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SUPPLEMENT TO
A MONOGRAPH OF THE TEREBRATULIDAE
OF THE BRITISH CHALK.

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SUPPLEMENT TO A MONOGRAPH OF THE TEREBRATULIDAE OF THE BRITISH CHALK¹

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ABSTRACT.—This paper embodies the results of examination of 335 British Chalk terebratulids collected zonally by the late Dr. A. W. Rowe, and placed at the author's disposal by the British Museum of Natural History. It supplements his earlier monograph on the subject (*Palaeontographical Society*, London, 1929).

Though the material contains only one new species and two new varieties, this important collection provides, by virtue of the extended vertical ranges now noted, additional data for emending the zonal distribution of the various species already described. Certain specific and, in a small measure, generic diagnoses have also been emended. The work confirms the author's earlier identifications, and suggests that wider morphological variation must be recognised for certain species than hitherto accepted.

INTRODUCTION

IN 1928 Dr. W. D. Lang, then Keeper of the Department of Geology, British Museum of Natural History, London, kindly entrusted to me for investigation a part of the late Dr. A. W. Rowe's valuable collection of British Chalk terebratulids. These had then been recently acquired by the Museum after the demise of Dr. Rowe who had spent many years on zonal studies of the British Chalk. Unfortunately, owing to preoccupation with my official duties, entailing field work in the remote areas of the Northern and Southern Shan States of Burma, and consequent absence from headquarters, it was found impossible to complete the study of these fossils despite uniform courtesy from the British Museum Trustees in renewing the loan more than once. The collection was, accordingly, returned to the British Museum. More recently on my return from the United States, I had occasion to spend a few days at the British Museum. As these fossils had remained uninvestigated, Dr. W. N. Edwards who succeeded Dr. Lang, again entrusted the collection to the author. The present paper is the result and supplements his "Monograph of the Terebratulidae of the British Chalk" (*Palaeontographical Society*, 1929) in which he gave a revised classification of species occurring in the British Chalk or related formations described upto date by Lamarck, D'Archiac, Sowerby, Davidson, Leymerie, Morris, Tate, Sahni (M. R.) and others.



M. R. Sahni

I am especially indebted to Dr. H. M. Muir-Wood, Deputy Keeper, British Museum of Natural History, who at considerable expense of her time prepared the collection for despatch to India.

While on a visit to the Geologisches Staatsinstitut, Hamburg, in November, 1956, I had the privilege of being shown by Prof. Earhardt Voigt the Chalk Terebratulid collection of the Institute. Prof. Voigt was good enough to present to the Geological Survey of India five specimens of a concinnithyrid Terebratulid collected by Mr. Gundolf Ernst of the Staatsinstitut. A description of these is given later. I take this opportunity of thanking Prof. Voigt and Mr. Gundolf Ernst for their courtesy.

I have to thank Mr. A. P. Tewari, Geological Survey of India, for assistance in arranging Plates, checking dimensions, registered and figure numbers and generally attending to the manuscript for the press.

MAIN CONCLUSIONS

Though the major part of the original collection of 335 brachiopods was composed of species already described by the aforementioned palaeontologists and the present

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author, the study of additional material has brought to light new data particularly in regard to range of variation, entailing emendations to some of the earlier diagnoses. This has necessitated placing certain species in synonymy with others which becomes inevitable when dealing with closely allied forms in profuse numbers.

Some of the more important conclusions are as follows :—

(i) By far and large, it was not found necessary to expose the internal characters of specimens for generic determination.

The diagnoses already given by the author (1925, 1925a, 1929) were found, except in one or two cases, adequate for such determination, while various other observations concerning internal characters such as muscle marks, brachidia and general classification were also confirmed, wherever available.

(ii) The vertical ranges of some of the species described have been more precisely defined. Thus, *Gibbithyris semiglobosa* (Sow.) hitherto known to occur in the *Rhynch. cuvieri* and *Holaster planus* zones has now been found in the *Micraster cor-testudinarium* and doubtfully also in the *Hol. subglobosus* zone. Its presumed occurrence in the Lower Chalk at Warminster (Holotype No. B 49904) is, however, still doubtful.

Concinnithyris albensis (Leymerie) already described from the *lata* zone is now also known from the *Mic. cor-testudinarium* zone.

(iii) Saeman and Triger (1861-62) examined different interpretations of the species *Anomia biplicata* Brocchi. It is concluded with them that Brocchi's species is probably identical with the Liassic *T. intendata* Sow.; also that, since this identification cannot be ascertained with sufficient accuracy, Sowerby's denomination for the Cretaceous form may be accepted.

The designation *Terebratula biplicata*, therefore, applies to the form described by Sowerby, not to Brocchi's *Anomia biplicata*. But it should be pointed out that under *T. biplicata* authors have described several polyphyletic species, some of which are probably closely allied to *Neolithyris obesa* Sahni. The author designates the original of the central figure in Plate 90 of Sowerby's *Mineral Conchology*, Vol. I as the lectotype. Thus, the controversy which has marked the interpretation of this well known species for over a century may now be considered closed.

(iv) True dwarfs have been given varietal names not so much from the biologic or systematic as stratigraphic point of view. The procedure is purely for convenience as cases are known where a dwarf characterises a particular zone, e.g., *Gibbithyris grandis*, var. *nana* and *G. ellipsoidalis* var. *quidhamptonensis* both from the *cor-angulum* Chalk of Quidhampton. They serve as local stratigraphic indices.

(v) The genus *Carneithyris* has still not been found in Chalk older than the zone of *Belemnitella mucronata* despite much additional material examined. The recti-marginate examples found in earlier horizons have almost invariably been found to belong to young stages of *Gibbithyris* or *Concinnithyris*. As confusion has occurred only too frequently and as internal characters are not always available, an examination of beak ridges is desirable and usually suffices for such separation—a smooth biplicate shell with well incurved beak but with poorly defined epithyrid beak ridges, and a small foramen being as a rule, characteristic of *Gibbithyris*.

In *Carneithyris* the position is somewhat complicated by the considerable thickness of the *B. mucronata* zone to which the genus is confined. Were it possible to collect large numbers of specimens at regular intervals of say, six inches or a foot in stratigraphic sequence, the pattern of external and internal variation would reveal itself.

The same is probably true of *Chatwinothyris* whose species exhibit fairly divergent internal characters but are otherwise often difficult to separate (Sahni, 1925). There is evidence that species with fused cardinalia (*Chatwinothyris*) are derived from those of *Carneithyris* by progressive modification of the cardinalia. In like manner, it is desirable to collect specimens of *Chatwinothyris* at short vertical intervals to determine how far its species represent orthogenetic evolutionary stages. In the corresponding type area in Denmark, species of *Chatwinothyris* appear to acquire ventral carination and dorsal sulcation, which is somewhat remarkable. Some of these may belong to a different stock and deserve close investigation.



Fig. 1
Concinnithyris

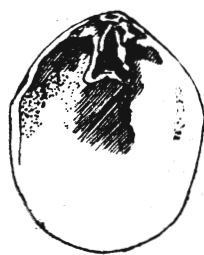


Fig. 2
Ornatothyris



Fig. 3

Chatwinothyris



Fig. 4



Fig. 5
Rectithyris



Fig. 6
Neolothyrina



Fig. 7

Carneithyris

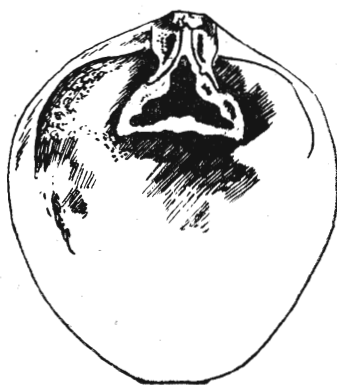


Fig. 8

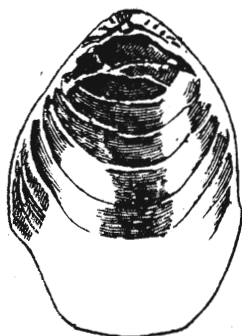


Fig. 9
Gibbithyris



(vi) Forms with fused cardinalia which characterise *Chatwinothyris*, were known to be confined in England to the highest Chalk, namely, the *Ostrea lunata* zone of Trimmingham; examination of new material has not altered the position.

(vii) With the increasing number of specimens that come under observation, the progressive variation in different species is more accurately appreciated and evolutionary lines become increasingly clear. It follows, *ipso facto*, that the limits within which specific characters vary, are widened. In the case of the Chalk Terebratulæ, however, the position becomes complicated by the fact that the early stages of several species are remarkably similar in many cases.

Sufficient stress cannot, therefore, be laid upon these factors, for literature on the British Cretaceous brachiopods is replete with instances where such divergent stocks as gibbithyrid, concinnithyrid, neoliothyrid, and even chatwinothyrid have been confused with one another. Close observation, however, shows important external differences in beak, plication, deltidial plates or ornamentation. These are summarised for the principal genera in the accompanying text figures 1-9.

(viii) There is some evidence that similar forms have arisen by modification of the same or similar radicles at different intervals, somewhat after the pattern of *Ostrea* radicles giving rise to the *Gryphaeae* in Jurassic times. (see p. 19). This has been discussed in detail under *Ornatothyris* in which rugation appears to have arisen independently at different intervals probably owing to repetition of similar environment or other physical causes.

(ix) The author had opportunities of making detailed comparisons of European species with those from the Indian Cretaceous described by Forbes (1846) Stoliczka (1872) and to examine their affinities in the light of their remarks. Detailed observations on these are not made here but will be found in the author's monograph on the Indian Cretaceous species, in the Press; (*Pal. Ind. N.S. Vol. X*; vide also summary including brief diagnoses in *Journ. Pal. Soc. India*, Vol. 2).

Systematic description of the species investigated now follows:—

SYSTEMATIC DESCRIPTION

Family TEREBRATULIDAE Gray

Subfamily GRYPHINAE Sahni 1929

GENUS CONCINNITHYRIS Sahni

Except for the fact that the new collections investigated extend the range of the genus, no new observations are required.

CONCINNITHYRIS SUBUNDATA (Sowerby)

Plate 1, figs. 1-7

1813, *Terebratula subundata* J. Sowerby; *Min. Conch.*, Vol. 1, p. 47, pl. 15, fig. 7.

