564. **HALOBIA STYRIACA**, UPPER TRIASSIC PELECYPOD, DISCOVERED IN OKINAWA-JIMA, THE RYUKYU ISLANDS*

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It was some years ago that new fossil localities were discovered in the Nakijin Formation by the junior author (1969) at Nakijin and Kamimotobu villages, Motobu peninsula, Okinawa-jima and a small lot of fossils was submitted to the senior author through Dr. KONISHI for identification. As the preliminary observation has already been reported in the 94th meeting of the Palaeontological Society of Japan at Akita, 1966, it included *Halobia styriaca* and a few other pelecypods.

The *styriaca* horizon is definitely Carnic and most probably lower Carnic in age, because the known occurrences of the *Halobia styriaca* group are exclusively in the Carnic stage and *Halobia styriaca* as a species is typical of the lower Carnic fauna. The discovery of such an Upper Triassic fossil beds in Okinawa is indeed an important addition to the stratigraphic column of the Ryukyu islands.

Setting aside obscure occurrences in a few places of the Pacific province, the distribution of the *styriaca* group has so far been restricted to the region from the Alps to Indonesia. Therefore the Okinawa *styriaca* indicates the eastern limit of the distribution of this Tethys species.

Since that time the junior author found additional new localities and greatly amplified the collection of pelecypods, ammonoids and other fossils by repeated explorations so much that it requires more time to be worked out. Therefore only *Halobia styriaca* is described here as an advanced report.

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Family Halobiidae KITTL

Genus Halobia BRONN

The Halobia styriaca Group

KITTL (1912) classified Halobia species into 11 groups. The styriaca group is one of them having the round or oval outline of the shell, scarcely prosogyralumbo, simple flat anterior ear, indistinct or flattened posterior triangular field and radial ribs broad, simple generally and sometimes once bifurcated, but twice bifurcation is rare. He referred the following 10 species to the styriaca group:

Halobia areata KITTL: North Alps, Carnic.
Halobia arthaberi KITTL: North Alps, upper (?) Carnic.
Halobia bosniaca KITTL: Dinarid, Carnic.
Halobia landlensis KITTL: North Alps, Carnic.
Halobia (?) lenticularis (GEMM.): Italy (Basilicata and Sicily), North Alps (?), lower Carnic.
Halobia marmorea KITTL: North Alps, lower Carnic.
Halobia (?) richthofeni (MOJS.): South Alps, lower Carnic (St. Cassian).
Halobia styriaca (MOJS.): North Alps, Hungary, Roumania (Dobrudschia), Dinarid (Bosnia, Dalmatia), Greece, Sicily, Indonesia (Timor, North Sumatra), lower Carnic.

The distribution of the above species is written here with reference to not only KITTL’s (1912), but also later publications. (See DIENER, 1923, KUTASSY, 1930, KOBAYASHI and MASATANI, 1968). All of them were described from the Carnic stage of the Alps and the Mediterranean region or Southeast Europe except for the isolated occurrences of H. styriaca in Indonesia (VOLZ, 1899, Krumbeck, 1921, 24, Wanner, 1931).

Halobia cf. styriaca and H. aff. styriaca are known to occur respectively at Basilia, Italy and the Himalaya (DIENER, 1908). Of H. cf. styriaca from the Malayan frontier of Thailand (KOBAYASHI and TOKUYAMA, 1959), CHEN (1964) identified it with Halobia substyriaca nov. from the Carnic of Western Szechuan.

Halobia styriaca has once been reported by PIROUTET (1908) from the isle of Sonde, New Caledonia in association with Halobia kwaluana in the basal part of the Upper Triassic formation, but no palaeontological work has since been published of the species. ARTHABER suggested the possible occurrence of the same species in Mexico, but this suggestion has presumably been derived from the confusion of the species with H. austriaca (FRECH, 1907, KITTL, 1912).

KITTL (1912, p. 94) quoted that “Die Art (H. styriaca) ist geradezu ein Leitfossil für die unterkarnischen Schichten.” In North America Halobia arthaberi and H. aff. lepsiusi were reported to occur in western Canada in the lower Noric stage (TOZER, 1961, McLEARN, 1960), but a further information is needed to confirm their specific identification.

