



HOKKAIDO UNIVERSITY

Title	Some Upper Palaeozoic Corals from Turkey
Author(s)	Kato, Makoto
Citation	北海道大学理学部紀要, 19(1-2), 137-148
Issue Date	1979-03
Doc URL	https://hdl.handle.net/2115/36677
Type	departmental bulletin paper
File Information	19_1-2_p137-148.pdf



SOME UPPER PALAEOZOIC CORALS FROM TURKEY

by

Makoto Kato

(with 3 text-figures and 2 plates)

(Contribution from the Department of Geology and Mineralogy,
Faculty of Science, Hokkaido University, No. 1629)

Abstract

Three Upper Palaeozoic corals from three different horizons are first described from the Sainbeyli region of Turkey. *Waagenophyllum* (W.) *kueichowense* Huang horizon is probably the Permian Khachik age. *Kueichouphyllum yabei* Minato horizon is the Viséan and *Caninia cornucopiae* Michelin horizon may be the Tournaisian in age. Both *Waagenophyllum* and *Kueichouphyllum* are the elements of old Tethyan faunal realm in the Permian and in the Carboniferous respectively, thus indicating that in general Turkey was a part of that palaeobiogeographical province during most of the Upper Palaeozoic.

Introduction

In 1972 a team of Turkish and Japanese geologists visited the Sainbeyli region, southeast of Kayseri, Central Turkey, in order to make a preliminary field investigation in connection with the Permian/Triassic boundary problems in the Tethyan faunal realm (Text-fig. 1).



Fig. 1 Index map showing the location of the Sainbeyli region (white arrow), from where some corals were collected.

Amongst fossils collected at that time only bryozoans were described by Sakagami (1976) from a bed within the Permian succession. And he concluded that bryozoan fossils there were related to those from the Julfian region and that the horizon was correlatable to the Gnishik horizon of the Armenian Julfa.

Three corals from three apparently different horizons were collected also at that time

from the same region. They are:

Waagenophyllum (W.) *kueichowense* Huang

Kueichouphyllum yabei Minato

Caninia cornucopiae Michelin

These corals were collected along a section depicted by Sakagami (1976, fig. 1) in Naltas, north of Sainbeyli (Text-fig. 2), and were trusted to the author for study.

To our knowledge Upper Palaeozoic corals have been little investigated in Turkey.

We may refer to Enderle (1901), Heritsch (1939) and Flügel (1955) for Permian corals. Minato and Kato (1965) commented on waagenophyllid corals described in the above cited articles.

For Carboniferous corals, works by Charles (1933), Heritsch (1941) and Flügel and Kiratolioglu (1955) are present. Mention was made by Hill (1948) on the corals which Charles described. More recently Ünsalaner-Kiragli (1958) described some Lower Carboniferous corals from various localities in Turkey.

Records therefore have been not thorough and satisfactory, and it is the purpose of the present paper to describe the above mentioned three species, with a consideration upon their ages, and to add little knowledge to the Turkish Upper Palaeozoic coral faunas.

Acknowledgements

The author acknowledges Prof. M. Minato of Hokkaido University for encouragements and supervision. Prof. K. Nakazawa (Kyoto Univ.) and Prof. K. Nakamura (Hokkaido Univ.) kindly entrusted the author the coral specimens they collected. Other members of the Expedition, Messrs. E. Göger and A. Özcan of MTA (Ankara, Turkey), Professors Y. Bando (Kagawa Univ.), K. Ishii (Himeji Univ. of Industry), M. Murata (Kumamoto Univ.), Y. Okimura (Hiroshima Univ.) and S. Sakagami (Chiba Univ.) supplied the author with necessary field informations. Prof. T. Bamba of Hokkaido Univ. instructed the author on some literatures on Turkish Geology. Mr. S. Kumano and Miss E. Mima of our department helped the author in the preparation of manuscript.

To all these persons the author would like to express his hearty thanks.

Age of the coral bearing horizons

Now let me consider the age of three coral bearing horizons.

Caninia cornucopiae Michelin was originally described from the Tournaisian of Belgium, but the species is now known to occur both from the Tournaisian and Viséan of Eurasia and Africa. It is therefore not indicative of precise age by it alone.

However *Syringothyris*, *Leptagonia* and *Unispirifer* have been obtained from nearby localities to the present one by Turkish geologists (verbal information given to Nakazawa by Göger of MTA). It is therefore quite certain that the Tournaisian deposits do exist in this region of Sainbeyli, from which *Caninia cornucopiae* is likely to have been obtained. This small, ceratoid coral was actually picked up by Nakamura, with no accompanied fossils from a horizon well below the *Kueichouphyllum* horizon which is depicted in a section shown in Text-fig. 2.

