

Det Kgl. Danske Videnskabernes Selskab.
Biologiske Meddelelser **XIII**, 10.

SOME ECHINODERM REMAINS
FROM THE JURASSIC OF
WÜRTTEMBERG

BY

TH. MORTENSEN

WITH 4 PLATES



KØBENHAVN

LEVIN & MUNKSGAARD

EJNAR MUNKSGAARD

1937

Det Kgl. Danske Videnskabernes Selskab udgiver følgende
Publikationer:

Oversigt over Det Kgl. Danske Videnskabernes
Selskabs Virksomhed,
Historisk-filologiske Meddelelser,
Filosofiske Meddelelser,
Archæologisk-kunsthistoriske Meddelelser,
Mathematisk-fysiske Meddelelser,
Biologiske Meddelelser,
Skrifter, historisk og filosofisk Afdeling,
Skrifter, naturvidenskabelig og matematisk Afdeling

Selskabets Kommissionær er *Levin & Munksgaard*, Nørre-
gade 6, København.

Det Kgl. Danske Videnskabernes Selskab.

Biologiske Meddelelser **XIII**, 10.

SOME ECHINODERM REMAINS
FROM THE JURASSIC OF
WÜRTTEMBERG

BY

TH. MORTENSEN

WITH 4 PLATES



KØBENHAVN

LEVIN & MUNKSGAARD

EJNAR MUNKSGAARD

1937

Printed in Denmark.
Bianco Lunos Bogtrykkeri A/S.

A few months ago Mr. K. FEIFEL, Stuttgart, wrote me a letter informing me that in the course of his investigations of the fauna of Foraminifera in the Jurassic deposits of Schwaben, Germany, he had come across a number of fragments of Echinoderms, among which a good deal of pedicellariæ of sea-urchins, saying that, if I would care to look them over and see whether they might be of interest, he would be glad to send me the material collected. On my reply that I would like very much to see his material he sent me a number of slides containing pedicellariæ and some other rests of Echinoids — isolated plates of tests, pieces of lanterns, and spines, etc. The marvellous state of preservation of most of the pedicellariæ roused my interest; it seemed probable that it might be possible, at least partly, to ascertain to which of the Echinoids known from the corresponding deposits they must belong, so I wrote to Mr. FEIFEL asking him to look out for more of these Echinoid remains in the washings from which he used to collect his Foraminifera. So he did, and in the course of the next few months he sent me several other samples of Echinoderm remains, among which I found quite a number different forms of pedicellariæ, the more important of which I shall describe in the present paper.

No doubt, it would be possible to do some valuable work also on the isolated plates of tests and lanterns and

spines of sea-urchins sent me, seeing particularly what BATHER has made out of similar material in his "Triassic Echinoderms of Bakony"; but that would require very much more time than I could possibly spare, and I must therefore confine myself mainly to the pedicellariæ, and only the more notable and characteristic ones. A single type of Cidarid spines, is so interesting that I must describe and figure it; it represents beyond any doubt a new species of *Anaulocidaris*. Mention may also be made of the sample figured in Pl. I. Fig. 6. It is a piece of the sucking disk of a tubefoot, exactly resembling the corresponding pieces in recent sea-urchins. They are so closely alike in the various recent forms that there is no possibility of ascertaining to which genus of the fossil forms it belongs, beyond the fact that it is of some Regular Echinoid, outside the Cidarids, in which the sucking disks are not so typically developed. Several such pieces are found in the collected material.

Another conspicuous type represented by various "species" in Mr. FEIFEL's material is the terminal plate of seastars. I shall confine myself to figuring a few species (Pl. I. Figs. 1—5); some specialist in fossil seastars might well be able to make a good deal out of these plates.

Remains of Ophiurids are very scarce in the material sent me; this fact, however, does not mean that they are scarce in the deposits studied by Mr. FEIFEL. On the contrary, Ophiurid vertebræ, ventral, dorsal, and lateral plates are, as Mr. FEIFEL informs me, very numerous in all the deposits, in many of them even so numerous as to be a nuisance. I do not regret to have not received all these Ophiurid remains. It seems questionable, whether a study of fossil Ophiurid vertebræ will lead to very valuable results; at least, it will be a very troublesome study. The

shape of the vertebræ changes greatly from the base to the end of the Ophiurid arms, without, on the other hand, being very characteristically different within the divers genera or even families — apart from the curious vertebræ with the closed ventral groove characteristic of the family of the Trichasterids (cf. my "Studies of Indo-Pacific Euryalids". Vid. Medd. Dansk Naturhist. Forening. 96. 1933. p. 3). In any case, a study of the fossil Ophiurid vertebræ will require a careful comparison with the vertebræ of a great number of representatives of the families of recent Ophiurids, before results of real value can be attained.

I was delighted to find in the material sent me by Mr. FEIFEL an extraordinarily fine piece of an Ophiurid arm, with a couple of hook-shaped spines preserved in situ (Pl. I. Fig. 10.). Nothing quite comparable is known to me among recent Ophiurids. The shape of the arm-joints proves that it is no Euryalid; it rather recalls an Ophiolepidid. The absence of dorsal plates recalls *Ophiomusium* (in which hook-shaped arm-spines do sometimes occur, e. g. *Ophiomusium spinigerum* Mrtsn.), but I do not think it can have anything with *Ophiomusium* or any other Ophiolepidid(?) to do. The hook-shaped spine represented in Pl. I. Fig. 11 recalls those of some Euryalids, e. g. *Astrothamnus*, but it may just as well belong together with the form of which the arm joints are preserved.

As already said, the preservation is in general remarkably fine. Moreover, I find that the mounting of the smaller forms in Canada balsam means a great improvement. The finest microscopical details often become quite distinct, so that these about 150 million years old small parts look almost as if they were taken directly from living specimens.

A very important paper has recently been published by H. L. GEIS: "Recent and Fossil Pedicellariæ" (Journ. of Paleontology. X. 1936. pp. 427—448), describing a number of different kinds of pedicellariæ from the Carboniferous (Pennsylvanian) deposits of the United States. I shall have to criticize some of his conclusions in the following, but otherwise I agree with him that the study of fossil pedicellariæ, even if found isolated, not attached to the tests of the sea-urchins, may yield important results not only from a taxonomic, but possibly also from a stratigraphical point of view. Wherever deposits are found which are in such condition that they can be washed out, there may be prospects of finding these delicate organs well preserved. It will be sure to pay the trouble.

Dr. GEIS gives a review of what has hitherto been done in the study of fossil pedicellariæ — but he is not quite up to date, not knowing my paper "Notes on some Fossil Echinoids" (Geol. Magaz. LXXI. 1934), which contains a chapter "On some Fossil Echinoid Pedicellariæ", with Plate XXII. That he does not mention the finds of pedicellariæ of fossil Echinoids recorded in Part II of my Monograph of the Echinoidea (*Acrosalenia*, *Trochotiara*) is more excusable, as that work could hardly have been in hands before his paper was sent to press. (I may mention here that also Part III of my Monograph of the Echinoidea will contain observations on the pedicellariæ of some fossil Echinoids.)

For the eventual identification of the fossil pedicellariæ it was, of course, very important to know which Echinoids have been found in the corresponding deposits. On my request Mr. FEIFEL sent me such list, worked out by Dr. BERCKHEMER, Vorstand. d. Geolog.-Paleontolog. Abtei-

lung d. Staatlichen Naturaliensammlung, Stuttgart, for which I am greatly indebted to the two named gentlemen.

The following list of the deposits from which the material comes is likewise due to Dr. BERCKHEMER and Mr. FEIFEL.

- 1) Lias α — Tone der Pylonoten-Schichten —, Sulzgrieser Kelter bei Esslingen a. N.;
- 2) Lias α — Tone der Angulaten-Schichten —, Uhlbach bei Stuttgart;
- 3) Lias β —, Ober-Esslingen;
- 4) Lias δ — Zone des *Amaltheus costatus* —, Gewand Enzenhart bei Nürtingen a. N.;
- 5) Lias ζ —, Probegrube der Reichsautobahn bei Holzmaden, Kreis Kirchheim u. T.;
- 6) Lias ζ —, Heiningen, Kreis Göppingen;
- 7) Dogger ε — Parkinsoni-Schichten —, "Erkenberg" bei Neidlingen, Kreis Kirchheim u. T.;
- 8) Malm α — Impresa-Mergel —, Reichenbach i. T., Kreis Geislingen;
- 9) Malm α — Schwammfacies —, "Lochengründle" bei Balingen;
- 10) Malm γ — Tonfacies —, Steige von Beuren n. Erkenbrechtsweiler, Kreis Nürtingen a. N.;
- 11) Malm δ — Schwammfacies —, "Bosler" bei Gruibingen, Kreis Göppingen;
- 12) Malm ζ — Cement-Mergel —, Sotzenhausen (Steinbrüche der Portlandcementfabrik Blaubeuren, Gebrüder SPOHN A. G.);
- 13) Malm ζ — Cement-Mergel —, Gerhausen (Steinbrüche der Portlandcementfabrik Blaubeuren, Gebrüder SPOHN A. G.).

