have two undivided primary chambers while the latter is coarsely pustulose (**14**; pl. i, fig. 8; **10**; pl. xiv, figs. 7—8).

These differences, together with the evidence of local origin, are considered to justify the separation of *S. blanckenhorni* var. *ornata* from other published species of small, granulated *Spiroclypei*.

Material and Types.—Samples 27, 28. About thirty specimens (mainly fragments) were examined.

Syntypes.—Reg. Nos. 2793-II(2), 2793-IV(1), 2793-XIX, 2793-XXIV, 2793-XXV.

Other specimens.—Reg. Nos. 2793-III(3), 2793-XX, 2793-XXI, 2793-XXII, 2793-XXIII.

Genus **Cycloclypeus** W. B. CARPENTER, 1856.

Cycloclypeus cf. **eidae** TAN SIN HOK.

cf. 1930. *Cycloclypeus eidae* TAN SIN HOK; **18**, p. 233.
cf. 1932. *C. neglectus* MARTIN *var. eidae* TAN SIN HOK; **5**, p. 186, pl. ii, figs. 15, 16.
cf. 1932. *C. eidae* TAN SIN HOK; **19**, p. 50, pl. v, fig. 6; pl. xii, figs 2, 3; pl. xiii, figs. 1, 2, 4—6.

Description.—Plate III, *V*.

Remarks.—The specimens described belong to the '*neglectus*' group of CAUDRI (**5**; pp. 182, 183) and to TAN's 'sectio of *Cycloclypeus eidae*' (**19**; pp. 39 and 49—50). The initial *Heterostegina* stage is well developed within the first annular chamber which is elliptical in shape.

Since details of the central part of the test are lacking, exact specific determination is not possible, but there is little doubt that the species compares closely with *Cycloclypeus eidae* TAN.

C. eidae is very common in the Upper Oligocene rocks of Ramleh, Palestine (**13**).

Material.—Samples 27, 28. Six incomplete specimens were examined. Reg. Nos. 2793-XXVI, 2793-V(2).

Genus **Rotalia** LAMARCK, 1804.

Rotalia viennoti GREIG.

1935. *Rotalia viennoti* GREIG; **12**, p. 523, pl. lviii, figs. 1—14.

This species is abundant and typical in the Aintab *Spiroclypeus* Limestone.

Material.—Samples 27, 28. Sixty-five specimens were found. Reg. Nos. 2793-XXIX, 2793-V(o).

Genus **Amphistegina** D'ORBIGNY, 1826.

Amphistegina cf. **hauerina** D'ORBIGNY.

cf. 1846. *Amphistegina hauerina* D'ORBIGNY; **16**, p. 207, pl. xli, figs. 3—5.
cf. 1913. *Amphistegina haueri* D'ORBIGNY; **21**, p. 34, fig. 24a—d.

Description.—The diameter varies from 1·36—1·58 mm. and the thickness at the umbo from 0·48—0·68 mm. The average ratio of diameter to thickness is about 2:1.

Umbos of clear shell material are well developed, the diameter at the surface being 0·33 mm. in one typical specimen. The margin is sub-acute. Full grown individuals have five whorls. The septa are highly inclined and there are $\pm$ 27 in the last whorl.

The septal lines on the dorsal side of the test are typically straight, or slightly curved, until they turn back sharply at about $\frac{3}{4}$ of the distance from the umbo to the periphery to meet the latter at an acute angle. On the ventral side the septal lines are rather more sinuous.

Remarks.—The Aintab specimens agree closely with examples from the Oligocene of Palestine and the Burdigalian of Syria (**13**) but differ in several details from the type illustrated by D'ORBIGNY. They are only about half the diameter while the ratio of diameter to thickness is less owing to somewhat greater relative development of umbos. The outer wall of the test is not conspicuously concave between the umbo and the periphery as shown in D'ORBIGNY's fig. 5 (op. cit.) but resembles ZITTEL's fig. 24d (op. cit.). The septa are usually straighter. Topotype specimens of *A. hauerina* from Nussdorf, Austria (British Museum Nat. Hist. No. P326), are very similar to the Aintab forms though larger.

