3 DISCOASTERIDAE, COCCOLITHINAE AND RADIOLARIA

BY

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DISCOASTERIDAE.

INTRODUCTION.

Notwithstanding the fact that representants of this group were already known to Prof. C. G. EHRENBERG, the great micropaleontologist of the first half of the 19th century and subsequent authors have mentioned them from various localities, they have remained almost unknown. Their organic nature too has not always been recognised.

In 1843 Prof. EHRENBERG referred them to his group „Polygastern" with the name *Actiniscus*; in his „Microgeologie", however, they were considered as inorganic bodies and mentioned as „Crystalldrusen", „Scheibensternchen" or „Crystalloids" (Bibl. 2, p. 115, p. 156, etc.). Very accurate descriptions of these forms are given by Mr. HILL from Barbados, where they are found in the calciferous oceanic deposits lying under the famous Radiolarian deposits in the marls directly overlain by the raised coral reefs (Bibl. 4, p. 177 & 216). He called them „crystalloids".

From the Indian Archipelago these asterisks have been discovered by Prof. C. G. EHRENBERG in marls from Timor (Bibl. 2); Messrs. JUKES BROWN and HARRISON mention them from the West Coast of Java (Bibl. 4, p. 215). According to them they occur in depths from 600—2000 fathoms (Bibl. 4, p. 201). Dr. HAUPT has described them from a marl found in the neighbourhood of Finschhafen (former German New Guinea, Bibl. 3).

The organic nature of these asterisks or disks is beyond doubt. For, as they are built up by aragonite, in case of an inorganic origin their stellate shape could only be explained by accepting that they are polyfold twins. Such consequence does not agree with the observation that between crossed nicols the asterisks optically appear as one homogenous crystal. Moreover similar shapes, as shown by the arms of certain *Discoaster*, e. g. *D. Brouweri var.* α, which are characterised by thickened distal ends, has never been met with among twins of aragonite.

According to Prof. ZITTEL (Bibl. 10, p. 560) the „Crystalldrusen" of EHRENBERG might be spicules of Holothuroids. Prof. HAECKEL has attributed the asterisks from Finschhafen to the same organisms (Bibl. 3).

Notwithstanding the fact that certain Holothurians, as *Chirodota gigas* DENDY (Bibl. 1) may show spicules which in immature stage have similar appearance as a *Discoaster*, the present author is of opinion that the asterisks in view do not belong to the Holothuroids, as these organisms, moreover, always show spicules of very characteristic shape, as rods, wheels, anchors, etc. In the numerous rock-specimens containing *Discoaster*, spicules which might with certainty be attributed to the Holothurians, have never been found, a fact which would be in explainable if the *Discoaster* belong to the Holothuroids.

Pending on the final identification of these bodies the present author has called them *Discoaster*.

In the Indian Archipelago the eldest representants of this group have been found in a foraminiferal marl of E. Borneo, occurring with *Nephrolepidina* sp. sp. and *Miogypsina sp.*

In recent seas the Challenger Expedition has dredged them from the Atlantic Ocean (Bibl. 4, Station 338), as appears from the figure 4 of Pl. 11. In the text they have not been mentioned. In this station they occur in a Globigerina-ooze.

The species mentioned below have been described from a young Tertiary, probably Pliocene marl from Bebalain, Rotti.

LIST OF SPECIES.

Discoaster Tan [1]).

Discoaster (Discoaster) Brouweri Tan with its varieties α—δ. — Young Tertiary, Mollucas, Bibl. 7*b*, p. 415.
„ Hilli Tan. — Idem.
„ pentaradiatus Tan, with the same varieties as D. Brouweri. — Idem, p. 416.

Hemediscoaster Tan.

Discoaster (Hemidiscoaster) Molengraaffi Tan, with the same varieties as D. Brouweri. — Idem, Bibl. 4*b*, p. 1097, and Bibl. 7, p. 417.
„ triradiatus Tan [2]). — Idem, p. 417.

Heliodiscoaster Tan.

Discoaster (Heliodiscoaster) barbadiensis var. bebalaini Tan. — Idem, p. 415.
„ Ehrenbergi Tan. — Idem, p. 415.

Remarks: 1) syn. Eudiscoaster Tan.
2) With variaties similar to the α- and β-shape of D. Brouweri.

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COCCOLITHINAE.

INTRODUCTION.

In recent years the sedimentologists have spent more attention on this group of the Flagellata. Rocks are known which are almost totally built up by coccoliths. Systematically the fossil representants of this group have not yet been worked out intensively.

From the Indian Archipelago the eldest coccolithic rocks are represented by the Oxfordian Radiolarian rocks of Rotti (Batoe Hoen and Soea Lain, Bibl. 1 and 4, p. 113). The species mentioned below have been described from the young-Tertiary, probably Pliocene marls from Bebalain, Rotti; they still occur in the recent seas. (Bibl. 3 and 4).

LIST OF SPECIES.

Syracosphaeraceae Kamptner.

Hymenomonas huxleyi (Lohmann). — Young-Tertiary Rotti, Bibl. 3*a*, p. 1098.

„ pellucida (Lohmann). — Idem.

Coccolithaceae Kamptner.

Coccolithus leptophorus (Murr. and Blackm.). — Idem.
„ pellagicus (Wallich). — Idem.
Discosphaera thomsoni Ostenfeld. — Idem.

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4. TAN SIN HOK. Over de samenstelling en het ontstaan van Krijt- en mergelgesteenten van de Molukken. Jaarb. Mijnwezen, 55, Verhand. 3e ged. 1926, p. 111—113.

RADIOLARIA.

INTRODUCTION.

Compared with the Foraminifera the fossil Radiolaria of the Indian Archipelago, notwithstanding the large number of species already known, are but little investigated. The first descriptions are from the hand of Prof. K. MARTIN in 1881. The number of the authors who had made a special study of the Radiolarian paleontology of the Indian Archipelago is very small. From the view point of stratigraphy the Radiolaria are of but small importance.

LIST OF SPECIES.

SPUMELLARIA HAECKEL.

Order BELOIDEA HAECKEL.

Formae incert. sed. („Sphaerozoum") [1]). — Billiton, Bibl. 2, p. 224; Prae-Cenomanian Borneo, Bibl. 3, p. 9; Cretaceous S. E. Borneo, Bibl. 9, p. 249; Jurassic, ? Cretaceous, Rotti, Bibl. 4, p. 700; Triassic Savoe; ? Triassic E. Ceram, E. Celebes, Bibl. 4, p. 700; Ceram, Boeroe, Bibl. 7, p. 172 and 225; Central Celebes, Bibl. 5, p. 954 and 955.
„ incert. sed. — ? Pliocene Rotti, Bibl. 8, p. 33.

Order SPHAEROIDEA HAECKEL.

Formae incert. sed. — ? Pliocene Rotti, Bibl. 8, p. 33.