Pl. I. Figs. 1—5. **Terminalia of Asteroids.** Lias α , Uhlbach; Malm δ , Bosler; Malm γ , Beuren.

Quite a number of different sorts of Asteroid terminalia are found in the material sent me, several of them highly characteristic. I have only figured three of them, wishing only to call the attention of specialists in fossil Asteroidea to these characteristic plates, which, according to Mr. FEIFEL, are well represented in all the various deposits. No doubt a careful study of them would give interesting results. The great number of characteristic forms found in this fossil material leads also to the suggestion that the terminalia of the recent sea-stars, which have up till now hardly received any attention at all, may deserve to be taken into consideration; it is probable that they would prove to offer characters of classificatory value. Also the fossil forms have scarcely been touched; a single form "*Astropecten Pichleri*" v. Wöhrmann is described and figured by BATHER in his "Triassic Echinoderms of Bakony" p. 235. Pl. XIII. 435—437.

Pl. I. Fig. 7. **Valve of rostrate pedicellaria.** Malm α . Reichenbach.

This very simple form of pedicellariæ can scarcely be anything but a rostrate pedicellaria of some Irregular Echinoid; certainly nothing like it is known from any Regular Echinoid. There are some small teeth along the distal edge of the blade, as usual in rostrate pedicellariæ of recent forms.

The following Irregular Echinoids are recorded from the Malm α — δ of Württemberg: *Collyrites carinata* Leske, *C. capistrata* Goldf., *C. bicordata* Klein; *Dysaster granulosus* Münster, *D. bicordatus* Klein; *Holctypus depressus* Leske, *H. orificiatus* Loriol. None of these have any near relations

among recent Echinoids, so it is impossible to say to which of them this type of pedicellaria belongs, but the hint herewith given as to its being either of a Collyritid or of a Holoctypid is already of some value and may lead to further discoveries of the pedicellariæ of these important, wholly extinct types of Irregular Echinoids.

Pl. I. Figs. 8—9. **Valves of tridentate pedicellariæ.** Malm α , Lochengründle; Malm δ , Bosler.

None of the larger samples of this very fine and interesting type of pedicellariæ are complete, but they must have reached a size of up to c. 4—5 mm length of head, and thus have been quite conspicuous organs, and apparently quite active defence weapons of the sea-urchin to which they belonged. Fig. 8, representing the terminal part in side view, shows that any small organism caught by these pedicellariæ would have little chance of escaping unhurt or alive. In contradiction to the elaborate and apparently powerful terminal part stands, however, the small size of the basal part and particularly the cavities lodging the adductor muscles, so that the strength of these pedicellariæ would seem not quite in correspondance with the size and elaborate shape of the valves.

The shape of the terminal part recalls a tennis racket; it is flat on the outer side and entirely smooth. The "shaft" is elegantly curved. The valves are found in different sizes, down to c. 0.5 mm length.

This type of pedicellariæ recalls the one figured on Pl. XXII, fig. 4 of my "Notes on some Fossil Echinoids" (Geol. Magaz. LXXI. 1934) and referred (Op. cit. p. 406) with rather great probability to the genus *Pelanechinus*, a nearly identical form of tridentate pedicellariæ being described from *Pelanechinus corallinus* by GROOM ("On

some new features in *Pelanechinus corallinus*'. Quart. Journ. Geol. Soc. XLIII. 1887), and we may then reasonably assume the form described here to belong to some, unknown, Echinoid allied to *Pelanechinus*. Among recent Echinoids pedicellariæ of this type are unknown.

Pl. I. Fig. 12. **Tridentate pedicellaria of a Cidarid.** Malm ζ , Sotzenhausen.

Only a single fragmentary specimen of this pedicellaria is found in the material received. Evidently, it has been quite a large one, some 5 mm long. It can hardly be doubtful that this is a tridentate pedicellaria of some Cidarid, similar forms being found in the genus *Phyllacanthus* (cf. Monograph of the Echinoidea I. Pl. LXXXVIII). Judging from the large size of this pedicellaria it must have been from a large Cidarid. From Malm ϵ and ζ are known no less than 10 species of *Rhabdocidaris* and 3 of *Diplocidaris*. As *Rhabdocidaris* is a near relation of the recent *Phyllacanthus* it may well be suggested that the pedicellaria here figured belongs to one of the *Rhabdocidaris*-species. It is, of course, also possible that it rather belongs to *Diplocidaris*; but as none of the recent forms are nearly related to *Diplocidaris*, we cannot have any idea of what the pedicellariæ of this genus looked like. Thus from our present knowledge we must conclude that this tridentate pedicellaria belonged to a *Rhabdocidaris*-species.

Pl. I. Fig. 13. **Periproctal spine of a Salenid.** Malm ζ , Sotzenhausen.

This little spine has all the appearance of being a periproctal spine of some Salenid, these spines in recent Salenids having a more or less similar characteristic, irregular shape. Mr. FEIFEL found it attached to a small irregular polygonal plate, which likewise has all the appearance

of a periproctal plate of a Salenid. The only Salenid known from the said deposit is *Pseudosalenia aspera* (Ag.), of the family Acrosalenidæ. Although no recent Acrosalenid exists, there is no reason to doubt that they would resemble the true Salenids in regard to their periproctal spines, and it is thus very probable that this spine does really belong to *Pseudosalenia aspera*.

Pl. I. Fig. 14. **Valve of tridentate pedicellaria.** Malm ζ , Sotzenhausen.

There is no possibility of ascertaining to which Echinoid this striking form of tridentate pedicellaria belongs. The only pedicellaria of recent sea-urchins recalling it is that of *Echinolampas sternopetala* A. Ag. & H. L. Clark, figured by H. L. CLARK in his "Hawaiian and other Pacific Echini". Echinoneidæ Spatangidæ (Mem. Mus. Comp. Zool. XLVI. 1917, Pl. 144. fig. 22). This is, however, a much smaller form, the valves c. 0.6 mm long, whereas the present, fragmentary valve must have been about 2 mm long (the point and the lower part of the base are broken away). It may be very tentatively suggested that it may belong to one of the (three) *Holectypus*-species known from this deposit. At any rate, it is so highly characteristic that it may easily be recognized by future researches, so I have found it desirable to figure it. That it must have been a no less effective defense-weapon than the form described above, Pl. I. Figs. 8—9, is evident, and it is interesting to witness the inventive power of nature in devising two so widely different apparatus for the same purpose, both highly elaborate.

Pl. II. Figs. 1—2, and 6. **Globiferous and ophicephalous pedicellariæ of Hemipedina.** Lias α ; Sulzgrieser Kelter; Lias ζ , Holzmaden; Malm ζ , Sotzenhausen and Gerhausen.

I hardly ever expected that the globiferous pedicellariæ of fossil Regular Echinoids would be found with their delicate terminal fangs in complete state of preservation. Thus the globiferous pedicellariæ figured by GEIS (Op. cit. Pl. 60. figs. 22—27) entirely lack the terminal part, and accordingly do not give more information than that globiferous pedicellariæ (— if indeed they are really globiferous —) existed already in some Echinoid of the Carboniferous period. As it is particularly the globiferous pedicellariæ which are of so great importance for the classification of some of the families of Regular Echinoids of the Order Camarodonta (the families Echinidæ, Toxopneustidæ, and Echinometridæ), besides the Cidarids, it was, of course, a serious drawback that the fossil forms, of which these pedicellariæ were not likely to be made known, could not with certainty be referred correctly to the family, in spite of the fact that they can be identified to both genus and species — exactly as it was the case with the recent forms before the structure of the globiferous pedicellariæ was taken into consideration in classification. The finding of the globiferous pedicellariæ here figured gives us hope that by and by we may find also these structures preserved in such fossils as belong to one or other of the above named families, and that their true position can thus be ascertained.