Material.—Samples 27, 28. About 45 specimens were found, only two being separated from the matrix. Reg. Nos. 2793-XXVIII, 2793-V(3).

Genus **Miogypsina** SACCO, 1893.

Miogypsina sp. indet.

Pl. IV, Fig. 6; Pl. V, Fig. 8; Text-fig. 5.

Description.—The largest individual has a diameter of 2·02 mm. and a maximum thickness of 0·44 mm.

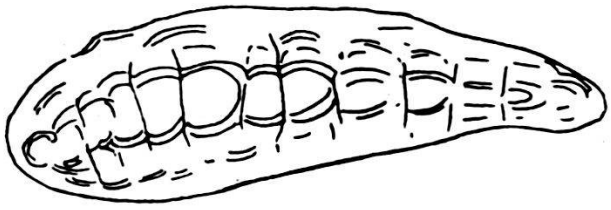

Fig. 5. *Miogypsina* sp. indet.
Transverse section; x 39·4; Reg. No. 2793-V(1).

The diameter of the spherical proloculum is 0·11 mm. The equatorial chambers are lanceolate, with a radial diameter varying from 0·09 to 0·15 mm. and a vertical diameter of 0·08 to 0·13 mm.

Axial sections show 9 to 12 or more equatorial chambers along the greater radius from the proloculum and 1—2 along the lesser radius.

There are about three layers of lateral chambers but in many specimens, probably owing to poor preservation, no lateral chambers are perceptible.

The external features of the test could not be observed exactly since no specimens were separated from the rock. In the best examples some indications were found of pillars terminating at the surface in granules which in one case measured 0·09 mm. in diameter.

Remarks.—The Aintab forms do not seem to correspond exactly with any published species but cannot be described adequately from the available specimens.

Material.—Samples 27, 28. About 30 sections were found. Reg. Nos. 2793-IV(2), 2793-V(1), 2793-III(2).

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Explanation of Plates.

Plate IV.

Figs. 1—5. *Heterostegina assilinoides* BLANCKENHORN.

1. Tangential section; plesiotype; x 23·1; Reg. No. 2793-XII.
2. Equatorial section of megalospheric individual; x 11·5; Reg. No. 2793-XI.
3. Axial section; plesiotype; x 22·4; Reg. No. 2793-II(4).
4. Axial section, showing pronounced umbonal bosses; plesiotype; x 30·3; Reg. No. 2793-II(3).
5. Axial section, showing small pillars; plesiotype; x 11·4; Reg. No. 2793-III(1).

6. *Miogypsina* sp. showing lateral chambers; x 30·0.

7. *Spiroclypeus blanckenhorni* sp. nov.; x 8·2.

Partial equatorial section showing (a) short radial prolongations of primary septa towards umbo (see page 50), (b) lateral chamber network; Reg. No. 2793-XV.

Plate V.

Figs. 1—3. *Spiroclypeus blanckenhorni* sp. nov.

1. Partial equatorial section showing early coils and lateral chambers; microspheric individual; syntype; x 12·4; Reg. No. 2793-XVI.
2. Partial equatorial section; megalospheric individual; syntype; x 10·0; Reg. No. 2793-XVII.
3. Transverse section, not axial; syntype; x 13·0; Reg. No. 2793-II(1).

4—7. *Spiroclypeus blanckenhorni* var. *ornata* sp. et var. nov.

4. Axial section; syntype; x 13·4; Reg. No. 2793-IV(1).
5. Axial section, showing exceptionally large polar pillars; syntype; x 13·5; Reg. No. 2793-II(2).
6. Tangential section showing equatorial and lateral chambers with small pillars; syntype; x 14·8; Reg. No. 2793-XXIV.
7. Equatorial section of megalospheric individual; syntype; x 29·1; Reg. No. 2793-XXV.

8. *Miogypsina* sp. Axial section; x 26·0; Reg. No. 2793-IV(2).