1929, *Concinnithyris subundata* (J. Sowerby); Sahni, Monogr. Brit. Chalk Terebratulidae, *Palaeontogr. Soc.*, p. 17, pl. 1, figs. 10-17, pl. 8, figs. 11, 12.

Several beautifully preserved specimens are referred to *C. subundata* (Sow.). The variation in shape has already been illustrated (Sahni, 1929, Pl. 1, figs. 10-17). Additional specimens are figured here to show further variation, and presence of labiation in the foramen (Pl. 1, fig. 2a).

In the present collection there are several smaller specimens (Pl. 1, figs. 3-7) which Rowe identified as *Terebratula carnea* Sowerby. But closer examination reveals that they can be safely referred to *Concinnithyris* and are probably young stages of the Sowerbyan species *C. subundata*. When their uniplication is somewhat advanced (as may be

seen in stray examples) they are strongly reminiscent of *C. albensis* (Leymerie). Indeed it is possible that both *C. subundata* and *C. albensis* had a common origin in some such radicle, the former remaining near to it, the latter becoming more strongly uniplicate and inflated, while yet retaining its smaller dimensions.

*Dimensions in millimeters*¹

Regd. No.	..	..	BV.	L.	B.	T.
B 51464	..	..	32	37	29.3	20
B 51467	..	..	32	36.2	32.2	20

Range.—Zone of *Holaster subglobosus*.

Figured specimens.—Nos. B 51464, B 51467 (adults) ; B 51484, B 51486-88 and B 51491 (young stages).

Locality of figured specimens.—Two adult specimens from West Cliffs, Dover, others from Norwich.

CONCINNITHYRIS ? sp. indet.

Plate I, fig. 15

There are two specimens in the Rowe collection, one complete and the other with a broken beak, whose systematic position is in doubt. The complete specimen, No. B 51473, is unique in some respects, combining the characters of *Concinnithyris* and *Gibbithyris*. My reasons for assigning them provisionally to the former are : firstly, the shell (dealing only with the complete specimen) is identical in all respects with *Conn. protobesa* Sahni (1929, Pl. II, figs. 1-7) save only for its smaller size and pinhole type of foramen, the latter being characteristic of *Gibbithyris* ; secondly, the beak is massive for the size of the individual—the beak in *Gibbithyris* being quite small even in large forms like *G. grandis* (cf. Pl. III, figs. 1—6.) ; thirdly, the stratigraphic position favours *Concinnithyris*, though this need not really affect the issue.

It is true that uniplicate species of *Gibbithyris* are known, but when this is the case, the beak is never so massive. In other respects species of the two genera repeatedly simulate each other as homoeomorphs, and, unless caution is exercised, confusion is likely to occur. In some cases, like the present, knowledge of internal characters is necessary for precise identification. This cannot be attempted for want of sufficient material. For these reasons, I consider the present form to be indeterminate. One thing is certain that it is an adult, not the uniplicate stage of a biplicate species, for the sharply incurved and closely adpressed beak entirely precludes this possibility.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51473	..	..	18.5	22.1	17	14.5

Range.—Zone of *Holaster subglobosus*.

Figured specimen.—No. B 51473.

Locality.—West Cliffs, Dover.

TEREBRATULA (? CONCINNITHYRIS) ROWEI sp. nov.

Plate I, figs. 16-17.

Two specimens in the Rowe collection (Nos. B 51478 and B 51325) which possess distinctive characters cannot be assigned, to any of the known Cretaceous terebratulids. They are of small size, with massive beaks, large foramen and a fairly well-defined uniplicate stage. Evidence of biplication is unsatisfactory though one of the two

¹ The abbreviations BV. L. B. T. refer to length of brachial valve, length, breadth and thickness of the shell respectively.

specimens appears to show a slight depression anteriorly on the dorsal valve. The overhanging beak is noteworthy. I am unable to define the precise generic position of the species and have, therefore, placed it under the broad denomination "*Terebratula*". Its general aspect points towards the shorter uniplicate species of *Gibbithyris*, but the beak is different and the stratigraphic horizon militates against it though the point is not important. The species may with equal justification be referred to *Concinnithyris*. Rowe provisionally identified these specimens as *Tereb. biplicata* but this cannot be held valid on account of the difference in folding. Definite conclusions may be deferred till more material is available.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51325	..	..	11.2	13.2	11.6	8.5
B 51478	..	..	10 appr.	13 appr.	11	9.5

Diagnosis.—Shell small, moderately convex, pentagonal, uniplicate with slight tendency towards biplication; Beak epithyrid, massive, curved and more or less adpressed to the dorsal umbo; beak ridges not very distinct; foramen comparatively large, open below.

Brachial valve.—Internal characters not known; the valve slopes evenly on both side.

Pedicle valve.—Interior unknown; maximum convexity falls close to the ventral umbo.

Remarks.—Resemblance with such forms as *T. robertoni* and allies may be pointed out. However, these probably belong to a totally different stock—that of *Rectithyris* Sahni as shown by their straight beaks, strong beak ridges and other characters not present in the form under review.

Range.—Chalk Marl; zones of *Ammonites varians* and *Holaster subglobosus*.

Holotype.—No. B 51325.

Paratype.—No. B 51478.

Locality.—Holotype from Folkestone; paratype from West Cliffs, Dover.

TEREBRATULA (? CONCINNITHYRIS) BIPLICATA (SOW.), Davidson var. *non*. Brocchi,

PLATE 1, figs, 8-14

1813, *Terebratula biplicata* Sow. *Mineral Conchology*, Vol. 1, pp. 201, pl. 90, figs. 1-5.

As pointed out by Stoliczka, there are few Cretaceous terebratulids that have caused so much confusion in nomenclature as the forms commonly described under *Terebratula biplicata*; Brocchi originally described a form from San Quirico, Italy, as *Anomia biplicata* and referred it to a Cretaceous horizon. The interpretations of this species were so varied that Saemann and Triger (1861-62), made it their special concern to visit the type locality and different geological museums in Italy to examine the specimens figured by Brocchi, and other material. The result of their labours (I need hardly go into details) led them to the conclusion that *Anomia biplicata* Brocchi was not a Cretaceous species at all, but Liassic. The error appears to have been due to an inadvertent mixing up of specimens from different horizons. In 1815, one year after the publication of Brocchi's work, Sowerby described a form under *Terebratula biplicata* from the Upper Greensand in the neighbourhood of Cambridge. According to Davidson (1853, p. 56) "these have generally been admitted to be the types of *T. biplicata*". Davidson and subsequently others have followed this interpretation, setting aside Brocchi's figures and description. In the present instance, however, this procedure has been fortunate, in view of Saemann and Triger's observations regarding Brocchi's *Anomia biplicata*. We therefore agree with Stoliczka (1872, p. 19) that "it appears most judicious to drop Brocchi's name altogether". Our specimen No. B 51318 represents a variety which

bears close resemblance to it but has a less massive beak and is not so strongly plicate (Pl. I, fig. 9). Nevertheless, it may be observed that *Terebratula biplicata* described by Stoliczka appears to be distinct from *T. biplicata* Sow. This point will, however, be discussed further in a paper dealing with the revision of the Indian Cretaceous terebratulidae recently completed by the author.

I have provisionally placed this species in the genus *Concinnithyris* but owing to the hardness of the chalk matrix it has not been possible to expose its internal characters, which leaves the generic position uncertain. The general character of the shell and presence of beak-ridges are suggestive of the genus *Neoliothyris* Sahni, so are the general characters of the species. The stratigraphic position of the species (only one form is known so far) militates against its reference to *Neoliothyris* (which has not been found in Great Britain in any horizon earlier than the zone of *Belemnitella mucronata*) but this factor cannot be considered decisive. Moreover, the biplication (the dorsal folds run almost half way up the shell) adds much to our difficulties. The species under reference occurs commonly in the Upper Greensand (Albian) Chalk Marl (Cenomanian) and there is a solitary example in the British Museum collection (B 51019), from the *Terebratulina lata* zone (Turonian) (Pl. I, fig. 14).

In our opinion, *T. carteri* Davidson (1852, p. 72, Pl. 8, fig. 3) is identical with *T. biplicata* except for the slightly greater curvature of its beak as compared with the Sowerbyan examples. The specimens figured come close to his *T. carteri*, except for the cardinal process shown in his fig. 7 which is definitely not of concinnithyrid pattern.

In view of the different and varied interpretations of the present species, an emended description may be given, the generic position being altogether doubtful.

Shell variable, elongate-ovate, sub-pentagonal or oval in outline; beak small, permesothyrid, slightly curved over but not closely adpressed to the dorsal umbo; beak-ridges indistinct. Foramen large, circular or ovate, sometimes slightly labiate; symphytium well exposed. Morphogeny: biconvex rectimarginate to uniplicate to biplicate.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51318	..	..	32.5	37.5	27.5	20.4
B 51319	..	..	33.5	38	26.4	21.3
B 51321	..	..	32	36.2	27.3	18.3
B 51019	..	..	30.3	35.2	26.5	20.5

Lectotype.—See p. 2.

Figured specimens.—Nos. B 51318 to B 51322, B 51324 and B 51019.

Range.—U. Greensand, Chalk Marl and *lata* zone.

Locality.—Lectotype from Castle Hill, Cambridge; other figured specimens from Folkstone and Hollywell, Eastbourne.

CONCINNITHYRIS ALBENSIS (Leymerie)

Plate II, figs. 1-8

- 1841, *Terebratula albensis* var. *major* Leymerie, *Mem. Soc. Geol. France*, Vol. 4, pt. ii, p. 11; pl. 15, figs. 2a-c.
 1929, *Concinnithyris albensis* (Leymerie). Sahni, *Monogr. Brit. Chalk Terebratulidae*, *Paleontogr. Soc.*, p. 14, pl. 2, figs. 20-25, pl. 8, figs. 13-15.

About thirty specimens are referred to Leymerie's well-known species which occurs profusely in the *Rhynchonella cuvieri* zone. One specimen (Pl. II, fig. 6) in the present collection is from the *T. lata* zone. So far it has not been recorded from the *Holaster subglobosus* zone, though some of the younger stages of *Con. subundata* (Sow)

from this zone look remarkably like it, especially when they show (as occasionally happens) slight uniplication and greater thickness than one expects, proportionately to the other dimensions. Indeed at one time I was inclined to regard them as adults which would place them as forerunners of *C. albensis*.