Halobia styriaca (MOJSISOVICS)

Pl. 26, figs. 1-10, text-figs. a, b.

1874. Daonella styriaca MOJS. Abhandl. k. k. geol. R.-Anst., Bd. 7, p. 10, pl. 1, figs.
None of the specimens before hand shows a complete outline of the shell, but evidently it is fairly tall and nearly equilateral. The umbo is located submedially, but a little anteriorly, moderately convex, slightly projected above the hinge margin and apparently shorter than the shell-length. The proportional height to the length is not exactly determinable, because all specimens are deformed.

The anterior ear is very flat and smooth, but it is not clearly separated from the inflated main part of the shell. Therefore it appears very indistinct, when the shell is flattened. The posterior triangular area is narrower than the ear and ill-defined. There radial sculptures are obscure or absent.

Some concentric grooves or folds are well marked in the umbonal one-third or one-fourth of the shell which is more inflated than the remaining part. They are generally stronger on the posterior lateral side. Additional concentric folds or gniculations are occasionally met with in grown stages. Radial ribs are obscure in the umbonal part where the concentric sculptures are strong. Some 15 to 20 ribs are countable in the median part of the shell in the middle stage of growth. They are very broad, flat, straight and separated from one another by narrow grooves. Some posterior ribs are, however, slightly aruncate with backward convexity. These ribs are partly bifurcated and very rarely even twice bifurcated by insertion of similar narrow grooves.

Figure 2 and 1 are respectively an external mould of a left valve and its rubber cast respectively. It measures 19 mm in height and its outline is thought less deformed than other specimens. The shell is nearly as long as high; umbo almost median and only a little projected above the hinge margin which is straight and horizontal in front of the umbo, but the margin is gradually descending behind the umbo and more distinctly slant than in other specimens. The other margins are well rounded. The shell is gently inflated and the convexity is strengthened in the umbonal region where some 10 concentric folds are regularly disposed. The anterior ear is simple, depressed and flat, but somewhat thickened at the hinge margin. The preumbonal angle of the ear is about 20 degrees.

The Posidonia or Bositra stage transmits into the Halobia stage at the height of about 7 mm. Radial ribs are broad, flattopped and separated from one another by narrow grooves, some of which are bifurcated by insertion of a groove. Anterior ribs are straight, while posterior ones are gently aruncate with backward convexity. About 20 ribs are countable near the ventral margin, but on the lateral sides of the shell the ribbing becomes obsolete.

The left valve in fig. 3 which is 50
mm long is nearly full mature. The height of this shell appears somewhat reduced secondarily. Some 23 ribs are countable along the ventral margin in the main middle part which forms an umbonal angle of 130 degrees.

In the specimen in fig. 4 two valves are disposed almost rectangually and strongly deformed in a diagonal direction. The upper and lower shell in the figure are respectively narrowed or shortened secondarily. The radial and concentric sculptures which are rectangular to the direction of compression are strongly emphasized whereas those parallel to the direction are obscured.

The left valve in fig. 6 is compressed diagonally as can be judged from its outline as well as distinct concentric striae in the posterior portion which are otherwise generally imperceptible.

The shells in figs. 5 and 7 are laterally compressed with the result it is seen that the length of the shell is quite reduced and the radial ribs and grooves are strengthened. Due to secondary emphasis of inserted grooves the ribs appear denser in these shells than in those in figs. 1 and 2. In fact they are countable about 30 in the specimen in fig. 7.

The above specimens were all collected at the ruin of the Nakijin castle. The specimen in fig. 8 which was obtained at Motobu high school is similarly compressed laterally, so that the shell looks tall and the ribs are densely populated. The figures 9 and 10 show the umbonal region of two specimens from the second locality which are not much deformed. They agree well in outline and sculpture with the shell from the first locality in figs. 1 and 2 which is also almost undeformed.

In the authors’ opinion two small specimens from Motobu high school illustrated here are immature shells of this species. Radial ribs are absent in the right valve, 12 mm long (text-figure a). It is fairly convex and the anterior ear clearly defined by a shallow groove. Its concentric sculpture consists of broad folds separated by narrow grooves and finer grooves on the folds. These concentric sculptures are stronger on the posterior than the anterior side where only the growth striae are visible. On the anterior side they are abruptly bent backward near the hinge margin. The right valve in fig. 9 represents the next stage of growth in which radial ribs appear in the middle and anterior portions. A few radials are already bifurcated.