FORAMINIFERAL SPECIMENS FROM AINTAB IN BLANCKENHORN'S COLLECTIONS AT THE HEBREW UNIVERSITY, JERUSALEM

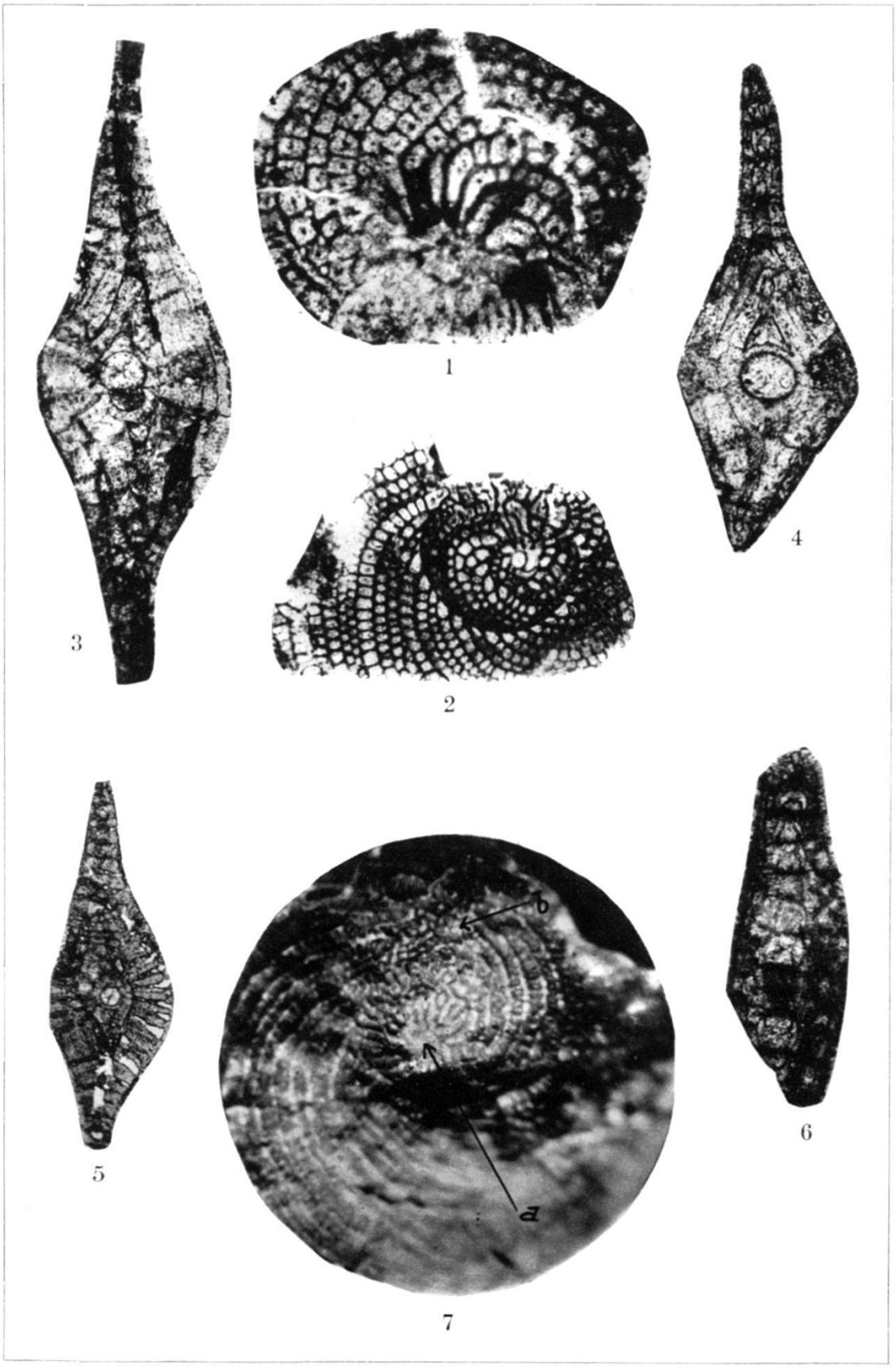
Blanckenhorn's Numbers	Descriptions & references accompanying specimens	Localities	Observations by F. R. S. Henson	Registration Numbers at Hebrew University, Jerusalem
27	Kalk mit Nummulites variolaria, Heterostegina assilinoides Blanck. (original:) verwandt mit H. ruida Schwager, aber viel grösser; Operculina sp. cf. ammonea, Operculina sp., Pecten sp., Bryozoa. 10. 5. 1888. Unter-Eocän. Bl. Eocän in Syrien, 1890, Taf XVII, S. 339-342	3/4 Stunden Östl. Aintab.	a, Yellowish, porous limestone with Spiroclypeus blanckenhorni sp. nov., S. blanckenhorni var. ornata sp. et var. nov., Cycloclypeus cf. eidae Tan Sin Hok, Heterostegina assilinoides Blanckenhorn, Operculina complanata Defrance & varieties, Miogypsina sp. indet., Amphistegina cf. hauerina d'Orb., Rotalia viennoti Greig, Textularia spp., Cibicides sp. &c. Lower Miocene. Ref ?3; p:156 § 3.	Hand specimens 2793 - I Thin sections 2793-II to V H. assilinoides 2793-VI to XIII S. blanckenhorni 2793-XIV-XVIII S. blanckenhorni var ornata 2793-XIX-XXV C. cf. eidae 2793 - XXVI O. complanata 2793 XXVII A. cf. hauerina 2793 XXVIII R. viennoti 2793-XXIX.
			b, Five weathered casts of macrofossils; matrix of compact, yellowish limestone with abundant Nummulites variolarius Lamarck, Mollusca, Coral fragments &c. Upper Eocene. Ref ?3; p: 156 § 3	Hand specimens 2793-XXX Thin section 2793-XXXI
28	Kalk mit Foraminiferen, Balanus, Ostrea. 10. 5. 1888. Eocän.	3/4 Stunden Östl. Aintab	As for Nº 27a with same foraminifera. Lower Miocene. Ref ?3; p:156. § 3.	2794
39	Poröser Hornstein. Pecten quinquepartitus Blanck: Operculina sp., Pecten sp. Eocän. Ref: 1. Blanckenhorn Z.D.G.G., 1890, pp 352-354, pl XIX fig. 2-3 2. Cox & Thomas Geol. Mag. 71, 1934, p. 431.	Nordwestlich Aintab	Compact, brownish-yellow, silicified limestone with Operculina spp., Heterostegina sp., Amphistegina sp., ? small Nummulites. Ref. ?3; p. 156, § 3.	2807
40	Pecten quinquepartitus, 12·5·1888, Eocän. Ref: 1. Blanckenhorn Z. D.G.G., 1890, pp. 352-354 pl. XIX, fig. 2-3 2 Cox & Thomas - Geol. Mag. 71, 1934, p. 431.	Nordwestlich Aintab, am Weg nach Arablar	As for Nº 39, with Operculina complanata Defr., O. camplanata Defr. var. heterostegina Silv. Ref. ?3; p. 156, § 3.	2806