FAM. LIOSPHAERIDAE HAECKEL EMEND. VINASSA DE REGNY.

Genus Cenosphaera Ehrenberg.

Cenosphaera aculeata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 13; Jurassic Rotti, Triassic Savoe; ? Triassic E. Ceram, Bibl. 4. p. 701.
„ affinis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 12.
„ Cayeuxi Hinde. — Jurassic Rotti; ? Triassic E. Ceram, Bibl. 4, p. 701.
„ crebipora Hinde. — Triassic Savoe, Bibl. 4, p. 701.
„ disseminata Rüst. — Prae-Cenomanian Borneo, Bibl. 3, p. 11.
„ gregaria Rüst. — Prae-Cenomanian Borneo, Bibl. 3, p. 11.
„ hispida Hinde. — ? Triassic E. Celebes, Bibl. 4, p. 702.
„ immanis Tan. — ? Pliocene Rotti, Bibl. 8, p. 34.
„ minuta Pantanelli. — Prae-Cenomanian Borneo, Bibl. 3, p. 12; Celebes, Bibl. 5, p. 954.
„ pachyderma Rüst. — Prae-Cenomanian Borneo, Bibl. 3, p. 11.
„ punctata Hinde. — Jurassic Rotti, Bibl. 4, p. 702.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 12.
„ sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 13.
„ sp. ind. c. — Prae-Cenomanian Borneo, Bibl. 3, p. 13.
„ tumida Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 10; ? Triassic E. Celebes, Bibl. 4, p. 701.

Genus Carposphaera Haeckel.

Carposphaera diversipora Tan. — ? Pliocene Rotti, Bibl. 8, p. 34.
„ Haeckeli Tan. — ? Pliocene Rotti, Bibl. 8, p. 35.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 13.

Genus Styptosphaera Haeckel.

Styptosphaera sp. Tan. — ? Pliocene Rotti, Bibl. 8, p. 35.

Genus Sphaeropyle Dreyer.

Sphaeropyle chonopora Tan. — ? Pliocene Rotti, Bibl. 8, p. 34.
„ fallax Tan. — ? Pliocene Rotti, Bibl. 8, p. 34.
„ nova Tan. — ? Pliocene Rotti, Bibl. 8, p. 34.
„ simplex Hinde . — Jurassic Rotti, Bibl. 4, p. 703.

FAM. DORYSPHAERIDAE NOV. GEN. [2])

Genus Dorysphaera Hinde.

Dorysphaera sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 14.
„ sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 14.
„ sp. ind. c. — Prae-Cenomanian Borneo, Bibl. 3, p. 14.

Genus Doryplegma Hinde.

Doryplegma Mendonense Hinde. — ? Triassic E. Celebes, Bibl. 4, p. 702.

FAM. STYLOSPHAERIDAE HAECKEL.

Genus Xiphosphaera Haeckel.

Xiphosphaera tuberosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 36; Cretaceous S. E. Borneo, Bibl. 9, p. 249.

Genus Stylosphaera Haeckel.

Stylosphaera densiporata Hinde. — Triassic Savoe, Bibl. 4, p. 703.
„ obtusa Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 15.
„ Squinaboli Tan. — ? Pliocene Rotti, Bibl. 8, p. 35.

FAM. STAUROSPHAERIDAE HAECKEL.

Genus Staurosphaera Haeckel.

Staurosphaera sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 15.

FAM. ASTROSPHAERIDAE HAECKEL.

Genus Conosphaera Haeckel.

Conosphaera mammillata Hinde. — Jurassic Rotti, Bibl. 4, p. 703.
„ tuberosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 36.

Order PRUNOIDEA HAECKEL.

FAM. ELLIPSIDAE HAECKEL.

Genus Cenellipsis Haeckel.

Cenellipsis compressa Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 16.
„ favus Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 704.
„ gracilis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 15; Triassic Savoe, Bibl. 4, p. 704.
„ micropora Haeckel. — ? Pliocene Rotti, Bibl. 8, p. 36.
„ praelonga Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 16.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 16.

Genus Ellipsoxiphus Dunikowski.

Ellipsoxiphus rugosus Tan. — ? Pliocene Rotti, Bibl. 8, p. 37.

Genus Lithapium Haeckel.

Lithapium sp. — Jurassic Rotti, Bibl. 4, p. 704.
„ sp. ind. — Prae-Cenomanian Borneo, Bibl. 3, p. 17.
„ spinosum Tan. — ? Pliocene Rotti, Bibl. 8, p. 37.

FAM. DRUPPULIDAE HAECKEL.

Genus Druppula Haeckel.

Druppula arcta Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 17.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 17.
„ ? sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 17.

Genus Stylatractus Haeckel.

Stylatractus ovatus Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 19.
„ Paronae Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 18.
„ tener Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 18.

FAM. SPONGURIDAE HAECKEL.

Genus Spongurus Haeckel.

Spongurus longaevus Parona. — Prae-Cenomanian Borneo, Bibl. 3, p. 20.

Order DISCOIDEA HAECKEL.

FAM. CENODISCIDAE HAECKEL.

Genus Theodiscus Haeckel.

Theodiscus sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 20.
„ sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 21.

FAM. COCCODISCIDAE HAECKEL.

Genus Trigonocyclia Haeckel.

Trigonocyclia sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 21.

FAM. PORODISCIDAE HAECKEL.

Genus Porodiscus Haeckel.

Porodiscus affinis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 21; Triassic Savoe, Bibl. 4, p. 705.
„ elegans Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 22.
„ levis Hinde. — Triassic Savoe, Bibl. 4, p. 705.
„ parvulus Rüst. — ? Triassic E. Celebes, Bibl. 4, p. 705.
„ pygmaeus Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 21.
„ tenuis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 22.

Genus Stylodictya Haeckel.

Stylodictya fimbriata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 22.

Genus Amphibrachium Haeckel.

Amphibrachium cordiformis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 23.
„ crassum Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 23.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 23.

Genus Dictyastrum Haeckel.

Dictyastrum desecatum Rüst. — Prae-Cenomanian Borneo, Bibl. 3, p. 24.
„ speciosum Parona. — Prae-Cenomanian Borneo, Bibl. 3, p. 24.

Genus Rhopalastrum Haeckel.

Rhopalastrum pistillum Hinde. — Jurassic Rotti, Bibl. 4, p. 706.
„ tortum Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 25; Cretaceous S. E. Borneo, Bibl. 9, p. 249.
„ Verbeeki Hinde. — Jurassic Rotti, Bibl. 4, p. 706.

Genus Hagiastrum Haeckel.

Hagiastrum obliquum Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 25.

FAM. SPONGODISCIDAE HAECKEL.

Genus Spongodiscus Haeckel.