The Tournaisian limestone was reported underlying the Permian in Northern Iraq (Hudson, 1958), not very distant from the present Turkish locality. *Caninia cornucopiae* was listed there together with *Zaphrentis delanouei* (Edwards and Haime), *Actinoconchus lamellosus* (Léveillé), *Spirifer* aff. *tornacensis* deKoninck, *Syringothyris cyrtorhyncha* North and so on.

Also from Iranian Baluchistan Douglas (1950) listed an assemblage of "*Caninia*" aff. *cylindrica* (Scouler), *Caninia* aff. *cornucopiae* Michelin, "*Zaphrentis*" *delanouei* (Edwards and Haime), *Syringothyris cuspidata* (Martin), etc. The combination suggests a fauna characteristic of the late Tournaisian.

The Tournaisian deposits in the above mentioned three localities, though widely separated with each other at present, might have formed a continuous belt in the Carboniferous.

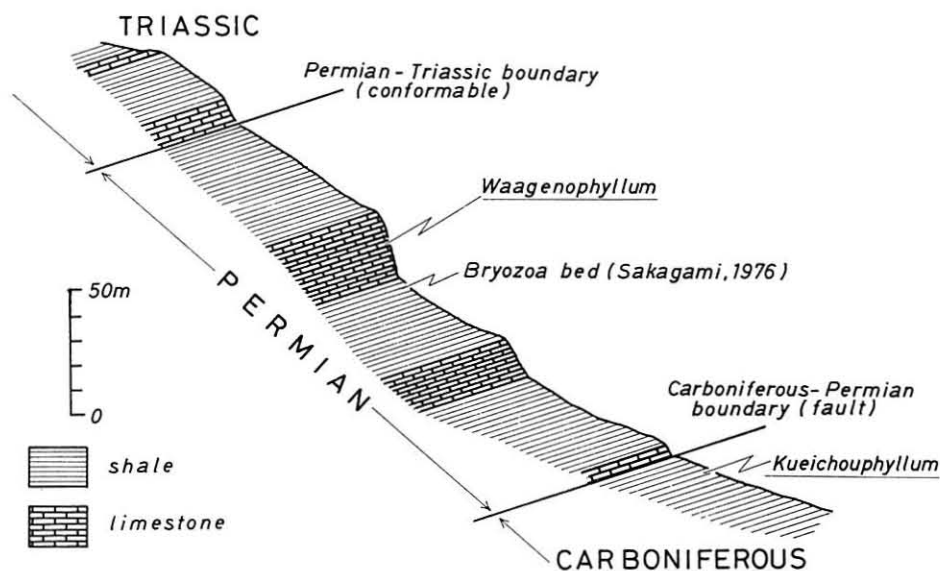


Fig. 2 Schematic geological profile showing the coralline horizons within the Carboniferous-Triassic succession in Naltas, north of Sainbeyli, Turkey (after the field investigation by Nakazawa et al, in 1972)

In the next, a specimen of *Kueichouphyllum* collected by Nakazawa (Text-fig. 2), which is turned up to be *Kueichouphyllum yabei* Minato, is brought into consideration. This species was first described from the Upper Viséan Onimaru Series of N.E. Japan, and it is essentially characterized by having long minor septa and very conspicuous cardinal dilation of all septa in the intrathecal region. Several previously described forms of *Kueichouphyllum* would be best classified as *Kueichouphyllum yabei*, as a list of synonymy in the following description indicates it. *Kueichouphyllum yabei* was recorded from Turkey already by Flügel and Kiratolioglu (1955), the occurrence of which is very close to the present locality. Recently Kato and Niikawa (1977) summarized the geological as well as geographical distributions of the genus *Kueichouphyllum*. Turkish *Kueichouphyllum* in both localities is

definitely the Viséan in age. And the presence of *Kueichouphyllum* in a fauna means that it is within the old Tethyan faunal realm, namely the *Kueichouphyllum* province (Hill, 1948).

Thus, within the Carboniferous succession in Naltas, Sainbeyli, at least two different coral horizons may be established. One is the *Caninia* horizon of possibly the Tournaisian age and the other is the *Kueichouphyllum* horizon of the Viséan.

Now, the relationship between the Carboniferous and the Permian in the studied section is a tectonic contact. A fault has been detected between the two. But the original stratigraphic relationship between the Carboniferous and the Permian might have been unconformable in this region. The above mentioned fault would be a slip plane along the unconformity (verbal information by Nakazawa et al.).

