CARNIAN CORAL-SPONGE REEFS IN THE AMPHICLINA BEDS BETWEEN HUDAJUŽNA AND ZAKRIŽ (WESTERN SLOVENIA)

(WITH 6 FIGURES IN TEXT AND 12 PLATES IN ANNEX)

KARNIJSKI KORALNO-SPONGIJSKI GREBENI V AMFIKLINSKIH PLASTEH MED HUDAJUŽNO IN ZAKRIŽEM (ZAHODNA SLOVENIJA)

(S 6 SLIKAMI V BESEDILU IN 12 TABLAMI V PRILOGI)

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THE GEOLOGY OF THE AREA

by Stanko Buser

Past investigations

Fossil finds of brachiopods and ammonites in Amphiclina beds attracted the attention of *STUR* who wrote in 1858 the geological description of a wider area of western Slovenia. The brachiopods collected at that time were identified by *BITTNER* (1890). Among them occurred the genus *Amphiclina* after which *KOSSMAT* (1907) named the entire succession Amphiclina beds. *STUR* and *BITTNER* attributed these beds to »Cassian«, and *KOSSMAT* (1907, 1910, 1913) the majority of them to »Cassian«, and their uppermost part to Raibl. Later *KOSSMAT* (1936) considered that the Pseudozilian* beds pass upwards into »Cassian« Amphiclina argillites. Considering their stratigraphic attribution *RAKOVEC* (1933) believed that the Amphiclina beds do not represent the upper part of the Pseudozilian beds, and that they cannot be attributed into Pseudozilian succession. A new indication of the age of the Amphiclina beds furnished *FLÜGEL* and *RAMOVŠ* (1970) by finding in their upper part the Upper Carnian conodonts and ammonites. *GRAD* and *FERJANČIČ* (1974, 1976) ranged the Amphiclina beds among the Pseudozilian beds, and they did not separate them lithologically from the Ladinian beds on the geological map of the sheet Kranj. *BUSER* and *KRIVIC* (1979) found in the Amphiclina beds at Hudajužna in Bača valley new species of Tuvalian conodonts. Sponges from the reef limestone at Hudajužna were paleontologically studied by *SENOWBARI-DARYAN* (1981) who attributed them to Ladinian — Cordevolian times. *ČAR* and others (1981) published the description of circular coral bioherm at Jesenica. They attributed the reef limestone to the Pseudozilian formation with the stratigraphic range Cordevolian — Julian. They attributed to Amphiclina beds only the upper 40 m of bedded limestone, marl and conglomerate. *BUSER* and others (1982) published a schematic development of Triassic reefs in Slovenia. They ascribed Hudajužna locality to the Ladinian-Cordevolian-partly Julian age.

The lithological composition of the Amphiclina beds

The Amphiclina beds are characterized by interbedding of dark grey to black argillite, quartz sandstone and micritic limestone. Subordinate are intercalations of conglomerate consisting of pebbles of chert, quartz and volcanic rocks. Less abundant are limestone pebbles. Quite frequently occur intercalations of limestone breccias. The micritic limestone occurs within clastites independently in several meters thick layers, or in several decimeters thick sheets inter-

*In German literature Pseudozilian beds are named Pseudogailthaler Schichten, in Slovenian psevdoziljske plasti. Zilja is Slovenian name for river Gail in Austria.

bedding with clastites. In the lower part of the Amphiclina beds the limestone intercalations are rare, and in their upper part the limestone horizon is several meters thick, and it passes upwards into the Bača dolomite of Norian-Rhaetian age. The sponge-coral reefs occur in the middle third of the about 300 meters thick column of the Amphiclina beds.

The age of the Amphiclina beds

Owing to absence of characteristic fossils in the considered beds the age determination of their lower and middle part is not feasible yet. On the basis of the position and lithological composition it is, however, considered that also the lower part of the Amphiclina beds belongs to the Carnian stage. During recent field investigations of the wider area this author arrived to the conclusion that the Amphiclina beds do not belong according to either their age or their lithology to Ladinian beds which were named in this area Pseudozilian by some investigators. It is true that in Ladinian beds occur also argillites like in the Amphiclina beds, but this is at the same time the only rock which is common to both beds. Characteristic for Ladinian beds in the wider area of Cerkno is the presence within argillites of numerous layers of greywacke, and very characteristic tuffs and extrusions of keratophyre and diabase. Until now it has been indicated in many places by the species *Daonella lomeli* that volcanism stopped in Ladinian, and that it does not continue into Lower Carnian i. e. into Cordevolian. This lamellibranch occurs in many profiles just below the Cordevolian dolomite and limestone, and therefore it can be confirmed with reliability that the lithologic and biostratigraphic boundaries between the Ladinian and Carnian entirely coincide. This proof is used by the author also for the determination of the lower part of the Amphiclina beds. Between Zakriž, Trebenče and the Drnovo hill the Ladinian beds are overlain by the massive Drnovo limestone which belongs to Cordevolian and represents the equivalent of the Cordevolian dolomites and limestone with the alga *Diplopora annulata* which are developed in southern Slovenia. The originally normal contact between the Drnovo limestone and the underlying Ladinian beds is at present in many places tectonized due to dissimilar behavior of rocks of various consistency during tectonic movements from north to south. However, this contact cannot be explained by the overthrust, since the latter occurs lower, between the Lower Triassic and Ladinian beds.

The Drnovo limestone is overlain by Amphiclina beds. Otherwise than in Ladinian clastic rocks in Amphiclina beds appear no remains of primary volcanism, not even in the form of tuffs. This fact served the author as a proof against the identity of the two beds. The firs layers of thickly bedded micritic black limestone appear within the Amphiclina beds approximately 50 m above the contact with the Drnovo limestone. Unfortunately, it was not possible to find conodonts in the numerous samples of this limestone. The fact that in southern Slovenia clastic rocks started depositing above the Cordevolian dolomite and limestone in the Julian substage is considered by the author as an indirect indication that a similar deposition occurred also in the Amphiclina beds. Very probably their lower part is also of Julian age, or at least of Upper Cordevolian age.

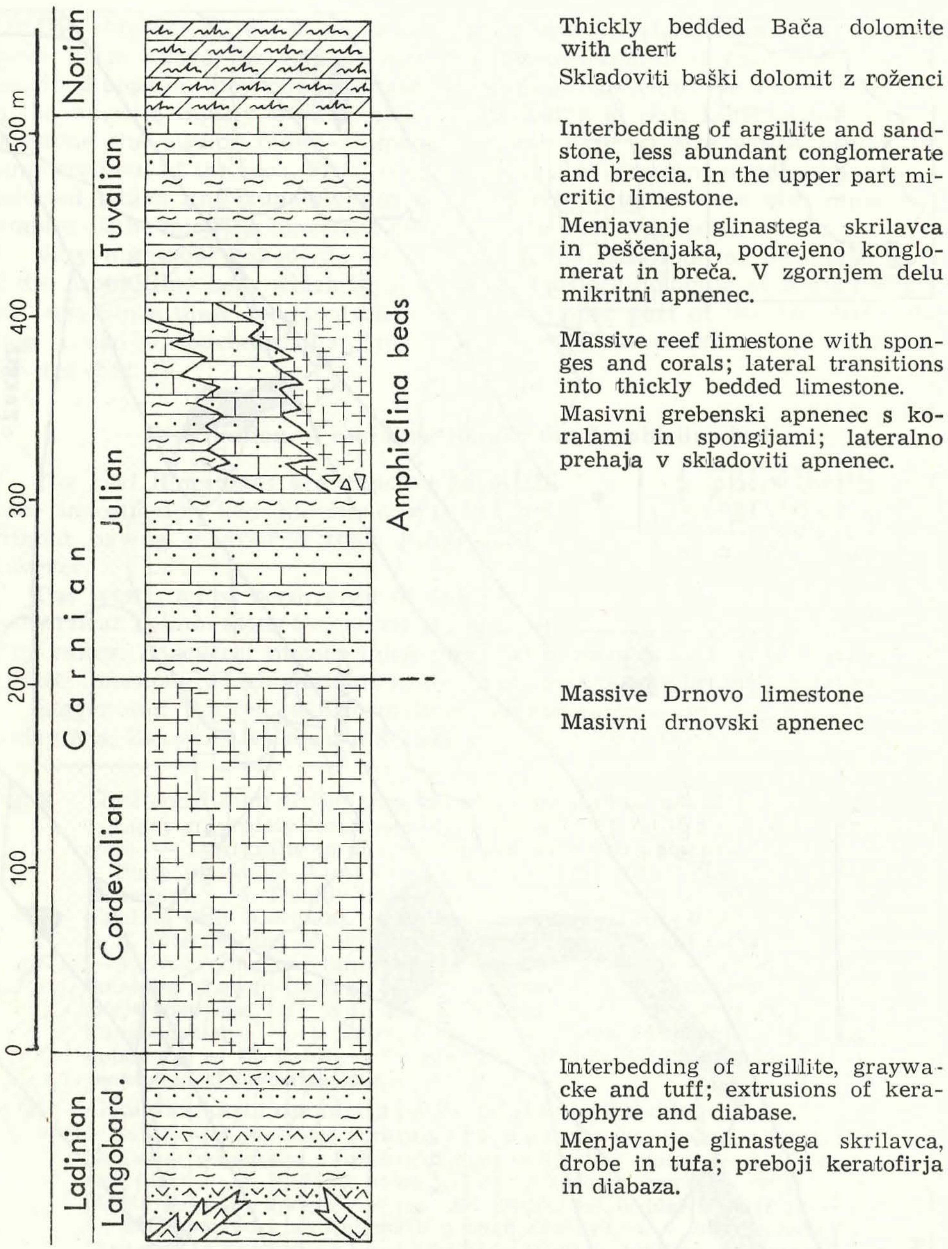
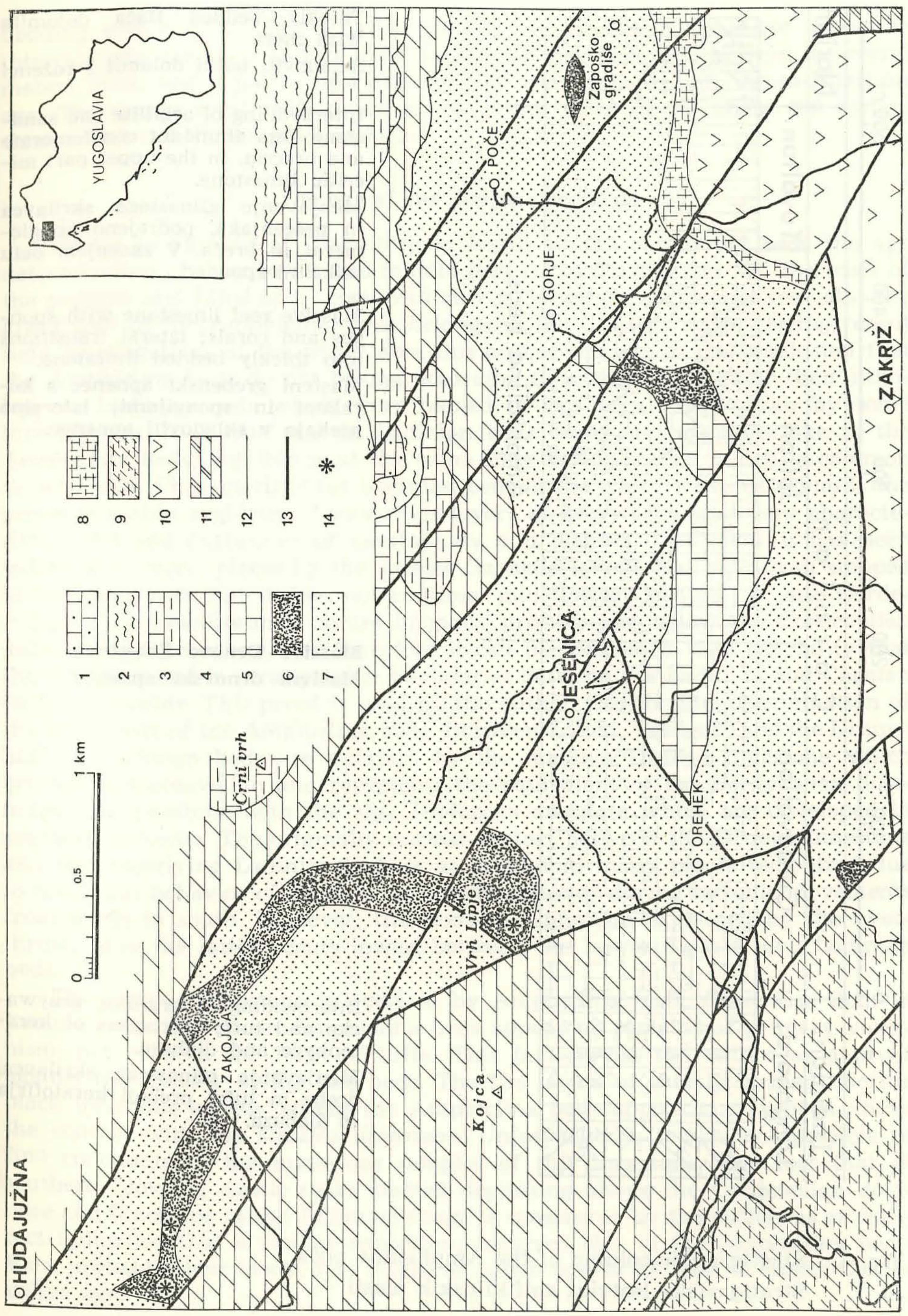


Fig. 1. Stratigraphic column of the Amphiclina beds

Sl. 1. Stratigrafska lestvica amfiklinskih plasti



The considered reef limestones appear between the Amphiclina clastites about 100 m above the contact with the Drnovo limestone; according to the described position they can be almost certainly attributed to the Julian substage. In the micritic thickly bedded limestone occuring at Vrh Lipje below to reef limestone the author found ammonites about 8 cm in size which cannot be hammered out of the rock. From this limestone also conodont samples have been collected which unfortunately proved all barren. Sterile were also numerous samples of the mictritic limestone cementing the reef organisms.

Very numerous conodonts were found in the limestone of the upper part of the Amphiclina beds which lie just below the Bača dolomite of Norian-Rhaetian age. Since these conodonts belong to the upper part of the Tuvalian substage, it can be concluded that the considered reef limestones are indeed of Julian age (Fig. 1).

Distribution of reef limestone in the Amphiclina beds

The reef limestones are exposed in relatively remote places. Among the older investigator this limestone was refered to only by *KOSMAT* (1913), without having mentioned their paleontological contents and their position, however.

The westernmost occurrence of the reef limestone in Amphiclina beds is known near Tolmin along the curves of the steep road below Perbla in the Zadlaščica valley. A several meters thick layer with sponges and corals lies within micritic limestone which contains in its upper part poorly preserved ammonites.

Bigger and thicker reef formations appear easterly in the area between Hudajužna, Zakojca, Jesenica and Zakriž near Cerkno. Their more or less con-

Fig. 2. Geological map of the area between Hudajužna and Zakriž
1. Light gray platy limestone of the Biancone type (Upper Malm — Berriasian). — 2. Argillite in alternation with chert (Dogger and Lower Malm). — 3. Platy limestone (Lias) — 4. Platy Bača dolomite with chert (Norian and Rhaetian). — 5. Thickly bedded micritic limestone — upper part of the Amphiclina beds (Carnian). — 6. Reef limestone in Amphiclina beds (Carnian). — 7. Interbedding of argillite and sandstone — Amphiclina beds (Carnian). — 8. Drnovo massive limestone (Lower Carnian = Cordevolian). — 9. Massive dolomite (Lower Carnian = Cordevolian). — 10. Interbedding of argillite, graywacke and tuff, with keratophyre and diabase extrusions (Ladinian = Langobardian). — 11. Thickly bedded dolomite (Anisian). — 12. Geological boundary. — 13. Fault. — 14. Localities of detailed paleontological and sedimentological investigations.

Sl. 2. Geološka karta ozemlja med Hudajužno in Zakrižem
1. Svetlo sivi ploščasti apnenec tipa Biancone (zg. malm — berriasij). — 2. Skrilavec v menjavi z roženci (dogger — spodnji malm). — 3. Ploščasti apnenec (lias). — 4. Ploščati baški dolomit z roženci (norij — retij). — 5. Skladoviti mikritni apnenec — zg. del amfiklinskih plasti (karnij). — 6. Grebenski apnenec v amfiklinskih plasteh (karnij). — 7. Menjavanje glinastega skrilavca in peščenjaka — amfiklinske plasti (karnij). — 8. Drnovski masivni apnenec (sp. karnij = cordevol). — 9. Masivni dolomit (sp. karnij = cordevol). 10. Menjavanje glinastega skrilavca, drobe in tufa s preboji keratofirja in diabaza (ladinij = langobard). — 11. Skladoviti dolomit (anizij). — 12. Geološka meja. — 13. Prelom. — 14. Mesta detajlnih paleontoloških in sedimentoloških raziskav.

tinuous outcrops extend for about 5 km as crow flies. These reefs will be in the following text described in more detail (Fig. 2.).

Smaller and isolated outcrops of reef limestone occur in landsliding slopes between Poče and Zapoško Gradišče. Reef limestones are known also at Novaki, Leskovica, and Dolenja vas, but these were not the subject of our investigation.

The sponge-coral reefs between Hudajužna and Zakriž

Clastic rocks of Amphiclina beds weather on the surface fast, and the thick weathered residue often creeps downslope covering the primary outcrops. Intercalations of reef and micritic limestone most often protrude in the form of steep rocks above the surrounding built up of clastites. From edges of these cliffs break off larger blocks and smaller fragments of limestone which cover contacts with neighboring rocks. Primary contacts of reef formations have been found only north of Zakriž and on the southern side of the reef of Vrh Lipje near Jesenica. Other visible contacts are mostly tectonic, and no explanation of the origin of reefs on their basis is possible. In explaining the origin of reefs the author was able to use only the mentioned two normal contacts, and the more or less continuous exposure of reef formations.

REEF AT HUDAJUŽNA: In the area between Hudajužna and Zakojca appear in Amphiclina beds larger remains of an originally uniform reef limestone. At the bend of the Porezen creek one km south of Hudajužna appears a larger outcrop which was quarried in a bigger quarry during the building of the Bohinj railroad. The limestone continues across the Porezen creek southeasterly, and can be followed continuously to Zakojca. The thickness of the reef limestone in the quarry amounts to 25 meters. Its contacts with clastic rocks are covered by limestone rubble. About 20 m below the bioherm occurs among clastites a three meters thick intercalation of non bedded micritic limestone which dips very steeply (75°) towards west. Similar steep dips can be measured also in the coarse grained sandstone above the reef. Already during the growth large blocks of limestone, up to 3 cube meters in volume, were torn off the reef and rolled into soft surrounding shales and sandstones. At present these blocks appear as apparently independent masses placed around the main reef. In the lower part of the reef limestone which consists largely of sponges occur numerous brachiopods of the genus *Terebratula* and up to 1 cm thick clubby spicules of urchins, crinoid stems of about the same thickness, as well as rare gastopods. Higher appear next to sponges also colonial corals which attain up to 60 cm in height. Solitary corals are up to 20 cm high, and less frequent. Among them occur also the lamellibranch of the genus *Isognomon*. The association of reef building organisms does not exceed 60 percent of the entire carbonate mass, but frequently it is lower on the account of the cement represented by dark gray micritic limestone. The abundance of sponges is the same in this locality than at Jesenica and Zakriž. Their individual colonies may exceed in volume one cubic meter. In this area especially frequent are reef breccias consisting of fragments of reef limestone and of micritic limestone. The cement is limy and strongly limonitized.