Spongodiscus celatus Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 26.
„ cribrosus Tan. — ? Pliocene Rotti, Bibl. 8, p. 37.
„ gracilis Hinde. — Triassic Savoe, Bibl. 4, p. 706.
„ nitidus Hinde. — ? Triassic Rotti; Triassic Savoe, Bibl. 4, p. 706.
„ sp. — ? Pliocene Rotti, Bibl. 8, p. 37.
„ tenuis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 26.
„ textilis Hinde. — Triassic Savoe, Bibl. 4, p. 707.

Genus Spongoloncbe Haeckel.

Spongoloncbe angularis Hinde. — Jurassic Rotti, Bibl. 4, p. 707.

Suborder LARCOIDEA HAECKEL.

FAM. LARCARIDAE HAECKEL EMEND TAN.[3])

Genus Cenolarcopyle Tan.[4])

Cenolarcopyle fragilis Tan. — ? Pliocene Rotti, Bibl. 8, p. 38.

Genus Stypolarcus Haeckel.

Stypolarcus cf. spongiosus Haeckel. — ? Pliocene Rotti, Bibl. 8, p. 38.
„ laboriosus Tan. — ? Pliocene Rotti, Bibl. 8, p. 38.

NASSELLARIA HAECKEL.

Order CYRTOIDEA HAECKEL.

Suborder MONOCYRTIDA HAECKEL.

FAM. TRIPOCALPIDAE HAECKEL.

Genus Tripocalpis Haeckel.

Tripocalpis Ellyae Tan. — ? Pliocene Rotti, Bibl. 8, p. 38.

Genus Tripilidium Haeckel.

Tripilidium obliquum Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 26.

FAM. CYRTOCALPIDAE HAECKEL.

Genus Cornutella Ehrenberg.

Cornutella acuta Tan. — ? Pliocene Rotti, Bibl. 8, p. 39.
„ adunca Tan. — ? Pliocene Rotti, Bibl. 8, p. 40.
„ apicata Tan. — ? Pliocene Rotti, Bibl. 8, p. 39.
„ facilis Tan. — ? Pliocene Rotti, Bibl. 8, p. 39.
„ nitida Tan. — ? Pliocene Rotti, Bibl. 8, p. 39.
„ procera Tan. — ? Pliocene Rotti, Bibl. 8, p. 39.

Genus Archicorys Haeckel.

Archicorys turgida Tan. — ? Pliocene Rotti, Bibl. 8, p. 40.
„ turgida Tan var. *α*. — ? Pliocene Rotti, Bibl. 8, p. 40.

Genus Cyrtocalpis Haeckel.

Cyrtocalpis digitiformis Tan. — ? Pliocene Rotti, Bibl. 8, p. 41.
„ modesta Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 27.
„ operosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 40.
„ pachyderma Tan. — ? Pliocene Rotti, Bibl. 8, p. 41.
„ tessellata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 27.

Genus Archicapsa Haeckel.

Archicapsa ficiformis Parona. — Prae-Cenomanian Borneo, Bibl. 3, p. 27.
„ guttiformis Tan. — ? Pliocene Rotti, Bibl. 8, p. 41.
„ guttiformis var. *α* — ? Pliocene Rotti, Bibl. 8, p. 41.
„ mutila Tan. — ? Pliocene Rotti, Bibl. 8, p. 42.
„ similis Parona. — Prae-Cenomanian Borneo, Bibl. 3, p. 28.
„ sp. — ? Triassic Rotti; ? Triassic E. Ceram, Bibl. 4, p. 707.
„ Tandjani Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 28.

FAM. TRIPOCYRTIDAE HAECKEL.

Genus Dictyophimus Ehrenberg.

Dictyophimus gracilis Tan. — ? Pliocene Rotti, Bibl. 8, p. 42.

Genus Peromelissa Haeckel.

Peromelissa crassa Tan. — ? Pliocene Rotti, Bibl. 8, p. 42.

FAM. SETHOCYRTIDAE HAECKEL.

Genus Sethoconus Haeckel.

Sethoconus Cordayae Tan. — ? Pliocene Rotti, Bibl. 8, p. 42.
„ Nashi Tan. — ? Pliocene Rotti, Bibl. 8, p. 43.

Genus Sethocapsa Haeckel.

Sethocapsa elevata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 29.
„ cometa Pant. sp. — Prae-Cenomanian Borneo, Bibl. 3, p. 28; Jurassic Rotti, Bibl. 4, p. 709.
„ gracilis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 30.
„ hastata Tan. — ? Pliocene Rotti, Bibl. 8, p. 43.
„ Martini Tan. — ? Pliocene Rotti, Bibl. 8, p. 43.
„ nobilis Tan. — ? Pliocene Rotti, Bibl. 8, p. 43.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 29.
„ sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 30.

Genus Dicolocapsa Haeckel.

Dicolocapsa cephalocrypta Tan. — ? Pliocene Rotti, Bibl. 8, p. 44.
„ exquisita Tan. — ? Pliocene Rotti, Bibl. 8, p. 44.
„ inauris Hinde. — ? Triassic E. Celebes, Bibl. 4, p. 709.
„ inclusa Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 30.
„ Verbeeki Tan. — ? Pliocene Rotti, Bibl. 8, p. 44.
„ Verbeeki Tan. var. *α*. — ? Pliocene Rotti, Bibl. 8, p. 44.
„ Wichmanni Hinde. — Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 709.

Genus Stylocapsa Principi.

Stylocapsa hastellata Tan. — ? Pliocene Rotti, Bibl. 8, p. 45.
„ pachyderma Tan. — ? Pliocene Rotti, Bibl. 8, p. 45.
„ pylosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 45.

FAM. PHORMOCYRTIDAE HAECKEL.

Genus Phormocyrtis Haeckel.

Phormocyrtis lagena Hinde. — Jurassic Rotti, Bibl. 4, p. 710.

Genus Sethamphora Haeckel.

Sethamphora pyriformis Hinde. — Jurassic Rotti, Bibl. 4, p. 708.
„ Squinaboli Hinde. — Jurassic Rotti, Bibl. 4, p. 708.

FAM. THEOCYRTIDAE HAECKEL.

Genus Theosyringium Haeckel.

Theosyringium Badauense Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 31.
„ Savuense Hinde. — Triassic Savoe, Bibl. 4, p. 710.

Genus Tricolocampe Haeckel.

Tricolocampe angularis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 32.
„ brevis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 32.
„ pumila Hinde. — ? Triassic E. Ceram, Bibl. 4, p. 711.

Genus Theocampe Haeckel.

Theocampe tumida Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 711.

Genus Theocapsa Haeckel.

