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THE CORAL GENUS *DARWASOPHYLLUM* PYZHJANOV, AND A RELATED CORAL FROM S. W. JAPAN

by

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(with 1 plate)

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A single geyerophyllid coral from the Akiyoshi district in Southwest Honshu, Japan, is the object of this short note. Although poorly preserved, this coral seems clearly to belong to the family Geyerophyllidae MINATO. As such, it is of interest in further defining the geologic and geographic distribution of this unusual group of rugose corals.

Since the Geyerophyllidae was originally proposed by MINATO in his comprehensive study of Japanese Carboniferous and Permian corals (1955, p. 155), the diagnosis of this group has been somewhat modified. Of primary importance was the recognition (DE GROOT, 1963; HAYASAKA & MINATO, 1966) that the axial structure of geyerophyllid genera such as *Lonsdaleoides* is connected to the cardinal, rather than the counter septum. Subsequent studies by MINATO and KATO (1967) and MINATO and ROWETT (1967) have added further information pertaining to this group of corals. Although some facets of the relationship of geyerophyllid corals to similar corals with amygdalophylloid, axolithophylloid and carcinophylloid axial structures remain unresolved, it seems advisable at this time to offer a revised diagnosis of this family as follows:

Family *Geyerophyllidae* MINATO, 1955

Geyerophyllidae MINATO, 1955, p. 155

Geyerophyllidae, DOBROLYUBOVA, 1962, p. 330

Koninckocariniidae DOBROLYUBOVA, 1962, p. 332

Loosely fasciculate or sometimes solitary rugose corals in which corallites are primarily characterized by having clinotabulae or clinotabellae as well as transverse tabellae, an axial structure that originates, at least in the early growth stages, from the axial elongation of the cardinal septum. The axial structure is a swollen colu-

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mella in the early stages but may become denticulated as far as it reaches carcino-phylloid or axolithophylloid axial column in later stages. Lonsdaleoid dissepiments may develop with variable degrees. Septa occur in two orders and are dif-fuso-trabecular in fine structure. Peripheral thickening of septa may sometimes be laterally coalesced with each other to form a distinct stereozone. Normal dissepimentarium is often masked by the well developed stereozone. Fossula indis-tinct. Rejuvenescence common.

Included genera: Within the limit of the above definition, the following genera appear to be referable to the Geyerophyllidae.

Kionophyllum CHI, 1931 (= *Geyerophyllum* HERITSCH, 1936)

Carinthiaphyllum HERITSCH, 1936

Lonsdaleoides HERITSCH, 1936

Koninckocarinia DOBROLYUBOVA, 1937

Amygdalophylloides DOBROLYUBOVA & KABAKOVICH, 1948

Axolithophyllum FOMITCHEV, 1953

Darwasophyllum PYZHJANOV, 1964

The genus *Carniaphyllum* HERITSCH (1936) may be a geyerophyllid coral but its assignment to this group will require restudy of the type species. The genus *Paracarruthersella* YOH (1961) may also belong to this group but this can not be confirmed at present, as is discussed below.

Although geyerophyllid corals appear not to have developed from lophophyl-lidiid antecedents, as was initially thought, clarification of phylogenetic relations of this group must await a comprehensive study of all genera involved.

Distribution: Searches on literatures reveal that corals of the family Geyerophyllidae are stratigraphically limited within Upper Carboniferous and Lower Permians (Sakmarian). Geographically they are distributed from Spain to the west, Spitz-bergen to the north, and as far as to Japan in the east. More specifically they are found in Spain, North Africa, Carnic Alps, Yougoslavia, Greece, Iran, Moscow basin, Donetz basin, Spitzbergen, Darwas in central Asia, Karakorum, Viet-Nam, South China and Japan. These are mostly within the realm of so-called Tethyan region, but some are found even in "boreal region".

Genus *Darwasophyllum* PYZHJANOV, 1964

Darwasophyllum PYZHJANOV, 1964, p. 170

? *Paracarruthersella* YOH, 1961, p. 5 & 13

Type species by original designation: *Darwasophyllum irregulare* PYZHJANOV, 1964

Bashkirian-lower Moscovian, Southern Darwas.

Generic diagnosis: Loosely fasciculate Geyerophyllidae with well developed lonsdaleoid dissepiments and carcinophylloid axial column. Wall thick. Stereozone prominent especially in young stages.