A colony of *Waagenophyllum* was collected by Nakamura from a cliff forming limestone bed in the middle part of the Permian succession. And the specimen is here identified as *Waagenophyllum* (*W.*) *kueichowense* Huang. The species may be quite long ranging (Minato and Kato, 1965), but it was originally described from a horizon above the *Neoschwagerina* zone of South China (Huang, 1932). At least a part of *Waagenophyllum indicum* of Iljina (1965) from Armenian Julfa is comparable with the present Turkish coral. In the Julfian region, according to Iljina (1965) *Waagenophyllum* is common in the Khachik horizon, although it may be found, though rarely from the lower Dzhulfian.

In the Sainbeyli region, below the *Waagenophyllum* limestone there is a bryozoan bed which was correlated by Sakagami (1950) with the Gnishik horizon of Armenian Julfa. From about the same horizon with the bryozoan bed Nakamura recognized some brachiopods (including large Martiniids and *Liosotella*) showing characteristics of the Gnishik age. Also on top of the *Waagenophyllum* limestone there lies another brachiopod bed which yields *Spinomarginifera*, *Orthotetina*, etc., the assemblage of which indicates the Dhulfian (s. str.) (verbal information by Nakamura). These evidences would suggest that the *Waagenophyllum* horizon, which is in between the Gnishik and the Dhulfian equivalents, falls roughly within the category of the Khachik horizon of Armenian Julfa.

The genus *Waagenophyllum* is, of course, one of characteristic faunal elements of the Permian Tethys (Minato and Kato, 1977).

Description of species

Order Rugosa Milne-Edwards and Haime, 1850

Family Cyathopsidae Dybowski, 1873

Genus *Caninia* Michelin, 1840

Caninia cornucopiae Michelin

(pl.1, figs.8-11)

1908 *Caninia cornucopiae*, Carruthers, p.159, pl.VI, figs.1-4.

1941 *Caninia cornucopiae*, Volkova, p.16, pl.1, fig.18.

1954 *Caninia cornucopiae*, Ma, p.15, pl.IV, fig.3.

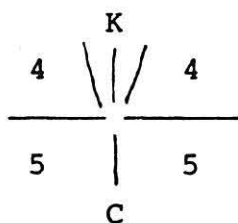
1964 *Caninia cornucopiae*, Wu, p.65, pl.xvi, figs.1-8.

1974 *Caninia cornucopiae*, Semenoff-Tian Chansky, pp.174-176, pl.75, fig.2. (See for further synonymy)

Description: Corallum simple, small and ceratoid. Corallite diameter at the peripheral margin of calice measures 20 mm. (pl.1, fig.11). Although tip part is missing the corallum attains the

length of 28 mm along its cardinal side which is on the convex side of the corallum. Surface characters are not known except for faint trace of growth striations on the epitheca which has been partially retained and exposed.

Corallite is round in transverse section (pl.1, fig.8). Wall is thin. Only major septa are present, the number of which is 24 in a diameter of 15.5 mm. Major septa in the cardinal quadrants are much dilated to reveal clearly fibro-normal fine structure of them. The length of major septa reaches two third the half diameter of the corallite, but they get shorter near the cardinal fossula. Cardinal septum is short and thin within a prominent fossula, both sides of which being subparallel. One septum on the counter side of the corallum is also considerably shorter than the other majors and it is here considered as the counter septum. Thus interpreted septal formula is as below.



In an early growth stage (pl.1, fig.10) all the septa are so thickened as to leave almost no interseptal space. Many of them are elongated to the centre of corallite.

In a longitudinal section (pl.1, fig.9) only tabulae are seen sparsely distributed, and are concave upward with flat bottom.

Remarks: *Caninia cornucopiae* has been rather broadly interpreted, but it is indeed a mutable species as is clearly demonstrated by Carruthers (1908).

The present Turkish specimen has growth form similar to that illustrated by Carruthers (1908) in his diagram E-1. A specimen illustrated by Ma (1954) from France is also similar in having ceratoid corallum.

In transverse section the present Turkish specimen resembles a Belgian form (Carruthers, 1908, pl.vi, fig.1f), a specimen from Kazakhstan (Volkova, 1941, pl.1, fig.18), a Chinese form (Wu, 1964, pl.xvi, figs.1–3) and especially a British form (Semenoff-Tian-Chansky, 1974, pl.75, fig.2) in possessing dilated major septa in cardinal quadrants. Many other specimens assigned to this species reveal more amplexoid nature in their septa.

Stratigraphical distribution of the species in Britain is according to Hill (1938–1941) ranging from Z_1 to $?E_1$. It is commonly known in the Tournaisian. The Chinese and Kazakhstan specimens above mentioned come also from the Tournaisian.

The Turkish form is most probably Tournaisian in age.

Genus *Kueichouphyllum* Yü, 1931

See Kato and Niikawa (1977) for discussion on the genus. But as to the distinction between the genus and *Palaeosmilia*, the author would like to add one more point that septal.

carinae are commonly seen in *Palaeosmia* but entirely absent in *Kueichouphyllum*.