The globiferous pedicellariæ here figured, with their three terminal fangs preserved complete, are so perfectly like those of the recent Pedinids of the genus *Cænopedina* that there cannot be any doubt that they likewise belong to a Pedinid. Similarly the ophicephalous pedicellaria, fig. 6, with the very characteristic double series of teeth along the margin of the blade, very closely resembles those of *Cænopedina*, and as no other recent Echinoid is known

to have such ophicephalous pedicellariæ we may conclude with certainty that this pedicellaria likewise belongs to some Pedinid. *Hemipedina nattheimensis* (Quenst.) and *H. calva* (Quenst.) being the only Pedinids known from the deposits in which these pedicellariæ were found, it can be regarded as certain that they must belong to one of these species.

Pl. II. Fig. 3. **Miliary spine of Collyrites (?)**. Malm *a*, Reichenbach.

The spine here figured so closely resembles those peculiar small spines of which the fascioles of Spatangoids are composed that one is tempted to say, it must be such one. However, none of the Echinoids recorded from the Malm have fascioles, such being known only in Spatangoids, which do not appear before the Cretaceous. Recalling that a kind of primitive fascioles are found in some of the Meridosternata, with clavulæ very closely resembling the one here figured (cf. my "Ingolf" Echinoidea. II. Pl. XI. 42, a clavula of the Pourtalesiid, *Echinisigra paradoxa* Mrtsn.), it would seem not unreasonable that these very small spines — which occur, evidently, in good numbers, several samples being found in the material at hand — may belong to *Collyrites* (or *Dysaster*), the spines of which, judging from the minute size of their tubercles, must have been very small.

The size of these spines is only c. 0.4—0.5 mm. They have not all of them a quite so elaborately formed terminal part as the one figured, but they are all of them of the same main type. They are remarkably well preserved, some of them showing the original microscopical structure almost as clearly as do the clavulæ of recent Spatangoids.

Pl. II. Figs. 4—5. **Ophicephalous pedicellariæ**. Malm *a*, Reichenbach.

This kind of ophicephalous pedicellariæ of which both a complete head and several isolated valves and stalks, in an exquisite state of preservation, are found in the material from Malm α , Reichenbach, recalls very much the ophicephalous pedicellariæ figured by GEIS (Op. cit. Pl. 59. 28—34), from the Carboniferous (Graham formation) of Texas, taken by him to indicate the existence already in this palæozoic period of Irregular Echinoids, though such have otherwise not been found earlier than the Jurassic period.

This is an exceedingly improbable assumption, and the isolated plate shown in GEIS Pl. 59.39, and regarded as a further indication of the existence in this carboniferous deposit of some unknown Irregular Echinoid, is certainly so indistinct and unidentifiable that it cannot be of any value at all in this connection. H. L. CLARK has informed Dr. GEIS that in his opinion this ophicephalous pedicellaria would rather belong to some Pedinid, but GEIS thinks it much more like the ophicephalous pedicellariæ of *Pourtalesia*, and reproduces (Pl. 58.15—17) my figures of the ophicephalous pedicellariæ of *Pourtalesia Wandeli* ("Ingolf" Ech. II. Pl. XI. 13, 14, 18) and bases thereupon the said assumption. Even if there is no proof that this ophicephalous pedicellaria belongs to some Pedinid as suggested by CLARK — and Pedinids are not known either from the palæozoic formations — we need not at all draw the conclusion that either Pedinids or Irregular Echinoids were already present in the Carboniferous. In Echinothurids ophicephalous pedicellariæ of a somewhat similar type occur (cf. Monograph of the Echinoidea II. e. g. Pl. LXXV. 9, 10, 16, 18, of the genus *Tromikosoma*, one of the more primitive of Echinothurids). As Echinothurids are, without doubt, (in

my opinion at least), derived from Lepidocentrids, the only reasonable suggestion is that the ophicephalous pedicellaria of GEIS belongs to some Lepidocentrid, a family so well represented in the Carboniferous period.

As for the ophicephalous pedicellaria represented here, Pl. II. Fig. 4—5, it is evidently not of a Pedinid, as it has not the characteristic double series of teeth along the edge of the blade. It has much the appearance of belonging to some Irregular Echinoid, which would then be either *Collyrites*, *Dysaster*, or *Holectypus*, the only Irregular Echinoids known from the same deposit. But it is also quite possible that it belongs to some Echinothurid. Till now no Echinothurids are known from these deposits, but the existence of some Echinothurid in these same deposits is proved by the pedicellariæ described below (p. 16).

Pl. II. Fig. 7. **Ophicephalous pedicellaria.** Lias β . Ober-Esslingen.

There are several valves of this very small pedicellaria, only c. 0.2 mm long, partly in exquisite state of preservation; not only the fine marginal teeth are distinct, but even the original holes in the calcareous substance of the blade. The edge of the blade is remarkably thick. The irregular top above the edge is not distinct on all the valves, and it is uncertain whether it is somewhat serrate.

Only *Acrosalenia minuta* Buckman and *Diademopsis Quenstedti* Desor are recorded from Lias β , from which fact it might be concluded that this pedicellaria would belong to one of them. As for *Acrosalenia* the ophicephalous pedicellaria of *A. hemicydaroides* Wright figured in the Monograph of the Echinoidea II. fig. 377.d (p. 640) is so different from the present form that it is hardly thinkable that they could both belong to the same genus. *Diademopsis*,

so closely related to *Hemipedina*, might be expected to have a similar form of ophicephalous pedicellariæ as has the latter genus, with the very characteristic narrowing of the lower part of the blade into a sort of "stalk", and also with the characteristic double series of marginal teeth. It is therefore not very likely that this pedicellaria belongs to any of the two forms. If *Magnosia* or *Polycyphus* were found in the Lias deposits, I would believe it to belong to one of these genera, but they are not known from older deposits than the Bathonian. For the present we can only say that this pedicellaria must belong to some (evidently small) Regular Echinoid. As it is a very characteristic and easily recognizable form, we may hope that by future finds it may be disclosed to which Echinoid it belongs.

Pl. II. Figs. 8—9. **Tridentate pedicellariæ of Echinothurids.**
Malm ζ, Sotzenhausen.

Tridentate pedicellariæ of the type represented in these figures are of common occurrence in Echinothurids, in the genera *Aræosoma* and *Asthenosoma* (cf. Monograph of the Echinoidea II. Pl. LXXVII; "Ingolf" Echinoidea. I. Pl. XIII. 27; XIV. 1, 5), but are not known in other Echinoids. We may then be safe in concluding that these pedicellariæ must belong to some Echinothurid and see herein the proof of the existence of some Echinothurid, probably related to *Aræosoma*, in the Malm period. That no such Echinoid has hitherto been recorded from any period below the Cretaceous (apart from the aberrant *Pelanechinus*) need not trouble us, since the loose connection of the skeletal plates renders the preservation of fossil tests of Echinothurids very exceptional. Isolated plates of Echinothurids, on the other hand, may well be expected to occur; no such plates, however, are present in the material sent me.

It is a matter of great satisfaction to have proved here-with the existence of Echinothurids in the Malm. If, as I think it certain, the Echinothurids are derived from the Lepidocentrids, they must, of course, have existed also in the long period between the Cretaceous and the Palæozoic eras. The present find begins to fill the gap. The still older pedicellaria (from the Bajocian) figured in my "Notes on some Fossil Echinoids" (Geol. Magaz. LXXI. Pl. XXII, 5, 6, and 8) may not improbably also belong to Echinothurids, as I have suggested there (p. 405), but it is less certain than is the case with the two pedicellariæ here represented.

Pl. II. Fig. 10. **Rostrate pedicellaria of Irregular Echinoid.**
Malm α , Reichenbach.

The valve here figured strikingly recalls the rostrate pedicellariæ of various Irregular Echinoids, whereas nothing very like it is known in the Regular Echinoids. It is therefore rather safe to conclude that it must belong to one of the Irregular Echinoids known from the Malm. A rather similar form is figured by H. L. CLARK in the "Hawaiian and other Echinoids". Echinoneidæ . . . Spatangidæ, Pl. 144,¹⁴ from *Echinolampas Alexandri* de Loriol. It may then not unreasonably be suggested that the present form belongs to *Holectypus* — but it can be no more than a suggestion for the present. Very similar rostrate pedicellariæ are found e. g. in *Aceste* and *Hemiaster*, but no true Spatangoid being known before the Cretaceous, these must be excluded.

Several other forms of pedicellariæ are found in the material at hand, among which some small globiferous pedicellariæ of Cidarids, but none of them are so characteristic that any reasonable suggestion can be made as to the Echinoids to which they belong, or that they would be

recognizable with certainty if found in other localities or formations. I have therefore thought it preferable to leave them out of consideration. But the forms mentioned above offer a considerable interest and indicate that further collecting of such micro-material may lead to very valuable results.