Hitherto described species:

Darwasophyllum irregulare PYZHJANOV, 1964

Darwasophyllum irregulare PYZHJANOV, 1964

D. irregulare forma *compacta* PYZHJANOV, 1964

D. sp. ((PYZHJANOV, 1964)

Remarks: PYZHJANOV (1964) classified his new genus as a member of Petalaxidae. The presence of clinotabulae and lonsdaleoid dissepiments in *Darwasophyllum* might have led him to consider this assignment. Yet in fact, as we consider, the genus *Darwasophyllum* is much more closely related to Geyerophyllidae. Amongst genera of this family, *Darwasophyllum* differs from *Amygdalophylloides* in having well developed lonsdaleoid dissepiments, large axial column and fasciculate corallum. It also differs from *Carinthiaphyllum* in possessing large lonsdaleoid dissepiments and axial column instead of columella like in the latter genus. Although the question is remained unsolved as to the true nature of corallum, *Lonsdaleoides* bears some resemblance with *Darwasophyllum*, which is distinguished from the former in having large lonsdaleoid dissepiments and prominent inner wall.

The genus *Paracarruthersella* was proposed by YOH (1961) for *Carruthersella*-like corals from the "Upper Carboniferous" Maping limestone of China, may possibly be synonymous with *Darwasophyllum*. For several reasons, however, we are inclined to regard this genus as unrecognizable until such time as the type materials can be restudied and redescribed. Although YOH's *Paracarruthersella bryocolumellata*, type species of the genus under consideration, appears to be a geyerophyllid coral and possesses declining tabulae and peripheral lonsdaleoid dissepiments, the relationship of the axial structure to the cardinal septum can not be determined with certainty from either his illustrations or description. The type species is illustrated by only two transverse and one longitudinal section (YOH, 1961, pl. 1, figs. 2, 3) that show only the ephebic stages. Furthermore the specimens described by YOH as the basis of the genus *Paracarruthersella* is said to have been collected a long time ago from unknown locality in the "Maping limestone" in South China. It therefore may be many years before either the precise stratigraphic occurrence or systematic position of these corals can be established.

Darwasophyllum sp. aff. *D. irregulare forma compacta*
PYZHJANOV, 1964

Pl. 10, figs. 1-6

Compare with: *Darwasophyllum irregulare forma compacta* PYZHJANOV, 1964, p. 173, pl. 1, fig. 4.

Material: One incomplete corallite, collected in matrix, from the Ryugoho, Akiyoshi-dai, Mito-cho, Miné-gun, Yamaguchi Pref., S.W. Honshu, Japan. Moscovian Fusulinella zone of the Akiyoshi limestone group. Coll. M. MINATO. Four transverse sections UHR 18475 a-c, f) and two longitudinal section (UHR 18475 d & e) were prepared.

Description: Although possibly solitary, the corallite is judged to have been part of a fasciculate corallum; according to the collector, M. MINATO, the corallite was found in limestone matrix together with several other specimens that unfortunately poorly preserved and not collectable. The proximity of these specimens, however, suggests that they comprised a loosely fasciculate corallum. The exterior of the corallite is only partially visible as having well developed septal grooves and inter-septal ridges. These can also be seen in the undulated nature of epitheca in transverse sections. Rugae appear to be subdued or absent.

Four successive transverse sections of the early and middle ephebic stages have alar diameters of 6.1 mm, 6.4 mm, 6.7 mm and 8.2 mm respectively. The lower two of these are peripherally eroded, and only in the uppermost is the epitheca and peripheral dissepimental zone entirely preserved. The epitheca is approximately 1.0 mm in thickness in this section but appears to have been somewhat thicker in earlier sections.

Septa are of two orders; major septa increase from 20 in the lowest section to only 22 in the highest; the septal arrangement in this section appears to be K 5 A 4 C 4 A 5 K. Major septa are pinnately disposed in the early ephebic stage, but this arrangement is less obvious in later stages. Septa are up to approximately 3 mm in length (measured from the outer wall), subequal in width or slightly rhopaloid in the earlier stages, and, except for the cardinal septum, do not extend to the axial structure. Minor septa appear first in the cardinal quadrants in the early ephebic stage but are well developed and about 1/3 as long as the major septa in latter stages. Both major and minor septa are interrupted by large lonsdaleoid dissepiments in the middle ephebic stage, but in a few cases cross the dissepimental zone to the

epitheca. Secondary deposits of skeletal material at the inner edge of the dissepimentarium produces a pronounced stereowall which superficially resembles the effect of rejuvenescence in the highest section. Septal microstructure is diffuso-trabecular.