Towards southeast, in the direction of the Zakojca village, the reef limestone can be followed partly in continuous beds, partly in huge displaced blocks

which most probably cover primary reefs. The outcrops of this limestone appear at the Bevk farm-house and on the low hill near the Dolinar farm north of Zakojca. In a few places here up to 6 cm large oncolites can be found. They contain in their nuclei fragments of urchin spicules, of crinoids and corals. Oncolites do not represent an independent horizon, they merely occur as »nests« in the reef limestone.

REEF AT JESENICA: The largest outcrop of the reef limestone with a thickness of about 130 m occurs in steep cliffs of Vrh Lipje above Jesenica. It was described in detail by *ČAR* and others (1981). Their work presents the only explanation of the origin of these reefs up to now. The authors belive the reefs grew within the clastic Pseudozilian formation which reaches according to their opinion up to the end of Carnian, and only its uppermost part, Tuvalian, belongs to the Amphiclina beds. Following their ideas several reefs grew simultaneously, they died off, and later new ones started growing. During the inspection of a wider area this (present) author came to the opinion that the considered reefs formed within the Amphiclina beds. Their position and age have been explained in the former section of this paper. According to present author's ideas in the Amphiclina beds occured a single reef horizon which was in places interrupted. There thickly bedded micritic limestones and reef breccias were deposited. The reef at Jesenica is obviously intersected by numerous faults which broke the originally uniform limestone reef mass into several smaller blocks which today give the appearance of several individualized and separated smaller reefs. Argillites and sandstones occuring at the top and on slopes of the reef at Jesenica do not represent primarily deposited clastites between individual reefs, they are tectonically pressed along faults into the limestone. The contact of two rocks is in many places straight, and the contact plane on the limestone is tectonically smoothed, silicified and limonitized. Argillites are in several places pressed in the limestone. An indication of the tectonic fracturing of the limestone is also the underlying micritic limestone which shows quite near the mentioned contact a dip different for about 180°.

In the reef at Jesenica the most abundant reef builders are sponges and corals. Colonial corals represent by their mass the highest proportion in the composition of this organogenic body. In the northern slope of the reef 10 cm long shells of a thick wall lamellibranch of genus *Isognomon* were found, similar to those at Hudajužna.

REEF AT ZAKRIŽ: In the area between the Vršič hill and the road from Zakriž to Gorje north of Cerkno, the outcrops of the reef limestone can be followed in a more or less continuous horizon. Below the reef limestone here occurs calcarenite with crinoids and limestone breccia consisting of fragments of micritis limestone and cemented by marly-argillaceous and limonitized cement. The breccia is overlain by 2 meters of reef limestone with mere sponges which form at least 60 % of the entire rock. Above appear along with sponges also colonial and solitary corals. Cement between the skeletons of the reef forming organisms belongs to dark gray or black micritic limestone. On the west side of the new road from Zakriž to Gorje there are nowadays only smaller outcrops up to 5 m high. But before the war there protruded up to 10 m high cliffs of these limestones. Later this limestone was used for construction of military fortifications and roads. In the surroundings of Zakriž appear among the clastites blocks of reef limestone several cubic meters in volume. They are not proper independent reefs, but only blocks which broke off larger reef complexes and got stuck in surrounding soft clastic roks.

Westerly, towards the Vršič hill, the ref limestone thins out, or it passes laterally into the micritic nonbedded limestone in which occurs in the eastern slope of Vršič a single one meter thick layer with building sponges. In the limestone talus material of this hill numerous tuft shaped tiny colonial corals were found. Between Vršič and Jesenica the reef limestone is replaced by thickly bedded limestone.

THE CORAL AND HYDROZOAN FAUNA

by Dragica Turnšek

Description of species

The system of Triassic coral is not fully established yet. The revisions of older works which have been evaluated approximately at the same time by *CUIF* (1966, 1972, 1974, 1975, 1976, 1977) and *MELNIKOVA* (1967, 1968a, 1968b, 1971, 1972, 1980), are not coordinated. Corals from Hudajužna are therefore here investigated only generically, and are not arranged into higher systematic categories. They will be systemized in a final way in a few years when the entire Triassic fauna from our area will be known and studied.

Besides corals are described in this study also hydrozoans and three species of sponges not investigated by *SENOWBARI-DARYAN* (1981).

Abbreviations used in the description of species are the following:

d = diameter of corallum or corallite.

s = number of septa in one individuum or density of septa in a distance of some mm.

s1, s2, s3 ... = cycles of septal development.

ANTHOZOA

Genus: *Margarophyllia VOLZ* 1896

Margarophyllia capitata (*MÜNSTER* 1841)

Pl. 1, Fig. 1—4

1841 *Montlivaltia capitata. MÜNSTER*: n. v.
1896 *Margarophyllia capitata M. — VOLZ*: 46—47, Taf. 3, Fig. 1—4, Synonymy.
1967 *Margarophyllia capitata MÜNST. — LEONARDI*: 255; 299
1974 *Montlivaltia capitata MÜNSTER* (= *Margarophyllia VOLZ*). — *CUIF*: 318 —324, Textfig. 10—12.
1981 *Margarophyllia capitata MÜNSTER. — ČAR* & al.: 237, Fig. 4D (not 4E).

D e s c r i p t i o n : Turbinate solitary corallum. Costosepta are laterally irreguarly dentate. Endotheca contains of numerous tabulate. Columella is absent. Wall is thin epithecate paratheca. Microstructure is of sclerodermites.

D i m e n s i o n s : d = 17 mm, s = ca 70.

C o m p a r i s o n : Its outside is very similar to *Coryphyllia irregularis CUIF* (1974: 324, 378), which is distinguished by the microstructure of simple trabeculae.

Distribution: Dolomites in Italy, Jesenica near Cerkno in Slovenia; »Cassian« beds.

Material: Hudajužna B 12310/P-706. Carnian.

Margarophyllia crenata (MÜNSTER 1841)
Pl. 1, Fig. 5—8

1841 *Montlivaltia crenata. MÜNSTER:* n. v.
1896 *Margarophyllia crenata M. — VOLZ:* 49—50, Taf. 3, Fig. 6—11.
1935 *Margarophyllia crenata (MÜNSTER). VOLZ. — KÜHN:* 112.
1967 *Montlivaltia crenata MÜNSTER. — LEONARDI:* 299.
1974 *Montlivaltia crenata MÜNSTER 1838 (= Margarophyllia crenata in VOLZ). — CUIF:* 325—327, Textfig. 13.
1981 *Margarophyllia crenata (MÜNSTER). — ČAR* & al.: 237, Fig. 4B.

Description: *M. crenata* species is one of the largest of this genus. It has been described exactly by *VOLZ* and *CUIF*.

Dimensions: d = 15—20 cm, s = ca 96 + s6.

Comparison: The endotheca is better developed as in *M. capitata.*

Distribution: Dolomites in Italy, Jesenica in Slovenia, Brasov in Rumania; »Cassian beds«.

Material: Hudajužna A 12312/ P-710, P-726, P-732, P-740, P-741, P-745, P-756; B 12310/ P-702; Zakriž 19308/P-779. Carnian.

Genus: *Margarosmilia VOLZ* 1896
Margarosmilia zieteni (KLIPSTEIN 1843)
Pl. 2, Fig. 1—4

1843 *Montlivaltia Zieteni. KLIPSTEIN:* n. v.
1896 *Margarosmilia Zieteni KL. — VOLZ:* 34—35, Taf. 1, Fig. 1—7, Textfig. 18.
1973 *Margarosmilia zieteni KLIPSTEIN. — MONTANARO GALLITELLI* & al.: 148, Tab. 1.
1974 *Margarosmilia zieteni. CUIF:* 358—366, Textfig. 29.
1981 *Margarosmilia zieteni KLIPSTEIN. ČAR* & al.: 237.

Description: The genus *Margarosmilia* differs from *Volzeia* in microstructure of sclerodermites instead of trabeculae (*CUIF* 1974). *Margarosmilia zieteni* has oblique lateral spines.

Distribution: Dolomites in Italy, Jesenica in Slovenia, »Cassian beds«.

Material: Hudajužna A 12312/ P-753; B 12310/ P-699, P-705. Carnian.

Margarosmilia confluens (MÜNSTER 1841)
Pl. 2, Fig. 5—6

1841 *Cyathophyllum confluens. MÜNSTER:* n. v.
1896 *Margarosmilia Zieteni KL.* var. *confluens M. — VOLZ.* 35—36, Taf. 1, Fig. 8—12.
1935 *Margarosmilia confluens (MÜNSTER) — KÜHN:* 113—114, Taf. 1, Fig. 1a—c.

1966a *Margarosmilia confluens (MÜNSTER). — KOLOSVÁRY:* 129, Taf. 1, Fig. 1.
1966b *Margarosmilia* cf. *confluens (MÜNSTER). — KOLOSVÁRY:* 184.
1967 *Thecosmilia confluens MÜNST. — LEONARDI:* 299.
1973 *Margarosmilia confluens MÜNSTER. — MONTANARO GALLITELLI* & al.: Tab. 1.
1974 *Margarosmilia zieteni* var. *confluens. CUIF:* 365—366, Textfig. 30d—f, 31.
1981 *Volzeia badiotica (VOLZ). — ČAR* & al.: 237, Fig. 4E (not 4D).

Description: was given by Volz and Cuif.

Dimensions: d = 4—7 mm, s = 48—96.

Comparison: In Hudajužna specimens the mictrostructure of sclerodermites has been stated. Because of the same form of coralites I attribute specimens from Jesenica preliminary determined as *Volzeia badiotica* to the *Margarosmilia confluens.* Microstructure of Jesenica specimens is not preserved.

Distribution: Dolomites in Italy, Bükk in Hungary, Mali Karpati in Czechoslovakia, Brasov in Rumania, Jesenica in Slovenia; »Cassian beds«.

Material: Hudajužna A 12312/ P-715; B 12310/ P-695, P-703, P-707, P-708. Carnian.

»Montlivaltia« cf. *cipitensis VOLZ* 1896
Pl. 3, Fig. 1—3

1896 *Montlivaltia cipitensis* nov. spec. — *VOLZ:* 44, Taf. 3, Fig. 26—27.

Description: Solitary coral has turbinate corallum with epitheca. Septa are even, compact, in 4—5 cycles. The first cycle is stronger than the later cycles. All septa are thicker at the periphery. Endotheca is well developed, it consists of large dissepiments and tabulae. Microstructure is of simple trabeculae. Single sclerodermites are not distinguished.

Dimensions: d = 13—17 mm, s = ca 60.

Comparison: With the microstructure of simple trabeculae this species differs from the genus *Margarophyllia,* which has sclerodermites. Such a microstructure approaches it to the genera *Coryphyllia CUIF* and *Distichophyllia CUIF,* the genera known from the younger Triassic beds. Before having studied all Triasic corals from Slovenia, I leave the species in the genus *»Montlivaltia«.* Its microstructure is similar to that of *Volzeia,* which is colonial. Nevertheless, this species belongs to the family Distichophyllidae.

Distribution: Dolomites in Italy, »Cassian beeds«.

Material: Hudajužna A 12312/ P-734, P-759, P-760. Carnian.

Genus: *Volzeia CUIF* 1966
Volzeia badiotica (VOLZ 1896)
Pl. 3, Fig. 4—5

1896 *Thecosmilia badiotica nov. spec. — VOLZ:* 26—30, Taf. 2, Fig. 14—19; Textfig 24—27.
1966a *Thecosmilia badiotica. VOLZ. — KOLOSVÁRY:* 127.
1966b *Thecosmilia badiotica VOLZ. — KOLOSVÁRY:* 186.

1966 *Volzeia badiotica (VOLZ).* — *CUIF:* 126—127, Pl. 4, Fig. 1, Textfig. 1A, B.
1967b *Thecosmilia badiotica VOLZ.* — *KOLOSVÁRY:* 103, Taf. 7, Fig. 3.
1967 *Thecosmilia badiotica VOLZ.* — *LEONARDI:* 299.
1974 *Thecosmilia badiotica* (= *Volzeia*). — *CUIF:* 337—352, Textfig. 19—22, 23c.
1975 *Volzeia badiotica (Thecosmilia* auct.). — *CUIF:* Pl. 11, Fig. 3.
1980 *Volzeia badiotica (VOLZ).* — *MELNIKOVA:* 157.
non 1981 *Volzeia badiotica (VOLZ).* — *ČAR* & al.: 237, Fig. 4E.

Description: was given by *VOLZ* and *CUIF*.

Dimensions: d = 9—15 mm, s = 48+s5.

Comparison: Some of our specimens have corallites of 15 mm, which are the largest so far known. The genus *Volzeia* is very similar in outside to genus *Margarosmilia*. It differs in microstructure of simple trabeculae (*CUIF* 1966, 1974).

Distribution: Dolomites in Italy, Bükk in Hungary, Male Tatre in Czechoslovakia, Pamir in SSSR, »Cassian beds«.

Material: Hudajužna A 12312/ P-712, P-719, P-720, P-726, P-737, P-754, P-755. Carnian.

Volzeia sublaevis (MÜNSTER 1841)
Pl. 3, Fig. 6

1841 *Lithodendron sublaeve. MÜNSTER:* n. v.
1896 *Thecosmilia sublaevis M.* — *VOLZ:* 24—26, Taf. 2, Fig. 1—5; Textfig. 21—22, Synonymy.
1935 *Thecosmilia sublaevis (MÜNSTER) VOLZ.* — *KÜHN:* 113.
1967 *Thecosmilia sublaevis (MÜNSTER).* — *LEONARDI:* 299.
?non 1972 *Remismilia sublaevis (MÜNSTER).* — *Beauvais:* 312—313.
1973 *Thecosmilia sublaevis MÜNSTER.* — *MONTANARO GALLITELI* & al.: Tab. 1.
1974 *Volzeia (Thecosmilia) sublaevis (MÜNSTER).* — *CUIF:* 337—352, Textfig. 18, 23, 24.

Description: Dendroid phaceloid colony has numerous corallites. Septa are developed in 4 cycles, the first cycle being thicker and stronger. Epitheca is thin. Endotheca consists of tabular and larger dissepiments. Microstructure is of simple trabeculae, very poorly preserved.

Dimensions: d = 4—5 mm, s = ca 48.

Comparison: *CUIF* (1974) stated that the microstructure of the species *Thecosmilia badiotica, T. sublaevis* and *T. subdichotoma* is the same. He consideres them to be synonyms. I describe *Volzeia sublaevis* as an independent species since it has smaller corallites than *V. badiotica*. The specimen »*Remismilia sublaevis (MÜNSTER)*« named by *BEAUVAIS* 1972: 312 in my oppinion does not belong to this species because having synapticulae. It must be a new species.

Distribution: Dolomites, Italy; »Cassian beds«.

Material: Hudajužna A 12312/ P-723, P-749. Carnian.

Genus: *Andrazella CUIF* 1976
Andrazella labyrinthica (KLIPSTEIN 1843)
Pl. 4, Fig. 1—3

1843 *Meandrina labyrinthica. KLIPSTEIN:* n. v.
1896 *Isastraea labyrinthica KLIPST.* — *VOLZ:* 52, Taf. 4, Fig. 16.
1967 *Isastraea* cfr. *labyrinthica KLIPST.* — *LEONARDI:* 299.
1976 *Isastraea labyrinthica (KLIPSTEIN).* — *CUIF:* 100—103, Textf. 9—10
1976 *Andrazella* n. g. (type: *Meandrina labyrinthica KLIPSTEIN).* — *CUIF:* 108—109.

Description: Very detailed desctription has been given by *VOLZ* and then by *CUIF*. Unfortunately *CUIF* did not follow the Nomenclatoral Rules.

Our only specimen is a fragment of a colony, 30 × 40 × 20 mm large. Colony is meandroid, with prolongated, mandroid or even monocentric corallites and series. Septa are compact, with lateral teeth, not meanians. Multiplication is intracalicinal. Microstructure is of simple trabeculae.

Dimensions: the width of series = 3—4 mm, density of septa at the wall = 4—6/2 mm.

Comparison: *CUIF* (1976) gives comparison of all meandroid forms for which he proposes more new genera names: *Gablonzeria, Stuoresia, Guembelastraea, Andrazella.* Our specimen fits in well with the specimens described by *VOLZ* as »*Isastraea labyrinthica*«. It is very close to »*Isastraea bronni*« *KLIPSTEIN* (= *Stuoresia bronni* after *CUIF* 1976: 103, 108), from which it differs in narrower series and lower number of septa.

Distribution: Dolomites in Italy, »Cassian beds«.

Material: Hudajužna 12312/ P-751. Carnian.

Genus: *Protoheterastraea WELLS* 1937
Protoheterastraea hudajuznensis n. sp.
Pl. 5—6

The name: After the locality Hudajužna.

Holotypus: Specimen P-761.

Locus typicus: Hudajužna A, the quarry at the road 1 km south of the village Hudajužna.

Stratum typicum: Carnian (? Cordevolian, ? Yulian).

Material: two colonies P-761 and P-746, 9 thin sections.

Diagnosis: *Protoheterastraea* with irregular hexameral system of septa, major septum stronger. Lateral budding. Strong epithecal wall. Microstructure of simple trabeculae. Axial part varies. d = 4—6 mm, s = 30—48.

Description: Phaceloid dendroid colony consists of round corallites, with thick epithecal wall. Septa are developed in 3—4 irregular cycles. The first cycle is thick. The main septum is stronger, and it causes bilateral symetry. Septa reach the centrum or they end irregularly forming some kind of irregular fossula which resembels the rugose corals. Septa are laterally smooth or bear very rare teeth. Microstructure is of simple trabeculae. The median dark line is visible through the whole septum. Endotheca consists of tabulate and long dissepiments. Multiplication takes part by budding along the septa or peripheral tabulae. Young corallites at once divide laterally from the mother corallites, changing only the septal arrangement.

Dimensions: See at diagnosis.

Comparison: The new species is most similar to *P. leonhardi VOLZ* 1896. It differs in more irregular septa and fossula. Dimensions vary between the species *P. leonhardi* (d = 6—7 mm, s = 48), and *P. fritschi* (d = 4—5 mm, s = 30—40). *CUIF* (1972: 258—268) arranged *P. fritschi* into the genus *Volzeia*, but the existence of major septum excludes it from *Volzeia*.

Protoheterastraea sp.

