Analysis of pseudorbitoids from Glenbrook, Jamaica, and discussion of a study by Cole & Applin (1970)

J. P. Krijnen

Krijnen, J. P. Analysis of pseudorbitoids from Glenbrook, Jamaica, and discussion of a study by Cole & Applin (1970). – Scripta Geol., 4: 1-15, 2 pls., Leiden, December, 1971.

Pseudorbitoid foraminifera from Glenbrook area, Jamaica, are analysed and identified as *Pseudorbitoides trechmanni trechmanni* Douvillé, 1922 in sample J 4044, and as *P. trechmanni trechmanni* or *P. israelskyi* Vaughan & Cole, 1932 in sample J 4043.
The present author disagrees with Cole & Applin's conclusions concerning the arrangement of juvenile chambers in *P. trechmanni trechmanni* and is of the opinion that their definition of this form has to be withdrawn. He favours Brönnimann's principles of subdividing *Pseudorbitoides* (1954-1958) on the basis of stages of nepionic reduction, resulting in a distinction of species according 1) to a shift in the distribution of the number of primary chambers in exclusively uniserial populations, and 2) to a transition in the arrangement of juvenile chambers from uniserial to quadriserial in advanced populations.

Jan P. Krijnen, Rijksmuseum van Geologie en Mineralogie, Hooglandse Kerkgracht 17, Leiden, The Netherlands.

Introduction

From a study of topotype material of *Pseudorbitoides trechmanni trechmanni* Douvillé, 1922 – for the establishment of the subspecies *P. trechmanni pectinata* see Krijnen, 1972 – the author is convinced that some conclusions concerning the arrangement of juvenile chambers published by Cole and Applin (1970) should be rejected. Hence, apart from giving a systematic description of pseudorbitoids from the area of Glenbrook, Jamaica, this article aims at rectifying their considerations and reestablishing the evolutionary model as given by Brönnimann (1955a).

A restudy of Jamaican pseudorbitoid foraminifera (Krijnen, 1972) has shown that the juvenarium in megalospheric forms of members of the subfamily Pseudorbitoidinae Rutten, 1935 has undergone a phylogenetic development which modified the original uniserial juvenarium progressively into a biserial, a triserial and finally a quadriserial one. It is concluded that the introduction and a subsequent deuterogenetic shift of the so-called retrovert aperture down to the deuteroconch, is responsible for this change in the arrangement of juvenile chambers. As a consequence the number of buddings prior to the first retrovert aperture (Mac Gillavry, 1963) may be used as an evolutionary parameter, and so may the total number of so-called primary chambers (Krijnen, 1972). In view of the phylogenetic behaviour of the entire juvenarium, the total number of (uni-apertural + bi-apertural) primary chambers has proved to be a more satisfactory parameter than the number of uni-apertural primary chambers alone. This is in accordance with the following definition: the primary chambers are the chambers which constitute the initial spiral of chambers around the protoconch – protoconch, deuteroconch and (first) principal auxiliary chamber included – up to the ontogenetic appearance of the first symmetrical (= secondary) chamber which terminates the initial spiral, or, what is considered analogous in primitive uniserial forms, up to that point in the ontogeny where the initial spiral is cut off by radial elements protruding from earlier primary chambers.

In megalospheric forms of populations from the Green Island and Sunderland Inlier, generally a continuous reduction of the number of primary chambers (Y) is noticed, accompanied by an increasing diameter of the protoconch (P). It should be mentioned that at an advanced evolutionary stage, the Y-value becomes approximately stationary, while the P-value decreases suddenly. However, both values are subjected to a more or less continuous shift in less advanced populations, *P. trechmanni trechmanni* included. As a result I would propose drawing a distinction between phylogenetic levels in megalospheric forms on the basis of the Y- and P-values. For the time being a subdivision of the genus *Pseudorbitoides* into species is based, in accordance with Brönnimann, on the number of primary chambers – in exclusively uniserial populations – and on the arrangement of juvenile chambers, in advanced populations. Regarding Cole & Applin's figured specimens of *Vaughanina cubensis,* attention should be paid to a revised differentiation between *Vaughanina* and *Pseudorbitoides* (see Krijnen, 1972). As suggested by Mac Gillavry (1963) and confirmed by the present author, the equatorial layer in all members of the family Pseudorbitoididae Rutten, 1935 consists of true secondary chambers which become annular in a post-juvenile phase in *Vaughanina, Aktinorbitoides* and *Ctenorbitoides,* but remain arcuate to truncated arcuate throughout the entire ontogenetic development of all species of *Pseudorbitoides* as well as the closely related forms *Sulcorbitoides, Historbitoides* and possibly *Rhabdorbitoides*.

A comparison of *P. trechmanni trechmanni* from Glenbrook with material from the type locality (Green Island, Jamaica) is based mainly on numerical data. A compilation of these data is given by the tables 1 to 3.