A detailed description of the species was given in my 1929 monograph. The new material has not revealed any additional characters, except that the species is extremely variable.

One specimen from Pinhay to the Hooken, S. Devonshire, possesses a decidedly triangular aspect. It is slightly uniplicate, the maximum breadth falling at about one-third the distance from the anterior margin. The variety differs much in shape from other representatives of *Concinnithyris albensis*. It shows some resemblance with the form doubtfully referred by me to *Con. abrupta* (Tate, 1885) but in the present shell the maximum convexity is not so abrupt as in Tate's species which is, moreover, biplicate and of Cenomanian age.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
<i>T. lata</i> zone.						
B 50710	..	..	23	25.9	22.2	16
<i>R. cuvieri</i> zone						
B 51010	..	..	27	32.8	25.6	23
B 50943	..	..	24.4	30	24.2	21.5
B 50931	..	..	24.4	29.9	27.5	21.6
B 50681	..	..	16.5	19.5	16.2	10.2
B 50670	..	..	20.2	23	19 appr.	13.2
B 50671	..	..	22	25	20.2	13
B 50676	..	..	20	22.5	20	12
B 50949	..	..	26.4	29.5	25.5	19.5
B 50950	..	..	24.5	28.5	23	19
B 50953	..	..	24	27.4	23.5	19
B 50928	..	..	21.3	24.5	17	14.8
<i>Mic. cortest</i> zone.						
B 51024	..	..	27.5	31	37	20.8

Range.—Zones of *Rhynch. cuvieri*, *T. lata* and *Mic. cor-testudinarium*.

Figured specimens.—Nos. B 51010, B 50710, B 50943, B 50931, B 50676, B 50950, B 51024, B 50928

Localities.—Dover and Pinhay to the Hooken, S. Devonshire.

CONCINNITHYRIS ALBENSIS var. LATIFRONS (Leymerie)

Plate II, fig. 9

1841, *Terebratula albensis* var. *latifrons* Leymerie. *Mem. Soc. Geol. France*, Vol. 4, pt. 2, pl. 12, pl. 15.
 1929, *Concinnithyris latifrons* (Leymerie). Sahni. Monogr. British Chalk Terebratulidae. *Palaeontogr. Soc.*, p. 15, pl. 2, figs. 26-28, pl. 8, figs. 3.

In 1941 Leymerie described the variety *latifrons* which on account of its distinctive characters was raised to specific rank by the author. However, the large number of specimens showing progressive variation now examined suggests that the varietal name may be retained, though it is becoming increasingly doubtful whether some at least of the varietal names, unless supported by stratigraphic grounds, can be justified.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51013	..	..	22	26	21.5	20.5

Range.—Zone of *R. cuvieri*.

Figured specimen.—No. B 51013.

Locality.—Dover.

CONCINNITHYRIS ALBENSIS var. MINOR (Leymerie)

Plate II, fig. 10

1841, *Terebratula albensis* var. *minor*, Leymerie, *Mem. Soc. Geol. France*, Vol. 4, p. 2, pl. 12, pl. 15, fig. 3.

1929, *Concinnithyris albensis* var. *minor* (Leymerie). Sahni, *Monogr. Brit. Chalk Terebratulidae, Palaeontogr. Soc.*, p. 15, pl. 2, fig. 29.

Two specimens are referred to this variety. There is nothing to add to Leymerie's description which, as I have already remarked (Sahni, 1929) was based mainly on its comparatively diminutive size, the variety resembling *C. albensis* (Leymerie) in other respects. It is in fact doubtful if the varietal name can be maintained.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51011	..	..	23.2	26.6	21.6	19.2
B 51012	..	..	21	25.4	22.5	18.4

Range.—Zone of *R. cuvieri*.

Figured specimen.—No. B 51011.

Locality.—Dover.

CONCINNITHYRIS sp. indet, aff. ALBENSIS (Leymerie)

Plate V, figs. 14-17

Five specimens collected by Mr. Gundolf Ernst (*vide* introduction) 10.00 meters below the *Uintacrinus* zone near Hamburg clearly fall into two groups—a short, stout, subpentagonal variety and a more elongate, flattened, distinctly uniplicate form. There is no doubt that they should be assigned to *Concinnithyris* as both possess the typical characters of the genus but there is an element of uncertainty whether to regard them as variants of a single species or as two distinct forms. In both the short and elongate forms the maximum thickness falls much nearer to the dorsal umbo than in *albensis*. The shorter stout form resembles *Concinnithyris albensis* Leymerie, but it has a less defined plica and less incurved beak than Leymerie's species. Biologically, therefore, the German specimens are less advanced than typical *C. albensis*. Indeed, the larger oval form resembles the earlier stages of some of the more elongate varieties of *C. subundata* (Sow) from the zone of *Holaster subglobosus*. The flat oval form may also be compared with *C. albensis* var. *minor* described earlier (Pl. II, fig. 10). In the absence of sufficient material, the author refrains from giving it a new name. Its position 10 meters below the *Uintacrinus* zone may suggest the zone of *Mic. cor-anguinum* or even an older zone. The youngest horizon where *C. albensis* has been found in England is the *Mic. cor-testudinarium* zone, where it is rare, its commonest occurrence being in the *Rhynch. cuvieri* zone.

Range.—10. meters (approx. 30 ft.) below the *Uintacrinus* zone.

Figured specimen.—G. S. I. Type Nos. 17702 to 17705.

Locality.—Lagerdorf bei Elmshorn, near Hamburg, Germany.

CONCINNITHYRIS PROTOBESA Sahni

Plate II, figs. 11-19

1855, *Terebratulula semiglobosa* var. *albensis* Davidson, *Brit. Cret. Brach.*, Vol. 1, p. 67, pl. 8, figs. 15, 15a.

1929, *Concinnithyris protobesa* Sahni, *Monogr. Brit. Chalk Terebratulidae*, *Pal. Soc.*, pp. 13-14, pl. 2, figs. 1-7, pl. 8, fig. 4.

1929, *Concinnithyris burhamensis* Sahni, *Ibid.*, p. 16, pl. 2, figs. 1-7, pl. 8, figs. 22, 23.

In 1929 the author described two species of *Concinnithyris*—*C. protobesa* and *C. burhamensis*, the former from the *Rhynch. cuvieri* and the latter from the *Holaster subglobosus* zone. Their separation was based on the relative curvature of the beak which is more incurved in the geologically younger form with stronger uniplication. It was then remarked that "these characters suggest close genetic relationship between the two forms" (1929, p. 16). The excellent material now available (there are about twenty specimens) emphasises their affinity. Indeed the range of variation suggests that the two are synonymous.

The provenance of the species now includes the *subglobosus*, *cuvieri*, *lata* and *cor-testudinarium* zones. The single specimens from the last two zones (Pl. II, figs. 16 and 17, respectively) resemble those from the older horizon. On the whole, however, the plication becomes more pronounced in higher zones.

Another specimen from the *cuvieri* zone is identical with *C. protobesa* in all respects except for its much smaller dimensions. (Plate II, fig. 19)

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 50713	..	..	22	25.8	19.8	14.6
B 50769	..	..	19.1	21.6	17	15.5
B 50920	..	..	23	28.5	23.4	19.4
B 50923	..	..	24	27.5	21	17
B 50924	..	..	22.6	26.4	20.8	16.3
B 50925	..	..	26	29.5	23.5	19.5
B 50929	..	..	22 appr.	26 appr.	21	16
B 50930	..	..	25.4	30	27	19.5
B 50958	..	..	19	22.5	11 appr.	14.5

Range.—Zones of *Holaster subglobosus*, *Rhynch. cuvieri*, *T. lata* and *Mic. cor-testudinarium*.

Figured specimens.—Nos. B 50920, B 50923, B 50924, B 50929, B 50930, B 50958, B 51499, B 50713, B 50769.

Locality.—Dover and Pinhay to the Hooken, S. Devonshire.

GENUS GIBBITHYRIS Sahni

As in the case of *Concinnithyris* the study of the present material extends the stratigraphic range of *Gibbithyris*. No further observations are necessary.

GIBBITHYRIS GRANDIS Sahni

Plate III, figs. 1-5

1929, *Gibbithyrus grandis* Sahni. Monogr. British Chalk Terebratulidae. *Palaeontogr. Soc.*, p. 27, pl. 3, figs. 1-4, pl. 8, figs. 8-10.

This species is represented by several well preserved examples. Except for minor variations, all possess the essential characters of the species described in my 1929 monograph.

It is noteworthy that two specimens come from the *Holaster subglobosus* zone which now constitutes the earliest record of the species and *ipso facto* of the genus. So far *G. grandis* was known only from the *gracilis*, *lata* and *cor-testudinarium* zones (Sahni 1929). In the *subglobosus* zone, the species is associated with *Con. subundata* (Sow). On this evidence, as indeed on the evidence of *Gibbithyrus hibernica*, the possibility of *Gibbithyrus* being a derivative of *Concinnithyrus* stands excluded, though other factors—progressive curvature of the beak, accentuation of biplication, diminution of the foramen seen in *Gibbithyrus* point in that direction. The possibility of multiple origin has also to be considered. I am, however, not at all certain that the specimens from the *subglobosus* zone have been correctly labelled, for their colour and matrix is suggestive of a higher horizon.

At younger growth stages, the length and breadth are nearly equal, giving an almost circular outline. When this is combined with the rectimarginate condition, the early stages are likely to be easily confused with *Carneithyrus*. With growth, the length increases slightly in proportion to breadth.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 45589 (holotype)	..	..	36	108	100	79
B 51463	..	..	34.8	37.5	35.2	24.9
B 51466	..	..	38	41.2	40	26
B 50720	..	..	38	41	40	indet.
B 50721	..	..	38.5	41.3	?	21.6
B 50658	..	..	31.5 appr.	34.5 appr.	34.5 appr.	21

Range.—Zones of *H. subglobosus*, *T. lata*, *H. planus* and *Mic. cor-testudinarium*.

Figured specimens.—Nos. B 51463, B 51466, B 50720, B 50721 and B 50658.