Pl. 4, Fig. 4—5

The specimen P-750 is ramose colony with small corallites which are strongly recrystallized. Only a thick wall and the rests of major and first cycle septa, and slight bilaterity, can be observed. These characteristics include the specimen into the genus *Protoheterastraea*. The species cannot be identified.

Dimensions:

	P. sp.	*Hexastraea fritschi* (*VOLZ* 1896)	*Hexastraea magna* (*KÜHN* 1935)	*Pinacophyllum gracile* (*VOLZ* 1896)
d =	2—3 mm	4—5 mm	1—1.5 mm	1.5—3 mm
s =	?	35—40	20—30	24—30

Comparison: In the manner of growth our specimen can be compared with the »*Hexastraea*« *fritschi* (*VOLZ* 1896: 91—92, Taf. 11, Fig. 14—20), which was revised by *WELLS* (1937) into *Protoheterastraea*, by *CUIF* (1972: 258; 1974: 352—354) into *Volzeia*, and by *MELNIKOVA* (1968) into *Quenstedtiphyllia*. In dimensions of corallites our specimen is similar to *Pinacophyllum gracile MÜNSTER* (see *VOLZ* 1896: 81—82, Taf. 10, Fig. 14—28), for which I think could belong to *Protoheterastraea*, because septa reach centres of corrallites, and bilaterity is observable.

Distribution: The similar species »*Hexastraea*« *fritschi* is known from Dolomites in Italy and from Jesenica in Slovenia, *Pinacophyllum gracile* from Dolomites (*VOLZ* 1896; *Montanaro Gallitelli* & al. 1973; *ČAR* & al. 1981), *Hexastraea magna* from Romania (*KÜHN* 1935), »Cassian beds«.

Material: Hudajužna A 12312/ P-750. Carnian.

Genus: *Omphalophyllia LAUBE* 1865

Omphalophyllia boletiformis (*MÜNSTER* 1841)

Pl. 7, Fig. 1—3

1841 *Montlivaltia boletiformis. MÜNSTER*: n. v.
1896 *Omphalophyllia boletiformis M.* — *VOLZ*: 68—69, Taf. 8, Fig. 1—8, Synonymy.
1935 *Omphalophyllia boletiformis (MÜNSTER). WÖHRMANN.* — *KÜHN*: 120—121.

1967 *Omphalophyllia boletiformis MÜNSTER.* — *LEONARDI*: 299.
1968 *Conophyllia boletiformis (MÜNSTER).* — *MELNIKOVA*: 7.
1975 *Omphalophyllia boletiformis (MÜNSTER).* — *CUIF*: 65—68, Pl. 5, Fig. 1—2, Textfig. 6.

Description: Solitary coral of cylindrical shape with the round calice. Septa are dense, thin, in 5—6 cycles. Endotheca is consisted of short tabulate dissepiments; paratheca, columella styliform. Lateral teeth are large, rare. Microstructure is of large scledodermites.

Dimensions: d = ca 20 mm, s = 96 + s6.

Distribution: Dolomites in Italy, Pamir in SSSR.

Material: Hudajužna A 12312/ P-716, P-754. Carnian.

Omphalophyllia radiciformis (*KLIPSTEIN* 1943)

Pl. 7, Fig. 4

1843 *Cyathophyllum radiciformis. KLIPSTEIN*: n. v.
1896 *Omphalophyllia radiciformis KL.* — *VOLZ*: 69, Taf. 8, Fig 27—33, Textfig. 14a-b.
1935 *Omphalophyllia radiciformis (KLIPSTEIN) VOLZ.* — *KÜHN*: 121—122, Taf. 1, Fig. 10a-c.
1966a *Conophyllia radiciformis. KOLOSVÁRY*: 132.
1967b *Conophyllia* cf. *radiciformis (KLIPSTEIN) VOLZ.* — *KOLOSVÁRY*: 105, Taf. 7, Abb. 4 (not Taf. 9, Abb. 12).
1973 *Conophyllia radiciformis (KLIPSTEIN).* — *MONTANARO GALLITELLI*: Tab 1.
1975 *Omphalophyllia radiciformis (KLIPSTEIN).* — *CUIF*: 71, Pl. 6, Fig. 5—6.

Description: Solitary coral is cylindrical in cross section, and has all the caracteristics of the genus *Omphalophyllia*.

Dimensions: d = ca 10 mm, s = 80.

Comparison: This species differs from *O. boletiformis* in its smaller corallum. Comparison in microstructure made by *CUIF* could not be observed in our material.

Distribution: Dolomites in Italy, Male Tatre in Czechoslovakia, Bükk and Bakony in Hungary, Brasow in Rumania; »Cassian beds«.

Material: Hudajužna A 12312/ P-717, P-735, P-739, P-748, P-758; Zakriž 19308/2 = P-764). Carnian.

Genus: *Myriophyllum CUIF* 1975

Myriophyllum badioticum (*VOLZ* 1896)

Pl. 7, Fig. 5—6

1875 *Montlivaltia badiotica n. sp. LORETZ*: specimen labelled, nomen nudum. n. v.
1896 *Myriophyllia badiotica LORETZ.* — *VOLZ*: 75—76, Taf. 9, Fig. 9, Textfig. 41—42.
1975 *Myriophyllum badioticum (VOLZ).* — *CUIF*: 61—65, Pl. 4, Fig. 1, Textfig. 5.

Description: This large solitary coral has been described by *VOLZ*, and revised by *CUIF*.

Distribution: Dolomites in Italy, »Cassian beds«.

Material: Hudajužna B 12310/ P-704, A 12312/ P-762. Carnian.

HYDROZOA

Genus: *Disjectopora WAAGEN & WENTZEL* 1887
Disjectopora cf. *dubia VINASSA* de *REGNY* 1915
Pl. 8, Fig. 1—2

1915 *Disjectopora dubia* n. f. — *VINASSA* de *REGNY*: 100—102, Taf. 67, Fig. 8—11.
1959 *Disjectopora dubia VINASSA* de *REGNY: FLÜGEL & SY*: 14—16.

Description: Massive small coenosteum has irregular round shape. Skeletal elements consist of vermiculate reticulum with irregular interspaces and zooidal tubes inbetween. Latilamination is visible. Microstructure is granular.

Dimensions: Coenosteum = ca 20 × 50 × 20 mm, density of skeletal elements = 10—12/2 mm.

Comparison: Similar skeleton have some sponges like *Corynella, Precorynella, Sestrostomella* in their peripheral parts of bodies. They have large axial tubes, too, which do not exist in specimens described as Disjectopora.

Distribution: Timor, Upper Triassic.

Material: Hudajužna B 12310/ P-701; A 12312/ P-727. Carnian.

Genus: *Balatonia VINASSA* de *REGNY 1907*
Balatonia kochi VINASSA de *REGNY* 1907
Pl. 8, Fig. 3

1907 *Balatonia Kochi* n. f. — *VINASSA* de *REGNY*: 14—17, Taf. 3, Fig. 18—19; Taf. 4, Fig. 1—8.
1959 *Balatonia kochi VINASSA* de *REGNY*: — Flügel & Sy: 57—59.

Description: Our specimens are small sphaerical coenostea. In radial section vertical elements predominate, which are discontinuous, uneven. Transverse elements are subordinate, unequal. In tangential section reticulum is vermiculate. Interspaces are irregular, somewhere there are large openings inbetween. No tabulae in tubes. Microstructure is granular, probably altered.

Dimensions: coenosteum = 7 × 12 × 10 mm, density of vertical elements = 6—8/2 mm.

Comparison: Our specimens fit in with the first description of this species. *VINASSA* de *REGNY* ascribed it to the Hydromedusae, Hydrocorallinae). *FLÜGEL* & *SY* (1959) are of opinion that it belongs to sponges. In our specimens axial tubes are absent. Vermiculate reticulum is similar to that of

stromatoporoids. Nevertheless, *Balatonia* is similar to the tangential section of *Dictyocoelia*.

Distribution: Veszprém and Sheele in Hungary, Carnian.

Material: Hudajužna A 12312/ P-742 (part of specimen). Carnian.

SPONGES

Not described by *SENOWBARI-DARYAN* in 1981
Sestrostomella robusta ZITTEL 1879
Pl. 9, Fig. 1—2

1968 *Sestrostomella robusta ZITTEL*. — *DIECI* & *ANTONACCI* & *ZARDINI*: 131—132, Tav. 25, Fig. 3—5; Tav. 26.

Description: Massive sponge with similar structure as *Corynella ZITTEL*, and *Precorynella DIECI* & al. 1968. It differs in axial canal which consists of more tubes.

Dimensions: sponge = ca 40 × 25 × 25 mm, the density of thin skeleton between the large openings = 8/2 mm.

Distribution: St. Cassian in Dolomites, Italy. Middle-Upper Triassic.

Material: Hudajužna A 12312/ P-716; B 12310/ P-696, P-697. Carnian.

Walteria sp.
Pl. 9, Fig. 3

Description: Sponge is large, cylindrical, with a wide axial opening or canal. Skeleton is rough and coarse, and similar to that of hydrozoans. Vertical elements predominate, they are uneven, discontinuous. Horizontal elements are offsets and laminae, uneven as well. In transverse section the skeleton is vermiculate reticulum.

Dimensions: the diameter of sponge = ca 80 mm, the height is not known. The density of vertical elements = 3/2 mm.

Comparison: Axial canal includes this genus into sponges. Our specimen is very similar to the species *Walteria* cf. *repleta VINASSA* de *REGNY* 1915, described by *SENOWBARI-DARYAN* (1980) from the Rhaetian of Alps, our specimen is even larger. This genus has the most rough skeleton of all sponges and hydrozoans from Triassic.

Material: Hudajužna A 12312/ P-711. Carnian.

Hartmanina sp.
Pl. 9, Fig. 4

Specimen P-725 includes fragment of vermiculate and tubulate reticulum which fits in with the *Hartmanina* sp. described by *FOIS* & *GAETANI* 1980. It has been ascribed to sponges.

D i m e n s i o n s : fragment = ca 15 × 12 × 7 mm.
D i s t r i b u t i o n : Dolomites in Italy, »Cassian beds«.
M a t e r i a l : Hudajužna A 12312/ P-725. Carnian.

The fossil association of the Hudajužna reef

From Hudajužna over 100 specimens of fossils were collected and investigated. Among them were indentified and described 13 species of corals, 2 species of hydrozoans, and in addition 3 species of sponges. Nineteen species of sponges from the same locality were investigated by *SENOWBARI-DARYAN* 1981 (Fig. 3).

fossil groups	examined in treatise	Senowbari 1981	total number of species	%
Anthozoa	14	-	14	15,93
Hydrozoa	2	-	2	3,70
Spongia	3	19	22	40,74
Foraminifera	-	4	4	7,41
Algae Rhodophycaea	2	1	3	5,56
Dasycladacaea	1	-	1	1,85
Microproblematica	1	7	8	14,81
	23	31	54	100

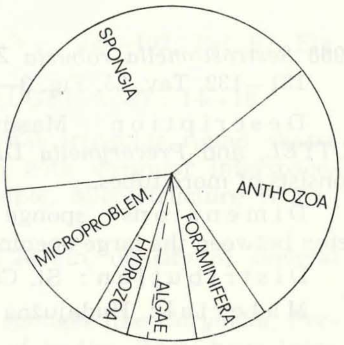


Fig. 3. Investigated fossil association in the locality Hudajužna with the number of species and their relative composition.

Sl. 3. Raziskana fosilna združba v nahajališču Hudajužna s številom vrst in njihovim procentualnim razmerjem.

CORALS: Most abundant are the ramose corals. They occur in phaceloid and dendroid colonies from several cm to one meter in size. They belong to genera *Margarosmilia, Volzeia, Protoheterastraea,* and contain 5 species. Abundant are also solitary corals which belong to genera *Margarophyllia, Omphalophyllia, »Montlivaltia«* similar to *Coryphyllia,* and *Myriophyllum,* and they contain 6 species. These specimens range in size from few to 25 cm. The massive meandroid colony of the genus *Andrazella* is represented with only one species which measures only a few cm in size.

HYDROZOANS: The hydrozoan-like organisms are attributed to genera *Balatonia* and *Disjectopora.* These genera resemble in some structural characteristics the sponges, therefore it is not certain whether they belong to proper hydrozoans. These forms occur in massive, but small coenostems, up to 10 cm in size.

SPONGES: Beside the 19 species of already investigated sponges (*SENOWBARI-DARYAN* 1981) 3 additional species of genera *Sestrostomella, Walteria* and *Hartmanina* were found. They also appear in massive colonies, up to 10 cm in size.

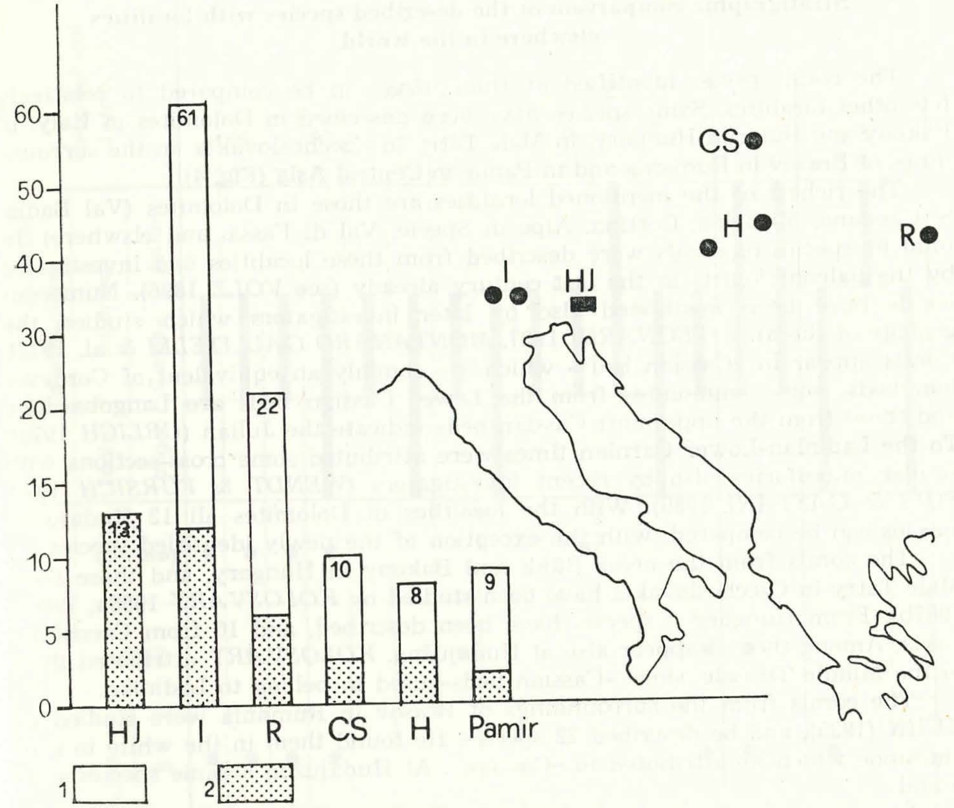


Fig. 4. Total number of coral species in known localities, and number of species common with Hudajužna.
1 = total number of species — 2 = number of species common with Hudajužna — HJ = Hudajužna, I = Italy, R = Rumania, H = Hungary, CS = Czechoslovakia.

Sl. 4. Število vseh koralnih vrst v znanih nahajališčih in število vrst enakih s Hudajužno.
HJ = Hudajužna, I = Italija, R = Romunija, H = Madžarska, CS = Češkoslovaška.

THE REMAINING FOSSILS: Along with the examined reef fossils occur among them algae, foraminifers and microproblematica. *ALGAE:* of the group Rhodophyta *Cayeuxia* sp. and *Solenopora* sp. were found which form tubular colonies several cm in size. Of the group Dasycladacaea a single species ? *Macroporella* sp. was found in a single specimen. *FORAMINIFERA* were investigated by *SENOWBARI-DARYAN.* He identified 4 species. Additional species have not been found in our material. *MICROPROBLEMATICA:* Beside the 7 species described by *SENOWBARI-DARYAN* occurs in our material the species *Macrotubus babai FOIS & GAETANI* 1980 (Pl. 9, Fig. 5).

Stratigraphic comparison of the described species with localities elswhere in the world

The coral species identified at Hudajužna can be compared to relatively few other localities. Same species have been described in Dolomites in Italy, Bakony and Bükk in Hungary, in Male Tatry in Czechoslovakia, in the surroundings of Brasov in Rumania and in Pamir in Central Asia (Fig. 4).

The richest of the mentioned localities are those in Dolomites (Val Badia, S. Cassiano, Misurina, Cortina, Alpe di Specie, Val di Fassa, and elswhere). In total 61 species of corals were described from these localities and investigated by the paleontologists in the last century already (see *VOLZ* 1896). Numerous corals have been mentioned also by later investigators which studied the geology of the area (*LEONARDI* 1967, *MONTANARO GALLITELLI* & al. 1973). Corals appear in »Cassian beds« which are roughly an equivalent of Cordevolian beds; some ammonites from the Lower Cassian beds are Langobardian, and those from the uppermost Cassian beds indicate the Julian (*URLICH* 1973). To the Ladinian-Lower Carnian times were attributed some cross-sections with similar microfacies also by recent investigators (*WENDT* & *FÜRSICH* 1979, *FOIS* & *GAETANI* 1980). With the localities in Dolomites all 12 Hudajužna species can be compared, with the exception of the newly identified species.

The corals from the areas Bükk and Bakony in Hungary, and those from Male Tatry in Czechoslovakia have been studied by *KOLOSVÁRY* 1966a, 1966b, 1967b). From Hungary 8 species have been described, and 10 from Czechoslovakia. Among them 3 appear also at Hudajužna. *KOLOSVÁRY* attributed them to the Middle Triassic, since »Cassian beds« used to belong to Ladinian.

The corals from the surroundings of Brasov in Rumania were studied by *KÜHN* (1935), and he described 22 species. He found them in the white to grey limestone which he attributed to »Cassian«. At Hudajužna 6 same species were found.

Rich localities of Carnian corals occur also in Pamir in Central Asia where they have been investigated by *MELNIKOVA* (1968a, 1980). She described or cited 9 coral species from this period. Two of them occur also at Hudajužna (see also *DRONOV* & *GAZDZICKI* & *MELNIKOVA* 1982).

Individual localities of Ladinian — Carnian reefs with a similar faunistic sponge-coral-hydrozoan associations are reported from other areas of the Alps (*JANOSCHEK* & *MATURA* 1980, *BRANDNER* & *RESCH* 1980, *WENDT* 1982, *FARABEGOLI* & *LEVANTI* 1982, *HENRICH* 1982), and also in Greece (*SCHÄFER* & *SENOWBARI-DARYAN* 1982), as well as in America (*STANLEY* 1980, 1981) and others. However, individual corals have not been investigated in de-

Fig. 5. List of investigated reef species with their stratigraphic and geographic distribution.
A, B = two separate finding places in the Hudajužna reef. I = Italy, H = Hungary, CS = Czechoslovakia, R = Rumania.