Anaulocidaris tuberculata n. sp.

Pl. II. Figs. 11—16.

The divers spines represented here, from Malm ζ , Sotzenhausen, undoubtedly represent a new species of the genus *Anaulocidaris*. The adoral "spatuliform" and "remiform" spines (Pl. II. 11—15) differ from those of the other two species of the genus known till now, *A. Buchi* (Münster) and *A. testudo* Bather¹, in being coarsely tuberculate on their aboral, flattened side, those of the other two species being smooth, or at most finely granulated (the var. *granulata* Bather of *A. Buchi*; cf. BATHER. Triassic Echinoderms of Bakony, p. 168). In the smallest of these spines, no doubt those nearest the peristome, the shaft is developed into a broad oblique plate on top of the short, distinctly striated neck; in the larger, subambital spines the shaft becomes gradually more straight and less widened. Only a single of the flattened ("trulliform") aboral spines is found in the material at hand (Pl. II. Fig. 16). The acetabular cavity is round, not transversely elliptical as in *A. testudo*. The figures here given make, I think, a more detailed description superfluous. No plates identifiable as belonging to the test of this species are found.

The largest of these spines (fig. 11) is only 3 mm long.

¹ The *Anaulocidaris Faurai* of LAMBERT is, in my opinion, no true *Anaulocidaris*; cf. Monograph of the Echinoidea. I. p. 67.

which indicates that this species must have been a very small one, a real pygmy.

The other species of *Anaulocidaris* being triassic, it is of very considerable interest to find now that the genus did survive till the upper part of the Jurassic period.

It is a curious fact that the Cidarid spine figured in side view in the diagrammatic figure 12 in BATHER'S Triassic Echinoderms of Bakony (p. 135) resembles a spine of *Anaulocidaris tuberculata* so much that one might think, BATHER had drawn it from one of these latter. Of course, it is only a very curious coincidence, BATHER'S figure being no doubt constructed after a "*Cidaris alata*" spine, as represented in Pl. XI of his eminent work.

Holothurians.

(Pls. III—IV).

A considerable number of Holothurian spicules, belonging to several distinct forms, are found in the material sent me by Mr. FEIFEL. Several of these are identical with those figured by A. Issler in his "Beiträge zur Stratigraphie und Mikrofauna des Lias in Schwaben" (Palæontographica. Bd. 55. 1908. Taf. VII.), whereas others are evidently unknown and, being very characteristic and easily recognizable, deserve to be described and figured. Also I have thought it desirable to give drawings of some of the species represented by ISSLER in photographic figures, which do not show all details very clearly.

I beg to say that it is not my intention to go into a critical study of the rather extensive literature dealing with fossil remains of Holothurians, the more so as this literature is only partly accessible to me. (A very careful review of this literature is given by C. CRONEIS and J. McCORMACK in their

paper "Fossil Holothurioidea" (Journ. of Paleontology. 6. 1932). All the forms figured by ISSLER I am trying to identify.

Pl. III. figs. 1—2. **Wheels of Myriotrochus.** Malm α , Reichenbach.

Several of these wheels are in an exquisite state of preservation, showing all the structural details almost as clearly as if they were taken from the skin of recent Holothurians. They vary very considerably in size; the two figures, drawn in the same magnification, represent the extremes, but there are all intermediate sizes. That the larger wheel has an undulating margin, the smaller one not, does not mean a specific difference. It is a difference due to size, and also in the smallest wheels there may be a slight undulation of the margin.

This form of wheels, evidently the same as represented in ISSLER's figures 363 and 365, so closely resembles those of the recent genus *Myriotrochus* that it seems beyond doubt they prove the existence of this genus at least so far back as Jurassic times.

Pl. IV. Figs. 1—2. **Wheels of Chiridota.** Lias β , Ober-Esslingen; Lias δ , Enzenhart.

These wheels likewise are present in good numbers, partly in very fine state of preservation. Probably the two figures represent two different species, as indicated by the considerable difference in size and number of serrations along the inner edge of the rim of the wheel. The difference in the number of spokes is of no specific importance, since the number varies from 6 to 10 in what is decidedly the same species. Also in the recent forms a similar variation occurs. It is probably this type of wheels which is represented in ISSLER's figure 364.

These wheels correspond so closely with the wheels of the recent genus *Chiridota* that there can be no doubt they do belong to this same genus, proving thus its existence already in the Lias period.

Pl. III. Figs. 9—15. **Spicules of Synaptids.** (*Ancistrum Issleri* Croneis). Lias β and δ ; Dogger ε ; Malm α .

Especially in Dogger ε , Erkenberg, these spicules are found in great numbers. They vary very much in size, as seen in Pl. III. 9—14, all from the said deposit.

It is hardly probable that all these hooks from the deposits of Lias β to Malm α belong to one and the same species; but it is not possible to distinguish different species of them in view of their great variation.

This type of spicules has been designated by the name of *Ancistrum* (Etheridge) Smith, and it may be correct to keep this name; they resemble the hooks of the recent Synaptids *Tæniogyrus* and *Scoliodota* to a rather striking degree, but differ from these latter in having the one end closed completely so as to form an eye, whereas in the recent forms it is only inrolled but not quite closed. But it cannot be doubted that the *Ancistrum* spicules belong to Synaptids closely related to the said recent genera. Such spicules are known already from the Lower Carboniferous of Scotland.

It is a curious fact that no anchors or anchor plates of Synaptids are found in the material sent me by Mr. FEIFEL. This does not mean that the genus *Synapta* (sensu latiori) had not yet appeared in the Jurassic period, since an anchor of a *Synapta* from the Jurassic Scyphia limestone of Streitburg was figured by v. MÜNSTER in his "Beiträge zur Petrefactenkunde" 6. 1843. Taf. IV. 9. On the other hand,

the fact that no wheels referable to the genus *Protocaudina* of CRONEIS are found either may indicate that this genus, so richly developed in the Carboniferous, became extinct before the end of the Paleozoic; at least, SPANDEL's *Chiridota geinitziana* from the Zechstein formation, designated by CRONEIS & McCORMACK (Op. cit. p. 132) as *Protocaudina geinitziana*, certainly does not rightly belong within that genus.

Pl. III. Figs. 4—5. **Spicules of Chiridota (?)**. Malm *a*. Reichenbach.

These large spicules, more than 1 mm long, so strikingly recall those of *Chiridota Stuhlmanni* Lampert figured p. 677, fig. 12.6 of S. G. HEDING's paper "Über die Synaptiden d. Zoologischen Museums Hamburg" (Zool. Jahrb. Syst. Bd. 51. 1931) that there can scarcely be any doubt that they must likewise belong to the genus *Chiridota*, together with the wheels Pl. IV. 1—2¹.

Pl. III. Figs. 6—8. **Spicules of Holothurians**. Lias ζ . Heiningen.

The spicules here figured recall very much the rods from the tentacles of *Stichopus* (cf. e. g. fig. 22. f., p. 329, of my Echinoderms of New Zealand and the Auckland-Campbell Isl. III—V. Papers from Dr. Th. Mortensen's Pacific Expedition. XXIX. Vid. Medd. Dansk Naturhist. Foren. Bd. 79. 1925). Also the C-shaped bodies figured by CRONEIS & McCORMACK, Op. cit. Pl. 21. figs. 24—28, are no doubt of the same nature.

Pl. III. Fig. 3. **Spicule of Holothurian**. Lias δ , Enzenhart.

Nothing very like this spicule is known from recent

¹ I am indebted to Mr. HEDING for calling my attention to these spicules of *Chiridota Stuhlmanni*, figured by him, as also to the "spectacle"-like spicules of *Cucumaria frauenfeldi* mentioned below.

Holothurians. It is not even possible to say with certainty whether it is from an Aspidochirote or a Dendrochirote Holothurian or perhaps from a Molpadid. We can only say with a fair degree of certainty that it is a Holothurian spicule, and as it is easily recognizable, it is well worth figuring. It is clearly the same as ISSLER's Tab. VII. fig. 379, which is only simply pentagonal, not so distinctly five-radiate as the one here figured; I have, however, also specimens which are simply pentagonal. They are rather thick and complicately built, as shown in the figure.

It is scarcely to be doubted that the form figured by TERQUEM & BERTHELIN (Etude microscopique des Marnes du Lias. Mém. Soc. Géol. France. Pl. VIII. a—b) under the name of "*Ophiotrix*" is in reality the same as the Holothurian spicule here mentioned.

Pl. III. Figs. 16—19. **Spicules of Holothurian.** Lias α , Sulzgrieser Kelter.