Locality.—West Cliffs, Dover.

GIBBITHYRIS GRANDIS var. NANA, nov.

Plate III, fig. 6

A beautifully preserved specimen of a small terebratula from Quidhampton, Salisbury, possesses adult characters and is obviously a variety of *G. grandis*. For this the varietal name *nana* is proposed, its stratigraphic position being different to that of the species. Two other specimens associated with it are dwarfs of another species described later by the author (see p. 13). In a note accompanying these specimens, Dr. Rowe (who identified all three specimens as *Terebratula semiglobosa*) observes that they are common in the lower *cor-anguinum* zone of this area. They are, therefore, likely to be useful in identifying the *cor-anguinum* zone around Salisbury, and may have a more extensive distribution. The variety is identical in every respect with *G. grandis* (cf. Pl. III, figs. 1 and 2), and though diminutive, it shows the same morphogenetic characters, superposition of biplication on the rectimarginate stage which characterises *G. grandis*.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51022	..	..	10.1	11.5	10.8	8.2

Range.—Lower part of the zone of *Micraster cor-anguinum* around Quidhampton.

Figured specimen.—No. B 51022.

Locality.—Quidhampton, Salisbury.

GIBBITHYRIS MEDIA Sahni

Plate III, figs. 7-12

1929, *Gibbithyrus media* Sahni; Monogr. Brit. Chalk Terebratulidae, *Palaeontogr. Soc.*, p. 28, pl. 3, figs. 19-21, pl. 8, fig. 29, text-fig. 7.

The present collection contains several examples with typical characters of *G. media*. Some are figured to show the range of variation. Specimen No. B 50726 from the zone of *Holaster planus* is of larger size than is usually met with. Another (No. B 50641), provisionally included here on account of its beak, small foramen and slight dorsal inflation reminds one of the young stage of *G. albensis*, particularly on account of its smooth appearance and anterior commissure. However, the beak and biplication are Gibbithyrid in pattern.

The species has previously been recorded only from the *planus* zone, but this range has to be extended to include the *lata*, *cor-testudinarium* and *cor-anguinum* zones.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 50641	..	..	23	25.5	24	15
B 50647	..	..	22.8	24.8	24	19.5
B 50648	..	..	23	26	25	17.5
B 51495	..	..	19.5	21.2	19.2	16
B 50772	..	..	21	23	21.5	16
B 50904	..	..	22	25	23	17.8

Range.—Zones of *T. lata*, *Hol. planus*, *Mic. cor-testudinarium* and *Mic. cor-anguinum*.

Localities.—Dover, Luton and Chatham, Litcham, Borstal Manor pit and Tingleys pit.

GIBBITHYRIS ELLIPSOIDALIS Sahni

Plate IV, figs. 1-10

1955, *Terebratula semiglobosa* var. *bullata* Davidson (non *T. bulla* J. de C. Sow.), Mon. Brit. Cret. Brachiopoda, Vol. 1, pl. 8, figs. 11, 11a, 11b.

1929, *Gibbithyrus ellipsoidalis* Sahni, Mon. British Chalk Terebratulidae, *Palaeontogr. Soc.* p. 21-22, pl. 3, figs. 6-14; pl. 8, fig. 31, text-fig. 5.

1929, *Gibbithyrus pyramidalis* Sahni, Mon. British Chalk Terebratulidae, *Palaeontogr. Soc.*, p. 23, pl. 2, fig. 14-19, pl. 9, fig. 27.

Very little needs to be added to the previous description of this species; however, three specimens are now recorded from the zone of *Mic. cor-testudinarium*, which correspondingly extends its vertical distribution. The specimens from the lower zone are proportionately smaller and much more regular in shape, otherwise there is no difference between specimens from the two horizons. Examples from both are figured here.

In 1929 I separated the species *G. pyramidalis* from *G. ellipsoidalis* on account of its biplication, different dimensions and particularly because of the pyramidal shape of its

dorsal valve. On the material then available *G. ellipsoidalis* appeared to show biplication only as a senile character. In the excellent material now available there are certain specimens which are similar to *G. ellipsoidalis* but show slight biplication as in *G. pyramidalis*, suggesting that the two might be regarded as synonymous, even though in the shorter specimens the pyramidal character is often better defined than in the more elongate ones.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 50759	..	..	24	26	19.8	19.4
B 50795	..	..	27.5	30.5	26.5	21.5
B 50847	..	..	24.8	27	23.5	21.3 appr.
B 50852	..	..	24.8	27.5	22.5	21.2
B 50865	..	..	23.8	27	22.2	20.6
B 50826	..	..	30.5	34	31.5	22.5 appr.
B 50782	..	..	19.4	21.5	19.8	16.5
B 50789	..	..	Young specimen ?			

Range.—Zones of *Mic. cor-anguinum* and *Marsupites testudinarius*.

Figured specimens.—Nos. B 50791, B 50795, B 50847, B 50826, B 50848, B 51028, B 50884, B 50802, B 50852 and B 50865.

Locality.—Thanet coast, Northfleet and Dover.

GIBBITHYRIS ELLIPSOIDALIS var. QUIDHAMPTONENSIS, var. nov.

Plate IV, figs. 11-12

The variety is based on two dwarfs (Nos. B 51020 and B 51021) from the lower part of the *cor-anguinum* zone at Quidhampton. Except for their small size they possess the adult characters of *G. ellipsoidalis*, namely, an ellipsoidal shape, strong uniplication, small beak and a minute foramen. No further description is necessary.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51020	..	..	10.5	12.6	9.5	10

Range.—Lower part of the zone of *Mic. cor-anguinum*.

Figured specimens.—Nos. B 51020 and B 51021.

Locality.—Quidhampton, Salisbury.

GIBBITHYRIS GIBBA Sahni

Plate IV, figs. 13-14

1925, *Gibbithyrus gibba* Sahni, *Ann. Mag. Nat. Hist.* [9] Vol. XV p. 372, pl. 23, figs. 4a, 9 and pl. 24, figs. 3, 5a, pl. 25, figs 2, 2a, 2b.

1929, *Gibbithyrus gibba* Sahni, *Monogr. Palaeontogr. Soc.* p. 20, pl. II. figs. 33-35, Pl. VIII figs. 30.

There are several specimens from Northfleet and from the Thanet coast which are referred to *G. gibba*. Two exceptionally well-preserved adults from Northfleet well exhibit the characters of the species—inflation combined with strong uniplication. In its globose character the species strongly recalls the earlier stages of *G. semiglobosa*. That they are not its younger stages is suggested by the fact that all specimens come

from a much higher horizon, zone of *M. cor-anguinum*, and, secondly, they maintain their uniplicate character even at senility.

This species is closely allied to *G. ellipsoidalis* and differs from it mainly in its relative proportions. In *G. gibba* the breadth is almost equal to the length whereas in *G. ellipsoidalis* the length considerably exceeds the breadth.

The species has previously been recorded only from the *Micraster cor-anguinum* zone. In the present collection, likewise, all authentic specimens are from the same zone. However, one specimen No. B 50807 from the *Uintacrinus* band of Thanet may belong here. Terebratulids are notably rare in the *Uintacrinus* band of Thanet and if this identification were confirmed, it would correspondingly extend the range of the species.

Dimensions in millimeters

Regd. No.	..	..	B.V.	L.	B.	T.
B 50856	..	..	25.4	27.6	27.6	23.4
B 50841	..	..	24.6	27.6	25.3	21.2

Range.—Zone of *Mic. cor-anguinum* zone and *Uintacrinus* zone of Thanet.

Figured specimens.—Nos. 50481 and 50856.

Locality.—Northfleet (Kent) ; also the Thanet coast.

GIBBITHYRIS SUBROTUNDA (SOW.)

Plate IV, fig. 15

1813, *Terebratula subrotunda* J. Sowerby *Min. Conch.*, Vol. 1, tab. 15, figs. 1 and 2.

1855, *Terebratula semiglobosa* Sow, Davidson *pars*, *Brit. Cret. Brach.*, Vol. 1, p. 66, pl. 8, fig. 9.

1929, *Gibbithyris subrotunda* (Sahni), Monograph Terebratulidae of the British Chalk, *Palaeontogr. Soc.*, p. 23, pl. 4, figs. 8-15 and pl. 8 figs. 16-18.

Sowerby (1813) figured a non-plicate shell under the denomination *Terebratula subrotunda*. In 1929 the author drew attention to the fact that this was obviously the young stage of a somewhat globose biplicate form.

All the previously figured specimens come from zones of *Rhynchonella cuvieri* and *Holaster planus*. About half a dozen specimens from the *Mic. cor-anguinum* zone are now referred to *G. subrotunda* Sow, which thus extends its known vertical range. No new characters have been noticed in specimens from the higher horizon.

Dimensions in millimeters

Regd. No.	..	..	B.V.	L.	B.	T.
B 50857	..	..	24.3	26.2	26	20.1

Range.—Zones of *R. cuvieri*, *Hol. planus*, *Mic. cor-testudinarium* and *Mic. cor-anguinum*.

Locality.—Northfleet. The species is also recorded from Norfolk and Luton and Chatham.

GIBBITHYRIS SEMIGLOBOSA (J. SOWERBY)

Plate V, figs. 5-13

1813, *Terebratula semiglobosa* J. Sowerby ; *Min. Conch.*, Vol. 1, p. 48, tab. 15, fig. 9.

1929, *Gibbithyris semiglobosa* (J. Sowerby). Sahni, Monogr. Brit. Chalk Terebratulidae ; *Pal. Soc.*, p. 21, pl. 4, figs. 1-7, pl. 8, fig. 5.

There is little to add to existing descriptions of this well-known species. From the large number of specimens now available it is clear that the species is fairly variable. Its previous records are from the *Holaster planus* and *Rhynchonella cuvieri* zones. In

the present collection specimens from the *Terebratulina lata* and *Micraster cor-testudinarium* zones have been found which, therefore, considerably extends the vertical distribution of the species.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 50703	..	..	28.2	32	26.2	23.5
B 50707	..	..	27	30.2	23.5	appr. 20
B 50722	..	..	35	28.5	31.4	26
B 50724	..	..	29	32	27	22
B 50735	..	..	24.6	28.1	25	17
B 50901	..	..	24	27.9	22.4	19.6
B 50954	..	..	27	30.2	24.8	22.3

Range.—Zones of *R. cuvieri*, *T. lata*, *Hol. planus* and *Mic. cor-testudinarium*.