Table 1: Arrangement of juvenile chambers

	Number of specimens	
	sample J 3978 (type locality)	Sample J 4044
Uniserial	8	0
Biserial with 1 principal auxiliary chamber	11	4
Biserial with 2 principal auxiliary chambers	32	2
Triserial	30	1
Quadriserial	9	1

Table 2: Distribution of the Y-values

Y-values	Number of specimens	
	sample J 3978 (type locality)	Sample J 4044
5	31	2
6	49	3
7	5	4
8	8	
9	6	
10	2	
11	1	
12	1	
13	1	

$Y_{J\ 3978} = 6.34$; $Y_{J\ 4044} = 6.22$

Table 3: Distribution of the P-values

Class-intervals (× .96 micron)	Number of specimens	
	sample J 3978 (type locality)	Sample J 4044
179.5 - 199.5	1	0
159.5 - 179.5	1	1
139.5 - 159.5	7	0
119.5 - 139.5	20	1
99.5 - 119.5	45	4
79.5 - 99.5	27	4
59.5 - 79.5	12	1
39.5 - 59.5	10	0

$P_{J\ 3978} = 102.15$ (× .96 micron); $P_{J\ 4044} = 98.27$ (× .96 micron)

Discussion

According to Cole and Applin, *Historbitoides* Brönnimann and *Pseudorbitella* Hanzawa (= *Lepidorbitoides nortoni* (Vaughan) – Cole, 1941, not *Orbitocyclina nortoni* Vaughan, 1929) are synonyms of *Pseudorbitoides* Douvillé. With respect to *Historbitoides* the author is inclined to share their opinion because of the occurrence of historbitoid-like radial elements in his topotype material of *Pseudorbitoides trechmanni trechmanni.* As to *Pseudorbitella,* the same may be said because many horizontal sections of the topotype material of *Pseudorbitoides trechmanni trechmanni* strongly resemble *Pseudorbitella* as well as *Lepidorbitoides nortoni* in the structure of the post-juvenile equatorial layer.

However, in Cole & Applin's subdivision the proposed corrections of Brönnimann's definition of *P. trechmanni* (= *P. trechmanni trechmanni* below) and *P. rutteni,* based on assumptions concerning the nature of the juvenarium, proved to be erroneous. Cole and Applin state that the juvenarium in megalospheric forms of these species is uniserial, with one principal auxiliary chamber, whereas from Brönnimann's and the present author's observations on topotype material of *P. trechmanni trechmanni* the conclusion is warranted that a second principal auxiliary chamber has developed in most of the specimens. Thus, in our material from Green Island only 19 specimens show a juvenarium with one principal auxiliary chamber, while in 71 specimens two principal auxiliary chambers are present (with 9 quadriserial individuals showing two peri-embryonic chamber spirals issuing from each principal auxiliary chamber).

Cole & Applin's definition of *P. trechmanni trechmanni* certainly does not agree with these observations and, accordingly, should be withdrawn. Instead I would propose the following tentative definition of *P. trechmanni trechmanni, P. israelskyi* and *P. rutteni,* as based on Brönnimann's data (1957, 1958):

P. israelskyi: a species in which the juvenarium, in the entire population, contains one principal auxiliary chamber, and ranges from uniserial to biserial in chamber arrangement. The total number of primary chambers ranges from 13 to 8.

P. trechmanni trechmanni: in this species the juvenarium, in the entire population, contains one or two principal auxiliary chambers, and ranges from uniserial to quadriserial in chamber arrangement (occasionally from uniserial to triserial, or from biserial to quadriserial). The total number of primary chambers ranges from 13 to 4.

P. rutteni: the juvenarium of this species, in the entire population, always contains two principal auxiliary chambers, and is exclusively quadriserial in chamber arrangement.

It will be clear that the distinction between the above-mentioned species can hardly be drawn at all without investigating a sufficiently large number of specimens from which the population parameters can be estimated with reasonable accuracy. Population parameters can not be obtained from Cole & Applin's figures because of an insufficient number of specimens shown. Therefore their assignment of figured specimens to *P. trechmanni* (Cole & Applin's Plate 15, figures 4, 6, 8, 9 and Plate 16, figures 2, 3, 6, 7) and *P. israelskyi* (ibid., Plate 14, figure 5) should be considered doubtful. On account of the biserial juvenarium occurring in these forms – one prominent protoconchal spiral of primary chambers and a small deuteroconchal contraspiral issuing from the third primary chamber – it is now concluded that all of the figured specimens mentioned above should be referred to the evolutionary range *P. israelskyi* – *P. trechmanni trechmanni* (and thus to either *P. israelskyi* or *P. trechmanni trechmanni*), but that their ultimate identification with *P. israelskyi* seems the more likely statistically.

Cole & Applin determined several forms with long spiraled juvenaria (their Plate 10, figure 9; Plate 12, figures 9, 11, 12; Plate 13, figure 9; Plate 17, figure 4) as *Sulcorbitoides pardoi* Brönnimann. However, whether we are dealing in this case with *S. pardoi* or *Pseudorbitoides curacaoensis* Krijnen, has not been definitely established.