Sl. 5. Seznam obdelanih grebenskih fosilnih vrst s stratigrafsko in geografsko razširjenostjo.
A, B = dve ločeni nahajališči v grebenu pri Hudajužni. I= Italija, H = Madžarska, CS = Češkoslovaška, R = Romunija.

	Fossils	Localities in Slovenia ?Cordevolian, ? Julian: Hudajužna A	Hudajužna B	Zakriž	Jesenica	Previous stratigraphical distribution: Ladin. Langob.	Carnian Cordev.	Carnian Julian	Geographical distribution
Anthozoa	1. Margarophyllia capitata		●		●		■		I
	2. Margarophyllia crenata	●	●	●	●		■		I, R
	3. Margarosmilia zieteni	●	●		●		■		I
	4. Margarosmilia confluens	●	●		●	■	■		I, R, H, CS
	5. "Montivaltia" cf. cipitensis	●					■		I
	6. Volzeia badiotica	●				■	■		I, H, CS, Pamir
	7. Volzeia sublaevis	●		●			■		I, R
	8. Andrazella labyrinthica	●				■	■		I
	9. Protoheterastraea hudajuznensis	●					■		
	10. Protoheterastraea sp.	●			●		■		I, R
	11. Omphalophyllia boletiformis	●					■	■	I, R, Pamir
	12. Omphalophyllia radiciformis	●		●		■	■		I, H, R, CS
	13. Myriophyllum badioticum	●	●	●			■		I
Hydroz.	14. Disjectopora cf. dubia	●	●	●			■	■	Timor
	15. Balatonia kochi	●					■	■ (dashed)	H
Spongia	16. Sestrostomella robusta	●	●			■	■		I
	17. Walteria sp.	●						■	Alps
	18. Hartmanina sp.					■	■		I

tail, and therefore they cannot be compared paleontologically with corals from Hudajužna.

Sponges from Hudajužna have been known until recently from Wetterstein limestones, and various authors attributed them to Ladinian and Carnian (*OTT* 1967, *DIECI* & al. 1968, *SENOWBARI-DARYAN* 1981).

Hydrozoans found at Hudajužna are known from the Carnian of Hungary and Timor (*VINASSA* de *REGNY* 1907, 1915).

In Slovenia the same fauna as in Hudajužna occurs also at Jesenica (*ČAR* & al. 1981) and Zakriž (see Table Fig. 5). Some species were found also elsewhere in Slovenia (*KOLOSVÁRY* 1967a; *BUSER* & al. 1982), but these localities have not yet been systematically investigated.

The comparison of entire fauna shows a high degree of similarity between the sponges and corals found in the Amphiclina beds between Hudajužna and Zakriž, and the »Cassian« and »Wetterstein« fossils of the Alps and the Carpathian Mountains. The considered beds were attributed until present to Langobardian and Cordevolian, sometimes also to Julian (Fig. 5). Since the position of the reef limestone in the studied area indicates, according to *BUSER'S* conclusions, the Julian age it may be concluded that the investigated localities represent the youngest part of the so called »Cassian« reefs, although the reef fauna does not differ from that in older reef horizons, i. e. Cordevolian and Langobardian. Two possibilities can be concluded: (1) »Cassian« reef fauna did not change from Upper Ladinian to Julian, or (2) the actually same horizon was or is subject to different age interpretations.

THE SEDIMENTOLOGICAL PART

by Bojan Ogorelec

Microfacial characteristics of the reef limestone

In the complex of the studied Carnian beds between Hudajužna and Cerkno in general two types of rocks can be distinguished, (a) the carbonate reef and fore-reef complexes, in which the reef nucleus, the basal, fore-reef and inter-reef breccias and lenses of stratified limestone can be distinguished, and (b), the surrounding clastic sediments. The sedimentological investigations deal in more detail only with microfacial and diagenetic characteristics of reef nuclei and breccias at Hudajužna and Zakriž; the surrounding clastites have been already investigated in the frame of the study of coral bioherms at Jesenica (*ČAR* & al. 1981).

The reef nucleus consists largely of calcite skeletons of various sponges up to several cm in size; they are followed by nonskeletal algae, solitary and colonial corals and hydrozoans. Rare are foraminifers, skeletal algae, gastropods, crinoids and problematica. Nonskeletal blue-green algae usually overcrust the numbered organic skeletons with envelops up to 0.5 cm thick. Only seldom they appear as individualized algal lumps or as tiny oncoids. In spite of a rather high proportion of organisms the investigated bioherms within the Amphiclina beds are attributed to the group of »bafflestone boundstone« (according to *EMBRY* & *KLOVAN* 1972), since the organisms have mainly the role of interceptor and stabilizer of carbonate mud and debris, to the contrary of the majority of fossil and also recent reef formations where the reef skeleton is built by organisms (»framestone boundstone«).

Quite frequent in the reef limestone are structural phenomena of Stromatactis. These are cavities up to 10 cm in size with a rather even bottom and irregular ceiling, mostly overgrown with an envelope of nonskeletal algae. The origin of these textures has been most often interpreted by decay of nondeterminable nonskeletal organisms, and to a lesser degree by bioturbational processes. During the diagenesis the caverns »Stromatactis« were filled with sparitic calcite; often also the internal micritic sediment appears in them, which can be used to indicate the normal position of the Amphiclina beds in the investigated territory. The micritic sediment has been often attacked by late diagenetic dolomitization. Due to iron admixture the dolomite has a yellowish brown stain on the surface.

The groundmass around reef forming organisms is fine grained micrite. Owing to a very slight admixture of organic matter and of pyritic pigment groundmass is of darker color. Micrite is locally recrystalized into microsparite, and in places washed out. Such interspaces of irregular shapes and various

Diagenetic characteristics of the reef limestone

Diagenetic characteristics of the reef limestone at Hudajužna are schematically shown in fig. 6.

After the deposition of carbonate micritic mud and organic skeletons in the relatively deeper and quiet shelf environment (marine phreatic phase) at first occured micritization of organic skeletons under influence of algae and bacteria, incrustation of them by nonskeletal algal envelopes, and replacement of unstable aragonite by the stable magnesium calcite. In the same environment later deposited into interspaces of organisms fine fibrous calcite of generation A, and afterwards the sparitic calcite of generation B which is characterized by increasing size of crystals towards centers of pores.

The reef sediment arrived owing to its growth at times closer to the sea surface, and it was exposed to the marine-fresh water phreatic environment. It is supposed that at that time it became late diagenetically dolomitized by dolomite, rich in iron (ferric dolomite).

Dolomitization of limestone in the environment of marine and fresh water mixing is known as the »dorag model of dolomitization« (*BADIOZAMANI* 1973) which is presently considered the most acceptable model of dolomitization of larger limestone complexes. A good primary porosity of reef sediment enabled the flux of considerable volumes of pore solutions saturated with Mg^{2+} ions.

Along with cementation and dolomitization appear in examined samples to a lesser degree also the folowing diagenetic processes: recrystallization of micritic grounmass into microsparite, silicification, albitization and pyritization. Quartz occurs largely together with albite in aughigenic crystals up to 250 µm in size, mostly in the micritic groundmass. Seldom it replaces also calcite in organic skeletons, especially in corals; in both cases it has a microcrystalline structure. The origin of quartz and albite is attributed to surrounding clastic rocks.

Pyrite occurs in rather evenly dispersed pigment with grains up to 20 µm in size. It is an indication of often reducing environments within the sediment. Especially frequent is pyrite in beds overlying the Hudajužna reef. There it is developed in pretty crystals up to 150 µm in diameter.

The Amphiclina sponge-coral reefs are at present compact carbonate complexes without observable porosity with the exception of tectonic fractures and karst caverns. It is supposed their porosity was much higher during their deposition and early diagenesis. Rocks at that time had partly the character of moldic porosity which was formed by leaching of aragonitic organic skeletons. A part of pores owes its origin to decomposition of soft parts of organisms (especially of sponges and of Stromatactis structures), and a smaller part of pores is due to mechanical bioturbation activity. All these pores were during later diagenesis completely cemented by calcite cement.

Depositional environment

Following the field observations of forms and shapes of sponge-coral reefs, their interrelationship, distribution ob basal and fore-reef breccias, type of surrounding clastic rocks and microfacial characteristics of limestones it can be stated that the Carnian reef complexes in the Cerkno area represent a peculiar geological phenomenon which cannot be easily compared to any reefs of older geological times described in the literature. A similar development, especially the microfacial characteristics, is displayed by coral bioherms of Lower Carnian age in Dolomites (*FOIS & GAETANI* 1980), (*WENDT & FÜRSICH* 1979), and, in view of the neighboring clastic rocks, by Cambrian bioherms from the Forteau formation in Canada (*JAMES & KOBLUK* 1978).

The depositional environment of one of the Cerkno area reefs — the complex at Jesenica — has been already described (*ČAR* & al. 1981); the same environment is suggested also for reefs at Hudajužna and Zakriž. The sponge-coral bioherms were formed in a somewhat deeper quiet shelf area, in the transition zone between the coast and the shelf margin. The skeletal algae indicate still the photic zone, i. e. sea depths of several tens of meters. The deposition itself is of cyclic character, as the result of alternation of clastic and carbonate material. After the deposition of clastic terrigenous material — shales, sandstones and intraformational breccias which locally have the appearance, as a whole, of shallow sea or proximal turbiditic formations, the geomorphologically favorable places were inhabited by sponges and other reef forming organisms. Such places are always associated with coarse grained clastites on which the organisms were able to fix themselves and to grow in colonies. Started a vigorous growth of bioherms composed mainly of sponges and corals.

In general, there is a local differentiation of organisms which form particular parts of reefs. For example, sponges are locally much more abundant than corals, in another place corals prevail in number of specimens above other organisms. Bioherms represent regular »mud mounds« (patch reefs) with walls up to 50° steep. Their size depends on the stage at which their growth was interrupted by the supply of terrigenous material. This supply was so abundant and sudden that the reef building organisms were not able to survive it. Owing to the relatively small extent of the investigated area of the Amphiclina beds it is difficult to indicate the source area of the terrigenous material surrounding the reef limestone. It is supposed it came from the south, as shown by regional considerations: clastites in Carnian beds are more abundant in the region to the south of the investigated area, for example in the Idrija region (*MLAKAR* 1969, *CIGALE* 1978), and Notranjsko (*GREGORIČ* & al. 1980, *DOZET* 1979), than to the north of Cerkno area (*BUSER* 1974, *OGORELEC* 1981, 1982).

CONCLUSION

In the 300 m thick column of clastic Amphiclina beds between Hudajužna and Zakriž occur interbedded in its middle third coral-sponge reefs. According to their position observed in the field which is consistent with developments of Triassic elsewhere in Slovenia, and to conodont finds, the Amphiclina beds are attributed to the Carnian stage. The reefs are attributed to the Julian substage of the Carnian.

From the reef limestone at Hudajužna were investigated 13 species of corals, 2 species of hydrozoans and 3 species of sponges. Nineteen species of sponges from the same locality were studied by Senowbari-Daryan (1981). Fauna shows similarities with the »Cassian« and partly »Wetterstein« fauna of

Alps and Carpathian Mountains where it was attributed mostly to Cordevolian, and in places also to Langobardian or to Julian. Our localities represent according to their position the Julian, i. e. the youngest part of »Cassian« reefs, while the coral-sponge fauna at Hudajužna indicates more the Cordevolian, i. e. the older part of the »Cassian« reefs. Two possibilities can be concluded: (a) »Cassian« reef fauna did not change from Upper Ladinian to Julian, or (b) the actually same horizon was or is subject to different age interpretations.

Sedimentological analyses showed that the reef beds consist of the reef nucleus, the reef breccias, and of lenses of bedded micritic limestone. All structures indicate processes of early and late diagenesis, especially dolomitization and silicification. They are attributed to »bafflestone-boundstone« bioherms, where fossils play the rôle of interceptors of the carbonate mud, and not that of the proper reef builders. They thrived in smaller reefs (»patch reefs«) in a quiet deeper intraplatform basin on the shelf area.

Povzetek

KARNIJSKI KORALNO-SPONGIJSKI GREBENI V AMFIKLINSKIH PLASTEH MED HUDAJUŽNO IN ZAKRIŽEM (ZAHODNA SLOVENIJA)

UVOD

Pri kartiranju za osnovno geološko karto SFRJ lista Tolmin smo zasledili leta 1977 pri Hudajužni v amfiklinskih plasteh večje čokate vložke grebenskega apnenca, ki vsebuje mnogo spongij in koral. Pojavljanje grebenskega apnenca v klastičnih globljemorskih skladih je za geološko strukturo bolj redek pojav, zato je pritegnil našo pozornost. Začeli smo ga podrobneje preučevati, zbrali smo tudi mnogo fosilov. Spongije iz Hudajužne je obdelal *SENOWBARI-DARYAN* (1981). Greben iz južneje ležečega področja pri Jesenici so opisali *ČAR* in sodelavci (1981). Od takrat smo raziskali širšo okolico med Hudajužno in Zakrižem, da lahko podamo celovitejšo sliko razvoja amfiklinskih plasti in tvorbe koralno-spongijskih grebenov v času in prostoru.

V razpravi so zajeta dognanja terenskih raziskav amfiklinskih plasti z grebenskimi tvorbami med Tolminom, dolino Bače in Cerknim. Paleontološka obdelava koral in hidrozojev ter sedimentološke in mikrofacialne raziskave grebenov so osredotočene na najdišča pri Hudajužni. Podana je tudi primerjava z nahajališčema koral pri Zakrižu in pri Jesenici.

GEOLOŠKA ZGRADBA OZEMLJA

Stanko Buser

Dosedanje raziskave

Fosilne najdbe brahiopodov in amonitov v amfiklinskih plasteh so pritegnile pozornost *STURA*, ki je leta 1858 podal geološki opis širšega ozemlja zahodne Slovenije. Takrat nabrane brahiopode je določil *BITTNER* (1890), med katerimi je bil tudi rod *Amphiclina*, po katerem je *KOSSMAT* (1907) poimenoval amfiklinske plasti. *STUR* in *BITTNER* sta te plasti uvrstila v »cassian«, *KOSSMAT* (1907, 1910, 1913) pa večji del v »cassian« in njihov vrhnji del v »rabelj«. Kasneje je *KOSSMAT* (1936) menil, da preidejo psevdoziljske plasti navzgor v »cassianske« amfiklinske skrilavce. Glede stratigrafske uvrstitve je bil *RAKOVEC* (1933) mnenja, da amfiklinske plasti ne predstavljajo zgornjega dela psevdoziljskih plasti, in da amfiklinskih plasti ni mogoče uvrstiti v psevdoziljske. Nov podatek o starostni uvrstitvi amfiklinskih plasti sta dobila *FLÜGEL* in *RAMOVŠ* (1970), ko sta našla v vrhnjem delu amfiklinskih plasti zgornjekarnijske konodonte in amonite. *GRAD* in *FERJANČIČ* (1974, 1976) sta prištela amfiklinske plasti k psevdoziljskim in jih na geološki karti lista Tolmin litološko nista oddvojila od ladinijskih plasti. *BUSER* in *KRIVIC* (1979) sta v amfiklinskih plasteh pri Hudajužni v dolini Bače odkrila nove vrste tuvalskih konodontov. Spongije iz grebenskega apnenca pri Hudajužni je paleontološko obdelal *SENOWBARI-DARYAN* (1981) in jih uvrstil v obdobje ladinij-cordevol. *ČAR* in sodelavci (1981) so podali opis krožnih koralnih bioherm pri Jesenici. Grebenske apnence uvrščajo v psevdoziljsko formacijo s stratigrafskim razponom cordevol-jul. Amfiklinpokrivajo primarne tvorbe. Primarne izdanke tega apnenca zasledimo pri Bevkovi domačiji in na hribu pri kmetiji Dolinar severno od Zakojce. Na več mestih dobimo tukaj do 6 cm velike onkolite, ki vsebujejo v jedrih odlomke bodic ježkov, krinoidov ali koral. Onkoliti ne predstavljajo samostojnega horizonta, ampak se pojavljajo kot »gnezda« v samem grebenskem apnencu.

GREBEN PRI JESENICI: Na strmih stenah Vrh Lipja nad Jesenico je ohranjen največji izdanek grebenskega apnenca v debelini 130 m. Tega so podrobno opisali *ČAR* in sodelavci (1981). Doslej je to edina razlaga tvorbe teh grebenov. Avtorji so mnenja, da so rasli grebeni v klastični psevdoziljski formaciji, ki po njihovem sega do konca karnija, in le njen vrhnji del, to je tuval, pripada amfiklinskim plastem. Po njihovem mnenju je istočasno nastajalo več grebenov, ki so odmirali in se kasneje pojavljali zopet novi.

Ob pregledu širšega terena sem prišel do spoznanja, da so obravnavani grebeni nastajali v amfiklinskih plasteh. Njihovo lego in starost sem razložil v prejšnjem poglavju. Po mojem prepričanju je v amfiklinskih plasteh obstajal samo en grebenski horizont, ki je bil na nekaterih mestih prekinjen, med vmesnimi prekinitvami so nastajali skladoviti mikritni apnenci in grebenska breča. Za greben pri Jesenici sem mnenja, da ga prečkajo številni prelomi, ki so razlomili nekdanjo enotno grebensko apnenčevo maso na več manjših grud, ki dajejo danes videz več med seboj ločenih manjših grebenov. Skrilavci in peščenjaki, ki jih dobimo na vrhu in na pobočju grebena pri Jesenici, po mojem mnenju ne predstavljajo primarno odloženih klastitov med posameznimi grebeni, ampak so tektonsko vgneteni ob prelomih med apnenec. Na več mestih je stik obojih kamenin ravno odrezan, stična ploskev ob apnencu je tektonsko zglajena, silicificirana in limonitizirana. O tektonski pretrtosti celotnega območja priča tudi talninski mikritni apnenec, ki ima nedaleč od omenjenega stika za 180° drugačen vpad.

V grebenu pri Jesenici so med grebenotvorci najštevilnejše spongije in korale. Po masi predstavljajo kolonijske korale celo največji delež v sestavu tega organogenega telesa. Na severnem pobočju grebena so najdene 10 cm dolge debelolupinaste školjke rodu *Isognomon*, podobno kot v Hudajužni.

GREBEN PRI ZAKRIŽU: Na ozemlju med hribom Vršič ter cesto med Zakrižem in Gorjami severno od Cerkna sledimo izdanke grebenskega apnenca v bolj ali manj sklenjenem horizontu. Pod grebenskim apnencem se tu pojavlja kalkarenit s krinoidi in apnenčevo brečo, ki jo sestavljajo kosi mikritnega apnenca, vezivo pa je laporno-glineno in limonitizirano. Nad brečo sledi 2 metra grebenskega apnenca s samimi spongijami, katerim pripada do 60 % celotne kamenine. Više se pojavljajo poleg spongij še kolonijske in solitarne korale. Vezivo med skeleti grebenotvornih organizmov pripada temno sivemu do črnemu mikritnemu apnencu. Danes dobimo na zahodni strani nove ceste med Zakrižem in Gorjami le še manjše do 5 metrov visoke ostanke izdankov. Še pred vojno pa so štrlele nad okolico do 10 m visoke čeri teh apnencev. Apnenec so namreč izkoristili za gradnjo vojaških utrdb in cest. V okolici Zakriža se pojavljajo med klastiti še nekaj kubičnih metrov veliki bloki grebenskega apnenca. To niso samostojni grebeni, ampak samo bloki, ki so se odlomili od večjih grebenskih kompleksov in se zarili v obdajajoče mehke klastične kamenine.