Numerous finely preserved specimens of this type of spicules are found in the said deposit. They are evidently identical with those figured in ISSLER's Tab. VII. figs. 359—360. It is impossible to say whether they belong to a Dendrochirote or an Aspidochirote Holothurian; they may perhaps be a primitive sort of buttons of a *Holothuria* (they recall to a no small degree the buttons of the tubefeet in some *Holothuria* species).

Pl. IV. Fig. 3. **Spicule of Holothurian.** Lias β . Ober-Esslingen.

This spicule so closely resembles that of *Staurocucumis Liouvillei* (Vaney) figured in fig. 7. c, p. 376 of Sv. EKMAN's "Holothurien d. deutschen Südpolar-Expedition" (1927) that it seems rather safe to say it must belong to a closely related Dendrochirote Holothurian. Only two specimens are found in the material sent me.

Pl. IV. Figs. 4—5. **Spicules of Dendrochirote Holothurians.**
Lias β , Ober-Esslingen.

There is no doubt that the two types of spicules here represented both belong to some Dendrochirote Holothurians; as to the genus to which they belong nothing can be said with certainty — but they may both very well be of the genus *Cucumaria*. Fig. 4 to some degree recalls ISSLER's figures 369 and 370, but it is not at all certain that it is the same species, I am even not at all convinced that these figures are really Holothurian spicules and not perhaps rather Foraminifera; at least, I have been unable to convince myself of the Holothurian structure of some specimens apparently identical with ISSLER's figures.

The very simple spicule represented in Pl. IV. 5 recalls the more or less fragmentary spicules from the Carboniferous of the United States represented under the name of *Ancistrum?* on Pl. 20.^{29—45} of CRONEIS & McCORMACK's paper. That the present form from the Lias of Germany is not identical with any of those from the Carboniferous of the United States is clear, but, on the whole, these simple spicules are so little characteristic that it is quite hopeless to try to distinguish species of them. That they have nothing to do with the Synaptid *Ancistrum* is certain; there can be no doubt that all these simple plates belong to Dendrochirote Holothurians.

In the material at hand there are several specimens, often fragmentary, which resemble the one represented in fig. 5, more or less. Some of them are not simple as the one figured, but more or less complicate, cushion shaped. But as they will hardly be recognizable with any reasonable degree of certainty, I have not thought it desirable to figure all these various forms.

Pl. IV. Figs. 6—9. **Spicules of Holothurians.** Lias β , Ober-Essligen; figs. 6—7 also from Lias δ , Enzenhart.

The two types of spicules here represented both very probably belong to Dendrochirote Holothurians. Several forms of spicules recalling figs. 6—7 are known from recent Holothurians, e. g. the one figured by Sv. EKMAN in his Report on the Holothurians of the Swedish Antarctic Expedition, 1925, p. 76, fig. 15. c (of *Cucumaria crocea* Lesson). Figs. 8—9 are to some degree recalled by the

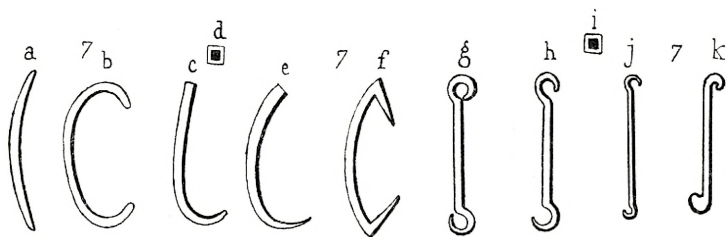


Fig. 1. *Uncinulina polymorpha* Terquem. From TERQUEM. Recherches sur les Foraminifères du Lias. (Pl. VII. fig. 7. a—k). $\times 10$.

curious spicules of *Phyllophorus incomptus* Théel (“Challenger” Holothurians. II. Pl. V. fig. 8. b). But an almost identical form of “spectacle”-like spicules is found in *Cucumaria frauenfeldi* Ludwig (cf. H. L. CLARK. Echinoderm Fauna of S. Africa. Ann. S. African Mus. XIII. 1923. p. 414). There can thus be no doubt that this remarkable spicule likewise belongs to a *Cucumaria* related to the said species.

Both the forms of spicules here represented are designated by ISSLER as *Uncinulina polymorpha* Terquem, and also the form represented in Pl. III. figs. 16—19, as well as a couple of *Ancistrum* spicules are likewise referred to *Uncinulina polymorpha* (ISSLER. Tab. VII. figs. 346—362). It is perfectly clear that the forms here mentioned represent four

different species, so it is inadmissible to designate them all by the same name, *Uncinulina polymorpha* — it is even doubtful whether any of them are identical with any of the forms represented under the name *Uncinulina polymorpha* by TERQUEM (Recherches sur les Foraminifères du Lias. II. Mém. Ac. Imp. Metz. XLII. 1862. Pl. V. fig. 7. a—k.). Of these forms, reproduced here in fig. 1, the figs. g—k recall my Pl. IV. figs. 8—9; but it is very unlikely that TERQUEM would have represented them with the “eyes” not closed, so I do not think they could be identical. If we want to keep the name *Uncinulina*, a type should be selected. The figs. a—e are so generalized forms that they cannot very well come into consideration as types, and with regard to figs. g—k some uncertainty remains, whether they are quite accurately drawn. Remains fig. f, which is a very unusual, but apparently highly characteristic form. Accordingly I select this as the lecto-holotype¹.

Pl. IV. Fig. 10. **Spicule of Holothurian.** Lias β . Ober-Esslingen.

Of this highly characteristic spicule, of which a couple of specimens are found in the material at hand, it cannot be said with certainty whether it belongs to an Aspidochirote or a Dendrochirote Holothurian. It has some resemblance to the quadriradiate spicules of *Staurocucumis*, but not so much that it could reasonably be referred to that genus. Anyhow, it is very easily recognisable and therefore may prove of importance, also from a stratigraphical point of view.

¹ I am greatly indebted to Dr. LESLIE BAIRSTOW, British Museum, Natural History, for information about TERQUEM's work, to which I had no access, and particularly for copies of the original figures of *Uncinulina polymorpha*.

The central prominence is a simple spire, about half the length of an arm.

Pl. IV. Fig. 11. **Spicule of Holothurian** (*Cucumaria Feifeli* n. sp.). Lias ζ, Heiningen.

This very unusual type of spicule I beg to dedicate to the collector of all this marvellous material, naming it *Cucumaria Feifeli*. There is scarcely any doubt that it is from a Dendrochirote; whether strictly of the genus *Cucumaria* is, of course, not quite so certain, nothing very similar being known from any recent form. As there is only a single specimen at hand, it is uncertain whether it is always threeradiate. It has much resemblance to such arenaceous Foraminifera as *Rhabdammina* or *Astrorhiza*, but the microscopical structure proves definitely that it is a Holothurian spicule. It makes the impression of being hollow; at least it is rather thick, not flat.

Pl. IV. Fig. 12. **Spicule of Holothurian** (*Cucumaria proteus* n. sp.). Lias ζ, Heiningen.

This again is a very unusual type of spicule, also represented by only a single specimen in the material at hand. The peculiar irregular shape, recalling an Amoeba (— it is perfectly preserved, the irregular outline not due to fracture of any kind —) seems to show that it must be referred to the genus *Cucumaria*.

It may still be added that of ISSLER's figures of "Echinodermenreste" I have seen nothing like figs. 380 and 381; they look much like sections of spines of sea-urchins, and I think it very doubtful whether they are really wheels of Holothurians. Figs. 382, 386, and 387 are scarcely Echinoderm remains, as also holds good of figs. 367—368.

Fig. 371 probably is a Holothurian spicule, perhaps identical with my Pl. III. figs. 4—5 and fig. 372 no doubt is an incomplete *Ancistrum*-spicule (cf. Pl. III. fig. 9). Fig. 373 is a spicule of a Dendrochirote of the type mentioned under Pl. IV. fig. 5. Finally figs. 383—385 are either braces from the lantern of Echinoids, as suggested by CRONEIS & McCORMACK (Op. cit. p. 128), or vertebræ of Ophiuroids; particularly 385 seems rather certainly to be an Ophiuroid vertebra.



Plate I.