Furthermore, the present author disagrees with Cole & Applin's identification of the forms illustrated on their Plate 13, figures 5, 7 and 10 as *Vaughanina cubensis* Palmer, particularly so with reference to figures 5 and 10, in which the annular shape of the secondary chambers – diagnostic for the genus *Vaughanina* – is definitely absent. Instead, arcuate to truncated arcuate secondary chambers are faintly visible. For this reason these specimens are determined by the author as megalospheric forms of either *Sulcorbitoides pardoi* or *Pseudorbitoides curacaoensis*. Plate 13, figure 7 apparently show annular structures, but this photograph does not show conclusively whether we are dealing with true annular secondary chambers (in which case it would be correct to refer to *Vaughanina*), or with annularly arranged truncated arcurate secondary chambers, in which case we would be dealing with *Sulcorbitoides pardoi* (or *Pseudorbitoides curacaoensis*) or with the slightly more advanced *Pseudorbitoides chubbi*.

It should be mentioned that *Pseudorbitoides* (?) *chubbi* Brönnimann is here considered as a species of *Pseudorbitoides* because of the occurrence of radial plates in a comparable population encountered in Jamaica (sample J 3416; Krijnen, 1972). Moreover, *P. chubbi* is distinguished from *S. pardoi* and *P. curacaoensis* by its significantly smaller number of primary chambers.

During the examination of the Jamaican samples it transpired that the total number of primary chambers could be estimated from central vertical sections of the juvenarium, by counting the number of primary chambers cut. Central vertical sections across the test may thus enable recognition of a certain evolutionary range. This conclusion may be supported by the data shown in Table 4 (see below) which was compiled after counting the number of comparatively large initial chambers in various vertical sections, as well as considering the maximum and minimum number of large initial chambers which would be cut by all possible central sections of every type of juvenarium present in the samples.

Table 4

	total number of large primary chambers	number of large initial chambers visible in vertical sections
P. trechmanni trechmanni	13 - 2	3 - 1
P. israelskyi	13 - 8	4 - 3
P. chubbi	25 - 15	5 - 4
P. curacaoensis / *S. pardoi*	32 - 20	6 - 5

From this table it is concluded that the vertical sections figured by Cole & Applin (Plate 13, figures 6, 8; Plate 14, figures 1, 2, 4; Plate 15, figures 1, 3, 5, ?7) should