Proti zahodu v smeri hriba Vršič se grebenski apnenec izklinja oziroma bočno prehaja v mikritni skladoviti apnenec, med katerim dobimo na vzhodnem pobočju Vršiča le še en meter debelo plast s kamenotvornimi spongijami. V apnenčevem grušču tega hriba se pojavljajo številne šopasto oblikovane drobne kolonijske korale. Med Vršičem in Jesenico je grebenski apnenec nadomeščen s skladovitim apnencem.

KORALNA IN HIDROZOJSKA FAVNA

Dragica Turnšek

Opis vrst

Sistem triadnih koral še ni dokončno izdelan. Revizije starejših del, ki sta jih približno istočasno izdelala *CUIF* (1966, 1972, 1975, 1976, 1977) in *MELNIKOVA* (1967, 1968a, 1968b, 1971, 1972, 1980) niso usklajene. Zato koral iz Hudajužne zaenkrat ne uvrščam v višje sistematske kategorije, ampak so opisane samo po vrstah. V sistem bodo uvrščene v prihodnjih letih, ko bomo poznali in obdelali vso triadno koralno favno iz naših krajev.

Poleg koral sem opisala še hidrozoje in spongije, ki jih *SENOWBARI-DARYAN* (1981) ni obdelal. Opis vrst je podan v angleškem besedilu. Seznam vrst je na sl. 5.

Okrajšave pri opisih vrst pomenijo: d = premer koraluma ali koralita, s = število sept ali gostota sept na določeni razdalji.

Fosilna združba v grebenu pri Hudajužni

Iz Hudajužne je zbranih in obdelanih čez 100 vzorcev fosilov, od katerih je določenih in opisanih 13 vrst koral, 3 vrste hidrozojev in dodatno 3 vrste spongij. 19 vrst spongij je iz istega nahajališča že obdelal Senowbari-Daryan (1981).

KORALE: Najštevilnejše so vejnate korale. To so faceloidne in dendroidne kolonije, ki so velike od nekaj cm do enega metra. Pripadajo rodovom *Margarosmilia, Volzeia, Protoheterastraea* in vsebujejo 5 vrst. Pogostne so tudi solitarne korale, ki pripadajo rodovom *Margarophyllia, Omphalophyllia* in *Myriophyllum* ter vsebujejo 6 vrst. Ti primerki so veliki od nekaj cm do 25 cm. Masivna meandroidna kolonija rodu *Andrazella* je zastopana samo z eno vrsto, ki meri le nekaj cm.

HIDROZOJI: Hidrozojem podobne organizme uvrščam v rodova *Balatonia* in *Disjectopora*. Ta rodova sta po nekaterih strukturnih značilnostih podobna spongijam. V Hudajužni predstavljajo hidrozoji masivne, toda majhne cenosteje, velike največ do 10 cm.

SPONGIJE: Poleg že obdelanih spongij (*SENOWBARI-DARYAN* 1981) sem našla še 3 vrste iz rodov *Sestrostomella, Walteria* in *Hartmanina*. Tudi to so masivne, do 10 cm velike kolonije.

OSTALI FOSILI: Poleg že omenjenih fosilov se kot povezovalni ali spremljajoči organizmi pojavljajo še alge, foraminifere in mikroproblematika. *ALGE:* Od skupine Rhodophyla so najdene *Cayeuxia* sp. in *Solenopora* sp., ki tvorita nekaj cm velike cevaste kolonije. Od skupine Dasycladacaea pa je najdena samo ena vrsta *?Macroporella* sp., pa še to en edini primerek. *Foraminifere* je obdelal *SENOWBARI-DARYAN.* Določil je 4 vrste. Novih oblik tudi med našim materialom nismo našli. *MIKROPROBLEMATIKA:* Poleg že 7 znanih vrst se v našem materialu pojavlja še *Macrotubus babai FOIS & GAETANI* 1980. Procentualni odnos omenjenih fosilnih skupin je prikazan na sl. 3. Žal tu niso upoštevane školjke, brahiopodi, krinoidi, ker niso paleontološko obdelani po vrstah.

Stratigrafska primerjava opisanih vrst z drugimi nahajališči v svetu

Koralne vrste iz Hudajužne lahko primerjamo z razmeroma redkimi nahajališči. Iste vrste so bile opisane v Dolomitih v Italiji, v Bakony in Bükk na Madžarskem, v Malih Tatrah na Češkoslovaškem, v okolici Brasova v Romuniji in na Pamirju v Centralni Aziji.

Najbogatejša od omenjenih nahajališč so v Dolomitih (val Badia, S. Cassiano, Misurina, Cortina, Alpe di Specie, val di Fassa in drugod). Skupaj je iz teh nahajališč opisanih 61 vrst koral, ki so jih obdelali paleontologi že v prejšnjem stoletju (glej *VOLZ* 1896). Številne korale omenjajo tudi poznejši raziskovalci, ki so raziskovali geologijo Dolomitov (*LEONARDI 1967, MONTANARO GALLITELLI* & al. 1973). Korale omenjajo v »cassianskih« skladih, ki so v glavnem ekvivalent cordelovskih plasti. Nekateri amoniti iz spodnjih kasijanskih skladov so tudi langobardske starosti, medtem ko amoniti iz najzgornejših »cassianskih« plasti kažejo na julsko starost (*URLICH* 1973). V ladinijsko-spodnjekarnijsko obdobje uvrščajo nekatere profile s podobnim mikrofaciesom tudi novejši raziskovalci (*WENDT* & *FÜRSICH* 1979, *FOIS* & *GAETANI* 1980). Hudajužna ima z Dolomiti 12 skupnih vrst.

Koralne vrste iz področij Bükk in Bakony na Madžarskem ter iz Malih Tater na Češkoslovaškem je obdelal *KOLOSVÁRY* (1966a, 1966b, 1967b). Iz Madžarske je opisal 8 vrst, iz Tater 10 vrst. *KOLOSVÁRY* jih uvršča v srednji trias, ker je »cassian« prej pripadal ladiniju. Od teh vrst so samo tri iste tudi v Hudajužni.

Korale iz okolice Brasova v Romuniji je obdelal *KÜHN* (1935), od koder je opisal 22 vrst. Omenja jih v belem do sivem apnencu, ki po izgledu ne ustreza našemu apnencu. Uvršča ga v »cassian«. V Hudajužni smo dobili 6 istih vrst.

Bogata najdišča karnijskih koral so tudi na Pamirju, kjer jih raziskuje *MELNIKOVA* (1968a, 1980). Opisanih ali omenjenih je 9 vrst, 2 sta isti tudi v Hudajužni (glej tudi *DRONOV* & al. 1982). Primerjava koral je prikazana na sl. 4. in 5.

Hidrozoji, najdeni v Hudajužni, so bili doslej znani iz karnija Madžarske in Timorja (*VINASSA* de *REGNY* 1907, 1915).

Spongije iz Hudajužne so bile doslej znane iz wettersteinskih apnencev, ki jih uvrščajo v langobard in cordevol, deloma jul (*OTT* 1967, *DIECI* & al. 1968; *SENOWBARI-DARYAN* 1981) (sl. 5).

Posamezna nahajališča ladinijsko-karnijskih grebenov s podobno favnistično spongijsko-koralno-hidrozojsko združbo so omenjana še iz več krajev Alp (*JANOSCHEK* & *MATURA* 1980, *BRANDNER* & *RESCH* 1980, *WENDT* 1982, *FARABEGOLI* & *LEVANTI* 1982, *HENRICH* 1982 in drugi), pa tudi iz Grčije (*SCHÄFER* & *SENOWBARI-DARYAN* 1982) in iz Amerike (*STANLEY* 1979, 1981), vendar posamezne korale iz teh krajev niso obdelane, zato paleontološka primerjava s Hudajužno ni mogoča.

V Sloveniji se enaka favna kot v Hudajužni pojavlja še v Jesenici (*ČAR* & al. 1981) in v Zakrižu (glej sl. 5). Najdena je bila tudi na drugih krajih (*KOLOSVÁRY* 1967a, *BUSER* & al. 1982), vendar sistematično še ni obdelana.

Iz vse primerjave lahko zaključimo, da kažejo spongije in korale, najdene v amfiklinskih plasteh med Hudajužno in Zakrižem, podobnost s »cassianskimi« in deloma »wettersteinskimi« fosili Alp in Karpatov. Ti so bili doslej uvrščeni v langobard in cordevol, mestoma tudi v jul (sl. 5). Lega grebenskega apnenca v naših krajih kaže po *BUSERJEVIH* ugotovitvah na julsko starost, po čemer lahko sklepamo, da naša nahajališča predstavljajo najmlajši del tako imenovanih »cassianskih« grebenov. Grebenska favna spongij in koral te starosti sicer ne izključuje, vendar kaže bolj na cordevolsko in deloma langobardsko starost, to je na starejši del »cassianskih« grebenov. Iz vsega lahko zaključimo dvoje: 1. da se spongijsko-koralna favna v času »cassianskih« grebenov, to je od langobarda do vključno jula, ni spreminjala, 2. da gre le za različne interpretacije starosti dejansko istega horizonta.

SEDIMENTOLOŠKI DEL

Bojan Ogorelec

Mikrofacialne značilnosti grebenskega apnenca

V kompleksu preiskanih amfiklinskih karnijskih plasti med Hudajužno in Cerknim ločimo v grobem dva tipa kamnin — a) karbonatne grebenske in obgrebenske tvorbe, pri katerih ločimo grebensko jedro, bazalne, predgrebenske in medgrebenske breče ter leče plastovitega apnenca in b) obdajajoče klastične sedimente. Sedimentološke raziskave zajemajo podrobneje le mikrofacialne in diagenetske značilnosti grebenskih jeder in breč pri Hudajužni in Zakrižu; obdajajoči klastiti so bili raziskani že v sklopu študije koralnih bioherm pri Jesenici (*ČAR* & al. 1981).

Grebensko jedro sestavljajo v večjem delu do nekaj cm veliki kalcitni skeleti raznovrstnih spongij; tem slede neskeletne alge, solitarne in kolonijske korale ter hidrozoji. Zelo poredki so še briozoji, foraminifere, skeletne alge, polži, krinoidi in problematični fosili. Neskeletne modrozelene alge navadno obraščajo naštete organske skelete z do 0,5 cm debelimi ovoji. Le redko jih opazujemo kot samostojne algne gruče ali kot drobne onkoide. Kljub precej visokemu deležu organizmov uvrščamo preiskane bioherme znotraj amfiklinskih plasti v skupino »bafflestone boundstone« (po *EMBRY* & *KLOVAN* 1972), saj imajo organizmi predvsem vlogo »lovilca« in stabilizatorja karbonatnega blata ter drobirja, v nasprotju z večino fosilnih in tudi recentnih grebenskih tvorb, kjer gradijo organizmi skelet grebenov (»framestone boundstone«).

V grebenskem apnencu so precej pogostne teksturne vrste Stromatactis. To so do 10 cm velike kaverne z dokaj ravnim dnom in nepravilnim stropom, največkrat obraščenim z ovojem neskeletnih alg. Nastanek teh tekstur se najpogosteje tolmači z odmrtjem nedoločljivih brezskeletnih organizmov in v manjši meri z bioturbacijskimi procesi. Med diagenezo so bile kaverne »stromatactis« zapolnjene s sparitnim kalcitom; v več primerih opazujemo tudi interni mikritni sediment, po katerem sklepamo lahko na normalno lego amfiklinskih plasti na preiskanem ozemlju. Mikritni sediment je pogosto zajela kasnodiagenetska dolomitizacija. Zaradi primesi železa je dolomit na površini obarvan rumenkasto rjavo.

Osnova med organizmi, ki sestavljajo greben, pripada drobnozrnatemu mikritu. Zaradi minimalne primesi organske snovi in piritnega pigmenta je temnejše barve. Lokalno je mikrit rekristaliziran v mikrosparit, mestoma pa je tudi izpran. Take medprostore nepravilnih oblik in različnih velikosti zapolnjuje sparitni kalcitni cement. Več medprostorov kaže geopetalno teksturo z internim mikritnim blatom. Od alokemih komponent so v osnovi prisotni še peleti in drobni do 1 mm veliki mikritni intraklasti. Razpored in količina omenjenih alokemov sta zelo spremenljiva, tako da lahko apnenec uvrstimo po Dunhamovi klasifikaciji v vse prehodne skupine od »mudstone« do »packstone«. Kot litološki tip kamnine je posebej zanimiv apnenec iz krovnine grebena pri Hudajužni. Apnenec je srednje do debeloplastovit in vsebuje števiine do 1 cm velike ploščice krinoidov, tako da ga lahko poimenujemo kar krinoidni apnenec.

Bazalna grebenska breča je relativno drobnozrnata in slabo sortirana. Odlomki merijo do 3 cm, po sestavi pa so precej monotoni. Med karbonatnimi odlomki prevladuje mikritni apnenec, kakršnega opazujemo v lečah in plasteh ladinijsko-karnijske klastične skladovnice. V manjši meri zasledimo tudi drobir pravega grebenskega (organogenega) apnenca, ki je produkt razgradnje in erozije starejših grebenskih tvorb in pa odlomke skrilavca. Kontakti med posameznimi odlomki so večidel omejeni s stilolitnimi šivi, bazalna breča pa je v precejšnji meri tudi silicizirana.

Prava grebenska breča se javlja le lokalno znotraj obeh grebenov. Od bazalnih breč se loči po tem, da vsebuje do 20 cm velike bloke samega organogenega apnenca, cementirana pa je s sparitnim kalcitom. Enako kot sam grebenski apnenec je pogostno tudi dolomitizirana.

Diagenetske značilnosti grebenskega apnenca

Diagenetske značilnosti grebenskega apnenca pri Hudajužni so shematsko prikazane na sl. 6.

Po odložitvi karbonatnega mikritnega blata in organskih skeletov v relativno globljem in mirnem šelfnem okolju (morska freatična faza) je najprej prišlo do mikritizacije organskih skeletov pod vplivom alg in bakterij, do inkrustacije le-teh z neskeletnimi algnimi ovoji in do zamenjave nestabilnega aragonita v stabilni magnezijev kalcit. V istem okolju se je v medprostorih organizmov kasneje odlagal drobni vlaknati kalcit generacije A, za njim pa sparitni kalcit generacije B, ki kaže večanje kristalov proti središču por.

Grebenski sediment je bil zaradi svoje rasti občasno bliže morski površini in izpostavljen morsko-sladkovodnemu freatičnemu okolju. Takrat predpostavljamo, da je prišlo do selektivne kasnodiagenetske dolomitizacije z dolomitom, bogatim z železom (feric dolomite). Dolomitizacija apnenca v okolju mešanja morske in sladkovodne vode je znana kot »dorag model dolomitizacije« (*BADIOZAMANI* 1973), v novejšem času najbolj sprejemljiv model dolomitizacije za večje komplekse apnenca. Dobra primarna poroznost grebenskega sedimenta omogoča tu pretok velikega volumna pornih raztopin, nasičenih z Mg^{++} ioni.

Poleg cementacije in dolomitizacije opazujemo v preiskanih vzorcih v manjši meri še naslednje diagenetske procese — rekristalizacijo mikritne osnove v mikrosparit, silicizacijo, albitizacijo in piritizacijo. Kremen se večidel javlja skupno z albitom, in sicer v do 250 µm velikih avtigenih kristalih, največkrat v mikritni osnovi. Poredko nadomešča tudi kalcit v organskih skeletih, predvsem koralah; v teh primerih ima mikrokristalno strukturo. Izvor kremena in albita pripisujemo okolnim klastičnim kamninam.

Pirit se javlja kot precej enakomerno razpršen pigment z do 20 µm velikimi zrni in kaže na pogostne redukcijske pogoje znotraj sedimenta. Posebno pogost je pirit v krovnini grebena pri Hudajužni, kjer je razvit v lepih do 150 µm velikih kristalih.

Amfiklinski karnijski koralni grebeni so danes kompaktne karbonatne tvorbe brez opazne poroznosti, z izjemo tektonskih razpok in kraških kavern. Predpostavljamo pa, da je bila njihova poroznost precej boljša v obdobju njihove sedimentacije in zgodnje diageneze. Kamnine so imele delno značaj moldične poroznosti, nastale z izluževanjem aragonitnih organskih skeletov, del por je nastal z razpadom mehkih delov organizmov (predvsem v spongijah in strukture Stromatactis), manjši del por pa je nastal tudi mehansko z bioturbacijsko aktivnostjo. Vse te pore so bile med kasnejšo diagenezo popolnoma zaprte, zapolnjene s kalcitnim cementom.

Sedimentacijsko okolje

Po terenskih opazovanjih oblike in velikosti koralnih grebenov, njihovem medsebojnem odnosu, razporedu bazalnih in predgrebenskih breč, tipu okolnih klastičnih kamnin ter po mikrofacialnih značilnostih apnencev ugotavljamo, da so ladinijsko-karnijske grebenske tvorbe na Cerkljanskem svojevrsten geološki fenomen in jih zelo težko primerjamo s katerimikoli grebeni starejših geoloških obdobij, opisanimi v literaturi. Sličen razvoj, predvsem mikrofacialne značilnosti, kažejo koralne bioherme spodnjekarnijske starosti v Dolomitih (*FOIS* & *GAETANI* 1980; *WENDT* & *FÜRSICH* 1979), po okolnih klastičnih sedimentih pa kambrijske bioherme iz Forteau formacije v Kanadi (*JAMES* & *KOBLUK* 1978).

Sedimentacijsko okolje enega od cerkljanskih grebenov — kompleks pri Jesenici je bil že opisan (*ČAR* & al. 1981) in enako okolje predpostavljamo tudi za grebena pri Hudajužni in Zakrižu. Spongijsko-koralne bioherme so nastajale v nekoliko globljem, mirnem šelfnem območju, na prehodu med obalo in šelfnim robom. Po skeletnih algah sklepamo še na fotično cono, to je globino morja nekaj deset metrov. Sama sedimentacija ima ciklični značaj kot rezultat menjave klastičnega in karbonatnega materiala.