Theocapsa curata Tan. — ? Pliocene Rotti, Bibl. 8, p. 46.
„ curata Tan. var. — ? Pliocene Rotti, Bibl. 8, p. 47.
„ elata Tan. — ? Pliocene Rotti, Bibl. 8, p. 47.
„ laevis Tan. — ? Pliocene Rotti, Bibl. 8, p. 46.
„ parvipora Tan. — ? Pliocene Rotti, Bibl. 8, p. 45.
„ simplex Tan. — ? Pliocene Rotti, Bibl. 8, p. 46.
„ urniformis Tan. — ? Pliocene Rotti, Bibl. 8, p. 45.
„ variabilis Tan. — ? Pliocene Rotti, Bibl. 8, p. 47.
„ variabilis Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 47.

Genus Tricolocapsa Haeckel.

Tricolocapsa arrecta Hinde. — Triassic Savoe, Bibl. 4, p. 713.
„ dispar Tan. — ? Pliocene Rotti, Bibl. 8, p. 48.
„ elongata Pant. sp. — Prae-Cenomanian Borneo, Bibl. 3, p. 32; Celebes, Bibl. 5, p. 954.
„ frequens Tan. — ? Pliocene Rotti, Bibl. 8, p. 49.
„ humilis Hinde. — Triassic Savoe, Bibl. 4, p. 712.
„ nodosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 49.
„ pachyderma Tan. — ? Pliocene Rotti, Bibl. 8, p. 48.
„ parva Tan. — ? Pliocene Rotti, Bibl. 8, p. 47.
„ parvipora Tan. — ? Pliocene Rotti, Bibl. 8, p. 48.
„ parvipora Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 49.
„ pauperata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 33.
„ pinguis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 32; Triassic Savoe; ? Triassic E. Celebes, Bibl. 4, p. 712; Cretaceous S. E. Borneo, Bibl. 9, p. 249.
„ pinguis var. — Prae-Cenomanian Borneo, Bibl. 3, p. 32.
„ piriformis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 34; Celebes, Bibl. 5, p. 954.
„ Rüsti Tan. — ? Pliocene Rotti, Bibl. 8, p. 50.
„ Rüsti Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 50.
„ simplex Tan. — ? Pliocene Rotti, Bibl. 8, p. 48.
„ spinosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 49.
„ triangulosa Tan. — ? Pliocene Rotti, Bibl. 8, p. 49.

Genus Hemicryptocapsa Tan. [5])

Hemicryptocapsa capita Tan. — ? Pliocene Rotti, Bibl. 8, p. 50.
„ pilula (Hinde) [6]). — Prae-Cenomanian Borneo, Bibl. 3, p. 33; ? Triassic E. Ceram, Bibl. 4, p. 712.
„ pilula (Hinde) var. [7]) — Prae-Cenomanian Borneo, Bibl. 3, p. 33.
„ pseudopilula Tan. — ? Pliocene Rotti, Bibl. 8, p. 51.
„ regularis Tan. — ? Pliocene Rotti, Bibl. 8, p. 51.

Genus Stylocryptocapsa Tan. [8])

Stylocryptocapsa fallax Tan. — ? Pliocene Rotti, Bibl. 8, p. 52.
„ Verbeeki Tan. — ? Pliocene Rotti, Bibl. 8, p. 51.
„ Verbeeki Tan. var. *α*. — ? Pliocene Rotti, Bibl. 8, p. 52.

Genus Holocryptocapsa Tan. [9])

Holocryptocapsa eclata (Hinde). — ? Triassic E. Celebes, Bibl. 4, p. 711.
„ fallax Tan. — ? Pliocene Rotti, Bibl. 8, p. 52.
„ Hindei Tan. — ? Pliocene Rotti, Bibl. 8, p. 53.

Genus Stichophormis Haeckel.

Stichophormis polita Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 713.

FAM. LITHOCAMPIDAE HAECKEL.

Genus Lithostrobus Bütschli.

Lithostrobus dignus Tan. — ? Pliocene Rotti, Bibl. 8, p. 54.
„ erectus Tan. — ? Pliocene Rotti, Bibl. 8, p. 53.
„ nodosus Tan. — ? Pliocene Rotti, Bibl. 8, p. 53.
„ ornatus Tan. — ? Pliocene Rotti, Bibl. 8, p. 54.
„ parvus Tan. — ? Pliocene Rotti, Bibl. 8, p. 55.
„ pseudomulticostatus Tan. — ? Pliocene Rotti, Bibl. 8, p. 54.
„ pusillus Hinde. — Triassic Savoe, Bibl. 4, p. 713.
„ Tandjani Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 34.

Genus Dictyomitra Zittel.

Dictyomitra affinis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 36.
„ arrecta Hinde. — Triassic Rotti, Bibl. 4, p. 716.
„ australis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 35.
„ cavea Hinde. — Triassic Savoe, Bibl. 4, p. 717.
„ cincta Hinde. — Triassic Savoe, Bibl. 4, p. 716.
„ consobrina Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 36.
„ cribraria Hinde. — ? Triassic E. Celebes, Bibl. 4, p. 714.
„ crassa Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 39.
„ decora Hinde. — Jurassic Rotti, Bibl. 4, p. 715.
„ dilatata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 36.
„ Ehrenbergi Pant. sp. — Prae-Cenomanian Borneo, Bibl. 3, p. 37.
„ Ehrenbergi Pant. var. Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 37.
„ glandula Hinde. — Triassic Savoe; ? Triassic E. Ceram; ? Triassic E. Celebes, Bibl. 4, p. 714.
„ gradata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 40.
„ Haeckeli Pant. sp. — Prae-Cenomanian Borneo, Bibl. 3, p. 37.
„ laevigata Hinde. — Jurassic Rotti, Bibl. 4, p. 715.
„ Lelaini Hinde. — Triassic Rotti, Bibl. 4, p. 717.

Dictyomitra Lilyae Tan. — ? Pliocene Rotti, Bibl. 8, p. 55.
„ mediocris Tan. — ? Pliocene Rotti, Bibl. 8, p. 55.
„ obtusa Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 41.
„ proxima Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 38.
„ pygmaea Hinde. — Triassic Savoe; ? Triassic 0, Ceram; ? Triassic E. Celebes, Bibl. 4, p. 713.
„ pseudoscalaris (Tan) [10]). — ? Pliocene Rotti, Bibl. 8, p. 56.
„ rudis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 38.
„ Savuensis Hinde. — Triassic Savoe, Bibl. 4, p. 716.
„ scalaris Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 40.
„ scansilis Hinde. — Upper Triassic Timor, Bibl. 4, p. 715.
„ scitula Hinde. — ? Triassic E. Celebes, Bibl. 4, p. 717.
„ simplex Hinde. — ? Triassic E. Ceram, Bibl. 4, p. 714.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 35.
„ sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 39.
„ sp. ind. c. — Prae-Cenomanian Borneo, Bibl. 3, p. 39.
„ sp. ind. d. — Prae-Cenomanian Borneo, Bibl. 3, p. 39.
„ superba Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 35.
„ tenuis Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 38; Cretaceous S. E. Borneo, Bibl. 9, p. 249.
„ truncata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 38.
„ velata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 40.
„ venusta Hinde. — Triassic Savoe, Bibl. 4, p. 715.