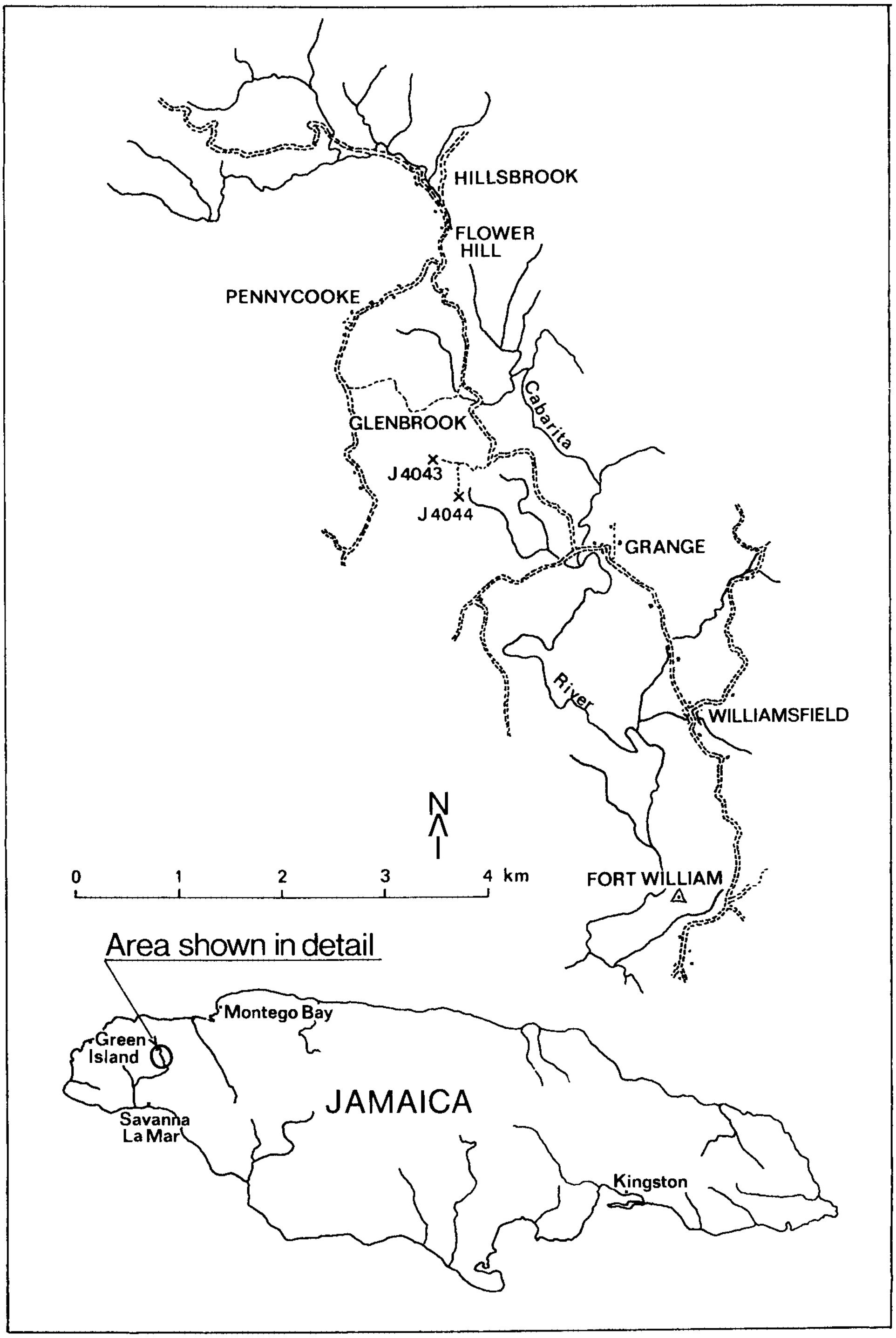


Fig. 1. Map of the Glenbrook area, showing the localities J 4044 and J 4043.

be identified with *P. israelskyi* or *P. trechmanni trechmanni* because they show two or three comparatively large initial chambers.

Systematic paleontology

Pseudorbitoides trechmanni trechmanni Douvillé, 1922
Plate 1, figs. 1-4; Plate 2, figs. 1-3; Tables 1-3.

1922 *Pseudorbitoides Trechmanni* nov. gen., nov. spec. – Douvillé, H., p. 204, fig. 1.
1941 *Lepidorbitoides (Lepidorbitoides) nortoni* (Vaughan). – Cole, W. S., p. 40, 41, pl. 12, figs. 1-8 (*not Orbitocyclina nortoni* Vaughan, 1929).
1955 *Pseudorbitoides trechmanni* Douvillé. – Brönnimann, P., p. 58, pls. 9, 10, text-figs. 1, 2-7.
1962 *Pseudorbitella americana* nov. gen., nov. sp. – Hanzawa, S., p. 149, pl. 7, figs. 1-4.
1972 *Pseudorbitoides trechmanni trechmanni* Douvillé. – Krijnen, J. P., pls. 5-9.

Locality, material – The accompanying map of the area near Glenbrook (textfig. 1) shows the location of sample J 4044 which contains an extremely fossiliferous fragmental limestone of Upper Cretaceous age with slightly rounded limestone fragments up to 30 cm in size embedded in a clayey matrix. Several of the limestone framents proved to be remains of rudists, mainly of the *Barrettia* branch (see Van Dommelen, 1971, pages 95 to 99), while the matrix turned out to yield a sufficient number of free specimens of pseudorbitoids to render a statistical study worth-while.

Description – Test lenticular, circular to sub-circular in outline, and orbitoid in structure, i.e. with an equatorial layer and adjacent layers of lateral chambers. Dimorphism is present and a rough differentiation between micro-and megalospheric forms based on the size of the test is possible. The megalospheric forms range from .50 to 1.25 mm in diameter, and from .20 to .70 mm in thickness. Microspheric forms seem to be larger, ranging from at least 1.90 to 3.15 mm in diameter, and from .85 to 1.10 mm in thickness.

Horizontal sections of megalospheric specimens show a usually well-defined juvenarium, with a biserial to quadriserial arrangement of the juvenile chambers, in which the first retrovert aperture is situated in either the third chamber (see Plate 1, figures 3a, 3b; Plate 2, figures 1a, 1b, 2a, 2b) or in the second (see Plate 1, figures 1a, 1b, 2a, 2b, 4a, 4b), in the latter case causing the formation of a second principal auxiliary chamber. The juvenarium is considered to be composed of primary and secondary chambers, the primary chamber spiral consisting of the protoconch, the deuteroconch, the (first) principal auxiliary chamber and the succeeding protoconchal spiral of 4 to 2 asymmetric primary chambers up to the appearance of the first symmetric (= secondary) chamber. Consequently, the total number of primary chambers consists of 7 to 5 chambers.

Surrounding the juvenarium, the equatorial layer appears to consist of arcuate to truncated arcuate secondary chambers arranged as for instance in *Orbitoides,* occasionally following a somewhat more radiate pattern. Radial elements, traversing the equatorial chambers, are usually difficult to observe.

One good horizontal section of a microspheric form is available, showing a juvenarium with 16 primary chambers (Plate 2, figures 3a and 3b). In this individual, radial elements are introduced in a late stage of the ontogenetic development, because a large zone around the juvenarium appears to be built up according to an 'orbitoid' pattern of secondary chambers which are not traversed by radial elements.