Recently a new species of the genus, *Kueichouphyllum liangxianense* Zuo (1977) was proposed. Thus nominal species of *Kueichouphyllum* now amounts 17 in number (Kato & Niikawa, 1977).

Kueichouphyllum yabei Minato

(pl.1, figs.1-7)

- 1933 *Palaeosmia* (*Kueichouphyllum*) *sinense* var. *gracile* Yü, p.72, pl.IX, figs.3a-b; pl.X, figs.3a-d. *non* pl.X, figs.2a-b; pl.XI, figs.2a-b.
- 1937 *Kueichouphyllum sinense*, Yü (*partim*), p.16, pl.III, figs.1a-c, 2. ? Pl.III, figs.3a-c. *non* pl.II, fig.6; pl.IV, fig.1
- 1943 *Palaeosmia* (*Kueichouphyllum*) *yabei* Minato, p.103, pl.II, figs.1-3; pl.III, figs.1-3; pl.IV, figs.1,3-5; pl.V; pl.VI, figs.5c, 4d, & 5f.
- 1952 *Kueichouphyllum latifossulatum* Kanmura, p.164, pl.VIII, figs.1-8.
- 1955 *Kueichouphyllum yabei*, Minato, p.172, pl.6, fig.1; pl.8, fig.3; pl.9, fig.8; pl.11, fig.2; pl.12, figs.1-2; pl.15, figs.6a-f, i-k, 7a-b.
- 1955 *Kueichouphyllum yabei*, Flügel and Kiratlioglu, S.513, Abb.1.
- 1961 *Kueichouphyllum sinense*, Fontaine, p.133 (*partim*), pl.IX, fig.2; no other figures.
- 1962 *Kueichouphyllum sinense*, Yü, Lin and Fan, p.18, pl.1, figs.3a-b.
- 1963 *Kueichouphyllum yabei*, Flügel, S.368, Text-fig.1, Abb.A.
- 1963 *Kueichouphyllum laosense* Flügel, S.371, Text-fig.1, Abb.C. *non* D. (*non Kueichouphyllum laosense* Fontaine).
- 1966 *Kueichouphyllum sinense* var. *gracile*, Bykova, p.40, pl.1, fig.7.

Description: A little silicified, weathered specimen is at hand. Corallum simple, large and ceratoid. Corallite diameter is 5 cm at the periphery of weathered calice in which a narrow, long, parallel sided cardinal fossula is prominent. The corallum is curved and the cardinal fossula is on the convex side of the corallum, the length of which is 7 cm along the cardinal side, as far as it is preserved. Conical portion of the corallum is missing. Epitheca is mostly eroded away, but bands of constrictions are seen on the wall. Three thin sections have been prepared. The position of them is indicated in Text-fig.3.

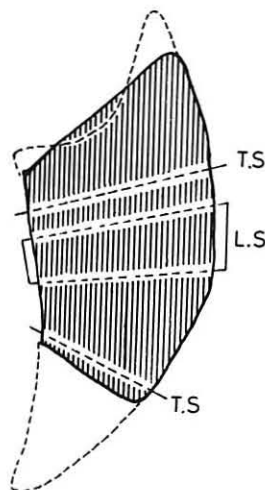


Fig. 3 Corallum shape of a specimen of *Kueichouphyllum yabei* Minato ($\times 2/3$), showing positions from which thin sections have been prepared. T.S. — Transverse section; L.S. — Longitudinal section; Dashed line — Reconstructed profile.

In transverse section the corallite is somewhat quadrate in outline in ephebic stage (pl.1, fig.5). Epitheca is not preserved. In general three parts are recognized in the corallite in transverse section, namely the dissepimentarium, the tabularium and the axial portion. Dissepimentarium is narrow, where mostly concentric but only occasionally pseudoherring-bonal dissepiments are disposed. Tabularium is wide, and is bounded from the dissepimentarium by a well developed inner wall. Septa are in two orders, all thickened in the tabularium, notably in the cardinal quadrants. Minor septa are very long to intrude into the tabularium. Major septa are 82 in number. Between the alar septum and the cardinal septum in each cardinal quadrant 15 majors are counted. Therefore, acceleration is clear in the counter quadrants although it is not possible to specify the counter septum. Major septa in the cardinal quadrants are all dilated to leave only narrow open space between the neighbouring septa. Major septa are not thickened in the axial portion of the corallite. About a quarter of them extend near to the centre of corallite, twisting anticlock wise and form a sort of axial structure together with some axial lamellae like plates present near the centre.