Figured specimens.—Nos. B 50703, B 50707, B 50722, B 50724, B 50735, B 50901, B 50954, B 50939 and B 50897.

Localities.—Dover, Pinhay to the Hooken, Luton and Chatham.

GENUS CHATWINOTHYRIS Sahni

The genus *Chatwinothyris* was erected for certain species in which, among other characters, the cardinalia were found to be more or less fused. The cardinal process in such forms becomes atrophied and its function is relegated, partly at any rate, to the fused cardinalia. In extreme cases the cardinal process becomes almost completely resorbed, e.g. in *Chatw. curiosa* Sahni from the *lunata* Chalk of England. In Great Britain, forms with fused cardinalia are not found in Chalk older than the *Ostrea lunata* zone but the genus occurs in the *Belemnitella mucronata* Chalk of the Isle of Rügen, Germany and in the Danian (Upper Chalk) of Denmark and Belgium. From its earlier occurrence in the German Cretaceous rocks, I previously suggested (1929) that the genus had migrated westwards from that region. Migration may also account for the sudden appearance of the (practically) non-plicate terebratulids at the base of the *mucronata* Chalk represented by the dominant genus *Carneithyris*, but here we are on a less sure footing for positive evidence is lacking.

CHATWINOTHYRIS SUBCARDINALIS Sahni

Plate V, figs. 1-4 and 4x

- 1925, *Chatwinothyris subcardinalis*, Sahni, *Ann. Mag. Nat. Hist.* (9), Vol. 15, p. 368, pl. 23, fig. 9, pl. 24, figs. 4-4a, pl. 26, figs. 4, 4a.
 1929, *Chatwinothyris subcardinalis* Sahni, *Monogr. Brit. Chalk Terebratulidae, Palaeontogr. Soc.*, p. 40, pl. 5, figs. 20-22, pl. 6, figs. 10-12, pl. 10, figs. 1-4.

In the present collection there are over fifty specimens which are referred to the species *C. subcardinalis* Sahni. The species is somewhat variable. Two specimens Nos. B 51046 and B 51049 are figured here, besides another showing internal characters (Pl. V, fig. 4x).

Specimen No. B 51049 resembles *Chat. gibbosa*, but the latter is narrow and relatively much more inflated. Externally the majority of specimens remind one of *Carneithyris*.

The cardinalia figured here belong to a comparatively young individual (specimen No. B 51060) which shows that resorption commences early. It would be of interest to study the cardinalia in a normal growth series to determinate the stage at which resorption commences, that is to say, the point at which the chatwinothyrid condition appears.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51049	..	..	26	29	24.1	17.2
B 51046	..	..	30	32.4	28.1	25.5

Range.—Zone of *Ortrea lunata*.

Figured specimens.—Nos. B 51046, B 51049, B 51058, B 51087 and B 51060.

Locality.—Trimingham, Norfolk.

GENUS CARNEITHYRIS Sahni

No further observations are necessary in regard to generic diagnosis.

CARNEITHYRIS GRACILIS Sahni, emend.

Plate VI, fig. 7

1925, *Pulchrithyris gracilis* Sahni, *Ann. Mag. Nat. Hist.* ((9), Vol. 15, p. 362, pl. 23, figs. 6, 6a, pl. 24, figs. 12, 12a.

1929, *Carneithyris gracilis* Sahni, *Monogr. Brit. Chalk. Terebratulidae*; *Pal. Soc.*, p. 36, pl. 5, figs. 26-29; p. 9, figs. 11-14.

There are seventeen specimens (Nos. B 51271-B 51273, B 51275-B 51287 and B 51492) which are identical in every respect with *Carneithyris gracilis*, Sahni as defined earlier, but differ from it in possessing incipient uniplication. However, since their internal characters are not adequately known they are provisionally assigned to *C. gracilis*.

It has been observed previously that occasional plication occurs in forms which are normally non-plicate. In the present case Rowe drew special attention to the plication which appears to be a normal character, none of the adults showing a plain anterior commissure. He remarks in a note accompanying the specimens. "In these examples the margin is broken by a slight but quite distinct plication, which is found in both the broad and elongate forms. These examples are notably rare. Davidson (p. 66) had evidently never seen them". Judging by their more advanced stage of development (as regards plication), these specimens may belong to a slightly higher stratigraphic level within the *mucronata* zone than those described earlier on which the species was founded (Sahni 1929). If exact stratigraphic positions of the various species and their progressive variations in the *mucronata* Chalk could be determined, it might be possible to further subdivide the *B. mucronata* zone on the basis of such vertical distribution or the stage of evolution attained by individual species, but that would entail very detailed work and careful collecting of material at different levels within the zone.

These specimens were first examined by me in the early thirties. They were not included in the collection sent in 1953, there was thus no opportunity to make a comparative study of internal characters of forms grouped under *C. gracilis*.

The emended diagnosis is given below :—

Diagnosis.—Shell oval, almost equally biconvex. Beak mesothyrid, slightly curved over the dorsal umbo; beak-ridges fairly distinct. Foramen small, circular, attrite, symphytium with transverse, rugosities. Morphogeny, biconvex rectimarginate to incipiently uniplicate.

Dimensions in millimeters

Regd. No.	..	..	BV.	L.	B.	T.
B 51273	..	..	34.6	39.1	32.5	26.6
B 51492	..	..	24 appr.	26 appr.	19 appr.	17
B 51285	..	..	25.8	28.5	23.1	18.2
B 51279	..	..	32	36	29.4	22.8

Range.—Zone of *B. mucronata*.

Figured specimen.—No. B 51492.

Locality.—Norwich.

CARNEITHYRIS CARNEA (J. Sowerby)

Plate VI, figs. 8-10

1813, *Terebratula carnea* J. Sowerby, *Min. Conch.*, Vol. 1, p. 47, tab. 105, fig. 5.1929, *Carneithyrus carnea* (J. Sowerby) Sahni, *Monogr. British Chalk Terebratulidae*; *Palaeontogr. Soc.*, pp. 31-32, pl. 4, fig. 34, pl. 9, figs. 25, 26.

In the entire collection consisting of 335 specimens there are only two which can be referred to *Carneithyrus carnea* Sowerby, *sensu stricto*. As previously remarked, this well known species is not common, unless a wide range of variation is accepted. The shell is subpentagonal with a sharp beak, terminated by a minute, pinhole type of foramen. Specimen No. 51289 is practically identical with one of Sowerby's, selected as Lectotype of the species by the author. The other specimen (No. B 51274) shows a slight uniplica and in that respect comes nearer to *C. subovalis*. However, as the internal characters are unknown, the position cannot be definitely ascertained. The cardinal process of *C. subovalis* Sahni (1925 Pl. fig.) it may be observed, is much smaller and more primitive than in *C. carnea*.

Dimensions in millimeters

Regd. No.	..	..	B V.	L.	B.	T.
B 51289	..	..	22.8	25.5	23.5	15
B 51274	..	..	35.8	39.5	32	21.8

Range.—Zone of *B. mucronata*.*Figured specimens*.—Nos. B 51289, B 51288 and B 51274 (cardinalia only).*Locality*.—Norwich.

"TEREBRATULA", gen. et sp. indet.

Plate VI, fig. 11

There is a single specimen—a well preserved brachial valve—with a puzzling combination of characters whose systematic position is difficult to determine. Externally the valve appears identical with the corresponding valve of such forms as *Carn. gracilis* or even *Chatw. gibbosa*. Its position in the *lunata* Chalk combined with such other characters as are available for examination would normally have suggested reference to *Chatwinothyris*. However, the cardinalia are unlike those of that genus, the cardinal process being on the gibbithyrid pattern. That the lamellar character of the cardinal process is not due to resorption of a boss-like process is clear from its well defined outline. However, it cannot be assigned to *Gibbithyris* or its allies in view of its hinge characters.

Pending examination of further material, the specimen may be left indeterminate.

Range.—Zone of *O. lunata*.*Figured specimen*.—No. B 51053.*Locality*.—Trimingham, Norfolk.

GENUS NEOLIOTHYRINA Sahni

The confusion which had arisen in the nomenclature of the species commonly referred to as *Terebratula obesa* was presumably due to the fact that the larger forms from the *macronata* Chalk were considered identical with the Sowerbyian species, (Davidson 1852) probably on account of its large size.

The complete absence of *N. obesa* Sahni in horizons older than *Bel. mucronata* lends further support to the view that Davidson's identification was misplaced. Other authors have also fallen into the same error and have advocated synonymy of the two forms. More recently J. Dort (*Bull. Soc. Geol. France* Series 6, Vol. III, 1953) has assigned a Cretaceous species from the Algerio-Tunisian border, to *Neoliothyria obesa* Sahni. Judging by the beak characters this form appears to belong to *Concinnithyris* Sahni. It is probably a new species closely allied to *C. obesa* (Sow.)

NEOLIOTHYRINA OBESA Sahni

Plate VI, figs. 1-4

1852, *Terebratula obesa* Davidson (non Sowerby). *Mon. Cret. Brach.*, Vol. 1, pp. 53-54, pl. 5, fig. 16.
 1925, *Neoliothyria obesa* Sahni. *Ann. Mag. Nat. Hist.*, Vol. 15, p. 376, pl. 23, fig. 10.
 1929, *Neoliothyria obesa* Sahni, Monogr. of the British Chalk Terebratulidae *Palaeontogr. Soc.*, p. 9, pl. 6, figs. 1-4, pl. 9, figs. 19-21, fig. 36.

There are four well preserved examples in the collection under review, which are referred to *N. obesa* Sahni. The species is variable in outline and may be oval, pentagonal to pentagonal-elongate. A young pentagonal specimen is strongly reminiscent of *Concinnithyris albensis* Laymerie. However, the beak and presence of well defined beak ridges establish its generic position beyond doubt.

The species has so far been known to be confined to the *Bel. mucronata* zone; this is confirmed by the present collection. The author is under the impression that he has seen in the British Museum externally similar forms from the Cenomanian, while Davidson (1952, Pl. V) has described a specimen from the U. Greensand (Albian) which he considers identical with Sowerby's *obesa*. As the latter is not available to me for examination, I am unable to confirm its identification. It is, however, more than likely that this specimen which is much more strongly biplicate than any of *N. obesa* I have met with, is a homoeomorph of our species.