Finally, all measurements and counts on the specimens are given in the following table:

Table 5

Dm = diameter of the test in mm.
Th = thickness of the test in mm.
P = internal diameter (width) of the protoconch in standard units of .96 micron.
D = internal diameter (width) of the deuteroconch in standard units of .96 micron.
Y = total number of primary chambers.

Megalospheric forms:

spec. no.	Dm	Th	P	D	Y
2	.50	.20	104	104	6
15	1.25	.70	115	134	7
17	1.15	.50	98	108	7
19	1.15	.35	105	109	
23	.85	.40	104	99	5
24	.95	.40	170	164	6
27	.80	.35	68	70	7
28	.85	.45	99	119	
29	.75	.30	97	99	7
32	.65	.35	132	125	5
33	.50	.20	93	103	6

Microspheric forms:

spec. no.	Dm	Th	P	D	Y
3	3.15	1.10			16
6	1.90	.85			

Comparisons – Applying Wilcoxon's two-sample-test (5% level of significance) to the Y- and P-values of samples J 4044, Glenbrook, and J 3978, Green Island, no significant difference between them can be found. Moreover, individuals of both populations are characterised by similar types of juvenile chamber arrangements (see Table 1) and a similar aspect of the number (5 to 6) and position of the larger primary chambers. It is therefore considered that both populations belong to 1) approximately the same phylogenetical, and, accordingly, approximately the same stratigraphical level (Upper Campanian), and 2) the same taxonomic unit i.e. *Pseudorbitoides trechmanni trechmanni* Douvillé.

Pseudorbitoides israelskyi Vaughan & Cole, 1932, or *Pseudorbitoides trechmanni trechmanni* Douvillé, 1922
Plate 2, figs. 4-8.

Locality, material – From locality J 4043, a few hundred meters northwest of locality J 4044 (see textfig. 1), a large number of rudists were obtained which apparently had been gathered there by local people, some of the rudists propping up a small cottage, and a fair number being used as fire-bricks. Calcarenitic sediment attached to various rudists proved to contain pseudorbitoid foraminifera and specimens of *Sulcoperculina.*

Description – The individuals show the orbitoid structure of the test by the presence of a distinct equatorial layer with adjacent layers of lateral chambers. Pillars may be present in the umbonal region. Dimorphism occurs and the 4 megalospheric forms shown on Plate 2, figures 4-7 – ranging from .8 to 2.4 mm in diameter of the test and from .4 to .9 mm in thickness – differ slightly in size from the microspheric form (Plate 2, figure 8) which measures 2.9 mm in diameter and 1.3 mm in thickness of the test.

The juvenarium of the megalospheric forms is usually well visible and in the specimens shown three comparatively large juvenile chambers are cut vertically. Those adjacent to the protoconch usually show a more or less prominent sulcus.

In all specimens, the microspheric form included, radial elements are seen dividing the secondary chambers which constitute the post-juvenile equatorial layer. In Plate 2, figure 5 a radial element shows a median gap: immediately to the left of the juvenarium.

Remarks – Only vertical sections are available and from these the nature of the juvenarium has been inferred and the specific rank of the individuals correspondingly deduced. Of course only a rough assessment of the juvenile chamber arrangement could be made because the exact number of larger primary chambers – more or less diagnostic for the different species – cannot be determined in vertical sections, but at best a certain range in the number of these chambers (see Table 4). The number of large juvenile chambers cut in the specimens of sample J 4043 (3 in the individuals illustrated by Plate 2, figures 4, 5 and 6) definitely indicate that we are not dealing with exclusively quadriserial juvenaria. In that case one or two larger juvenile chambers would be cut vertically (compare the quadriserial examples in material from the *Barrettia* Limestone near Stapleton in the Sunderland Inlier, Krijnen, 1972; see also Tabel 4 above). Neither do we have to do with uniserial juvenaria like those in *P.* (?) *chubbi* (in which case at least four comparatively large juvenile chambers are visible in central vertical sections; see Bronnimann, 1958). Hence it is considered that the vertical sections of sample J 4043 represent a population with a phylogenetic stage intermediate between *P. chubbi* and exclusively quadriserial populations (*P. rutteni* ?). This would imply that the specimens considered here should be referred to either *P. israelskyi* or *P. trechmanni trechmanni* in the *Pseudorbitoides*-lineage which comprises *P. curacaoensis, P. chubbi, P. israelskyi, P. trechmanni trechmanni* (*P. trechmanni pectinata*) and possibly *P. rutteni,* in this order of succession.

Acknowledgements

I have had the benefit of advice and assistance from Prof. H. J. Mac Gillavry. The samples J 4044, J 4043 and J 3978 were collected in Jamaica in 1967 by him, Dr. H. van Dommelen and myself while doing fieldwork which was financed by the 'Koninklijke Shell Prijs' awarded to Prof. Mac Gillavry. I also wish to thank Dr. E. Robinson, Mr. H. R. Versey, Mr. L. J. Chubb and Mr. R. Wright for valuable information on field data, Mr. Versey furthermore for the loan of camping equipment, and Mr. D. H. Wozab for the use of Green Park House near Falmouth, Jamaica.