44	Tuffartig, sandig-kalkiges Gestein reich an Nummuliten (N. intermedia d'Arch., Fichteli Micht., Chavannesi de la Harpe und eine Koralle) Ober-Eocän	Nordsyrien. Wasserscheide zwischen Afrûn und Usum-Deri = Kirsun Tschai zwischen Tarb und Arablar.	Yellowish-brown, porous, granular limestone with abundant detritus from limestones and roches vertes (II. Pp. 17-23); fossils include Nummulites intermedius-fichteli, N. gr. vascus Joly & Leymerie, Operculina sp., Amphistegina sp., worn fragments of Orbitoids Corals, Bryozoa &c. Ref: ?3; p. 157 § 4. Oligocene ?	Hand specimens 2810 - I Thin sections 2810-II - V N. gr. vascus 2810 - VI
46	Feuerstein mit Nummuliten und Orbitoiden.	2 Stunden westlich Aintab.	Silicified limestone with numerous small, radiate Nummulites including N. subatacicus H. Douv.; Assilina sp., Operculina sp., Discocyclina spp. (abundant), radiate Discocyclininae &c. Lutetian	Hand specimens 2814 - I Thin sections 2814 - II
47	Feuerstein (aus dem Kieselkalk) mit Nummuliten und Orbitoiden.	Im Westen von Aintab. Wasserscheide zwischen Afrûn und Sadjûr-See.	As for Nº 46 with same foraminifera. Lutetian	Hand specimens 2815-I Thin section 2815 - II
58	Feuerstein mit Foraminiferen 10. 5. 1888, Eocän.	3/4 Stunden östl. Aintab Nordsyrien.	Silicified limestone with Amphistegina sp. &c.	Hand specimen 2826 - I Thin section 2826 - II
495	Kalke mit Nummuliten, Korallen, Bivalven, Eocän	Zwischen Tab & Arablar (Weg Aintab-Marash)	a, Brown limestone with abundant Amphistegina lessonii d'Orb. Elphidium cf. crispum (Linné), Gypsina, Textularia, Bolivina Globigerina, Ostracods, Echinoids, Lithothamnium, Probably Vindobonian or later.	Hand specimen 3975 - I Thin section 3975 - II A. lessonii 3975 - III
			b, Grey, pink & yellow conglomeratic limestone with calcareous detritus in a marly matrix. Fossils (indigenous & derived) include worn fragments of Orbitoids and Nummulites (N. fichteli Mich., N. cf chavannesi de la Harpe, &c.). Globigerina, Miliolidae, Lithothamnium, Corals, Bryozoa, Mollusca, Echinoids, &c.	Hand specimen 3975 - IV Thin section 3975-V - VII Nummulites spp 3975-VIII
514	Aus einem Handstück mit Pecten quinquepartitus Blanck.	Im Süden von Aintab.	As for Nos: 39 & 40 with Spiroclypeus sp. (rare), Gypsina, sp. Textularia &c. Ref: ?3; p. 156, § 3.	Hand specimen 2126-I. Thin sections 2126-II & III