- Figs. 1—5. Terminalia of Asteroids. 1—2. From Malm δ . Bosler; dorsal (1) and ventral side (2). 3—4. From Malm γ . Beuren; dorsal (3) and ventral side (4). 5. From Lias α . Uhlbach; dorsal side. 1—4 $\times 35$; 5 $\times 30$.
- 6. Part of sucking disk of a Regular Echinoid. Malm ζ . Sotzenhausen. $\times 80$.
- 7. Valve of rostrate pedicellaria of an Irregular Echinoid; from the inside. Malm α . Reichenbach. $\times 120$.
- 8—9. Tridentate pedicellaria of a Regular Echinoid, apparently allied to *Pelanechinus*. Malm α . Lochengründle. 8. Distal part of the blade in side view; 9. distal part of the blade, and the basal part, from the inside. $\times 35$.
- 10. Part of arm of an Ophiuroid, with hook-shaped arm-spines preserved in situ. Malm ζ . Sotzenhausen. $\times 35$.
- 11. Hook-shaped arm-spine of Ophiuroid, probably the same as fig. 10. Malm ζ . Gerhausen. $\times 95$.
- 12. Basal part of valve of tridentate pedicellaria of a Cidarid, probably *Rhabdocidaris*; in side view. Malm ζ . Sotzenhausen. $\times 30$.
- 13. Periproctal spine of a Salenid. Malm ζ . Sotzenhausen. $\times 35$.
- 14. Valve of tridentate pedicellaria, in side view. The lower part of the base reconstructed on free hand; the point of the valve lacking. Malm ζ . Sotzenhausen. $\times 80$.

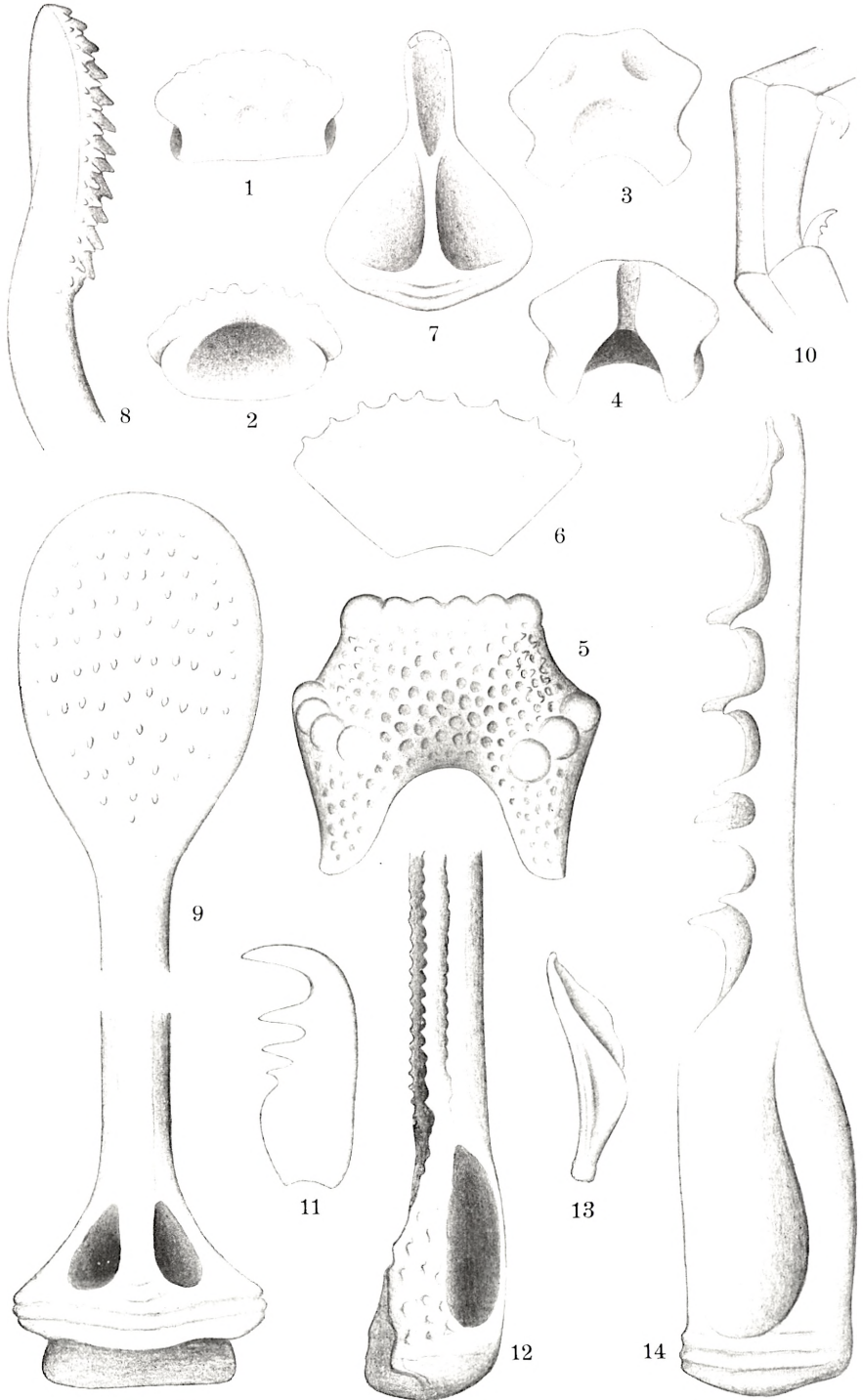


Plate II.

- Figs. 1—2. Valve of globiferous pedicellaria of *Hemipedina*, from the inside (1) and in side view (2). Malm ζ . Sotzenhausen. $\times 80$.
- 3. Spine of an Irregular Echinoid. Malm α . Reichenbach. $\times 230$.
- 4. Ophicephalous pedicellaria, head and stalk, of an Irregular Echinoid(?). Malm α . Reichenbach. $\times 120$.
- 5. Valve of the same sort of ophicephalous pedicellaria as fig. 4, from the inside. $\times 230$.
- 6. Valve of ophicephalous pedicellaria of *Hemipedina*, from the inside. Malm ζ . Sotzenhausen. $\times 95$.
- 7. Valve of ophicephalous pedicellaria from Lias β , Ober-Esslingen. $\times 200$.
- 8—9. Valves of tridentate pedicellariæ of Echinothurids, in half side view. Malm ζ . Sotzenhausen. $\times 80$.
- 10. Valve of rostrate pedicellaria of *Holectypus*(?); from the inside. Malm α . Reichenbach. $\times 230$.
- 11—16. Spines of *Anaulocidaris tuberculata* n. sp. Fig. 16 seen from the under-side. Malm ζ . Sotzenhausen. $\times 22$.