The points of distinction between the two forms which have been frequently confused with each other may be summarised as follows :

Neoliothyria obesa Sahni

1. Beak ridges strong.
2. Foramen reformat.
3. Radial lineation well defined.

Concinnithyris obesa (Sowerby)

1. Beak ridges indistinct, epithyrid (normally not seen).
2. Foramen entire.
3. Radial lineation very subdued ; shells smooth.

Dimension in millimeters

Regd. No.	..	..	B V.	L.	B.	T.
B 51314	..	..	42	48.6	37.5	28

Range.—Zone of *B. mucronata*.

Figured specimen.—Nos. B 51312 to B 51315.

Locality.—Norwich.

GENUS ORNATOTHYRIS Sahni

Earlier I had emphasised (1929) that the stratigraphic distribution of the *Totirugate* and *Partirugate* species of *Ornatothyris* was somewhat unexpected, the former, though biologically more advanced, being confined to an earlier horizon—the *Hol. subglobosus* zone (Cenomanian)—and the latter less advanced ones, to the *Mic. cor-anguinum* zone (Senonian). In the present collection there are no *Partirugate* forms but the occurrence of the only known *totirugates* conforms with our previous knowledge, that is, from the *Hol. subglobosus* zone.

In respect of plication, species of *Ornatothyris* correspond with those of *Concinnithyris*. The similarity of their young stages particularly suggests such relationship, while their large foramen reminds one of *Neoliothyris*. The absence of beak ridges, however, precludes this relationship. Their stratigraphic distribution is moreover totally different, a gap covering several zones involving a considerable thickness of the British Chalk separating the Totirugate *Ornatothyris* from *Neoliothyris*.

The origin of the Partirugate group suggests two possibilities that they are either derived from the Totirugates by catagenesis or are an independent offshoot from some *Concinnithyris*-like form produced under similar conditions which brought about rugation of the species in the *Holaster subglobosus* zone. It is, in my opinion, unlikely that catagentic processes are involved in partial rugation and it seems more plausible that rugation was repeated due to repetition of similar environmental conditions in the two geological horizons. If so, the phenomenon would be similar to that which gave rise to *Gryphaea*-like forms from species of *Ostrea* at different geological horizons during the Jurassic.

ORNATOTHYRIS SULCIFERA (Morris)

Plate VI, figs. 5-6

1847, *Terebratula sulcifera* Morris and Davidson, *Ann. Mag. Nat. Hist.*, Vol. 20, p. 354, pl. 18, fig. 7.

1855, *Terebratula sulcifera* Morris and Davidson, *Brit. Cret. Brach.*, Vol. 1, p. 64, pl. 7, figs. 17-20.

1929, *Ornatothyris sulcifera* (Morris and Davidson) Sahni, *Monogr. Terebratulidae of the British Chalk*, *Palaeontogr. Soc.*, p. 48, pt. 7, figs. 1-10, pl. x, figs. 25-27.

Three specimens in the Rowe collection are referred to this well known species described by Morris and Davidson (1847). Two of these are figured here. *T. sulcifera* belongs to the Totirugate subdivision proposed by the author for those species of the *sulcifera* group in which rugation occurs on the entire shell.

Dimension in millimeters

Regd. No.	..	..	B V.	L.	B.	T.
B 51483	..	..	27.9	32.1	26.1	21.1

Range.—Zone of *H. subglobosus*.

Figured specimens.—Nos. B 51483 and B 51481.

Locality.—Cambridge.

ZONAL DISTRIBUTION

A study of the zonal distribution summarised in the Table accompanying this monograph is significant. Some of the points may be noted again as follows :—

- (1) The genus *Chatwinothyris* is confined in Great Britain to the *lunata* zone.
- (2) The genus *Carneithyris* is confined to the *cor-anguinum* zone.
- (3) The *quadratus* zone is poor in Terebratulids, for scarcely any form appears to have been obtained from this horizon.
- (4) By far, the larger number of species occurs between the *subglobosus* and *cor-anguinum* zones. However, in individuals the *mucronata* zone is very prolific.

For further details reference may be made to the zonal distribution Table. Broken lines indicate presumed or uncertain occurrences.

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EXPLANATION OF PLATE I

All figures are of natural size except where otherwise indicated.

FIGS. 1-7 *CONCINNITHYRIS SUBUNDATA* (Sowerby).

All specimens from *Hol. subglobosus* zone ; figs. 1-2 from West Cliffs, Dover ; figs. 3-7 from Norwich.

Fig. 1—Three views of an oval specimen, No. B 51464.

2—Similar views of another, somewhat broader form with slightly better defined uniplicate stage ; No. B 51467.

3-7—Different views of young specimens representing progressive growth stages, Nos. B 51484, B 51486, B 51487, B 51488 and B 51491, respectively.

FIGS. 8-14 *TEREBRATULA* (? *CONCINNITHYRIS*) *BIPLICATA* (Sow.), var., *non*. Brocchi.

All specimens from Chalk Marl, Folkestone, except No. B 51019 from *lata* zone, Hollywell, Eastbourne.

Fig. 8—A somewhat oval form showing fairly well-defined biplication, No. B 51319.

9—Three views of specimen No. B 51318.

10—A dorsally depressed form with less incurved beak, No. B 51321.

11-13—Young specimens indicating that degree of folding does not depend on age, Nos. B 51322, B 51320 and 51324, respectively.

14—Specimen No. B 51019 from *lata* zone (*cf.* fig. 9 above).

FIG. 15 *CONCINNITHYRIS*, sp. *indet.*

15—Dorsal, anterior and lateral views of specimen No. B 51473

FIGS. 16-17. *CONCINNITHYRIS ROWEI* sp. *nov.*

16-17—Three views of complete specimen No. B 51325 and of specimen B 51478, with damaged beak.

EXPLANATION OF PLATE II

All figures are of natural size except where otherwise indicated.

FIGS. 1-8 *CONCINNITHYRIS ALBENSIS* Leymerie.

All from *Rhynchonella cuvieri* zone, except No. B.50710, from *T. lata* zone and No. B 51024 from *Micraster cor-testudinarium* zone. Figs. 2-7—Different views of six specimens showing oval, subpentagonal, cuneate and other varieties with large well formed foramen.

Fig. 1—Three views of a typical example showing a massive beak and well formed unplica, No. B 51010, Dover.

2-4—Nos. B 50950 (Dover), B 50943 and B 50931, respectively.

5—From *cuvieri* zone ; No. B 50676.

6—No. B 50710, from *lata* zone, S. Devon.

7—Adult specimen No. B 51024, *cor-testudinarium* zone.

8—A triangular variety No. B 50928, *cuvieri* zone.

FIG. 9 *CONCINNITHYRIS ALBENSIS* var. *LATIFRONS* Leymerie.

9. Three views of specimen with highly inflated brachial valve, No. B 51013, *cuvieri* zone ; Dover.

FIG. 10 *CONCINNITHYRIS ALBENSIS* var. *MINOR* Leymerie.

10. Dorsal and anterior view of specimen No. 51011 ; *cuvieri* zone ; Dover.

FIGS. 11-19 *CONCINNITHYRIS PROTOBESA* Sahni.

All from *cuvieri* zone, except No. B 50713 from *lata* zone and No. B 50769 from *cortest* zone.

Fig.—11—Dorsal, anterior and lateral views of specimen No. B 50930 from *cuvieri* zone, Pinhay to the Hooken.

12—Specimen with a flat brachial valve, No. B 50920, Pinhay to the Hooken.

13-15—Different views of three specimens No. B 50929, B 50924, and B 50923, respectively from Pinhay to the Hooken.

16—From *lata* zone ; No. B 50713, S. Devon.

17—Specimen from *cor-testudinarium* zone, Dover, No. B 50769.

18—A laterally compressed form, No. B 50958, Dover.

19—Dorsal anterior and lateral views of a specimen of diminutive size No. B 51499 from *cuvieri* zone ; from Barret, Norfolk.

EXPLANATION OF PLATE III

FIGS. 1-5 GIBBITHYRIS GRANDIS Sahni.

Figs. 1-2—Dorsal anterior and lateral views of specimens No. B 51466 and No. (?) respectively, *subglobosus* zone ; West Cliffs, Dover.

3-5—Different views of specimens No. B 50720, B 50721 and B 50658, respectively ; *planus* zone ; fig. 5 represents a comparatively young stage ; all from Dover, Kent.

FIG. 6 GIBBITHYRIS GRANDIS var. NANA, var. nov.

6—Three views of No. B 51022, *cor-anguinum* zone of Quidhampton, Salisbury.
According to Rowe small forms are common at Quidhampton.

FIGS. 7-12 GIBBITHYRIS MEDIA Sahni.

Six specimens from different zones.

7—Three views of a typical example, No. B 50647 ; *lata* zone, Tingleys pit.

8—Specimen No. B 50648 from the same locality and zone.

9—A comparatively young specimen, No. B 50641 ; *planus* zone ; Borstal Manor pit, Rochester.

10—Two views of No. B 50722 ; *cor-testudinarium* zone ; Dover.

11—Another example from the *cor-testudinarium* zone, No. B 50904 ; Luton and Chatham.

12—Specimen No. B 51495, *cor-anguinum* zone ; Litcham, Norfolk.

13-18—Dorsal, anterior and lateral views of six specimens from the *cuvieri* zone.

19—Three views of a small example from the *cuvieri* zone.

EXPLANATION OF PLATE IV

FIGS. 1-10 GIBBITHYRIS ELLIPSOIDALIS Sahni.

All specimens from the *cor-anguinum* zone, except No. B 51028 from the *Marsupites* band of Thanet coast.

Figs. 1-4—Different views of specimens No. B 50852, B 50865, B 50847 and B 50826, respectively, showing range of variation; No. 50865 a somewhat narrow and No. B 50826 an exceptionally broad form; Northfleet, Kent.

5-9—Different views of specimens No. 50795, B 50848, B 50791, B 50884, respectively. Figs. 5 and 7 show a well defined pyramidal elevation; figs. 9-10, young specimens Nos. B 50802 and B 51028, the last from the *Marsupites* band, Thanet coast.