Genus Lithomitra Bütschli.

Lithomitra catenata Hinde. — Triassic Rotti, Bibl. 4, p. 718.
„ excellens Tan. — ? Pliocene Rotti, Bibl. 8, p. 56.
„ extensa Hinde. — Triassic Rotti, Bibl. 4, p. 717.
„ praelonga Hinde. — ? Jurassic, ? Cretaceous Rotti; Triassic Savoe, Bibl. 4, p. 718.
„ pseudopinguis Tan. — ? Pliocene Rotti, Bibl. 8, p. 57.
„ scalaris Hinde. — Triassic Rotti, Bibl. 4, p. 718.

Genus Eucyrtidium Ehrenberg.

Eucyrtidium Brouweri Tan. — ? Pliocene Rotti, Bibl. 8, p. 58.
„ Brouweri Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 59.
„ Brouweri Tan var. β. — ? Pliocene Rotti, Bibl. 8, p. 59.
„ Brouweri Tan var. γ. — ? Pliocene Rotti, Bibl. 8, p. 58.
„ Brouweri Tan var. δ. — ? Pliocene Rotti, Bibl. 8, p. 57.
„ cincta Hinde, emend. Tan. — ? Pliocene Rotti, Bibl. 8, p. 60.
„ deformis Tan. — ? Pliocene Rotti, Bibl. 8, p. 58.
„ parviporum Tan. — ? Pliocene Rotti, Bibl. 8, p. 57.
„ Thiensis Tan. — ? Pliocene Rotti, Bibl. 8, p. 59.

Genus Eusyringium Haeckel.

Eusyringium gracile Hinde. — Triassic Rotti, Bibl. 4, p. 719.
„ ingens Tan. — ? Pliocene Rotti, Bibl. 8, p. 62.

Eusyringium jaculum Hinde. — Triassic Rotti, Bibl. 4, p. 719.
„ Kruizingai Tan. — ? Pliocene Rotti, Bibl. 8, p. 61.
„ Niobeae Tan. — ? Pliocene Rotti, Bibl. 8, p. 61.
„ Niobeae Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 61.
„ Niobeae Tan var. β. — ? Pliocene Rotti, Bibl. 8, p. 61.
„ Niobeae Tan var. γ. — ? Pliocene Rotti, Bibl. 8, p. 62.
„ Niobeae Tan var. δ. — ? Pliocene Rotti, Bibl. 8, p. 62.
„ parvulum Hinde. — Triassic Rotti, Bibl. 4, p. 719.

Genus Syringium Principi.

Syringium ingens Tan. — ? Pliocene Rotti, Bibl. 8, p. 63.
„ Molengraaffi Tan. — ? Pliocene Rotti, Bibl. 8, p. 63.

Genus Lithocampe Ehrenberg.

Lithocampe elegans Hinde. — Triassic Savoe, Bibl. 4, p. 720.
„ Grutterinki Tan. — ? Pliocene Rotti, Bibl. 8, p. 63.
„ Hanni Tan. — ? Pliocene Rotti, Bibl. 8, p. 64.
„ levis Hinde. — Triassic Savoe, Bibl. 4, p. 720.
„ Mendonensis Hinde. — ? Triassic E. Celebes, Bibl. 4, p. 720.
„ pseudochrysalis Tan. — ? Pliocene Rotti, Bibl. 8, p. 63.
„ pseudochrysalis Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 64.
„ pupoides Hinde. — Triassic Savoe, Bibl. 4, p. 720.

Genus Cyrtocapsa Haeckel.

Cyrtocapsa Asseni Tan. — ? Pliocene Rotti, Bibl. 8, p. 67.
„ Asseni Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 67.
„ Gilseae Tan. — ? Pliocene Rotti, Bibl. 8, p. 68.
„ Grutterinki Tan. — ? Pliocene Rotti, Bibl. 8, p. 64.
„ Grutterinki Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 65.
„ horrida Tan. — ? Pliocene Rotti, Bibl. 8, p. 65.
„ Houwi Tan. — ? Pliocene Rotti, Bibl. 8, p. 65.
„ Houwi Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 67.
„ Indonesiensis Tan. — ? Pliocene Rotti, Bibl. 8, p. 70.
„ Indonesiensis Tan var. — ? Pliocene Rotti, Bibl. 8, p. 70.
„ miserabilis Tan. — ? Pliocene Rotti, Bibl. 8, p. 69.
„ Molengraaffi Tan. — ? Pliocene Rotti, Bibl. 8, p. 66.
„ Molengraaffi Tan var. α. — ? Pliocene Rotti, Bibl. 8, p. 66.
„ Molengraaffi Tan var. β. — ? Pliocene Rotti, Bibl. 8, p. 66.
„ Molukkensis Tan. — ? Pliocene Rotti, Bibl. 8, p. 69.
„ ovalis Tan. — ? Pliocene Rotti, Bibl. 8, p. 66.
„ piriformis Tan. — ? Pliocene Rotti, Bibl. 8, p. 68.
„ pseudocerra Tan. — ? Pliocene Rotti, Bibl. 8, p. 68.
„ pseudonauris Tan. — ? Pliocene Rotti, Bibl. 8, p. 69.
„ pseudoreticulata Tan. — ? Pliocene Rotti, Bibl. 8, p. 69.
„ Rottensis Tan. — ? Pliocene Rotti, Bibl. 8, p. 67.

Genus Stichocapsa Haeckel.