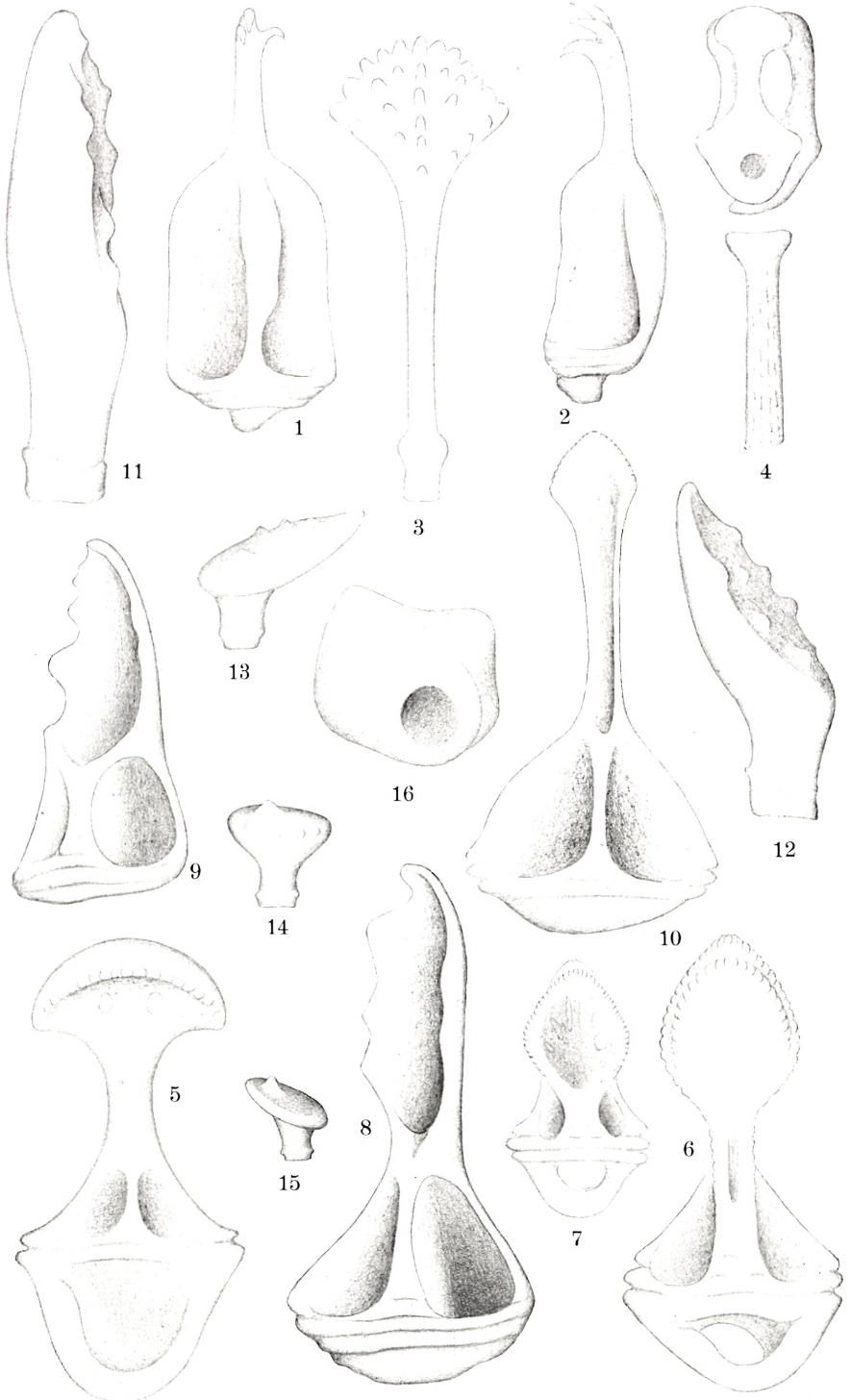
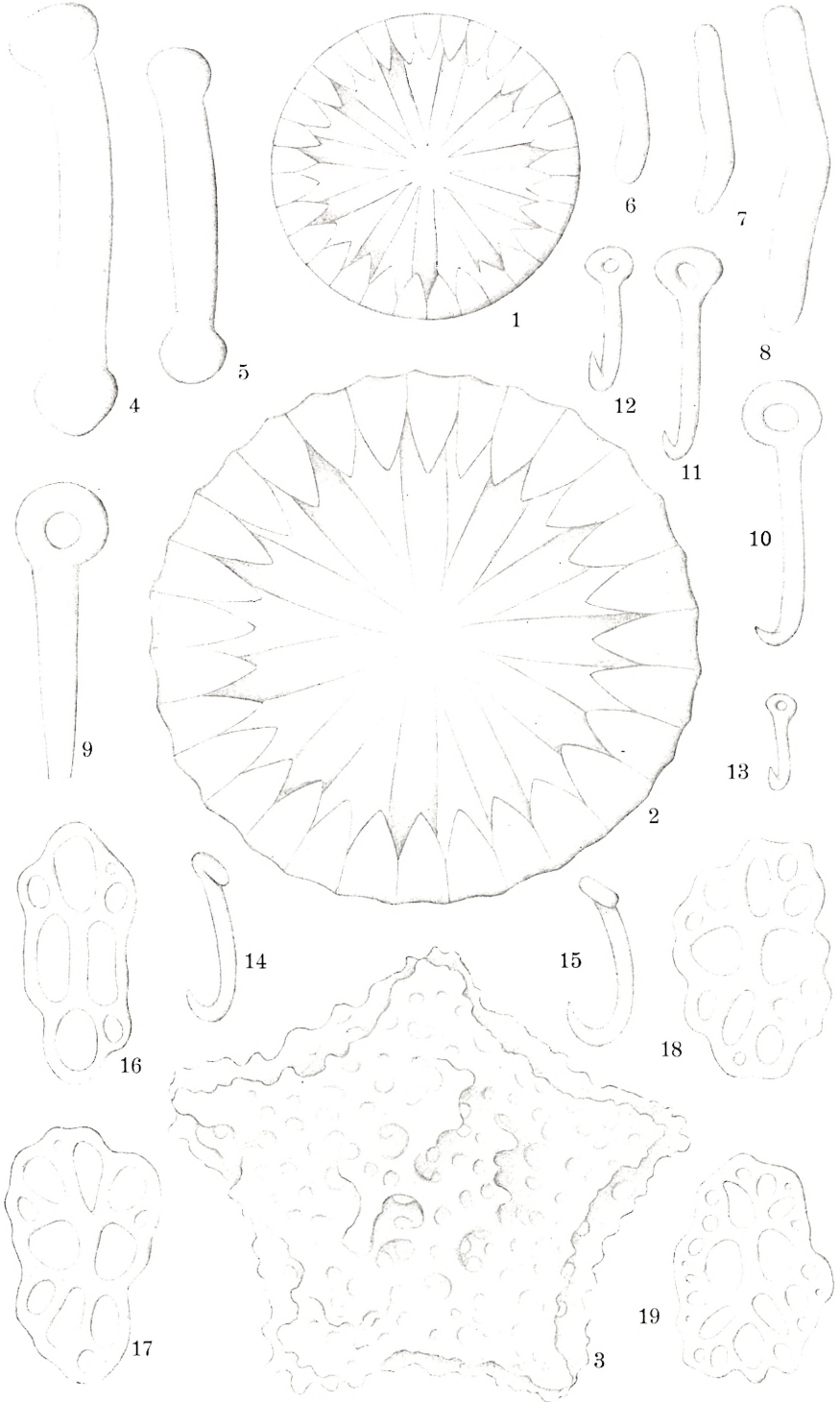


Plate III.

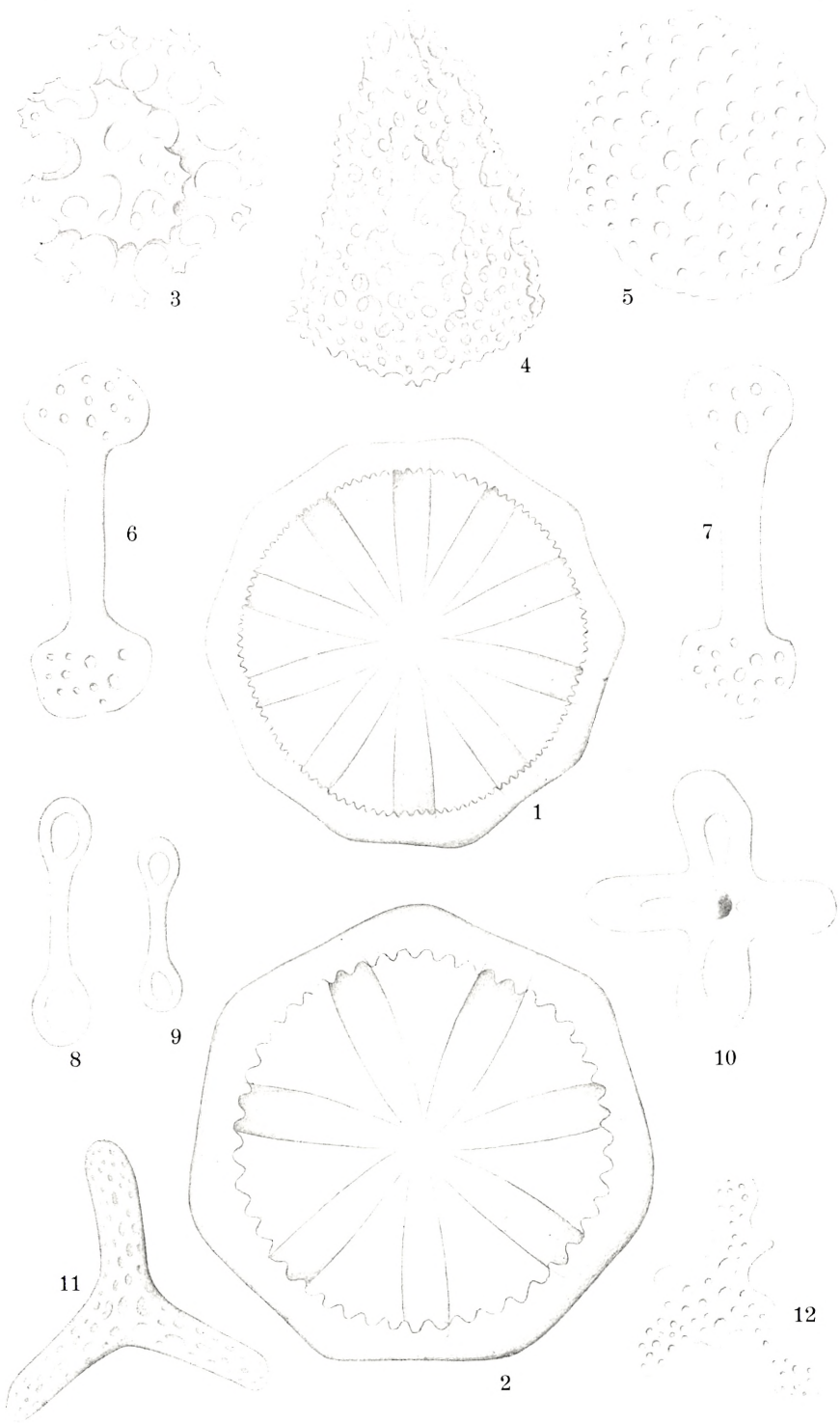
- Figs. 1—2. Wheels of *Myriotrochus*. Malm *a.* Reichenbach. $\times 200$.
— 3. Spicule of Holothurian. Lias δ . Enzenhart. $\times 200$.
— 4—5. Spicules of *Chiridota* (?). Malm *a.* Reichenbach. $\times 45$.
— 6—8. Spicules from tentacles of Holothurians. Lias ζ , Heiningen. $\times 45$.
— 9—15. Spicules of Synaptid (*Ancistrum*). 9—14. Dogger ϵ , Erkenberg; 15. Malm *a.* Reichenbach. $\times 45$.
— 16—19. Spicules of Holothurian. Lias *a.* Sulzgrieser Kelter. $\times 80$.