Po odložitvi klastičnega terigenega materiala — skrilavcev, peščenjakov in intraformacijskih breč, ki kot celota dajejo lokalno vtis plitvovodnih oziroma proksimalnih turbiditnih tvorb — so geomorfološko ugodna mesta naselile spongije in drugi grebenski organizmi. Taka mesta so vedno vezana na debelozrnate klastite, kjer so se organizmi lahko fiksirali in kolonizirali. Pričela je intenzivna rast bioherm, katere so gradile predvsem spongije in korale. V splošnem opazujemo lokalno diferenciacijo organizmov, ki tvorijo posamezne dele grebenov. Tako so na primer spongije v nekaterih mestih pogostnejše, medtem ko drugje prevladujejo korale po številu primerkov

nad ostalimi organizmi. Bioherme predstavljajo prave »mud mounds« (patch reefs) z do 50° strmimi stenami, njihova velikost pa je odvisna od tega, v kakšni fazi je njihovo rast prekinil dotok terigenega materiala. Ta je bil toliko sunkovit in obilen, da ga grebenotvorni organizmi niso mogli preživeti. Glede na relativno majhen prostor, kjer smo raziskali amfiklinske plasti, je težko zaključiti na izvorno področje terigenega materiala, ki obdaja grebenski apnenec. Domnevamo, da je ta prihajal z juga, na kar bi kazale regionalne ugotovitve: klastiti so v karnijskih plasteh namreč pogostejši v prostoru južno od preiskanega — na primer na Idrijskem (*MLAKAR* 1969. *CIGALE* 1978) in Notranjskem (*GREGORIČ* & al. 1980, *DOZET* 1979) — kot tudi severno od Cerkljanskega (*BUSER* 1974, *OGORELEC* 1981, 1982).

SKLEPI

V 300 m debeli skladovnici klastičnih amfiklinskih plasti med Hudajužno in Zakrižem se v njihovi srednji tretjini pojavljajo vložki koralno-spongijskih grebenov. Po legi, ki je usklajena z ostalimi razvoji triasa v Sloveniji in po najdbah konodontov so amfiklinski skladi uvrščeni v karnij, grebeni pa v julsko podstopnjo karnija.

Iz Hudajužne je obdelanih 13 vrst koral, 2 vrsti hidrozojev in 3 vrste spongij. 19 vrst spongij je iz istega nahajališča že obdelal Senowbari-Daryan (1981). Favna kaže podobnost s »cassiansko« in deloma »wettersteinsko« favno Alp in Karpatov, in je bila doslej uvrščena v glavnem v cordevol, mestoma tudi v langobard in mestoma v jul. Naša nahajališča predstavljajo torej po legi julski, to je najmlajši del »cassianskih« grebenov, medtem ko koralno-spongijska favna v Hudajužni kaže bolj na cordevol, to je na starejši del »cassianskih grebenov«. Ostane torej vprašanje: 1. ali se koralno-spongijska favna od langobarda do vključno jula ni spreminjala, in 2. ali gre morda le za različne interpretacije starosti dejansko istega horizonta.

Po sedimentoloških analizah sestoje grebenske tvorbe iz grebenskega jedra, grebenske breče ter leč plastovitega mikritnega apnenca. Vse strukture kažejo procese zgodnje in kasne diageneze, predvsem dolomitizacijo in silicizacijo. Uvrščamo jih v »bafflestone-boundstone« tip bioherm, kjer imajo fosili vlogo lovilca karbonatnega blata in ne pravega graditelja grebenov. Uspevali so kot manjši grebeni (»patch reefs«) v mirnem globljem intraplatformskem bazenu na območju šelfa.

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PLATES-TABLE

EXPLANATION TO PLATES

All Figs on Plates 1—9 (except Pl. 6, fig. 3) are negatives. Thin sections are enlarged directly onto the paper.
Figs. on Plates 10—12 are made by film.

RAZLAGA K TABLAM

Vse fotografije na tablah 1—9 (razen Tab. 6, sl. 3) so negativi. Zbruski so povečani direktno na papir.
Slike na tablah 10—12 so pozitivi, narejeni s filmom.

PLATE 1

Figs. 1—4. *Margarophyllia capitata (MÜSTER* 1841*)*
1. Transverse section of corallum. Thin section P-706a, 2 ×.
2. Longitudinal peripheral section of corallum. Thin section P-706b, 2 ×.
3. Part of section from Fig. 1., 4 ×.
4. Microstructure showing sclerodermites. Thin section P-706a 20 ×.

Figs. 5—8. *Margarophyllia crenata (MÜNSTER* 1841*)*
5. Transverse section of corallum. Thin section P-745, 2 ×.
6. Transverse section of an other corallum. Endotheca is abundant. Thin section. P-702a, 2 ×.
7. Transverse section of corallum. Thin section P-710, 2 ×.
8. Microstructure showing sclerodermites. Thin section from Fig. 6., 20 ×.

TABLA 1

Sl. 1—4. *Margarophyllia capitata (MÜNSTER* 1841*)*
1. Prečni presek koraluma. Zbrusek P-706a, 2 ×.
2. Podolžni presek koraluma ob zunanjem robu. Zbrusek P-706b, 2 ×.
3. Del preseka s sl. 1., 4 ×.
4. Mikrostruktura sept s sklerodermiti. Zbrusek P-706a, 20 ×.

Sl. 5—8. *Margarophyllia crenata (MÜNSTER* 1841*)*
5. Prečni presek koraluma. Zbrusek P-745, 2 ×.
6. Prečni presek drugega koraluma. Zbrusek P-702a, 2 ×.
7. Prečni presek koraluma. Endoteka bogata. Zbrusek P-710, 2 ×.
8. Mikrostruktura sept s sklerodermiti. Del preseka s sl. 6., 20 ×.

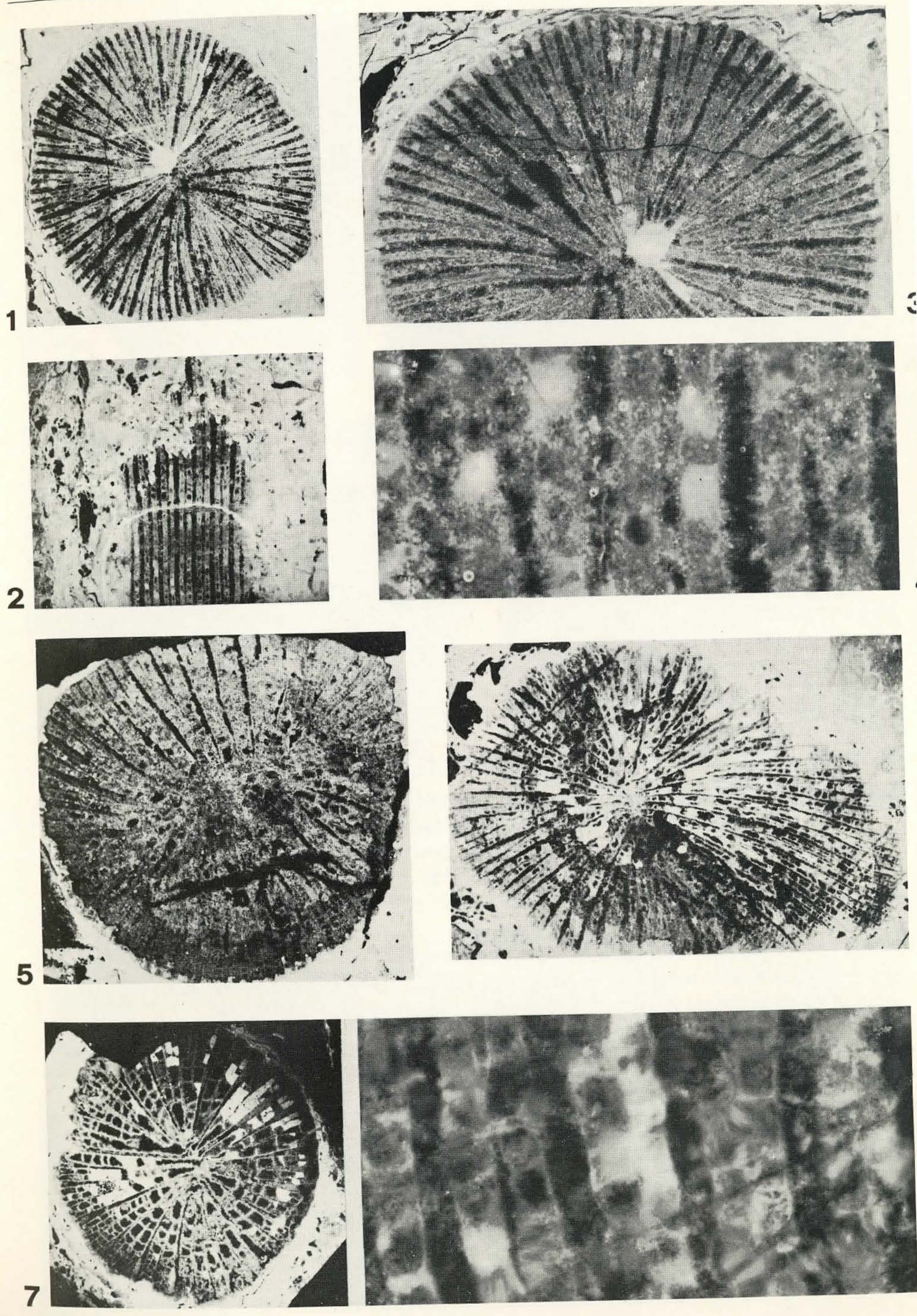

PLATE 2

Figs. 1—4. *Margarosmilia zieteni (KLIPSTEIN* 1843*)*
1. Transverse section of the colony showing two corallites. Thin section P-705b, 2 ×.
2. Longitudinal and oblique sections of two corallites. Thin section P-705a, 2 ×.
3. Transverse section of one corallite. Thin section P-699a, 4 ×.
4. Microstructure showing sclerodermites and lateral thorns. Thin section P-705a, 20 ×.

Figs. 5—6. *Margarosmilia confluens (MÜNSTER* 1841*)*
5. Transverse section of confluent corallites. Thin section P-708b, 2 ×.
6. Longitudinal section of one corallite. Thin section P-708d, 2 ×.

TABLA 2

Sl. 1—4. *Margarosmilia zieteni (KLIPSTEIN* 1843*)*
1. Prečni presek kolonije, vidna sta dva koralita. Zbrusek P-705b, 2 ×.
2. Podolžni in poševni presek dveh koralitov. Zbrusek P-705a, 2 ×.
3. Prečni presek enega koralita. Zbrusek P-699a, 4 ×.
4. Mikrostruktura sept s sklerodermiti in lateralnimi zobci. Zbrusek P-705a, 20 ×.

Sl. 5—6. *Margarosmilia confluens (MÜNSTER* 1841*)*
5. Prečni presek kolonije s konfluentnimi koraliti. Zbrusek P-708b, 2 ×.
6. Podolžni presek enega koralita. Zbrusek P-708d, 2 ×.

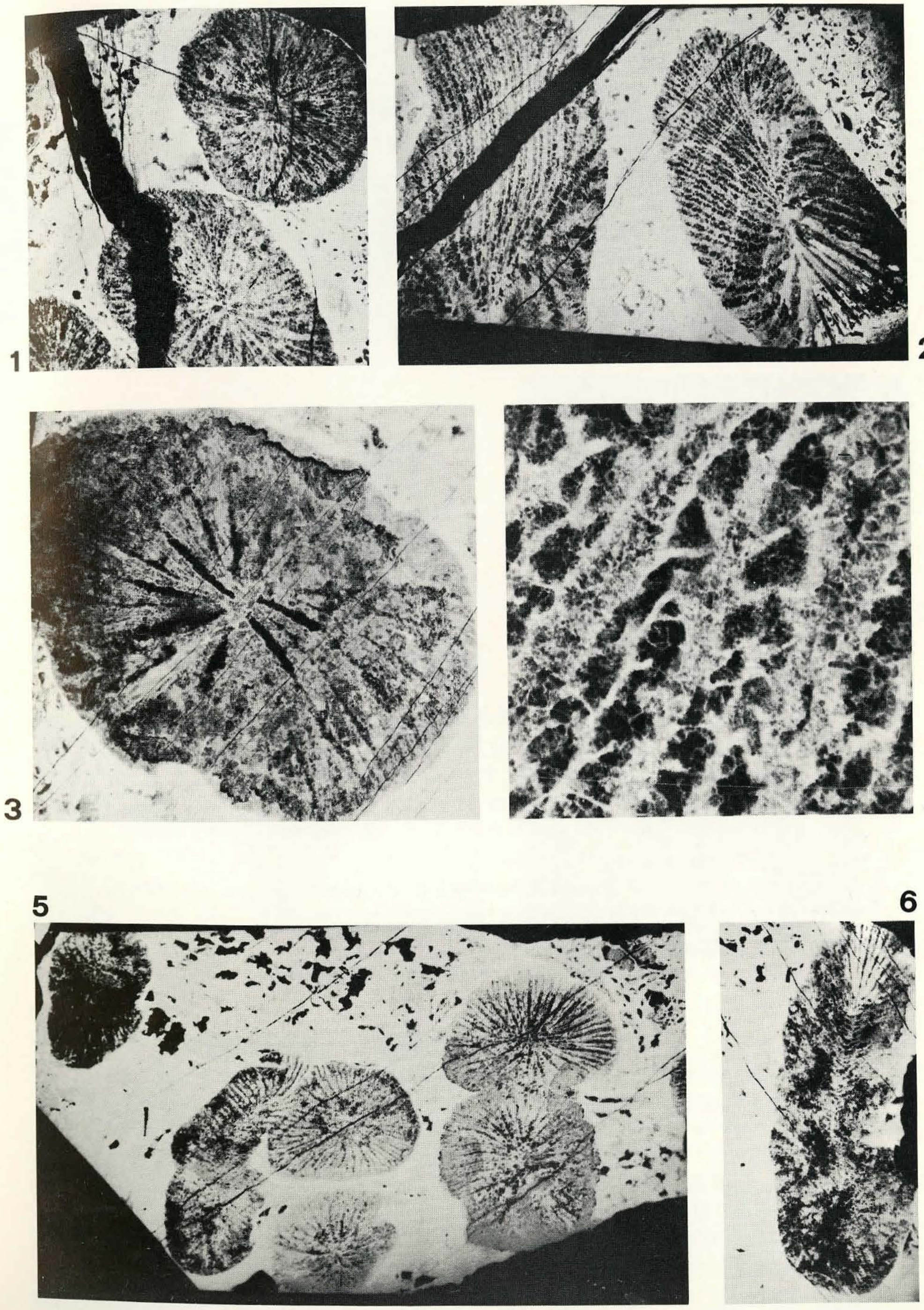

PLATE 3

Figs. 1—3. »*Montlivaltia*« cf. *cipitensis VOLZ* 1896
1. Transverse section of corallum. Thin section P-760b, 2 ×.
2. Longitudinal section of corallum. Thin section P-760a, 2 ×.
3. Microstructure showing simple trabeculae. Thin section P-760b, 20 ×.

Figs. 4—5. *Volzeia badiotica (VOLZ 1896)*
4. Transverse section of colony showing two corallites. Thin section P-755a, 2 ×.
5. Longitudinal section of budding corallites. Thin section P-755b, 2 ×.

Fig. 6. *Volzeia sublaevia (MÜNSTER 1841)*
Transverse section of the colony. Thin section P-749, 4 ×.

TABLA 3

Sl. 1—3. »*Montlivaltia*« cf. *cipitensis VOLZ* 1896
1. Prečni presek koraluma. Zbrusek P-760b, 2 ×.
2. Podolžni presek koraluma. Zbrusek P-760a, 2 ×.
3. Mikrostruktura sept z enostavnimi trabekulami. Zbrusek P-760b, 20 ×.

Sl. 4—5. *Volzeia badiotica (VOLZ 1896)*
4. Prečni presek kolonije, kaže dva koralita. Zbrusek P-755a, 2 ×.
5. Podolžni presek dveh koralitov, ki se delita. Zbrusek P-755b, 2 ×.

Sl. 6. *Volzeia sublaevis (MÜNSTER 1841)*
Prečni presek kolonije. Zbrusek P-749, 4 ×.

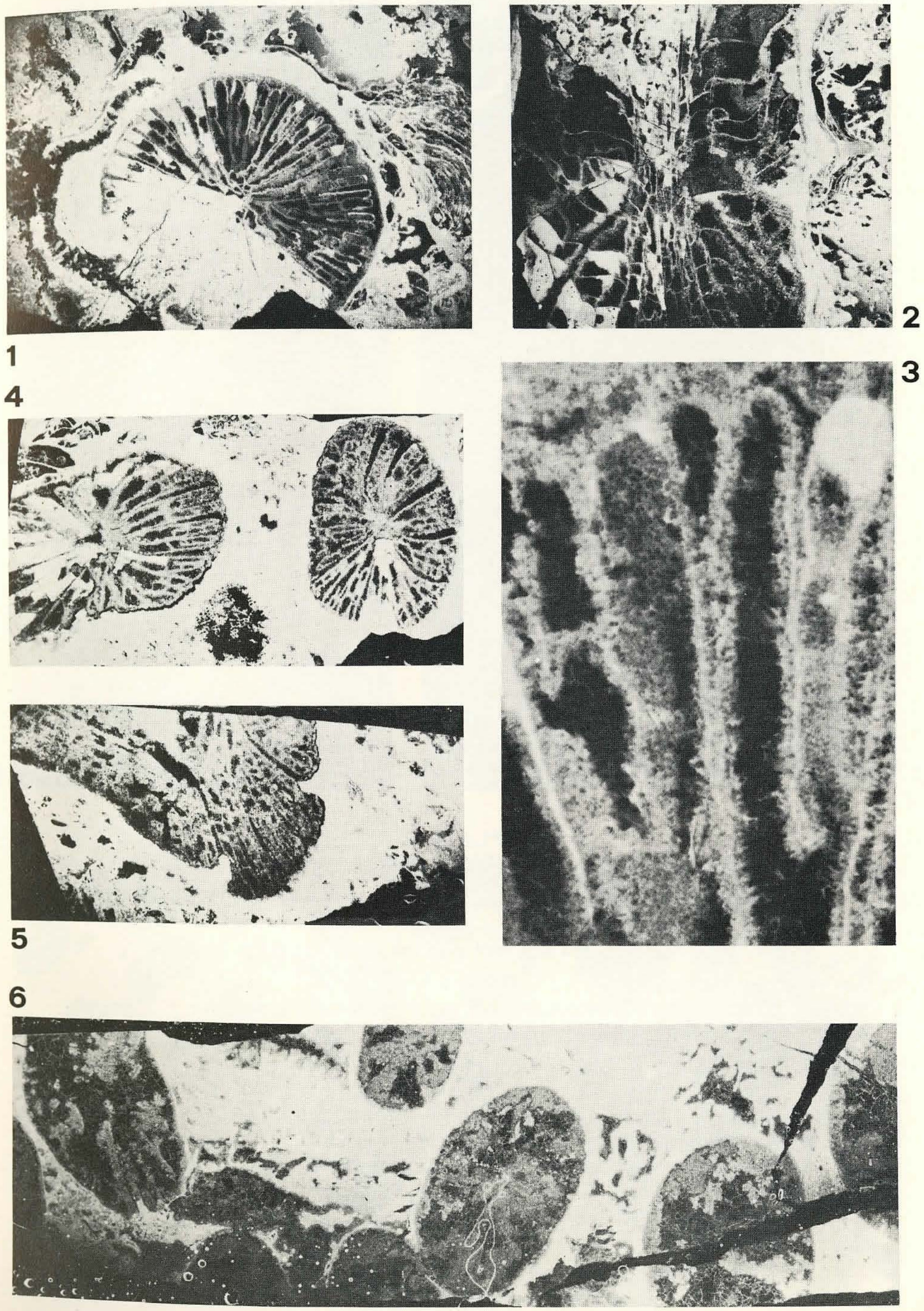

PLATE 4

Figs. 1—3. *Andrazella labyrinthica (KLIPSTEIN* 1843*)*
1. Transverse section of meandroid colony. Thin section P-751a, 2 ×.
2. Section from Fig. 1., 4 ×.
3. Microstructure of septa and wall, part of section from Fig 1., 20 ×.