DESCRIPTIONS OF CAMERINIDAE FROM A SPIROCLYPEUS LIMESTONE OF AINTAB

Note: All measurements are given in millimeters

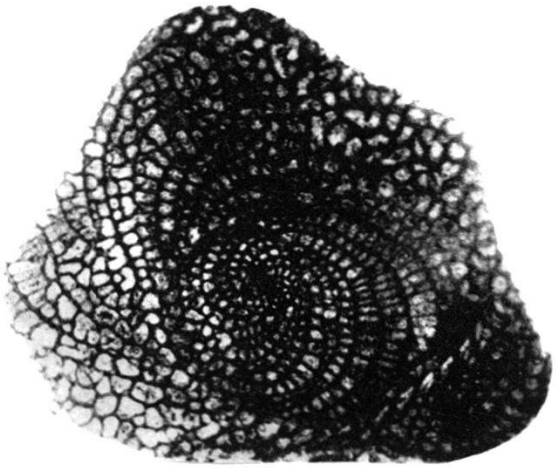
		Form	1 Shape & structure of test	2 External ornament &c.	3 Character of megalospheric embryon	4 Shape of primary septa	5 Shape of secondary septa	6 Shape of secondary chambers	7 Maximum diam:	8 Diam: of umbo	9 Polar thickness	10 Thickness at peripheral margin	11 Eccentricity of axis	12 Diam: of polar pillars at surface	13 Diam: of other pillars at surface	14 No: of whorls	15 Radii of whorls	16 Thickness of marginal cord in 1st whorl	17 Diam: of proloculum	18 Length (rad.) x length of embryonic chamber	19 Thickness of wall round embryon.	20 No: of nepionic primary chambers	21 No. of primary septa in 1st, 2nd, 3rd, whorls	22 Dist: between primary septa	23 Thickness of primary septa	24 Dist: between secondary septa	25 Thickness of secondary septa	26 Vert: diam: of equatorial chambers	27 Max: no: of lateral chamber layers	28 Horiz: diam: of lateral chambers	29 Vert: diam: lateral chambers	30 Thickness of lateral shell laminae
I	**Operculina complanata** Defrance	A	Outline sub-circular to elliptical; axis eccentric; test bilaterally symmetrical, compressed, slightly thickened over axis; peripheral margin rounded; whorls typically evolute.	Test smooth or with granules on septal lines which are generally visible.	Bicellular with approx: spherical proloculum partly embraced by a crescentric second. chamber.	Approximately radial at inner ends, curving backwards to meet the marginal cord at an acute angle; sometimes the radial trend is prolonged the septa then being rather sharply reflexed towards the marginal cord.	—	—	4·7+	?	?	?	?	—	?	2-3	See Spiral Graphs Plate VI	±0·07	±0·10	0·08 x ?	?	—	7-10 16-19	?	?	—	—	?	—	—	—	?
II	**Heterostegina assilinoides** Blanckenhorn	A	Outline roughly a major segment of a circle or a rounded quadrilateral; axis eccentric; test bilaterally symmetrical, lenticular or biumbonate with a thin marginal flange; peripheral margin rounded; whorls involute, with alar prolongations of primary chambers converging towards the axis; secondary chamberlets occur only in the marginal flange of each whorl; typically with large, conical, polar pillars &/or smaller pillars in umbonal area.	Test typically smooth. Primary & secondary septal lines generally visible on marginal flange; secondary chambers often with small spot in centre; umbonal area with radiate primary septal filaments; Pillars visible but rarely projecting at surface, not always present.	As above	Earlier septa approx: radial at inner ends curving back to meet outer margin at an acute angle; later septa at acute angle (± 30°) to inner margin & of semi annular form, becoming nearly parallel to outer margin; septa typically parallel & equidistant throughout.	Straight normal to primary septa.	Nearly square or slightly hexagonal.	5·06	± 2·0	0·70 to 1·36	±0·22	1/1·5	0·25 to 0·44	0·06 to 0·09	2+		0·03 to 0·04	0·11 to 0·33 Mean 0·23	0·06 x 0·20 x 0·15 to 0·44	0·02 to 0·06	0 ? to 1	8-11 17-18	0·11 to 0·24 Mean 0·16	0·02 to 0·03	0·11 to 0·22 Mean 0·15	±0·02	0·05 to 0·09	—	—	—	0·09 (Margin) to 0·44 (Umbo)