Stichocapsa acerra Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 725.
„ apicata Hinde. — Triassic Savoe, Bibl. 4, p. 723.
„ aspera Hinde. — Triassic Savoe, Bibl. 4, p. 724.
„ Bebalainsis Tan. — ? Pliocene Rotti, Bibl. 8, p. 70.
„ Boengani Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 42.
„ capax Hinde. — Triassic Savoe, Bibl. 4, p. 723.
„ capitata Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 724.
„ cepula Hinde. — Triassic Rotti, Bibl. 4, p. 721.
„ cribrata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 43.
„ crinita Hinde. — ? Cretaceous Rotti, Bibl. 4, p. 722.
„ fenestrata Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 725.
„ fallax Tan. — ? Pliocene Rotti, Bibl. 8, p. 73.
„ fusiformis Hinde. — Triassic Savoe, Bibl. 4, p. 727.
„ hispida Hinde. — Triassic Savoe, Bibl. 4, p. 722.
„ inauris Hinde. — Triassic Rotti, Bibl. 4, p. 721.
„ intermedia Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 42.
„ lageniformis Tan. — ? Pliocene Rotti, Bibl. 8, p. 72.
„ lens Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 43.
„ mucronata Hinde. — Jurassic Rotti, Bibl. 4, p. 726.
„ nitida Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 726.
„ ornata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 41.
„ ovata Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 43.
„ patula Hinde. — Triassic Savoe; ? Triassic E. Ceram, Bibl. 4, p. 723.
„ polita Hinde. — Jurassic Rotti, Bibl. 4, p. 721.
„ procera Hinde. — ? Jurassic, ? Cretaceous Rotti, Bibl. 4, p. 725.
„ pseudocincta Tan. — ? Pliocene Rotti, Bibl. 8, p. 73.
„ pseudodecora Tan. — ? Pliocene Rotti, Bibl. 8, p. 72.
„ pseudopentacola Tan. — ? Pliocene Rotti, Bibl. 8, p. 72.
„ pseudapicata Tan. — ? Pliocene Rotti, Bibl. 8, p. 73.
„ pseudornata Tan. — ? Pliocene Rotti, Bibl. 8, p. 71.
„ pygmaea Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 43.
„ reticulata Hinde. — Triassic Savoe, Bibl. 4, p. 724.
„ rotunda Hinde. — Prae-Cenomanian Borneo, Bibl. 3, p. 41.
„ rustica Hinde. — Triassic Savoe, Bibl. 4, p. 727.
„ Rutteni Tan. — ? Pliocene Rotti, Bibl. 8, p. 71.
„ singularis Tan. — ? Pliocene Rotti, Bibl. 8, p. 73.
„ sp. ind. a. — Prae-Cenomanian Borneo, Bibl. 3, p. 42.
„ sp. ind. b. — Prae-Cenomanian Borneo, Bibl. 3, p. 42.
„ Wichmanni Tan. — ? Pliocene Rotti, Bibl. 8, p. 71.

Genus Artocapsa Haeckel.

Artocapsa bicornis Tan. — ? Pliocene Rotti, Bibl. 8, p. 74.
„ ultima Tan. — ? Pliocene Rotti, Bibl. 8, p. 74.

ANNOTATIONS TO THE LIST OF SPECIES.

For the system of the Radiolaria the present author refer to Prof. HAECKEL's Report on the Radiolaria of the Challenger Expedition.

The comparison of Radiolaria available in section with the isolated ones shows that the former give but an incomplete motion of the form. In consequence, if complete skeletons are not available, systematical study cannot be done in a satisfactory manner. Many of the fossil Radiolaria from the Netherlands Indies, which have been described from slides are but poorly known.

For examination siliceous Radiolarian rocks are to be cut up in not too thin slides. The best results will be obtained in such rocks in which the Radiolaria show off distinctly against a clear matrix. Another way is the preparation of the siliceous rocks by the very laborious method of Dr. SCHWARZ (Bibl. 17). The rocks most favourable for systematical work are the Radiolarian Tripels or marls, from which the forms can be isolated by dissolving the matrix. The isolated forms are then to be mounted in very much diluted Canada-balsam. Such mounting renders possible an examination of the form from all sides, as by a gentle pressure on the cover-slip, they can be brought to rotation.

On some of the forms in the preceding list remarks are to be made; they relate to emendationes or to genera whose diagnosis has only been published in Dutch. The references bear upon the above list.

1. The attribution of these spicules to *Sphaerozoum* is not exact, as such spicules may belong to various genera. After Dr. HINDE „Sphaerozoum" is common in nearly all Prae-Tertiary Radiolarian rocks. (Bibl. 3, p. 9).
2. This new family is established as to include genera with but one single primary radial spine, such as *Dorysphaera* HINDE and *Doryplegma* HINDE. This family is to be placed between the Liosphaeridae and the Stylosphaeridae.
3. The present authors emandatio refer to the enlargement of HAECKEL's diagnosis of the Larcaridae in that sense that this family may also include the forms provided with a pylom. (*Larcopylidae* DREYER).
4. The diagnosis of this genus is: *Larcoidea* without internal Larnacilla-skeleton, without radial spines, provided with a pylom. Genotype: *Cenolarcopyle fragilis* TAN.
5. The diagnosis of this genus is: Tricyrtida eradiata, clausa without apical horn, Thorax hidden in the abdomen. Genotype: *Hemicryptocapsa capita* TAN.
6. Syn. *Tricolocapsa pilula* HINDE.
7. Syn. *Tricolocapsa pilula* HINDE var.
8. The diagnosis of this genus is: Tricyrtida eradiata, clausa, with apical horn. Both cephalis and thorax hidden in the abdomen. Genotype: *Stylocryptocapsa Verbeeki* TAN.

9. The diagnosis of this genus is: Tricyrtida eradiata, clausa, without apical horn. Both cephalis and thorax hidden in the abdomen. Genotype: *Holocryptocapsa fallax* TAN.
10. Syn. *Stichomitra pseudoscalaris* TAN.

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STRATIGRAPHICAL REMARKS.

As many of the Radiolaria of the Netherlands Indies have been found in rocks devoid of other fossils, so that their age had to be arrived at by comparison with Radiolarian faunae of known age, a consideration of the stratigraphical value of the Radiolaria in general will be appropriate.

Persistency of the genera and boundless variability are the striking features of this group of the Rhizopoda. Their eldest representants have been found in the Algonkian phtanites of Brittany; in this earliest dawn of Life, they already occur in a great multitude of forms. Most of them, remarkable enough, can be attributed to recent genera (Bibl. 12). The persistency is furthermore very well illustrated by the fact that in the fossil faunae described from various formations, but very few genera were to be established, which were not yet discerned in Prof. HAECKEL's Report of the Radiolaria collected by the Challenger Expedition. (Bibl. 1).

Every student of Radiolaria will become aware of the marvellous wealth of form; every new systematical investigation always discloses an abundance of new species, notwithstanding the fact that in all Radiolarian faunae so many forms are to be excluded from consideration, as a result of their insufficient state of preservation. In 1892 Dr. RÜST (Bibl. 15, p. 117) one of the well-known Radiolaria-paleontologists of the end of the last century is of opinion that every new occurrence ought to yield fifty new species, an estimate which for some cases has appeared to be too low. So in 1898 Dr. RÜST (Bibl. 16) could discern a further 212 new species in the siliceous limestones of Cittiglio (Italy) from which Prof. PARONA in 1890 already described 90 forms. Prof. SQUINABOL remarks that the 214 species which he described from the Euganei (Italy) were but a part of the whole fauna, ..almeno un altro centenaio di forme resti a discrivere... ... In oltre ad ogni nuova preparazione che si fa, appare qualche forma che prima non era stato veduta, ciò che mi fa supporre che aumentando di molto il numero di preparazioni si fossa certamente portare a molto più del centenaio le forme che restano a descriversi". (Bibl. 18, p. 12). The same can be said of the young Tertiary fauna of Bebalain, Rotti, notwithstanding the fact that already about 140 species are known. (Bibl. 8).