Cardinal fossula is prominent in elongated horseshoe form. In a late neanic or an early ephebic stage (pl.1, fig.7) only one or two rows of concentric dissepiments are developed. Pseudofossular depression is observed on one side of the cardinal quadrants where thickened major septa are somewhat shortened. This is not an alar fossula and is not explained here. In longitudinal section (pl.1, fig.6) dissepiments are small and globose, or only a little elongated. Tabulae are incomplete and doming upward. Septal fine structure is diffusotrabecular, but fibres are oblique to the septal surface.

Remarks: Here a few comments may be necessary on the type specimen of *Kueichouphyllum sinense* var. *gracile* Yü (1933) which reveals strong intrathecal dilation of major septa in cardinal quadrants. Actually Yü's specimens did contain two similar but a little different forms within this "variety", which many authors later consider as a species.

One form is provided with short minor septa (Yü, 1933, pl.X, fig.2) and the other with a little long minor septa which are still confined to the dissepimentarium (Yü, 1933, pl.X; fig.3; pl.X, fig.3). Yü (1933) apparently based his description mainly on the latter form, but he mentioned in his explanation of plates that a specimen with the former type was "the type". Yü actually had the third specimen which is however to the author not separable from *K. sinense*.

Papojan (1969) described that the type specimen for *Kueichouphyllum gracile* was No.4980 of Yü (1933). But the author considers the specimen No.4981 of Yü (1933) to be the type as Yü clearly indicated. Therefore specimens of *Kueichouphyllum* with strong dilation may be *K. yabei* or comparable forms if they have long minor septa. Whereas such specimens with short minor septa would be best placed under the proper *K. gracile*.

K. latifossulatum may fall in the category of *K. yabei* here defined.

The present Turkish specimen has long minor septa and much thickened major septa in the tabularium in the cardinal quadrants, and thus is identified as *Kueichouphyllum yabei*. The same species was formerly recorded from a place near Kayseri by Flügel and Kirtatlioglu (1955).

In Japan, *K. yabei* occurs abundantly in the Upper Viséan Onimaru Formation (Series)

at a number of places. Turkish form of *K. yabei* may be also of the Upper Viséan in age.

Family Waagenophyllidae Wang, 1950
Genus *Waagenophyllum* Hayasaka, 1924
Subgenus *Waagenophyllum* Hayasaka, 1924
Waagenophyllum (Waagenophyllum) kueichowense Huang
(pl.2, figs.1-4)

1932 *Waagenophyllum indicum* var. *kueichowense* Huang, pp.48-50, pl.3, figs.1,2.

1965 *Waagenophyllum (Waagenophyllum) kueichowense*, Minato and Kato, p.99, text-fig.47-1 (for further synonymy see).

Description: Corallum compound, fasciculate and dendritic. The whole colony is 10.2 mm × 5.2 mm × 4.9 mm in size as far as it is preserved. Corallites are closely distributed, and interspace between them being 2 to 4 mm. Diameter of mature corallites is 5 to 6 mm. Largest one is 7.5 mm in size. Septal grooves and interseptal ridges are prominent on the wall of corallite. Budding is lateral.

In transverse section, corallites are round in outline with three distinct internal zones, namely the axial column, the tabularium and the dissepimentarium. Axial column is round to oval in outline, usually with a distinct median septum, a few septal lamellae and several rings of axial tabellae. Peripheral margin of the axial column is sometimes thickened by stereoplasmic deposits and is distinct from the other skeletal elements. The size of axial column is small, 1 to 1.5 mm in diameter, which is less than one third the diameter of corallite. The median septum is sometimes much thickened. A major septum, presumably the cardinal one, is often connected with the median septum. In very young corallite the cardinal septum (?) extends to the centre of corallite to form a simple axial structure. Septa are in two orders, major and minor respectively. Septa are somewhat wavy especially in the dissepimentarium. Septal fine structure is diffuso-trabecular. Number of major septa is usually 20 to 23 in mature corallites. Minor septa are long to intrude into the tabularium. Intrathecal dilation is not conspicuous, but inner wall is occasionally seen. Dissepimentarium is wide, with irregularly concentric, sparse dissepiments. In some corallites relatively large dissepiments interrupting the continuation of minor septa are developed. Wall is moderately thick and crenulating. When peripheral portion of corallite is protruded and skeletal elements there are much thickened a new offset is arisen which then forms a