Another small right valve in text-fig. b is exceptionally attached with the counter valve. The surface sculpture is, however, ill-preserved in this specimen.

Text-fig. a. Rubber cast of a small right valve; HMO. ×3
Text-fig. b. Rubber cast of a small right valve attached with the counter valve; HMO. ×2½.

In the outline of the shell, position of the umbo and particularly in the aspects of concentric and radial sculptures this Okinawa form fits nicely with the group of Halobia styriaca by Kittl. and especially with Halobia styriaca. It is closer
to *H. styriaca* than *H. areata* KITTL which the latter was synonymized with the former by KRAMBECK (1921). Because the ear of this species is not always distinctive, it has originally been placed by MOJSISOVICS in *Daonella*. It has been accepted by some others until KITTL transferred it to *Halobia*.

*Daonella cassiana* MOJSISOVICS is a common associate with *Halobia styriaca* with which it was confused by RENZ (1906) and others. Like *Daonella styriaca* MOJSISOVICS, *D. cassiana* was transferred later into the genus *Halobia* by KRAMBECK (1921). *Halobia cassiana* redefined by KRAMBECK differs from *H. styriaca* in having a more anterior umbo, longer shell expanded postero-ventrally and radial ribs much more numerous in comparison with *H. styriaca*. He included *Halobia arthaberi* KITTL in his *H. cassiana*. Incidentally, KRAMBECK erected *Daonella kitti* to include *Daonella cassiana* by BITTNER (1895) and KITTL (1912).

*Halobia cassiana* (MOJS.) var. *yunnanensis* REED (1927) from the Upper Triassic of Yunnan is represented by a few deformed specimens which look more likely a member of the *H. austriaca* group rather than the *H. styriaca* group. *H. yunnanensis* may be a close ally to *Halobia kwalluana* VOLZ of the former group.

Finally, *Halobia tobensis* KOBAYASHI and MASATANI (1968) from the Carnic of Sumatra has the outline of the shell and some other aspects resembling this species, but it fits better with the *H. austriaca* group in the mode of ribbing.

**Occurrence:**—Dark grey siltstones of the Nakijin formation at localities, HMO and HNa-P.

**HMO**: Motobu high school, Motobuccho, Okinawa.

**HNa-P**: 200 m west of the ruin of the Nakijin castle, Nakijin-son, Okinawa.

This is the eastern most occurrences of *Halobia styriaca* because its known distribution has been in the lower Carnic beds from the Alps to Indonesia.

**References**


—— (1923) : Lamellibranchiatia triadica. *Fossilium Catalogus 1, Animalia*, Pars 19.


KUTASSY, A. (1928) : Die Ausbildung der
— (1931): Lamellibranchiata triatica, 2. Fossilium Catalogus, 1, Animalia, Pars 51.


Explanation of Plate 26

*Halobia styriaca* (Mojsisovics) from Okinawa, Ryukyu Islands

Loc. HNa-P: 200 m west of ruin of Nakijin castle, Nakijin-son, Okinawa.
Loc. HMO: Motobu high school, Motobu-cho, Okinawa.

Fig. 1. Rubber cast of a left valve from HNa-P. ×2
Fig. 2. External mould of the same valve as the preceding. ×3
Fig. 3. A left valve cut by a vein; HNa-P. ×1 4
Fig. 4. Two deformed valves disposed almost rectangularly; HNa-P. ×1 4
Fig. 5. Internal mould of a left valve laterally compressed; HNa-P. ×1 4
Fig. 6. Rubber cast of a left valve diagonally compressed; HNa-P. ×1 4
Fig. 7. Rubber cast of a left (?) valve laterally compressed; HNa-P. ×1 4
Fig. 8. Rubber cast of a right valve laterally compressed; HMO. ×2
Fig. 9. Rubber cast of a right valve; HMO. ×1 4
Fig. 10. Rubber cast of a left (?) valve; HMO. ×2.