I am greatly indebted to 'Shelltankers N.V.' for transportation to and from Jamaica, and to Shell Jamaica, who took care of the shipment of rock samples to Amsterdam. Finally thanks are due to the technical staff of the Geological Institute of Amsterdam University for the able preparation of the thin-sections, and to the technical staff of the Rijksmuseum van Geologie en Mineralogie for making the photographs.

References

Brönnimann, P., 1954a. Upper Cretaceous Orbitoidal Foraminifera from Cuba, Part I: *Sulcorbitoides* nov. gen. – Contr. Cushman Found. Foram. Res., 5: 55-61.

——, 1954b. Upper Cretaceous Orbitoidal Foraminifera from Cuba, Part II· *Vaughanina* Palmer 1934. – Contr. Cushman Found. Foram. Res., 5: 91-105.

——, 1955a. Upper Cretaceous Orbitoidal Foraminifera from Cuba, Part III: *Pseudorbitoides* H. Douvillé, 1922. – Contr. Cushman Found. Foram. Res., 6: 57-76.

——, 1955b. Upper Cretaceous Orbitoidal Foraminifera from Cuba, Part IV: *Rhabdorbitoides* nov. gen. – Contr. Cushman Found. Foram. Res., 6: 97-104.

——, 1956. Upper Cretaceous Orbitoidal Foraminifera from Cuba, Part V: *Historbitoides* nov. gen. – Contr. Cushman Found. Foram. Res., 7: 60-66.

——, 1957. Morphology and stratigraphic significance of *Pseudorbitoides israelskyi* Vaughan & Cole. – Eclogae Geol. Helv., 50: 582-604.

——, 1958. New Pseudorbitoids from the Cretaceous of Guatemala, Texas and Florida. – Eclogae Geol. Helv., 51: 422-437.

——, 1958b. New Pseudorbitoididae from the Upper Cretaceous of Cuba, with remarks on encrusting Foraminifera. – Micropaleontology, 4, 2: 165-186.

Cole, W. S. & E. R. Applin, 1970. Analysis of some American Upper Cretaceous Larger Foraminifera. – Bull. Amer. Pal., 58, 258: 39-80.

Dommelen, H. van, 1971. Ontogenetic, Phylogenetic and Taxonomic Studies of the American Species of *Pseudovaccinites* and of *Torreites* and the Multiple-fold Hippuritids. – Thesis Amsterdam.

Douvillé, H., 1922. Orbitoides de la Jamaique: *Pseudorbitoides Trechmanni* nov. gen., nov. spec. – C. R. Soc. Géol. France: 203-204.

Glaessner, M. F., 1960. Upper Cretaceous Larger Foraminifera from New Guinea. – Sci. Repts. Tohuku Univ. Sendai, 2 (Geol.), Spec. Vol. 4 (Hanzawa Memorial Volume): 37-44.

Krijnen, J. P., 1967. Pseudorbitoid foraminifera from Curaçao. – Kon. Ned. Akad. Wetensch., Proc., B, 70, 2: 144-164.

——, 1972. Morphology and phylogeny of pseudorbitoid foraminifera from Jamaica and Curaçao, a revisional study. – Scripta Geol. (in the press).

Mac Gillavry, H. J., 1963. Phylomorphogenesis and Evolutionary Trends of Cretaceous Orbitoidal Foraminifera. – Van der Vlerk Anniversary Volume, Elsevier, Amsterdam.

Rutten, M. G., 1935. Larger Foraminifera of Northern Santa Clara Province, Cuba. – Jour. Paleont, 9, 6: 59-62.

——, 1941. A synopsis of the Orbitoididae. – Geologie en Mijnbouw, 3, 2: 34-62.

Tan, S. H., 1932. On the genus *Cycloclypeus* Carpenter, Part I. – Wetensch. Mededeel. Dienst Mijnbouw Ned. Indië, 19: 3-194.

——, 1939b. The results of phylomorphogenetic studies of some larger Foraminifera (a review). – Ingenieur Ned. Indië. 3 (IV): 93-97.

Vaughan, T. W., 1929a. *Actinosiphon semmesi* a new genus and species of orbitoidal Foraminifera, and *Pseudorbitoides trechmanni* H. Douvillé. – Jour. Paleont., 3, 2: 163-169.

——, 1929b. Species of *Orbitocyclina,* a genus of orbitoid Foraminifera from the Upper Cretaceous of Mexico and Louisiana. – Jour. Paleont., 3, 2: 170-175.

Wabeke, D. & C. van Eeden, 1965. Handleiding voor de toets van Wilcoxon. – Rapport S 176 (M 65), Mathematisch Centrum, Amsterdam.

Manuscript received 13 August 71.