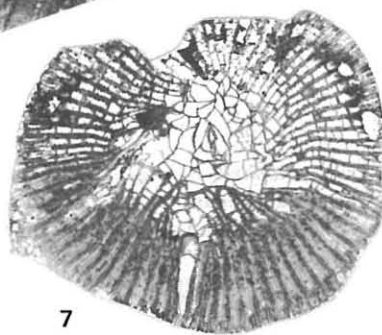
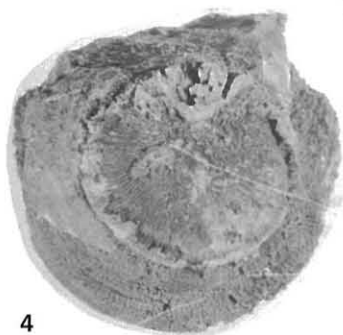
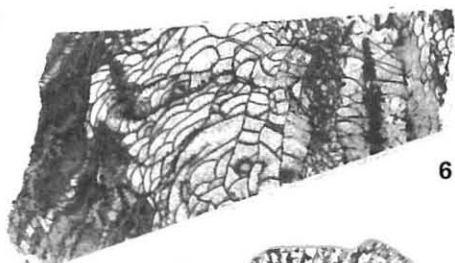
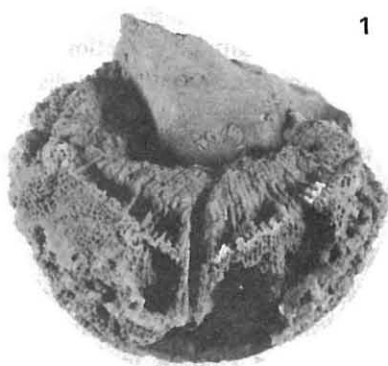
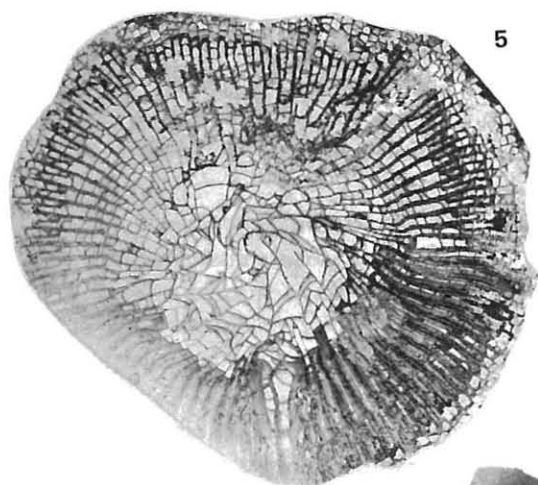
Explanation of Plate 1

Figs. 1-7 *Kueichouphyllum yabei* Mianto

1. Calicular view of a weathered corallite, ×1. 2. Lateral view of the same specimen seen from the cardinal side, ×1. 3. Lateral view seen from the alar side, ×1. 4. Sole view, ×1. 5. Transverse section, ephebic stage, ×2. 6. Longitudinal section, ×2. 7. Transverse section, neanic stage, ×2. Coll by K. Nakazawa.

Figs. 8-11 *Caninia cornucopiae* Michelin

8. Transverse section, ephebic stage, ×2. 9. Longitudinal section, ×4. 10. Transverse section, early growth stage, ×4. 11. Weathered corallite, ×1. Coll. by K. Nakamura.



branch.

In longitudinal section wall is undulating. Dissepimentarium consists of globose dissepiments, gourd shaped dissepiments and elongated dissepiments. Tabularium is narrow, where clinotabulae and transverse, horizontal tabulae are sparsely distributed. Axial column is composed of piled up axial tabellae and edges of septal lamellae cutting the tabellae.

Remarks: The present Turkish form is identical with Chinese *Waagenophyllum* (*W.*) *kueichowense*, in having small axial column and well developed globose dissepiments. *W.* (*W.*) *indicum* has large axial column and weaker globose dissepiments compared to *W.* (*W.*) *kueichowense*. However the present form slightly differs from *W.* (*W.*) *kueichowense* in revealing a kind of weak lonsdaleoid dissepiments in some corallites, the character also known in a form from Iraq (Hudson, 1958, pl.33, fig.9).

The present Turkish form also resembles *W.* (*W.*) *wengchengense* Huang especially of characters in transverse section. But the latter Chinese species does possess relatively wide tabularium, so that it should be separated from the present form.