		B							3·70+							3-4			0·06			?±8	± 10 ± 14 ± 20						—	—	—	
III	**Spiroclypeus blanckenhorni** spec. nov.	A	Outline probably sub-circular or roughly elliptical, axis eccentric; test bilaterally symmetrical; compressed lenticular with a thin marginal flange, often undulating; peripheral margin rounded; whorls involute with layers of rounded to polygonal lateral chambers; typically without pillars.	Test typically smooth. Septal lines of primary & secondary equatorial chambers sometimes visible on marginal flange & those of lateral chambers over umbonal area.	As above	Semi-annular, at acute angle to inner margin, curving until nearly parallel to outer margin; septa approx: parallel or diverging gradually outwards distance between septa increases slightly in later stages earlier septa sometimes radial at inner ends.	As above	Nearly square or slightly hexagonal in early stages becoming elongated in later stages due to wider spacing of primary septa.	±5·0	2·20 to 3·30	0·55 to 0·99	0·11 to 0·28	?			1-2		±0·02	0·15 to 0·31 Mean 0·22	0·11 to 0·18 0·25 to 0·37	0·02 to 0·03	0	8-(12) 17-18	0·05 to 0·44	0·01 to 0·03	0·05 to 0·15 Mean 0·09	±0·02	0·02 to 0·09	5	0·11 to 0·22 Mean 0·14	Mean 0·02 to 0·03	0·02 to 0·10
		B							8·13+ (16·0+)							3-4						?±8	?±8 12-13 17-18									
IV	**Spiroclypeus blanckenhorni** var. **ornata** spec. et var. nov.	A	As above but with numerous pillars mainly at vertices of lateral chambers; sometimes biumbonate due to development of large, conical, polar pillars.	Septal lines of primary & secondary equatorial chambers often visible on marginal flange which is typically smooth but sometimes has small granules along primary septa. Umbonal area with small granules increasing towards centre: with or without larger polar pillars	As above	As above	As above	As above	4·0 to 5·0	1·10 to 1·98	0·87 to 1·14	0·14 to 0·22	1/1·8	(0·22)	0·05 to 0·09	1-2		0·02 to 0·03	0·15 to 0·38 Mean 0·24	0·07 to 0·22 x 0·20 to 0·33	0·02 to 0·03	0	7-10 ?	Nr. Umbo 0·11 to 0·22 Nr. Margin 0·16 to 0·33	0·02 to 0·03	0·06 to 0·13	±0·02	0·03 to 0·10	8	0·11 to 0·16	0·02 to 0·03	0·02 to 0·09
V	**Cycloclypeus** cf. **eidae** Tan Sin Hok	A	Outline sub-circular; axis slightly eccentric; test bilaterally symmetrical, discoidal, thickened over axis; peripheral margin rounded.	External ornament of umbonal area not observed, septal lines of equatorial chambers generally visible towards margin with small granules at junctions of primary & secondary septa; the latter are frequently marked at the surface by small, wedge-shaped ridges.	As above	Semi-annular & at acute angle to spiral margin at both ends in nepionic stage; annular elliptical, becoming circular in adult stage; septa typically parallel & equidistant.	As above	Nearly square or slightly hexagonal	5·5	?	?	?	?	?	?	?	?	?	0·22	0·11 x ?	?	> 10 < 20	?	0·06 to 0·10	±0·02	0·06 to 0·11	±0·02	?	—	-	—	?