Plate 1

Figs. 1-4: Central vertical sections of *Pseudorbitoides trechmanni trechmanni* Douvillé, 1922 from locality J 4044, Glenbrook, Jamaica (all figures 83 ×).

1a, 1b: Quadriserial megalospheric form. Specimen no. J 4044-24.

2a, 2b: Megalospheric form with two principal auxiliary chambers. Specimen no. J 4044-32.

3a, 3b: Biserial megalospheric form with one principal auxiliary chamber. Specimen no. J 4044-29.

4a, 4b: Biserial megalospheric form with two principal auxiliary chambers. Specimen no. J

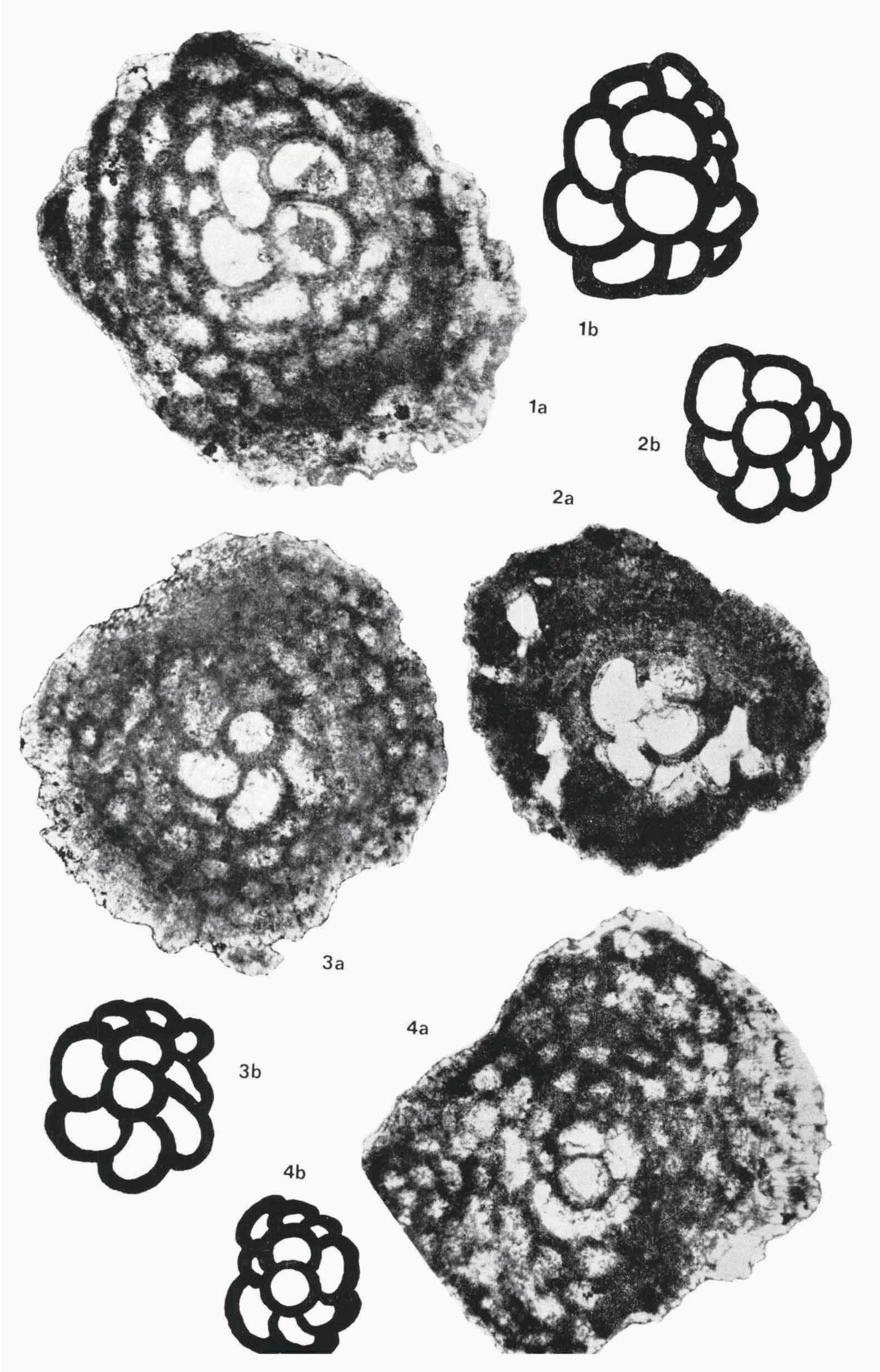

1a
1b
2a
2b
3a
3b
4a
4b

Plate 2

Figs. 1-3: Central horizontal sections of *Pseudorbitoides trechmanni trechmanni* Douvillé, 1922 from locality J 4044, Glenbrook, Jamaica (all figures 83 ×).

1a, 1b: Biserial megalospheric form with one principal auxiliary chamber. Specimen no. J 4044-27.