FIGS. 11-12 GIBBITHYRIS ELLIPSOIDALIS var. QUIDHAMPTONENSIS var. nov.

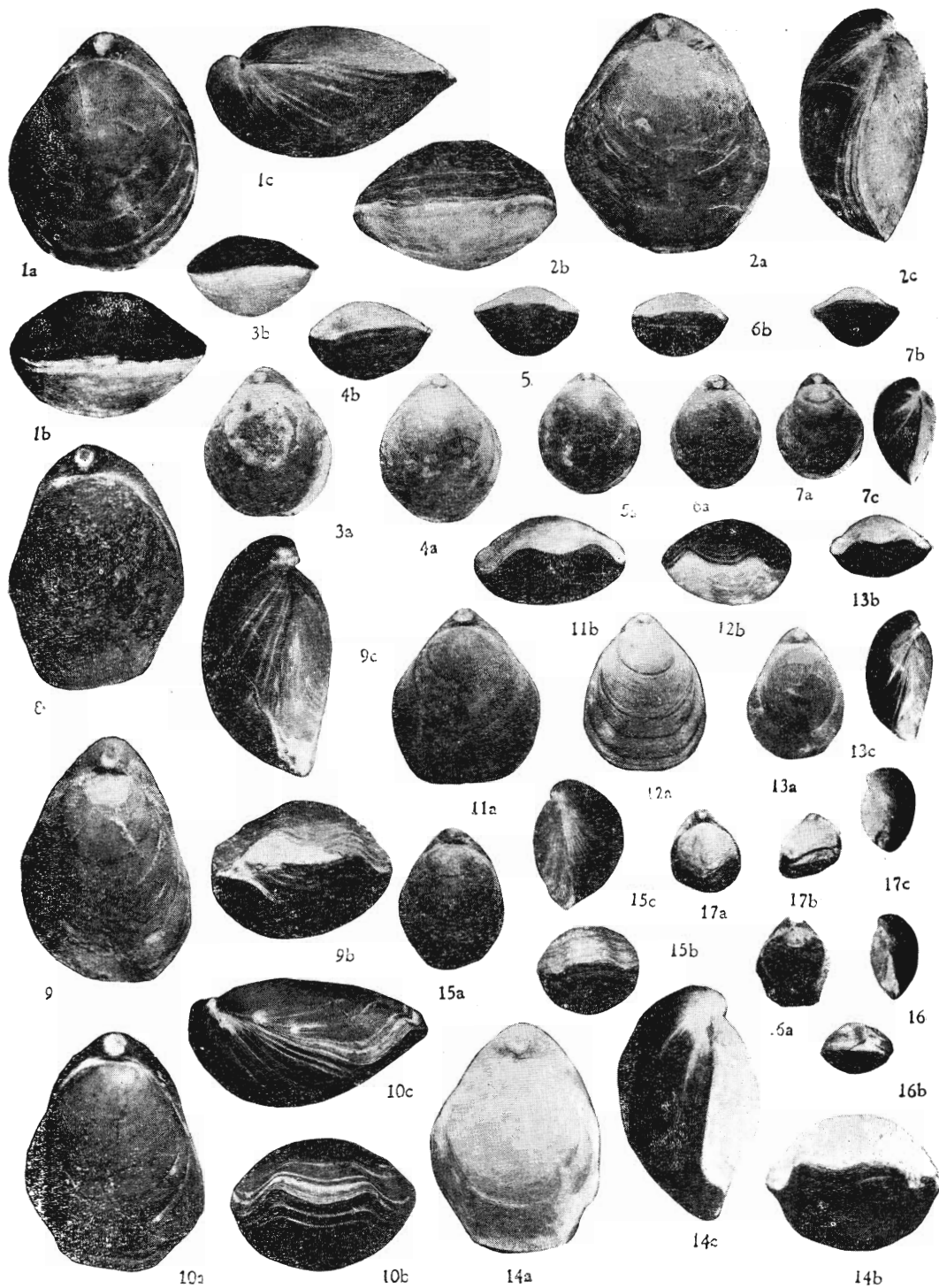
11-12—Dorsal, lateral and anterior views of two specimens showing well developed uniplication and conspicuous foramen; Nos. B 51020 and B 51021. From *cor-anguinum* zone of Quidhampton, Salisbury.

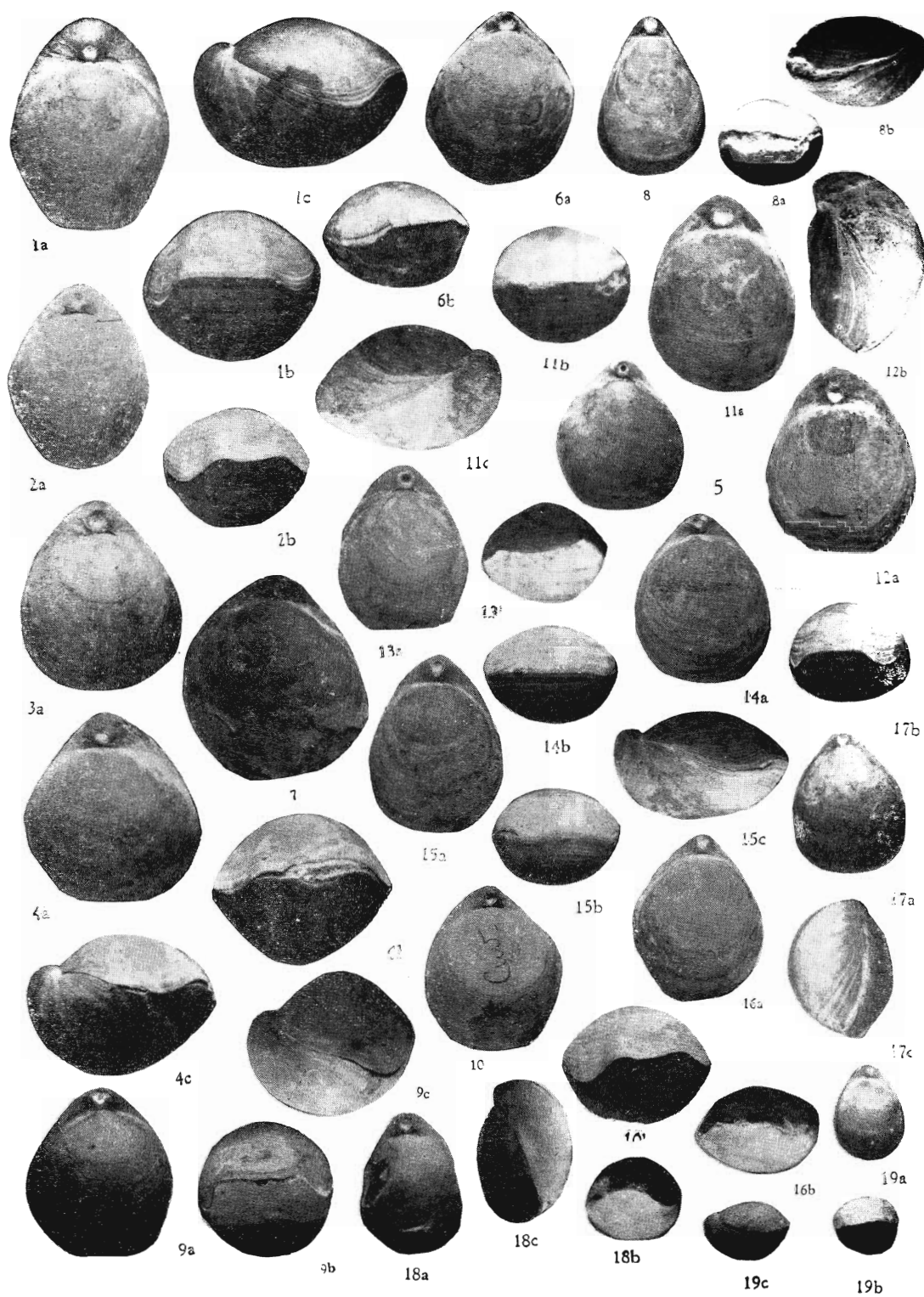
FIGS. 13-14 GIBBITHYRIS GIBBA Sahni.

13-14—Three views of specimens No. B 50841 and No. B 50856, respectively; fig. 14 shows a highly inflated individual; *cor-anguinum* zone; Northfleet.