① Many of the measurements given above were made on thin slices of the fossils; some allowance should be made, therefore, for accidental factors such as obliquity of sections. ② Values in brackets are exceptional; those followed by a + sign are based on incomplete specimens.
③ The values given in column 20 represent the number of undivided (Operculine) primary chambers in Heterostegina & Spiroclypeus & the number of discontinuous (Heterostegine) primary chambers in Cycloclypeus.



Birkhæuser, Basle, repr.

4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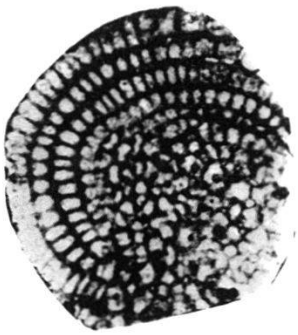
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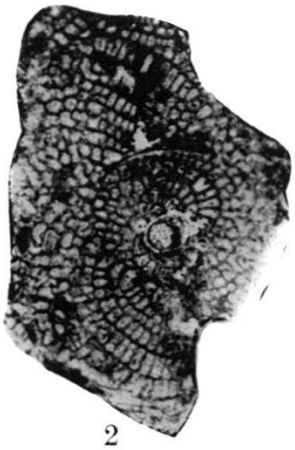
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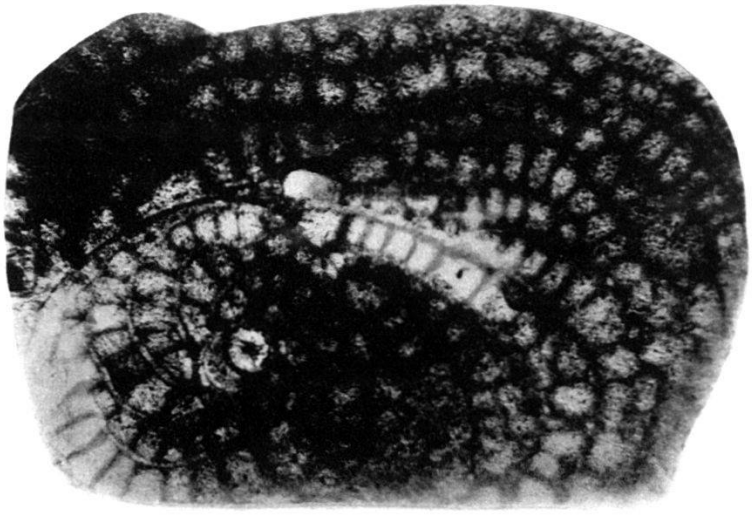
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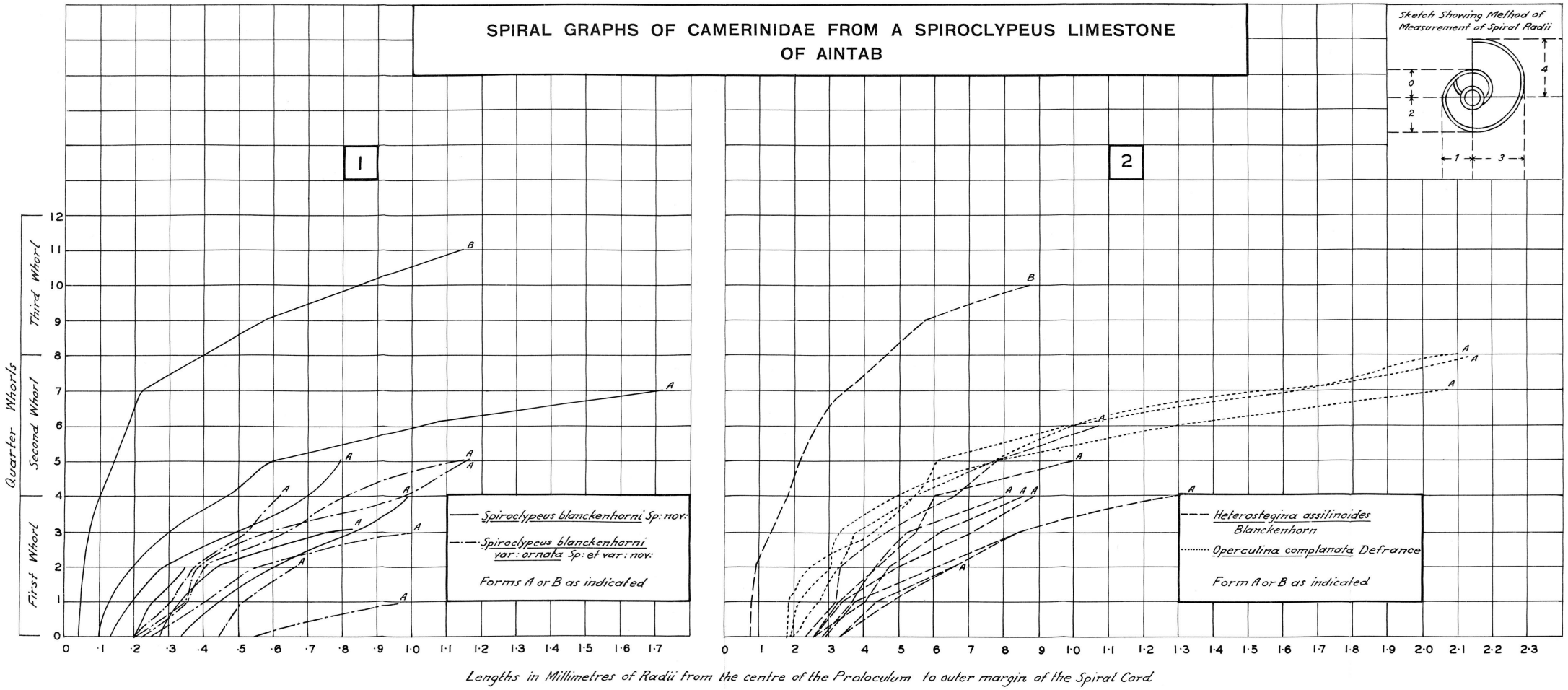
Birkhæuser, Basle, repr.


SPIRAL GRAPHS OF CAMERINIDAE FROM A SPIROCLYPEUS LIMESTONE OF AINTAB
Sketch Showing Method of Measurement of Spiral Radii
0
2
4
1
3
1
2
Quarter Whorls
First Whorl
Second Whorl
Third Whorl
Spiroclypeus blanckenhorni Sp: nov:
Spiroclypeus blanckenhorni var: ornata Sp: et var: nov:
Forms A or B as indicated
Heterostegina assilinoides Blanckenhorn
Operculina complanata Defrance
Form A or B as indicated
Lengths in Millimetres of Radii from the centre of the Proloculum to outer margin of the Spiral Cord