The axial structure of this coral consists of a solid oval amygdalophylloid column with a distinct dark median lamella. Short calcite fibres can be observed to be oriented perpendicularly to this lamella immediately adjacent to it, but the remainder of the axial structure consists of irregularly radial calcite fibres. Both transverse and longitudinal sections indicate that the median lamella of the axial structure is vertically continuous. The axial structure is more prominent in the early ephebic stage, where it is 3.1 mm in length and 2.1 mm across (equal to approximately 1/3 the diameter of the section). In higher sections the axial structure is reduced to a length of 2.8 mm and a diameter of 0.9 mm and thus comprises only about 1/8 of the diameter.

Tabulae intersected by transverse sections are highly irregular in disposition and in part fragmental. A few "normal" dissepiments may be present between the major and minor septa but these are difficult to distinguish from peripheral tabulae in transverse sections.

The two longitudinal sections, although in part oblique, clearly show the compact axial structure and continuous median lamella. Two or three rows of peripheral dissepiments are also visible, and irregular but in general subhorizontal or axially declined tabulae (clinotabulae). A few axial tabellae are separated from the otherwise solid column and are steeply inclined or vertical.

Comparison: This corallite is superficially similar to corals described by YOH (1961) as *Paracarruthersella bryocolumellata* and by PYZHJANOV (1964) as *Darwasophyllum irregulare*. For reasons discussed below, it nevertheless can not be assigned with confidence to either species.

The former species appears to be different in several respects from the specimen from Japan; it is a much larger form, with a maximum diameter of 11×14 mm, and has more numerous septa (up to 32); moreover, major septa appear to have zig-zag carinae (cf. pl. 1, fig. 2 c), although this is not mentioned in the text description. The axial structure of *P. bryocolumellata* is considerably less compact than that of the corallite described above and consists of a loose aggregate of axial tabellae and irregular lamellae. Further differences include a more regular disposition of tubulae and better developed lonsdaleoid dissepiments in YOH's species.

The genus *Darwasophyllum* was based upon corals described by PYZHJANOV (1964) as *D. irregulare* and *D. irregulare* forma *compacta* from the Middle Carboniferous (Bashkirian to lower Moscovian) of Russia. This species is also similar in some respects to the present specimen, especially with respect to the disposition of tabulae. However, *D. irregulare* (ibid., 1964, p. 171, pl. 1, figs. 1-3) also is a much larger form and also has more numerous septa and a wider zone of lonsdaleoid

dissepiments. The axial structure of *D. irregulare* corresponds more closely to that of *P. bryocolumellata* than to the compact axial structure of the present specimen; however, that considerable variability is present in this species is suggested by the morphology of *D. irregulare* forma *compacta* (ibid., 1964, p. 173, pl. 1, fig. 4), which is similar to the present corallite in size, construction of the axial structure and development of lonsdaleoid dissepiments. Longitudinal characters unfortunately are not shown, however, which precludes detailed comparison at this time.

"*Lophophyllidium*" *uzurensis* YAMAGIWA & OTA (1963) from the Carboniferous of the Akiyoshi limestone is possibly genetically closely related to the present form in having simple axial structure, thick wall, diffuso-trabecular septa and nearly complete subhorizontal tabulae. But the former differs from the latter in showing very short minor septa, ill developed dissepiments, a plain columella and no lonsdaleoid dissepiments. Thus it should be at least specifically distinguished from the present form. The species may be better transferred to the genus *Amygdalophylloides*.

Acknowledgements

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PLATE 10 AND EXPLANATION

Explanation of Plate 10

(All figures eight times natural size.)

Figs. 1—6 : *Darwasophyllum* sp. aff. *D. irregulare* forma *compacta* Pyzhjanov.

Successive thin sections cut from the single corallite, UHR 18475 from Ryugoho,
Akiyoshi-dai, Miné-gun, Mito-cho, Yamaguchi Prefecture.

Figs. 1, 2, 3 & 6 are cross section, figs. 4 and 5 are longitudinal ones

Plate 10