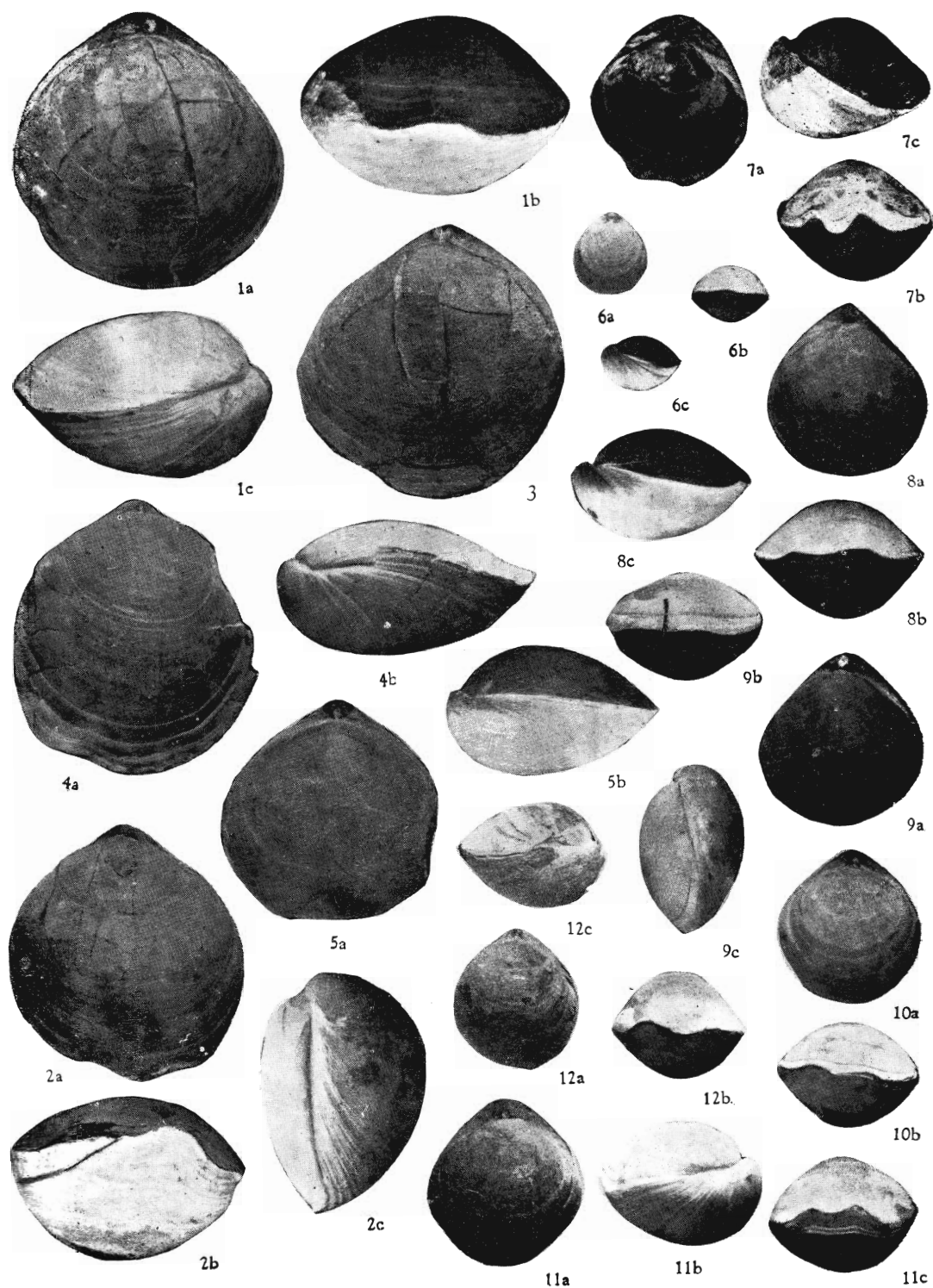
FIG. 15 GIBBITHYRIS SUBROTUNDA Sow.

15—Three views of a typical example No. B 50857, from *cor-anguinum* zone; Northfleet, Kent.



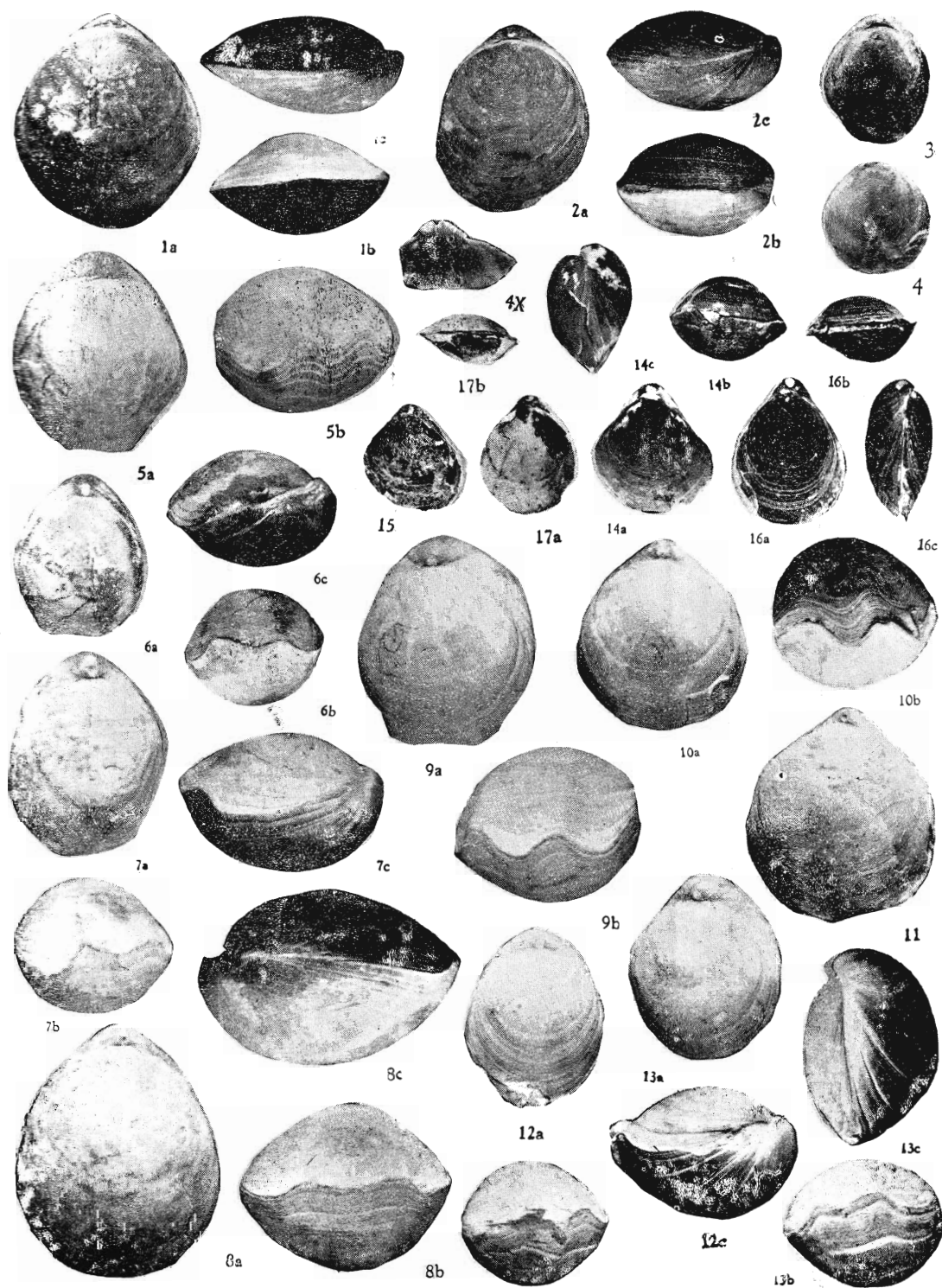


SAHNI : TEREBRATULIDAE OF THE BRITISH CHALK.

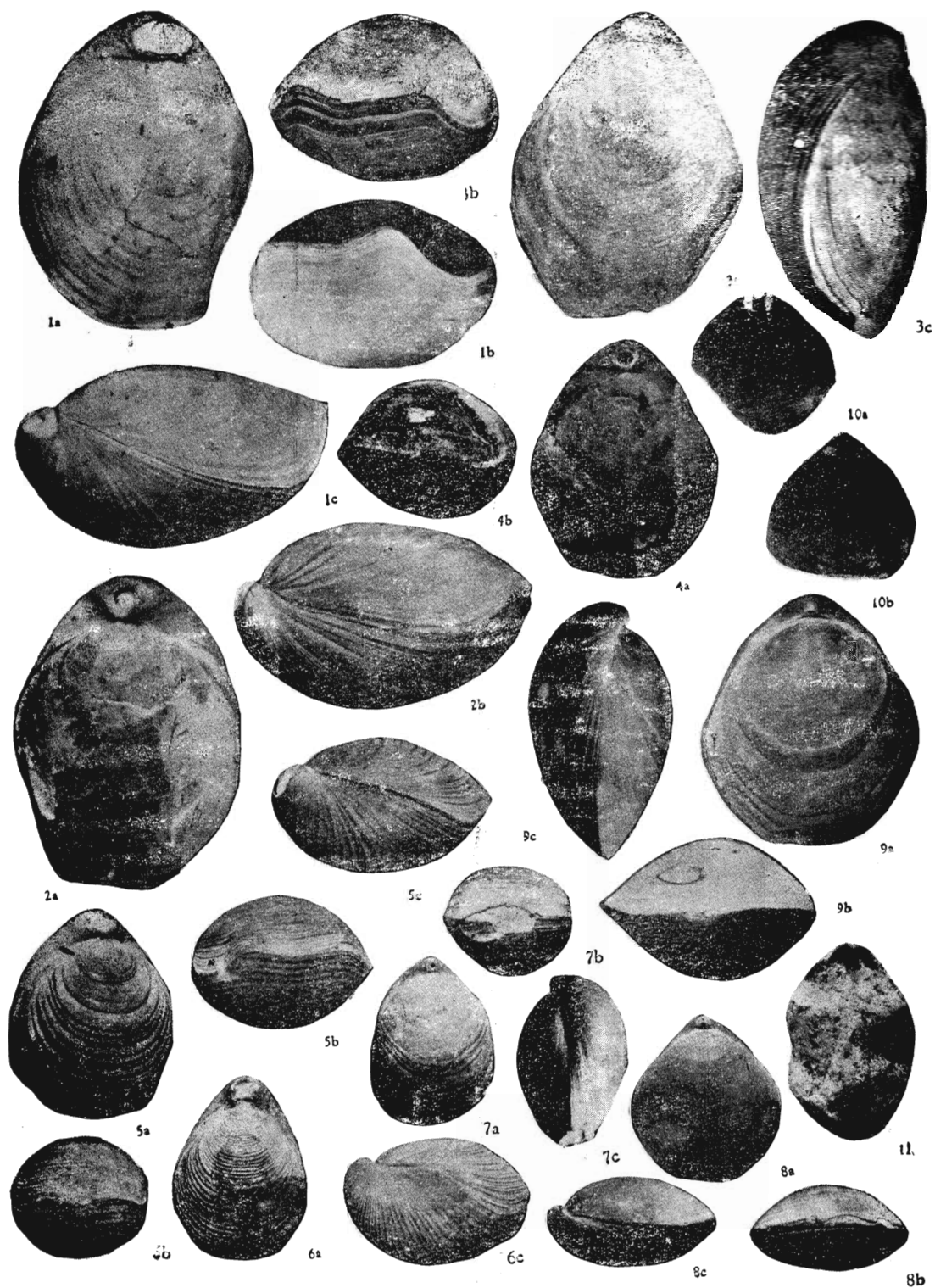


SAHNI : TEREBRATULIDAE OF THE BRITISH CHALK.





SAHNI : TEREBRATULIDAE OF THE BRITISH CHALK.



SAHNI ; TEREBRATULIDAE OF THE BRITISH CHALK.

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