References

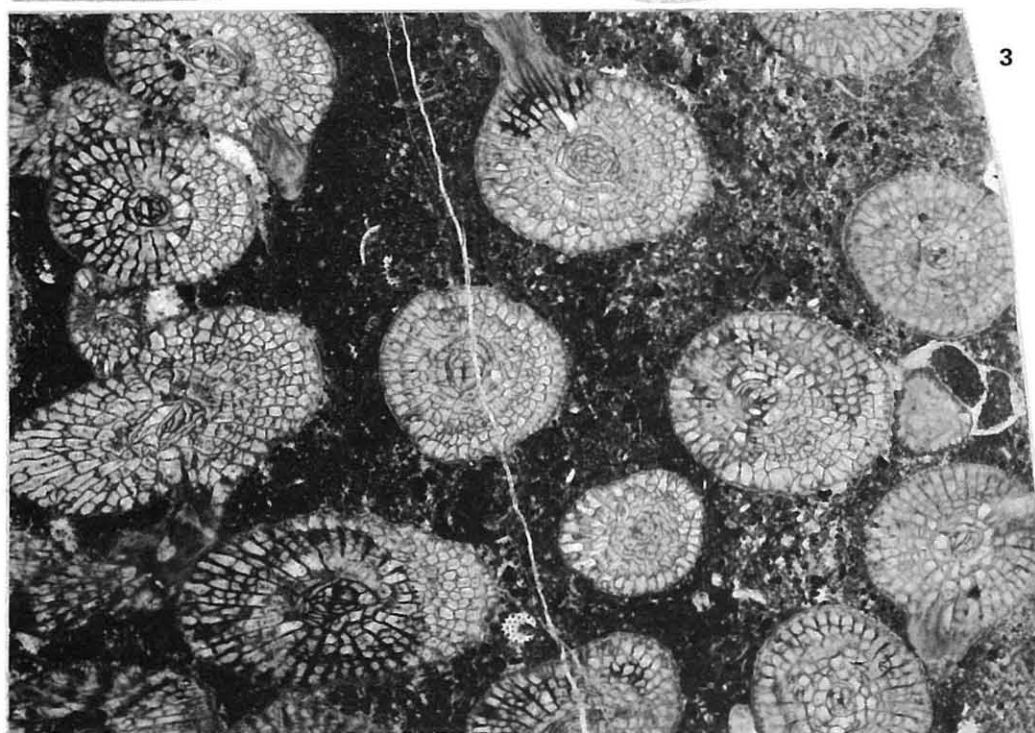
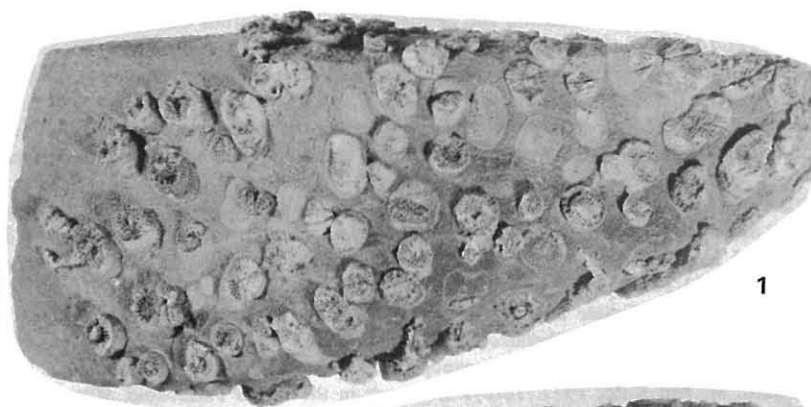
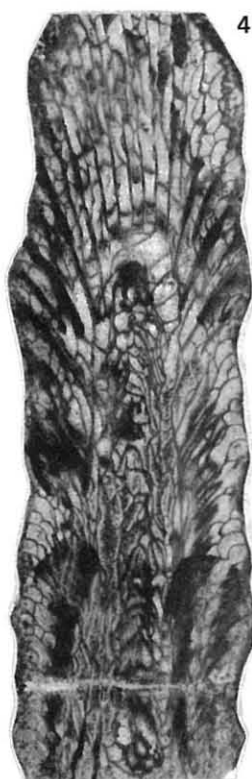
- Bykova, M. S. 1966. Нижнекаменноугольные кораллы Восточного Казахстана. Акад. Наук Казахской ССР, 214pp.
- Carruthers, R.G. 1908. A revision of some Carboniferous corals. *Geol. Mag.*, (5), V: 158-171.
- Charles, F. 1933. Contribution a l'étude des Terrains paléozoïques de L'Anatolie du Nord-ouest (Asie Mineure). *Mem. Soc. Géol. Belg.*, 1933: 54-151.
- Douglas, J.A. 1950. The Carboniferous and Permian faunas of south Iran and Iranian Baluchistan. *Palaeont. Indica*, N.S., 22. (7): 1-57.
- Enderle, J. 1901. Über eine anthracolitische Fauna von Balia Maaden in Kleinasien. *Beitr. Paläont. Geol. Österr. Ung.*, 13 (2): 49-110.
- Flügel, H. 1955. Zur Paläontologie des anatolischen Paläozoikums. IV. Permische Korallen aus dem südanatolischen Taurus. *Neues Jb. Geol. u. Paläontol.*, Abh., 101 (3): 293-318.
- Flügel, H. 1963. Korallen aus der oberen Visé-Stufe (*Kueichouphyllum*-Zone) Nord-Irans. *J.B. Geol. B.A.*, 106: 365-404.
- Flügel, H. & Kiratolioglu, E. 1956. Zur Paläontologie des anatolischen Paläozoikums. VI. Visékorallen aus dem Antitaurus. *Neues Jb. Geol. u. Paläontol.*, Mh., 11: 512-520.
- Fontaine, H. 1961. Les madreporaires paleozoïques du Viet-Nam, du Laos et du Cambodge. *Arch. Geol. Viet-Nam*, 5: 1-276.
- Heritsch, F. 1939. Ein Vorkommen von marinen Perm in nördlichen Ala Dag (Kilikischer Taurus, Türkei). II. Korallen, stratigraphische und paläogeographische Bemerkungen. *Sitz. Ber. österr. Akad. Wiss., (Math.-naturw. kl.)*, 1, 148: 171-194.
- Heritsch, F. 1941. Unterkarbonische Korallen aus Anatolien. *Zbt. Mineral. Geol. u. Paläont.*, (B), 1941: 188-190.