Sedimentologists know that only special circumstances give rise to a Radiolarian deposit; Radiolarian jaspers, cherts, tripolis belong to the more

exceptional sediments. Besides, of these rocks only a part is suited for systematical investigation of its fauna. Dr. RÜST, for example, had to examine 5000 slides for a recolt of 200 species! It is no wonder that our knowledge of the fossil Radiolaria has been acquired from but few occurrences. The 750 species of the European Jurassic and Cretaceous have been derived from about 12 occurrences; the greater part of the 300 forms described from the Netherlands Indies were provided by about 10 localities.

Notwithstanding the thousands of species already known both in fossil and living state, it is evident from the above statements that our knowledge of the Radiolaria covers but a small part of the wealth of forms that actually did exist; it is not yet possible to distinguish index-fossils and if only few forms are found in common in faunae of different regions — which normally is the case — we have but little evidence if any, for the homotaxy of these faunae.

To substantiate this latter opinion the following example may serve. On 8 species identical with forms found in the Carboniferous of the Harz, Dr. RÜST (Bibl. 15, p. 113) inferred that the jaspers of Sicily, from which in total 63 forms have been described, were of Carboniferous age. In agreement with Prof. VINASSA DE REGNY the present author is of opinion that this small number is of little value, if any, for parallelisation; the same number of Paleozoic forms, for instance, was found by Prof. VINASSA DE REGNY in rocks of Tithonian age, notwithstanding the fact that a smaller number of species was known from this locality. In this question the statement of Dr. STEFANI that in the Permo-Carboniferous of Sicily no jaspers exist and that the rocks which Dr. RÜST has examined belong to the Jurassic and the Eocene, clinches the matter. (Bibl. 22, p. 35).

Now Dr. HINDE arrived at a probable Jurassic age for certain rocks of Central Borneo, a conclusion based on the characters of the Radiolaria included in those rocks (Bibl. 3, p. 50). The dates available from the species discerned, are as follows: of the 100 forms described it appears that only 8 species could be identified with forms which have been met with in Jurassic rocks, 2 occur in the Jurassic or Cretaceous and 4 were found in rocks of Triassic age (Bibl. 8, p. 85). These statements show sufficiently that an attempt at establishing the true age of the Radiolarian rocks of Central Borneo from the species of Radiolaria found meets with too great an element of doubt.

Some authors have arrived at the recognition of special features for the Radiolarian faunae of different formations. So in 1892 Dr. RÜST (Bibl. 15) suggests that in the Paleozoic faunae the Cyrtoids are less abundant than in the younger ones. In 1897 Dr. HINDE put into practice this suggestion when determining the age of the cherts of Billiton and in 1900 of the Radiolarian rocks of Central Borneo. This criterion, however, is too unreliable, for many Cyrtoids of globular appearance, such as *Stylocapsa pachyderma* and many others, only show their cyrtoidal character in an axial section. In slides such sections will happen only accidentally and in most cases these Cyrtoids will appear as a *Cenosphaera*. The above suggestion, furthermore, refers to the Paleozoic Radiolaria in

toto as opposite to the Mesozoic Radiolaria as a whole and as such it will not be valid for each separate case. For example, from the Radiolarian fauna of Grotte, Dr. STÖHR states, Bibl. 20, p. 506, „che la fauna delle radiolarie muta non soltanto nelle diverse località, ma anche nella stessa località esistono diversità grandissime: così in un campione di Grotte non si trova quasi altro che Spongiuride e Discide, mentre in un altro prevalgono le Ommitide e le Cyrtide". Dr. RÜST's criterion, when applied to this case would accordingly point to a Paelozoic age for the former one of the two instances mentioned by Dr. STÖHR, which actually form part of one and the same deposit, the age of which was established on other grounds as Miocene. Dr. HINDE found in the diabase tuffs of the Badoengan River, Central Borneo that „sphaeroidal and prunoidal forms are common, but less numerous than the Cyrtoidea", whereas in the marly limestones and marls from the rivers Tepoewai and Gaäng, which he considered as having the same age, he found „forms ..... similar to those in the diabase-tuffs, but they ..... principally belong to Cenosphaera and Cenellipsis and to the Discoidea" (Bibl. 3, p. 506). Thus the percentage of the Cyrtoids in occurrences of the same age is rather unsteady. Very illustrative are furthermore the following examples: the Radiolarian fauna of the Devonian jaspers South Ural from which 37 forms have been described, contains 37 % Cyrtoids (Bibl. 15), the same percentage was found in the coproliths of Jurassic age von Ilsede, Germany with in total 64 species described (Bibl. 14, p. 274). The Radiolarian fauna of the Algonkian of Brittany already contains as much as 65 % Cyrtoids.

In this connection we have to consider Dr. HINDE's further argumentation for the determination of the age of the Borneo Radiolarian rocks, as based on the statement that the proportion of the species of Cyrtoidea has been found to approach most closely to that found in the Jurassic Radiolarian rocks; in other words, we have to trace our knowledge on the relative number of the Cyrtoids in the various Mesozoic formations.

Dr. HINDE's argumentation is based on the fact that no less than 54 per cent Cyrtoids occurs in the Borneo rocks, whereas these percentages are: 22 % for the Paleozoic; 55 % for the Jurassic; 35 % for the Cretaceous and 50 % for the Tertiary. In a preceding paragraph we have already stated that the percentage found for a group in toto is not imperatively valid for each separate case, which statement equally applies to the different formations. It is evident that these percentages only give some general idea of the relative number of the Cyrtoids, their stratigraphical value is, apart from the preceding statement of the very great abundance of the Cyrtoids in the Algonkian of Brittany, not inconsiderably diminished by the ignorance of the percentage for the Triassic, as Dr. RÜST's tabel contains no sufficient Triassic forms. In our special case, for example, this ignorance forms an unsurmountable obstacle for a conclusion of the non-Triassic age of the Borneo-rocks.

The great difference in the percentages of the Jurassic and the Cretaceous faunae, moreover, is but an apparent one, as is shown, for example, by Prof. SQUINABOL, who found 52,7 per cent Cyrtoidea in the Senonian fauna of the Euganei (Bibl. 18) from a total number of 214 forms described,

a percentage which too is very close to that found in the Borneo rocks. After these statements it is evident that as yet the relative number of the Cyrtoids is of no stratigraphical value.

Dr. HINDE's further remark that the principal Cyrtoidean genera of the Jurassic Rocks of Allgäu are also represented in Borneo is of no value, as in the young Tertiary rocks of Rotti, for example, they are found too, besides, occurring in a large number of species, and furthermore these genera are still found in recent faunae.

Another feature, namely the prevalent spined character of the forms in the cherts of Billiton has been considered by Dr. HINDE as indicative of a Paleozoic age, an idea which agrees well with Dr. RÜST's and Prof. SQUINABOL's observation on the simplicity of the skeletons of respectively the Jurassic and Cretaceous Radiolaria (Bibl. 14, p. 11 and Bibl. 18, p. 12). This criterion, however, may be considered very doubtful, especially when one considers Dr. RÜST; statement that the simplicity of the Mesozoic forms is due to their less favourable preservation: the Mesozoic Radiolaria in general have been studied from siliceous limestones, whereas the Paleozoic from hornstones, jaspers or „Kieselschiefer" (Bibl. 15, 119). It is a known fact that of the solid rocks the latter contain the best preserved Radiolaria.