Figs. 4—5. *Protoheterastraea* sp.
4. Transverse section of colony with small corallites. Thin section P-750b, 4 ×.
5. Longitudinal section of two corallites. Thin section P-750a, 4 ×.

TABLA 4

Sl. 1—3. *Andrazella labyrinthica (KLIPSTEIN* 1843*)*
1. Prečni presek meandroidne kolonije. Zbrusek P-751a, 2 ×.
2. Presek s sl. 1., 4 ×.
3. Mikrostruktura sept in stene, del preseka s sl. 1., 20 ×.

Sl. 4—5. *Protoheterastraea* sp.
4. Prečni presek kolonije z majhnimi koraliti. Zbrusek, P-750b, 4 ×.
5. Podolžni presek dveh koralitov. Zbrusek P-750a, 4 ×.

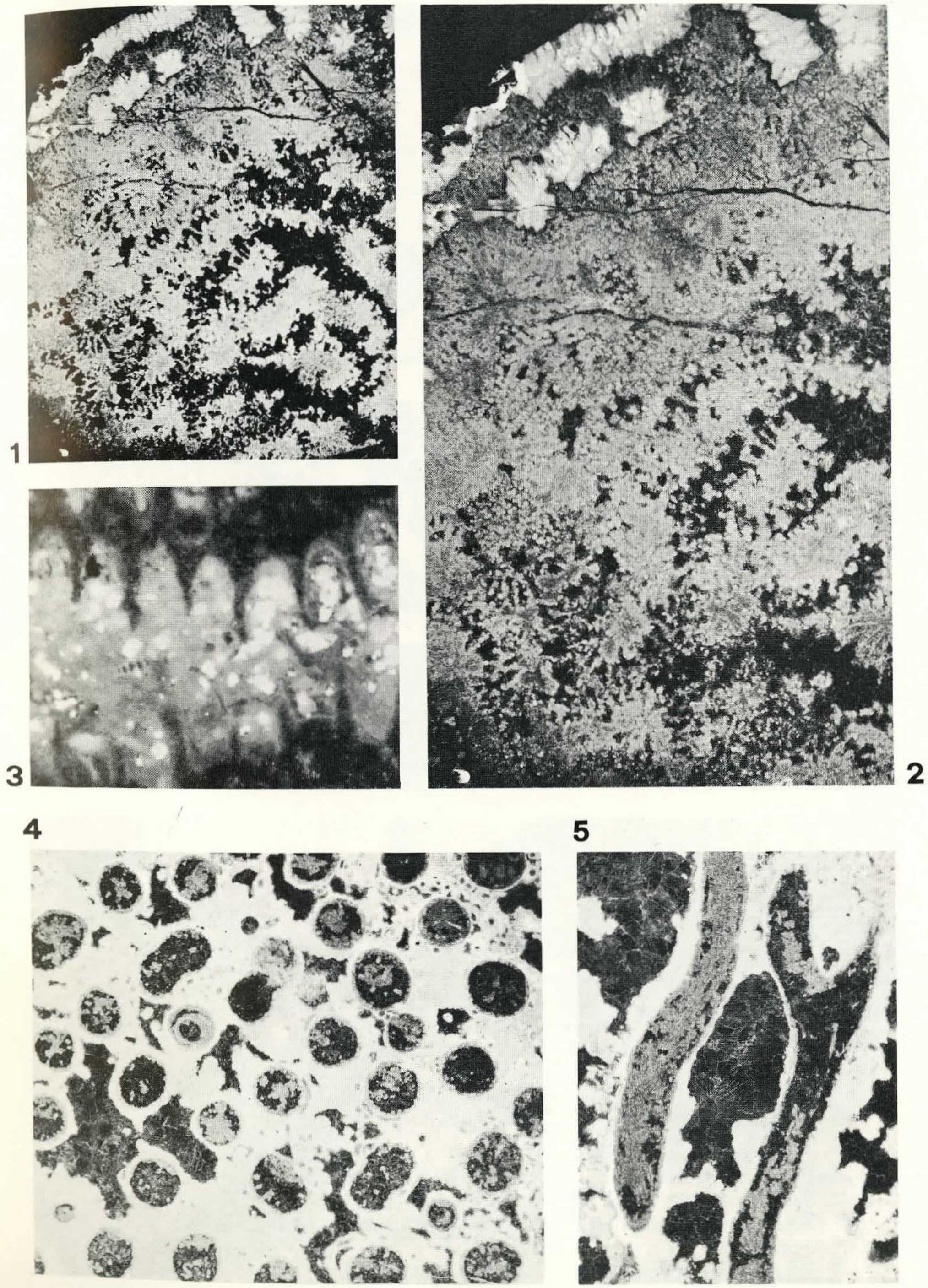

PLATE 5

Figs. 1—4. *Protoheterastraea hudajuznensis* n. sp.

1. Transverse section of colony. Thin section P-761c, 2 ×.
2. Longitudinal section of one corallite. Thin section P-761b, 4 ×.
3. Transverse section of colony. Note various axial structures. Thin section P-761d, 4 ×.
4. Transverse section of two corallites. Thin section P-761d, 10 ×.

TABLA 5

Sl. 1—4. *Protoheterastraea hudajuznensis* n. sp.

1. Prečni presek kolonije. Zbrusek P-761c, 2 ×.
2. Podolžni presek enega koralita. Zbrusek P-761b, 4 ×.
3. Prečni presek kolonije. Različne aksialne strukture v koralitih. Zbrusek P-761d, 4 ×.
4. Prečni presek dveh koralitov. Zbrusek P-761d, 10 ×.

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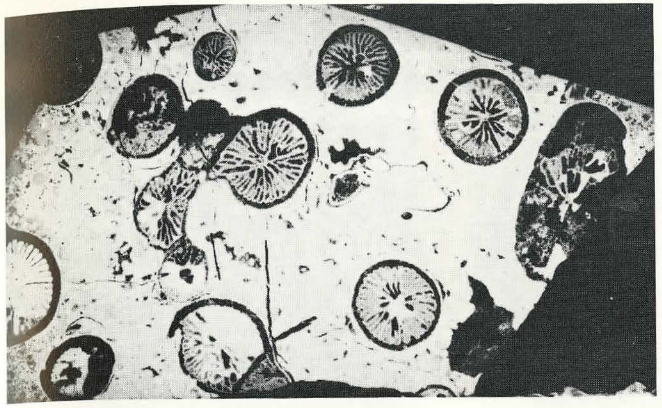


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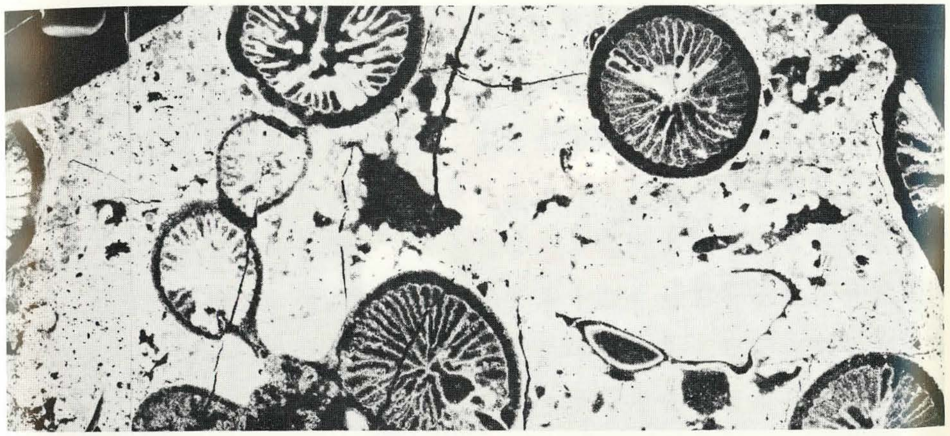


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PLATE 6

Figs. 1—3. *Protoheterastraea hudajuznensis* n. sp.

1. Transverse section of one corallite. Long first septum and bilaterity. Thin section P-761d, 10 ×.
2. Transverse section of corallum. More septa reach the centrum. Thin section P-761d, 10 ×.
3. Transverse section of corallite with empty "fossula". Thin section P-761c, 20 ×.

TABLA 6

Sl. 1—3. *Protoheterastraea hudajuznensis* n. sp.

1. Prečni presek enega koralita. Dolg prvi septum, bilateralnost. Zbrusek P-761d, 10 ×.
2. Prečni presek enega koralita. Več sept sega v center. Zbrusek P-761d, 10 ×.
3. Prečni presek enega koralita. Centralni prostor je prazna »fosula«. Zbrusek P-761c, 20 ×.


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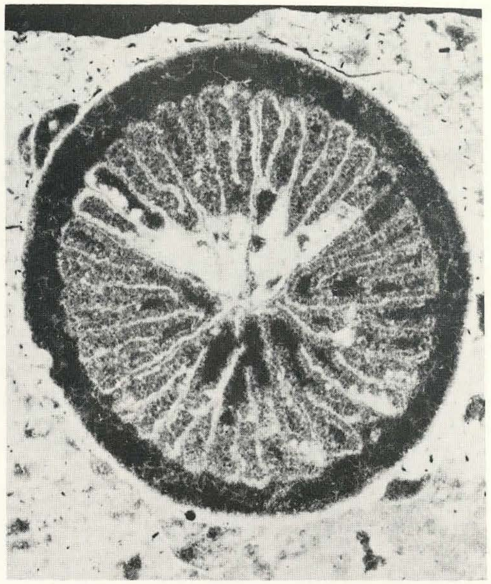
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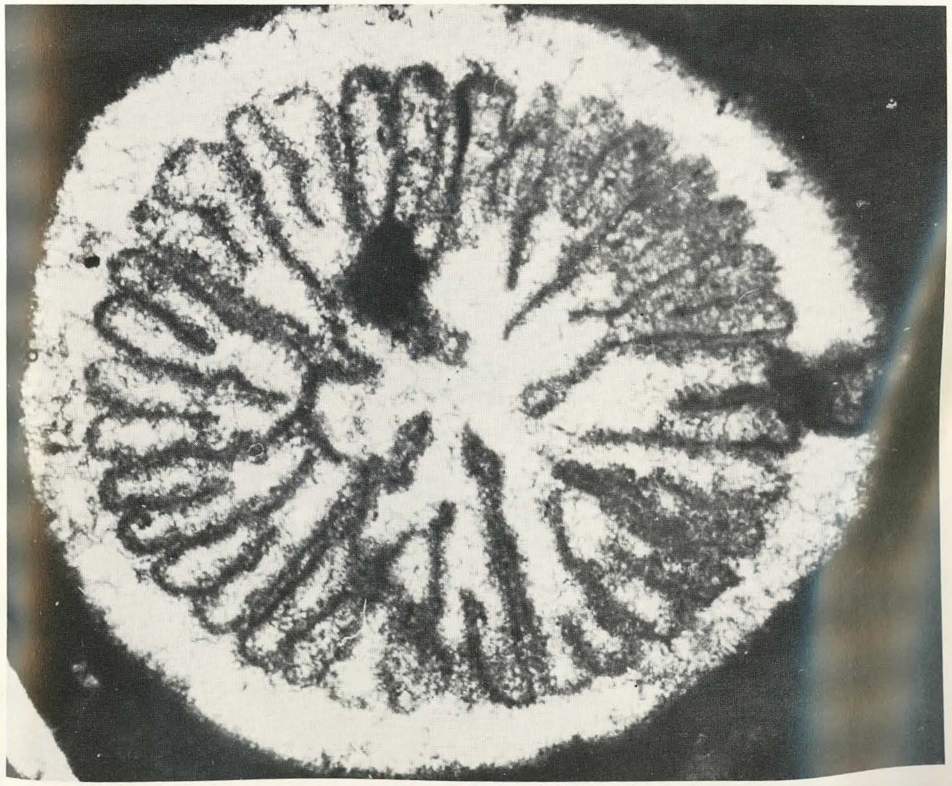
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PLATE 7

Figs. 1—3. *Omphalophyllia boletiformis (MÜNSTER* 1841*)*
1. Transverse section of corallum. Thin section P-716b, 2 ×.
2. Longitudinal section of corallum. Thin section P-754, 2 ×.
3. Microstructure of septa showing recrystalized sclerodermites. Thin section P-716b, 20 ×.

Fig. 4. *Omphalophyllia radiciformis (KLIPSTEIN* 1843*)*
Transverse section of corallum. Thin section P-735, 2 ×.

Figs. 5—6. *Myriophyllum badioticum (VOLZ* 1896*)*
5. Transverse section of corallum. Note numerous dense septa. Thin section P-762 a, 2 ×.
6. Part of the transverse corallum from Fig. 5., 4 ×.

TABLA 7

Sl. 1—3. *Omphalophyllia boletiformis (MÜNSTER* 1841*)*
1. Prečni presek koraluma. Zbrusek P-716b, 2 ×.
2. Podolžni presek koraluma. Zbrusek P-754, 2 ×.
3. Mikrostruktura sept z rekristaliziranimi sklerodermiti. Zbrusek P-716b, 20 ×.

Sl. 4. *Omphalophyllia radiciformis (KLIPSTEIN* 1843*)*
Prečni presek koraluma. Zbrusek P-735, 2 ×.

Sl. 5—6. *Myriophyllum badioticum (VOLZ* 1896*)*
5. Prečni presek koraluma. Številna tanka septa. Zbrusek P-762a, 2 ×.
6. Del preseka koraluma s sl. 5., 4 ×.

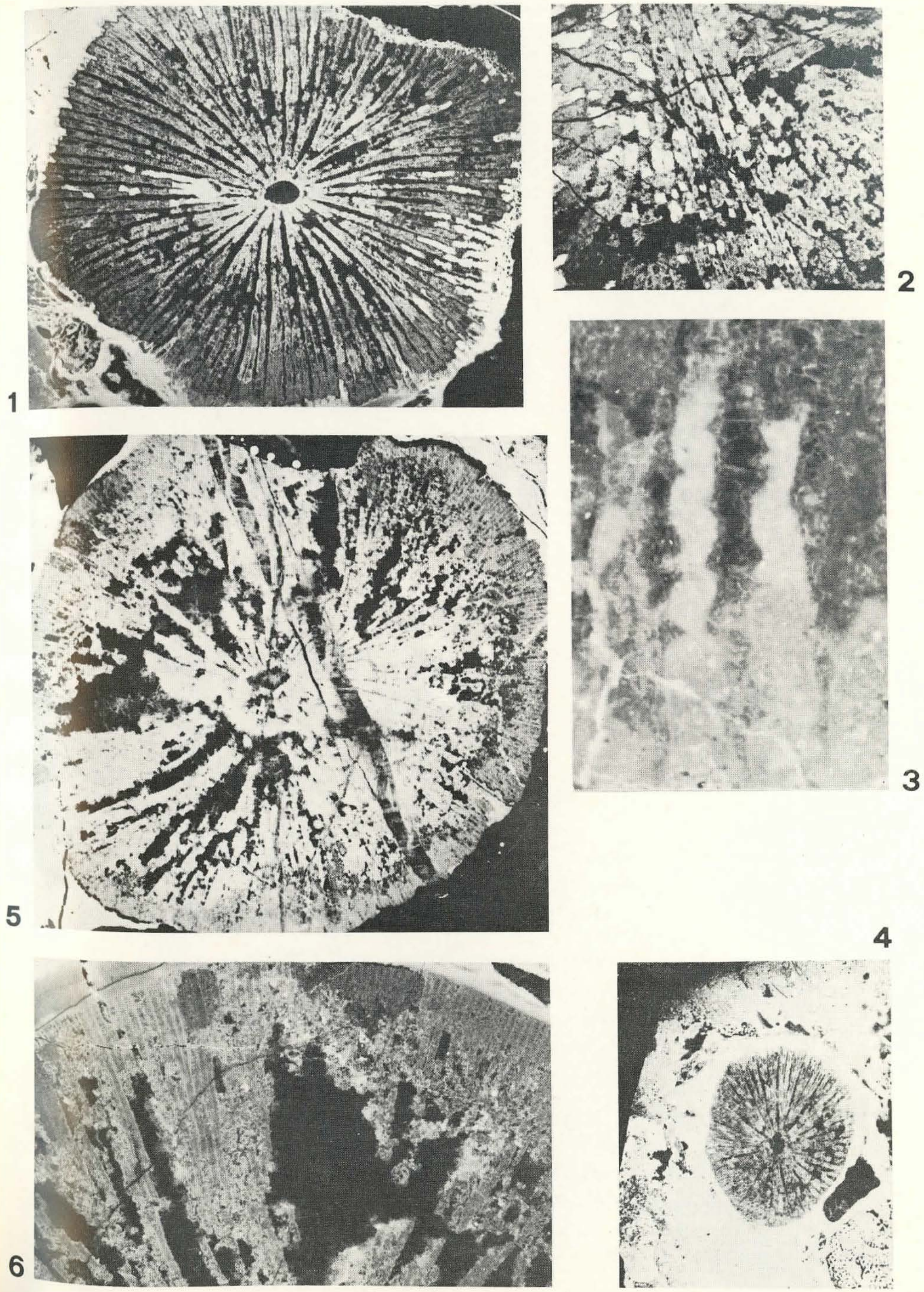

PLATE 8

Figs. 1—2. *Disjectopora* cf. *dubia VINASSA* de *REGNY* 1915
1. Longitudinal section of coenosteum showing larger tubes in reticulum. Thin section P-701a, 4 ×.
2. Transverse section of coenosteum. Thin section P-727a, 4 ×.

Fig. 3. *Balatonia kochi VINASSA* de *REGNY* 1907
Transverse and partly longitudinal section of coenostea. No axial canals. thin section P-742a, 4 ×.

TABLA 8

Sl. 1—2. *Disjectopora* cf. *dubia VINASSA* de *REGNY* 1915
1. Podolžni presek cenosteja. Večje cevi so med retikulom. Zbrusek P-701a, 4 ×.
2. Prečni presek cenosteja. Zbrusek P-727a, 4 ×.

Sl. 3. *Balatonia kochi VINASSA* de *REGNY* 1907
Prečni presek in deloma podolžni presek cenostejev. Brez aksialnega kanala. Zbrusek P-742a, 4 ×.