Explanation of Plate 2

Figs. 1-4 *Waagenophyllum* (*Waagenophyllum*) *kueichowense* Huang

1. Top view of a weathered corallum, $\times 1$. 2. Side view of the same corallum, $\times 1$. 3. Transverse section of the same corallum, $\times 4$. 4. Longitudinal section of a corallite, $\times 4$.

The specimen was collected by K. Nakamura from a locality in Naltas, north of Sainbeyli, Turkey.



- Hill, D. 1948. The Distribution and Sequence of Carboniferous Coral Faunas. *Geol. Mag.*, LXXXV (3): 121-148.
- Hopei Geol. Inst. etc (eds.). 1977. "Palaeontological Atlas of south - central China, 2". Peking, 856pp.
- Huang, T.K. 1932. Permian corals of southern China. *Palaeont. Sinica*, Ser.B, 8 (2): 1-115.
- Hudson, R.G.S. 1958. Permian Corals from northern Iraq. *Palaeontology*, 1 (3): 174-192.
- Ијина, Т. Г. 1965. Четырехлучевые кораллы поздней перми и раннего триаса Закавказья. *Тр. Палеонт. Инст.* 107: 1-104.
- Kanmera, K. 1952. The Lower Carboniferous Kakisako Formation of southern Kyushu, with a description of some corals and fusulinids. *Mem. Fac. Sci., Kyushu Univ.*, Ser.D, 3 (4): 157-177.
- Kato, M. and Niikawa, I. 1977. *Kueichouphyllum* from Central Japan. *Earth Science (Chikyu Kagaku)*, 31 (6): 243-249.
- Ma, T.Y. 1954. Climate and the Relative Positions of the Continents During the Lower Carboniferous Period. *Acta Geol. Taiwanica*, 6: 1-111.
- Minato, M. and Kato, M. 1965. Waagenophyllidae. *Jour. Fac. Sci., Hokkaido Univ.*, Ser.4, 12 (3-4): 1-241.
- Minato, M. and Kato, 1977. Tethys sea corals in the Upper Palaeozoic. *Mém. Bur. Recherches Géol. et Min.*, 89: 228-233.
- Паројан, А.С. 1969. О некоторых раннекаменноугольных видах род *Kueichouphyllum* в Армении. *Пал. ж.*, 1969 (1): 19-30.
- Sakagami, S. 1976. On the Permian Bryozoa from the northern part of Sainbeyli, central Turkey. *Trans. Proc. Palaeont. Soc. Japan*, N.S., 103: 398-405.
- Semenoff-Tian-Chansky, P. 1974. Recherches sur les Tétracoralliaires du Carbonifère du Sahara occidental. *Mém. Mus. National d'Histoire Naturelle*, sér.C. XXX: 1-316.
- Ünsalaner-Kiragli, C. 1958. Lower Carboniferous corals from Turkey. *Jour. Palaeont. Soc. India*, 3: 53-58.
- Volkova, M.S. 1941. Lower Carboniferous corals from central Kazakhstan. *Mat. Geol. Useful Min. Kazakhstan*, 11: 1-119.
- Wu, W.S. 1964. Lower Carboniferous Corals in Central Hunan. *Mem. Inst. Geol. & Palaeont.*, 3: 1-100.
- Yü, C.C. 1933. Lower Carboniferous corals of China. *Palaeont. Sinica*, Ser.B, 12 (3): 1-211.
- Yü, C.C. 1937. The Fenginian corals of south China. *Mem. Nat. Res. Inst. Geol.* 16: 1-70.
- Yü, C.C., Lin, I.D. and Fan, Y.N. 1962. "Permo-Carboniferous rugose corals of the Sinkiang-Chinhai province, China". *Scientific Articles for the Commemoration of 10th Anniversary of the Changchun Geol. Coll.* 1-11.

(Received on Oct. 23, 1978)