With respect to Prof. SQUINABOL's suggestion (Bibl. 19) that the genus *Saturnalis* may be indicative of the Mesozoic the present author is of opinion that we have still too little evidence. The high percentage of Mesozoic forms, moreover, will certainly be reduced considerably if the delimination of the species of *Saturnalis* is somewhat enlarged. Prof. SQUINABOL himself, writing on the delimination of his species, states: „si può molto facilmente venire alla conclusione che non vi è quasi mai una delimitatione netta tra forme e forma....." Bibl. 16, p. 304. Besides the recent Radiolarian fauna has not yet been investigated in all details. (Bibl. 1, Preface p. 1). Anyhow, in the present state of our knowledge of *Saturnalis*, the prevalence of representants of this genus in the Italian Jurassic and Cretaceous does not impose that they are characteristic for the Mesozoic.

Prof. SQUINABOL (Bibl. 10, p. 12) and Miss CANAVERI (Bibl. 11, p. 4) draw the attention to the different dimensions of the representants of the same genera as found in different formations: namely, in comparison with the Miocene forms the Cretaceous ones seems to possess larger dimensions. Dr. RÜST, on the other hand, states that „in ihrer Gesamterscheinung..... in den alten (= paläozoischen) Schichten viel häufiger sehr grosse und mit starken Kugelschalen ausgestattete Formen auftreten, als in den mittleren.....". Similar differences in dimensions have been found in the Radiolarian fauna of Central Borneo which are considered as being of the same age: Dr. HINDE, namely, observed that the forms prevalent in the tuffs are, as a rule, of smaller proportions than those in the cherts and jaspers (Bibl. 3, p. 47). In the samples of Rotti which practically belong to one and the same occurrence similar differences have also been found. These differences thus have probably nothing to do with the age of the faunae. As the dimensions and the thickness of the Radiolaria of the respective samples of Rotti show a correlative relation, in sofar that

larger and thicker skeletons of the same species occur in a greater percentage in the one than in the other sample, I have come to the explanation, in agreement with Prof. HAECKER's observations on the Radiolaria of the Valdivia-Expedition that possibly the larger and thicker forms are representants of greater depths, so that these differences, as observed in Rotti, are possibly due to bathymetrical causes. The bathymetrical value of the Radiolaria being in general not well understood some quotations from Prof. HAECKER's Report will not be superfluous. On page 562 (Bibl. 13) it says: „In sehr auffälliger Weise macht sich beinahe in allen Tripyleengruppen den Gegensatz zwischen den kleinen Formen der warmen Oberflächenschichten und den grossen Arten der kühleren und damit dichteren und zäheren Schichten gelten und zwar lassen sich fast immer zwei Grössenkategorien unterscheiden, nämlich die oberflächlichen Zwergformen und die tiefenlebenden Riesenformen". After the results of the investigation on the Radiolaria of Rotti it seems that the application of this rule holds good also for the Sphaerellaria and Cyrtellaria too. On page 570 of Prof. HAECKER's Report it further says: „In besonders schöner Weise tritt die Derbschaligkeit der Tiefenformen in den Gruppen der Sphaerellarien und Cyrtellarien hervor. Trotzdem die Kenntnis dieses für die Tiefseeforschung neugewonnenes Gebietes, erst in den Anfängen begriffen ist, und trotzdem das vorliegende Schliessmaterial noch sehr grosse Lücken aufweist, kann doch mit grosser Wahrscheinlichkeit der Satz aufgestellt werden, dass auch unter den Sphaerellarien und Cyrtellarien die Oberflächenformen im Ganzen zierliche dünnschalige, die Tiefenformen dagegend sehr derbwandige, zum Teil sogar verhältnismässig grobe und plumpe Skelette besitzen". For the sedimentological elaboration of these questions I refer to my paper (Bibl. 8).

When admitting that the percentage of lime or clastic material in a sediment is closely connected with the depth at which it was laid down, the above cited observations of Dr. RÜST and Dr. HINDE on the differences of the dimensions of the Radiolarit can be explained in the same way by differences due to bathymetrical causes. The Paleozoic Radiolaria namely in Dr. RÜST's papers, appear to have been derived from jaspers, hornstones, lytides and „Kieselschiefer" in which, besides the Radiolaria, only sponge-spicules have been found, whereas the Mesozoic forms have generally been studied from limestones and siliceous limestones, in which fossils with calcareous skeletons occur too. Jaspers and hornstones play but an unimportant part in Dr. RÜST's collection of the Mesozoic Radiolarian rocks. Dr. HINDE's observation is made from the jaspers and cherts of the Upper Kapoeas Plain on the one hand in which no admixture of terrigenous material has been found, and, on the other hand from the diabase tuffs South of the Semitau Hills and marls and marly limestones. The forms with smaller dimensions, now, have been found in the latter rocks. These petrographical dates again agree with the view of bathymetrical differences.

Recapitulating the above statemens the present author is of opinion that for parallelisation the Radiolaria give but very little evidence, if any; no index-fossils are as yet known; if only few species are found in common in faunae of different localities which has been the normal

case no conclusion can practically be arrived at as regards the homotaxy of these faunae.

The only geological value with which the Radiolaria can be credited is the fact that the morphology of their skeletons seems to be a function of the temperature of the zone in which they lived, in consequence a function of the depth too, but this value is diminished by the circumstance that in a Radiolarian deposit the Radiolaria of all the higher zones of depth are represented.

On the Age of the Radiolaria of the Indian Archipelago.

In the above list of the fossil Radiolaria, according to the views exposed in the preceding chapter the age of the species is taken as follows:

1. the Radiolaria of the cherts of Billiton are of unknown age.
2. the Radiolaria of Central Borneo are Prae-Cenomanian as concluded from the fact that the rocks are overlain by sandstones with *Orbitolina concava.*
3. the Radiolaria of the Moluccas, as described by Dr. HINDE are partly Triassic. This is the case with those which have been found in rocks whose age can he determined by other fossils as *Halobia, Daonella, Astroconites,* etc. Another part must be attributed to the Jurassic or possibly to the Cretaceous as has been ascertained by Prof. BROUWER. (Bibl. 57*a*, p. 68). The age of the other Radiolarian cherts and jaspers of the Moluccas are taken in correspondence with the dates available in Dr. HINDE's paper. The Radiolaria of the Isle of Rotti in the present author's paper are according to Prof. BROUWER (Bibl. 10) of Young-Tertiary age, possibly Pliocene.

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