2a, 2b: Biserial megalospheric form with one principal auxiliary chamber. Specimen no. J 4044-17.

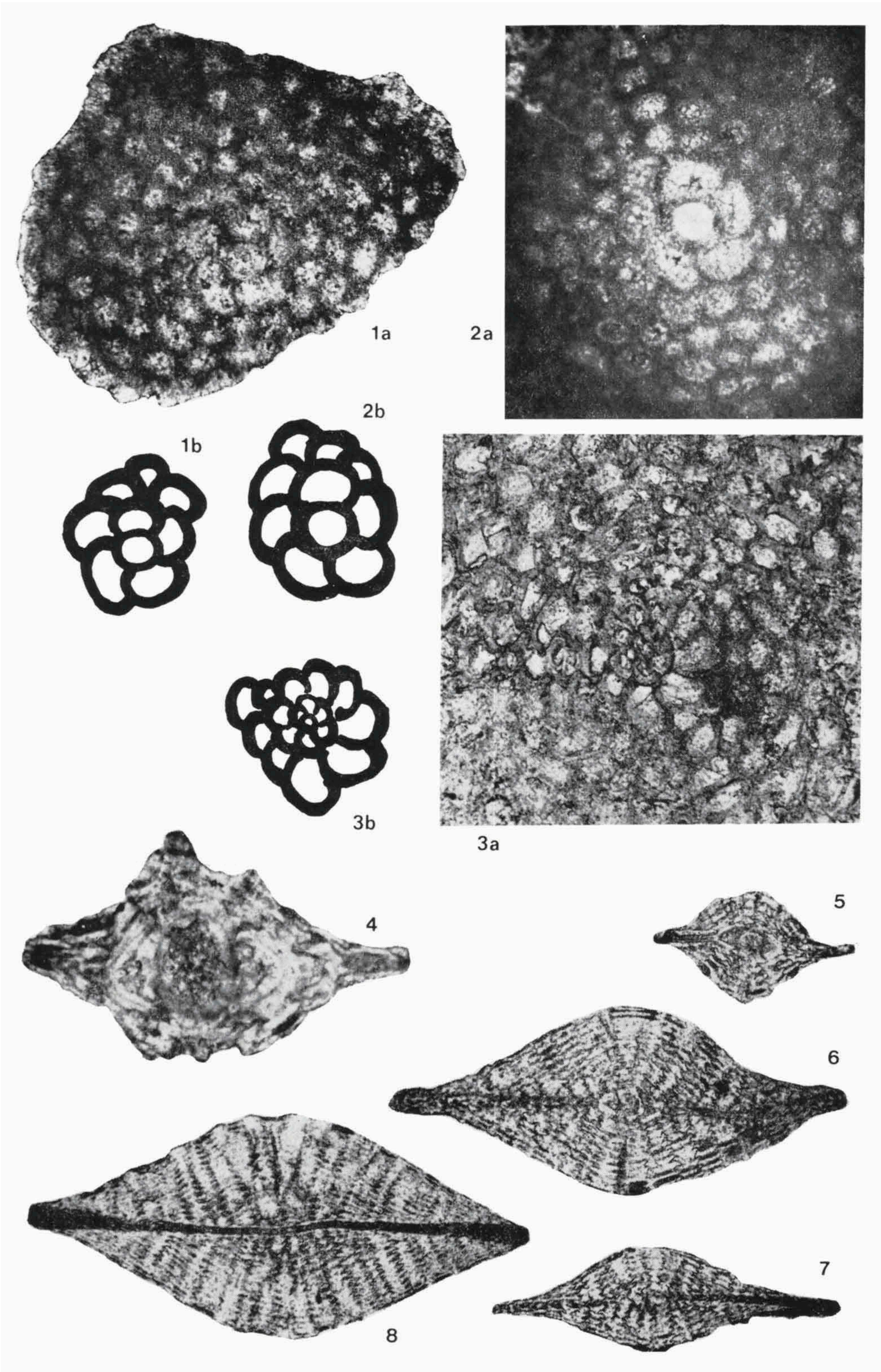
3a, 3b: Uniserial microspheric form. Specimen no. J 4044-3.

Figs. 4-8: Central or nearly central vertical sections of *Pseudorbitoides trechmanni trechmanni* Douvillé, 1922 or *Pseudorbitoides israelskyi* Vaughan & Cole, 1932 from locality J 4043, Glenbrook, Jamaica.

4: Central vertical section of a megalospheric form, showing three large juvenile chambers in cross-section. Thin-section no. J 4039-9 (80 ×).

5, 6, 7: Nearly central vertical sections of megalospheric forms, showing three large juvenile chambers. Figs. 5 and 6: thin-section no. J 4043-2 (32 ×); fig. 7: thin-section no. J 4043-1 (32 ×).

8: Almost central vertical section of a microspheric form. Thin-section no. J 4043-5 (32 ×).


1a
2a
1b
2b
3b
3a
4
5
6
7
8