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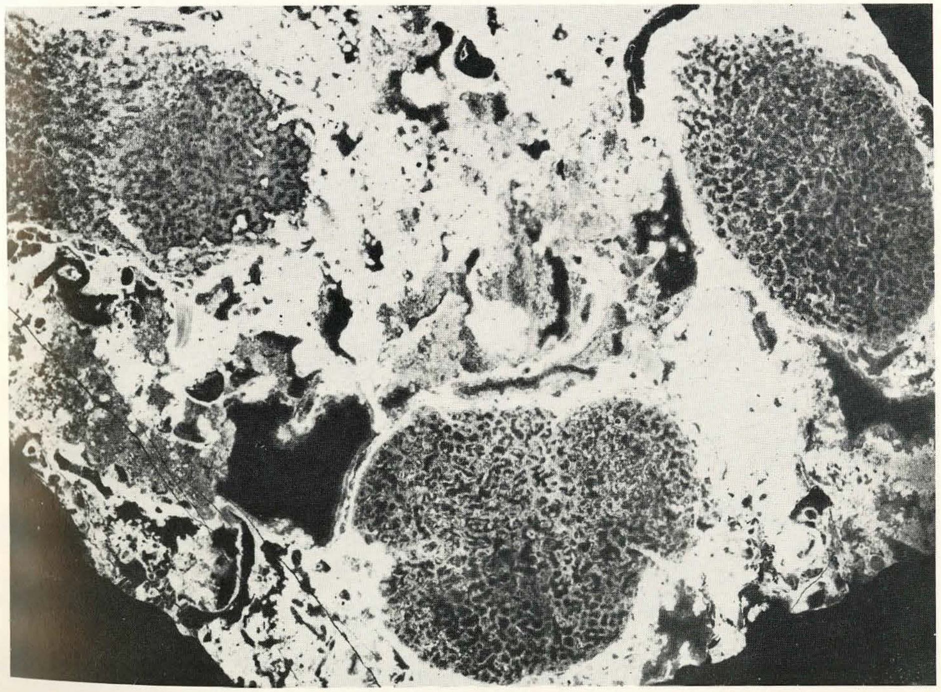

PLATE 9

Figs. 1—2. *Sestrostomella robusta ZITTEL* 1879
1. Transverse section of sponge showing numerous axial canals. Thin section P-697b, 2 ×.
2. Longitudinal to oblique section of sponge. Thin section P-697a, 2 ×.

Fig. 3. *Walteria* sp.
Partly vertical and partly transverse section of vermiculate reticulum. Left below large axial canal. Thin section P-711b, 2 ×.

Fig. 4. *Hartmanina* sp.
Transverse section of vermiculate skeleton. Thin section P-725a, 4 ×.

Fig. 5. *Macrotubus babai FOIS & GAETANI* 1980
Transverse section of tubular colony. Thin section P-723a, 20 ×.

TABLA 9

Sl. 1—2. *Sestrostomella robusta ZITTEL* 1879
1. Prečni presek spongije s številnimi aksialnimi kanali. Zbrusek P-697b, 2 ×.
2. Podolžni do poševni presek spongije. Zbrusek P-697a, 2 ×.

Sl. 3. *Walteria* sp.
Deloma podolžni in deloma prečni presek črvastega retikula. Spodaj levo je velik aksialni kanal. Zbrusek P-711b, 2 ×.

Sl. 4. *Hartmanina* sp.
Prečni presek črvastega retikula. Zbrusek P-725a, 4 ×.

Sl. 5. *Macrotubus babai FOIS & GAETANI* 1980
Prečni presek cevaste kolonije. Zbrusek P-723a, 20 ×.

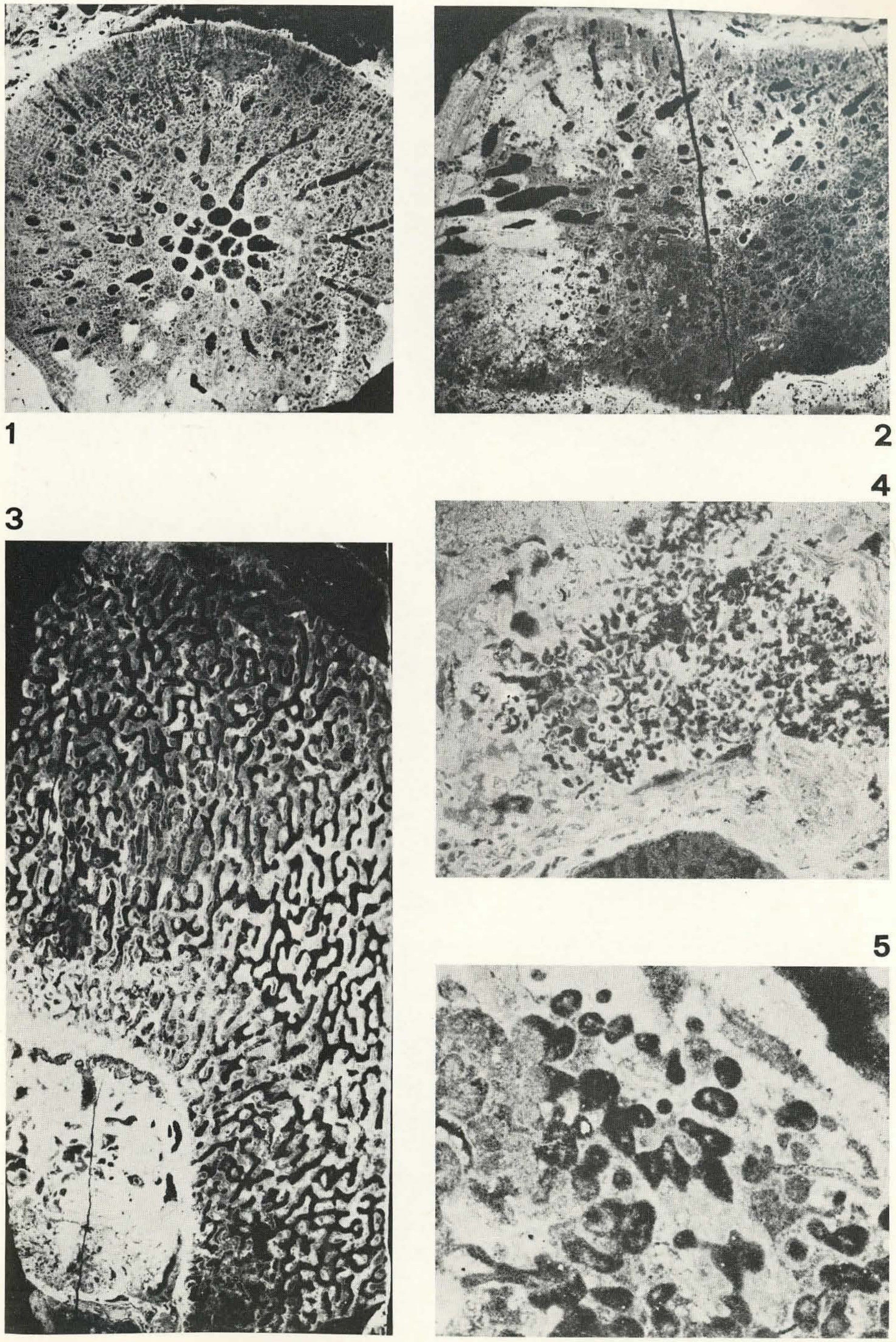

PLATE 10

Fig. 1. Organogenic limestone built by colonies of sponge *Vesicocaulis reticuliformis JABLONSKY*, one of the most abundant species in the Hudajužna reef. Thin section P-725, negative, 4 ×.

Fig. 2. Section of sponge *Cryptocoelia zitteli STEINMANN* in intrapelmicritic groundmass. The sponge is overgrown by nonskeletal algae. Thin section HJ 8/82, 10 ×.

Fig. 3. Detail of sponge skeleton. Openings or interspaces are filled by two generations of cement. — the peripheral cement A and the sparitic cement B. Thin section HJ 73b, 15 ×.

Fig. 4. Overgrowing of sponge by nonskeletal algae. Thin section HJ 30/2-82, 15 ×.

TABLA 10

Sl. 1. Organogeni apnenec, ki ga grade kolonije spongije *Vesicocaulis reticuliformis JABLONSKY*, ene od najpogostnejših v grebenu pri Hudajužni. Zbrusek P-725, negativ, 4 ×.

Sl. 2. Presek spongije *Cryptocoelia zitteli STEINMANN* v intrapelmikritni osnovi. Spongije obraščajo neskeletne alge. Zbrusek HJ8/82, 10 ×.

Sl. 3. Detajl spongijskega skeleta. Odprtine ali medprostore zapolnjujeta dve generaciji cementa — obrobni cement A in sparitni cement B. Zbrusek HJ 73b, 15 ×.

Sl. 4. Obraščanje spongije z neskeletnimi algami. Zbrusek HJ 30/2-82, 15 ×.

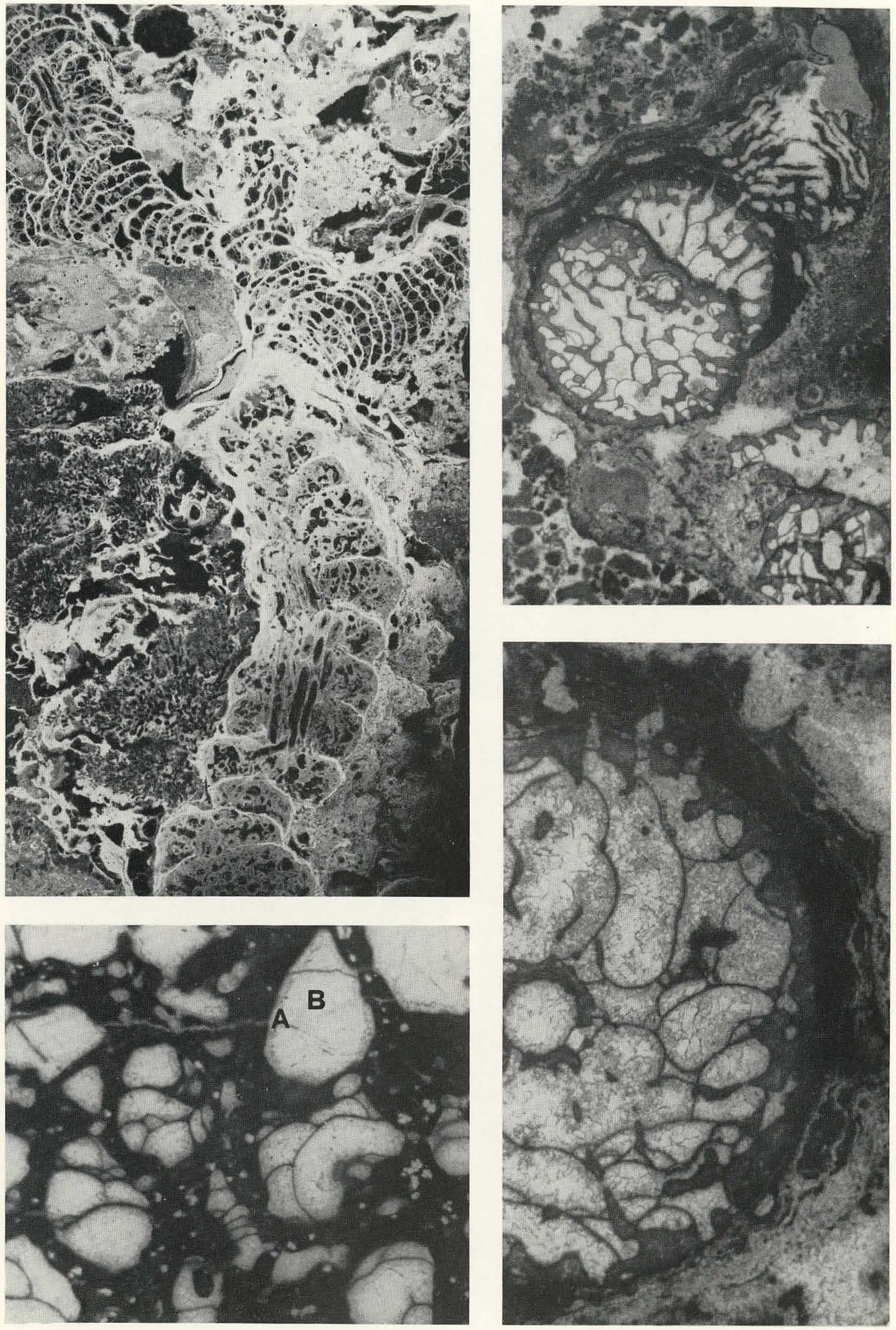

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PLATE 11

Fig. 1. Interspace with geopetal texture in organic limestone (alga *Marinella* sp.). The lower part of the space is filled by micrite (A), and the upper part by sparitic calcite (B). Zbrusek HJ 26, 15 ×.

Fig. 2. Part of the »Stromatactis« texture overgrown in the upper part by nonskeletal algae. Geopetal texture is well visible. Peripheral calcite cement (A), coarse grained dolomite (B), and sparitic calcite (C). Thin section HJ 40/2, 10 ×.

Fig. 3. Cross-section of coral. Openings between septa are filled by micritic carbonate mud and sparitic cement. Thin section P-759, 15 ×.

Fig. 4. Solitary coral *Margarophyllia crenata (MÜNSTER)* with an entirely silicified wall (white rim). Penetration of silicification is well visible into the interior of the corallum. Thin section P-732, 4 ×.

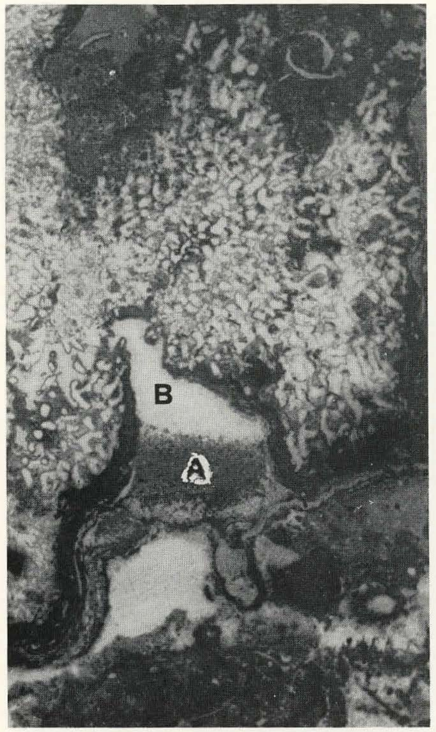
TABLA 11

Sl. 1. Medprostor z geopetalno teksturo v organogenem apnencu (alga *Marinella* sp.). Spodnji del prostora zapolnjuje mikrit (A), zgornji del pa sparitni kalcit (B). Zbrusek HJ 26, 15 ×.

Sl. 2. Del teksture »Stromatactis«, katero v vrhnjem delu obraščajo neskeletne alge. Jasna je tudi geopetalna tekstura. Obrobni kalcitni cement (A), zrnat dolomit (B) in sparitni kalcit (C). Zbrusek HJ 40/2, 10 ×.

Sl. 3. Presek korale. Odprtine med septi zapolnjujeta mikritno karbonatno blato in sparitni cement. Zbrusek P-759, 15 ×.

Sl. 4. Solitarna korala *Margarophyllia crenata (MÜNSTER)* s popolnoma silicizirano steno (bel rob). Opazujemo prodiranje silicizacije v notranjost korale. Zbrusek P-732, 4 ×.



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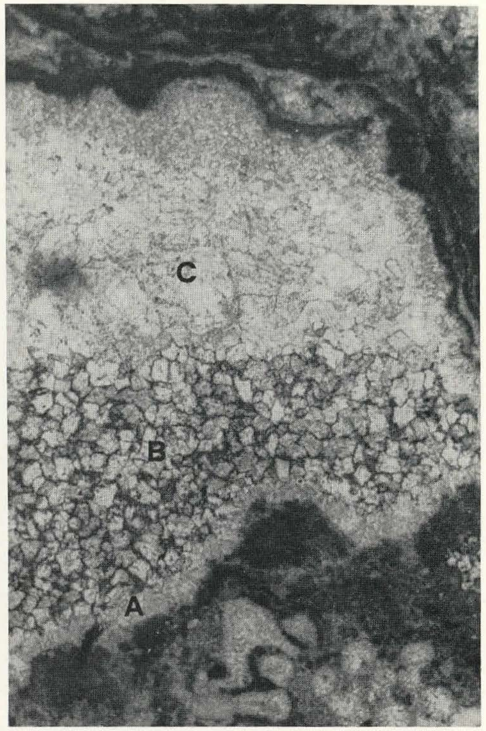

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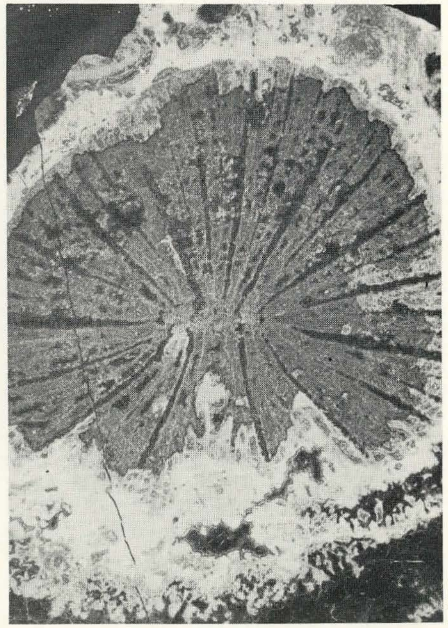
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PLATE 12

Fig. 1. Authigenic pyrite grains in crinoid limestone (black). Sample from the upper part of the Hudajužna reef. Thin section HJ 1/82, 15 ×.
Fig. 2. Cross-section of skeletal alga (Dasycladacaea). Thin section HJ 10, 15 ×.
Fig. 3. Crystals of authigenic quartz in recrystallized coral. Thin section HJ 4/82, 15 ×.
Fig. 4. Type of "umbrella like" porosity below the shell test. Thin section HJ 41/1, 15 ×.
Fig. 5. Desiccation pores in micritic limestone filled by sparitic calcite. Texture is characteristic for littoral environment of deposition. Thin section, Zakriž, 15 ×.

TABLA 12

Sl. 1. Avtigena piritna zrna v krinoidnem apnencu (črno). Vzorec je iz vrhnjega dela grebena pri Hudajužni. Zbrusek HJ 1/82, 15 ×.
Sl. 2. Presek skeletne alge (Dasycladacaea). Zbrusek HJ 10, 15 ×.
Sl. 3. Kristali avtigenega kremena v rekristalizirani korali. Zbrusek HJ 4/82, 15 ×.
Sl. 4. Tip »dežnikaste« poroznosti (»shelter porosity«) pod školjčno lupino. Zbrusek HJ 41/1, 15 ×.
Sl. 5. Izsušitvene pore v mikritnem apnencu, zapolnjene s sparitnim kalcitom. Tekstura je značilna za litoralno okolje sedimentacije. Zbrusek, Zakriž, 15 ×.