Faint, illegible text, possibly bleed-through from the reverse side of the page.

Plate IV.

- Figs. 1—2. Wheels of *Chiridota*. 1. Lias β . Ober-Esslingen; 2. Lias δ , Enzenhart. $\times 200$.
- 3. Spicule of Dendrochirote Holothurian. Lias β . Ober-Esslingen. $\times 200$.
- 4—5. Spicules of Dendrochirote Holothurians. Lias β . Ober-Esslingen. 4. $\times 180$. 5. $\times 200$.
- 6—7. Spicules of Dendrochirote Holothurian. Lias δ . Enzenhart. $\times 90$.
- 8—9. Spicules of Dendrochirote Holothurian. Lias β . Ober-Esslingen. $\times 80$.
- 10. Spicule of Holothurian. Lias β . Ober-Esslingen. $\times 180$.
- 11. Spicule of Dendrochirote Holothurian, *Cucumaria Feiffeli* n. sp. Lias ζ . Heiningen. $\times 90$.
- 12. Spicule of Dendrochirote Holothurian, *Cucumaria proteus* n. sp. Lias ζ . Heiningen. $\times 90$.



BIOLOGISKE MEDDELELSER

UDGIVNE AF

DET KGL. DANSKE VIDENSKABERNES SELSKAB

BIND X (KR. 23,25):

Kr. Ø.

1. JENSEN, AD. S.: Der grosse europäisch-sibirische Kreuzschnabelzug 1927. 1930 1.00
2. KOLDERUP ROSENVINGE, L.: The Reproduction of *Ahnfeltia Plicata*. 1931 1.75
3. WEIS, FR.: Fortsatte fysiske og kemiske Undersøgelser over danske Hedejorder og andre Podsoldannelser. With an English Summary: Further investigations on danish Heath Soils and other Podsols. Med 2 Tavler. 1932 9.25
4. ENGELBRETH-HOLM, J.: Undersøgelser over den saakaldte Erytroleukose hos Høns. 1932 2.75
5. JENSEN, AD. S.: Studier over *Incurvaria Koerneriella* Zell (Lepidoptera, Incurvariidae). Med 32 Figurer i Texten. Deutsche Zusammenfassung. 1932 2.90
6. BOAS, J. E. V.: Der Hinterfuss von *Caenolestes*. Ein Supplement zu der Abhandlung über den Hinterfuss der Marsupialier. Mit einer Tafel. 1933 1.00
7. HAGERUP, O.: Zur Organogenie und Phylogenie der Koniferenzapfen. 1933 3.20
8. BØRGESEN, F.: On a new Genus of the Lophotalieæ (Fam. Rhodomelaceæ). 1933 0.90
9. MORTENSEN, TH. and KOLDERUP ROSENVINGE, L.: Sur une nouvelle Algue, *coccomyxa astericola*, parasite dans une Astérie. 1933 0.50

BIND XI (KR. 23,50):

1. ASMUSSEN, ERLING und LINDHARD, J.: Potentialschwankungen bei direkter Reizung von motorischen Endplatten. 1933 1.50
2. LIND, J.: Studies on the geographical distribution of arctic circumpolar Micromycetes. 1934 4.50
3. BOAS, J. E. V.: Über die verwandtschaftliche Stellung der Gattung *Antilocapra* und der Giraffiden zu den übrigen Wiederkäuern. Mit 3 Tafeln. 1934 2.40
4. O. HAGERUP: Zur Abstammung einiger Angiospermen durch *Gnetales* und *Coniferae*. 1934 3.20
5. JENSEN, AD. S.: The Sacred Animal of the God Set. 1934 1.00
6. BØRGESEN, F.: Some Marine Algæ from the northern part of the Arabian Sea with remarks on their geographical distribution. With 2 Plates. 1934 3.50
7. MORTENSEN, TH. et KOLDERUP ROSENVINGE, L.: Sur une Algue Cyanophycée, *Dactylococcopsis Echini* n. sp., parasite dans un Oursin. 1934 0.70
8. GABRIELSEN, E. K. und LARSEN, POUL: Über den Kohlenstoffhaushalt der terrestrischen Halophyten. 1935 2.20
9. HAGERUP, O.: Zur Periodizität im Laubwechsel der Moose. Mit 4 Tafeln. 1935 4.50

Bind XII (KR. 23,55):

	Kr. Ø.
1. JESSEN, KNUD: The Composition of the Forests in Northern Europe in Epipalæolithic Time. With the assistance of H. JONASSEN. With 3 Plates. 1935.....	3.75
2. BØRGESEN, F.: A list of Marine Algæ from Bombay. With 10 Plates. 1935.....	4.25
3. KRABBE, KNUD H.: Recherches embryologiques sur les organes pariétaux chez certains reptiles. Avec 19 planches. 1935....	7.00
4. NIELSEN, NIELS: Eine Methode zur exakten Sedimentationsmessung. Studien über die Marschbildung auf der Halbinsel Skalling. Mit 16 Tafeln. 1935.....	5.50
5. BØRGESEN, F. and FRÉMY, P.: Marine Algæ from the Canary Islands especially from Teneriffe and Gran Canaria. IV. Cyanophyceæ. 1936.....	1.80
6. SCHMIDT, S., OERSKOV, J. et STEENBERG, ELSE: Immunisation active contre la peste aviaire. Avec 1 planche. 1936.....	1.25

Bind XIII (under Pressen):

1. BOYSEN JENSEN, P.: Über die Verteilung des Wuchsstoffes in Keimstengeln und Wurzeln während der phototropischen und geotropischen Krümmung. 1936.....	1.50
2. FRIDERICIA, LOUIS SIGURD and GUDJÓNSSON, SKULI V.: The Effect of Vitamin A Deficiency on the Rate of Growth of the Incisors of Albino Rats. 1936.....	1.00
3. JENSEN, AD. S.: Den kinesiske Uldhaandskrabbe (<i>Eriochair sinensis</i> M-Edw.) i Danmark. Med 3 Tavler. Deutsche Zusammenfassung. 1936.....	1.50
4. KROGH, AUGUST and SPÄRCK, R.: On a new Bottom-Sampler for Investigation of the Micro Fauna of the Sea Bottom with Remarks on the Quantity and Significance of the Benthonic Micro Fauna. 1936.....	0.75
5. SPÄRCK, R.: On the Relation between Metabolism and Temperature in some Marine Lamellibranches, and its Zoogeographical Significance. 1936.....	1.50
6. HAGERUP, O.: Zur Abstammung einiger Angiospermen durch <i>Gnetales</i> und <i>Coniferae</i> . II. <i>Centrospermae</i> . 1936.....	3.00
7. HEMMINGSEN, AXEL M. and KRARUP, NIELS B.: Rhythmic Diurnal Variations in the Oestrous Phenomena of the Rat and their susceptibility to light and dark. 1937.....	3.00
8. HEMMINGSEN, AXEL M. and KRARUP, NIELS B.: The production of Mating Instincts in the Rat with chemically well-defined Oestrogenic Compounds. 1937.....	0.50
9. CHIEVITZ, O. and HEVESY, G.: Studies on the Metabolism of Phosphorus in animals. 1937.....	1.25
10. MORTENSEN, TH.: Some Echinoderm Remains from the Jurassic of Württemberg. With 4 Plates. 1937.....	2.50