161. Tertiary Foraminiferous Rocks of Taiwan (Formosa).

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(Comm. by H. YABE, M.I.A., Oct. 2, 1928.)

Microscopical examination of 81 sorts of samples of Tertiary rocks, with larger foraminifera, derived from Taiwan (Formosa) revealed that each of them falls in one of the following categories: (A) Orthophragmina and Nummulites limestone, (B) Spiroclupeus and Eulepidina limestone, (C) Nephrolepidina-, Nephrolepidina and Miogypsina-, Miogypsina-, Cycloclypeus-, Operculina and Nephrolepidina-limestone, (D) Ditrupa rocks, either containing Miogypsina and Operculina or Operculina only, (E) Operculinella sandstone and marl, (F) Globigerina marl and limestone, (G) raised coral limestone, (H) limestone containing geologically indifferent forms of foraminifera. The geographical distribution of the materials is shown in the annexed table.

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A is the oldest foraminiferous horizon of the Tertiary of Taiwan now known to us and occurs at a single locality (Kunanau-sha, Choshū-gun, Takao Prefecture; the rock is sandy limestone with two species of Discocyclina and a small form of Nummulites; it is very similar to the Orthophragmina rock of the Philippines, reported by us in a recent paper.1) It is evidently not younger than the older Oligocene.

B represents a younger horizon, approximately of Aquitanian stage, and occurs only on the small islet Botel-tobago; it is a limestone with Spiroclupeus leupoldi VLERK and Eulepidina sp.

The rocks of C and D groups belong to the coal bearing Arisan formation2) which has an extended distribution in northern Taiwan. Those of C group, containing Cycloclypeus communis, Lepidocyclina

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verbeeki, Miogypsina dehaartii var. formosensis among others, and believed to be Burdigalian in age are derived from a horizon lying just above the lower series of coal seems, while those of D group, with Operculina bartschi, Operculinella venosa and Miogypsina, represent another horizon, about 300 m higher.

The geological age of E, Operculinella rocks, with O. venosa only, is hardly to settle on the fossil evidence; although most of them are obtained from the Byōritsu formation, younger than the Arisan, some of them are quite similar to the Operculinella rocks of the Philippines, cited in another paper.

We know now very little about the stratigraphical position of the Globigerina rocks of F, and these are derived from the fields partly of the Byōritsu formation and partly of the next younger Shokkōzan. There are Globigerina marls which strongly recall that of the Shimajiri Group of Okinawa-jima, Riukiu Islands.

G includes all the limestones derived from the raised coral limestone formation, geological age of which has been discussed by us in another occasion.


Of these forms, there are two worthy of special attention:

1) **Miogypsina** (Miogypsinoïdes, nov. subg.) *dehaartii* Vlerk

   formosensis, nov. var.

   This is distinguished from the typical *M. dehaartii*\(^1\) in the relative position of early chambers, spirally arranged in the median plane, to the apical border of the test. While the apical part of test is occupied by the second chamber in the typical *dehaartii*, this is done by the eighth chamber in this variety, and this disposition of the early chambers are constant in all the specimens of the latter microscopically examined. *M. dehaartii* (including this variety and *M. abunensis* Tobler\(^2\), which apparently does not much differ from *M. dehaartii*) is distinguished from all the other species of *Miogypsina*, in having thick lateral-walls, of lamellar structure on the site of several layers of lateral chambers characterising the typical forms (including the genotype *M. irregularis* Michelotti) of *Miogypsina*, and deserves at least subgeneric separation from them. In this feature, *Miogypsina* recalls *Spiroclypeus* and *Miogypsinoïdes* (a new subgenus for *M. dehaartii*) *Cycloclypeus*.

2) **Lepidocyclina sumatrensis** (Brady) forma mirabilis nov.

   There is an aberrant type of *Lepidocyclina* shells. It is more or less spherical, bipolar and tricarinate, with the intervening surface either somewhat convex, almost flat or concave; the layer of median chambers are arranged on three planes each of which extends from the axial line to one of the three carinae. Consequently the test is trigonal in all sections transversal to the axial line. Otherwise there is no difference between the normal *L. (N.) sumatrensis* (Brady)\(^3\) and the present type.

   The monstrous shells are due to aberrant growth, but can not be twinshells, because the nucleoconch is always single; nor they are a product of an accidental lobe-formation of test, because all the three planes of median chambers extend inwards to the outer wall of one and the same nucleoconch which lies at the center of the test. This particular mode of growth should be called trigonolepidine, and our specimens of *L. sumatrensis* in this mode of growth should be distinguished as forma *mirabilis*. It is richly found in a limestone from Taikanko, Mizuho-ku, Kwarenkō District, in association of *Lepidocyclina*

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1) I. M. Van der Vlerk: *Miogypsina dehaartii* nov. sp. de Larat (Moluques). Eclogae Geol. Helv., XVIII, 1924, p. 429.
2) A. Tobler: Verkalkung der Lateralkammern bei *Miogypsina*. Ibid., XX, 1926; p. 323.
(N.) sumatrensis, L. (N.) taiwanensis Y. and H., Cycloclypeus communis Martin, Operculina (Operculinella) venosa (F. et M.), and several other indifferent forms.

In general, monstrous orbitoidal shells seem to be rather of rare occurrence, one figured by W. P. Carpenter in "Introduction to the Study of Foraminifera" (Orthophragmina fortisi, Pl. XX, Fig. 15) and another by K. Martin in "Die Fossilien von Java"1) (Lepidocyclina multipartita, Pl. I, Fig. 9) being most familiar to us, and the latter strongly simulates our form in a section vertical to the axial line. We found also a specimen, in trigonolepidine growth, of Lepidocyclina (N.) taiwanensis in a limestone from Iriomote-jima, Riukiu Islands, which, besides, contains, L. (N.) taiwanensis in normal growth and L. (N.) angularis Newton and Holland.

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1) Samml. Geol. Reichs Mus. Leiden, N. F., I, 1905. Die Foraminiferen führenden Gesteine, p. 9, Pl. I, Fig. 9.