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MESOZOIC FRESHWATER MOLLUSCAN FAUNULES FROM SHANTUNG, SHENSI AND KANSU

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The Mesozoic freshwater molluscs described in this paper were from the provinces of Shantung, Shensi, and Kansu. The Shantung specimens were collected in 1951 by the Laboratory of Vertebrate Paleontology at Chinkongkou, Laiyang, Shantung in association with the dinosaur bones. Those from Shensi and Kansu, which comprise the greater portion of the material in the collection, were collected from the Northwestern Provinces during the year 1952, and sent for study by the Bureau of Petroleum Exploration. The present paper gives a description of the new forms together with a brief discussion of the stratigraphy of the fossil-bearing formations.

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A. Systematic Description of Species

GASTROPODA

Genus *Campeloma* Rafinesque

Campeloma liui, sp. nov.

Pl. 1, figs. 1, 1a, 1b.

Shell turbinate, high than broad, test rather thick, surface smooth. Body whorl high and correspondingly large; spire consisting of 5 rather rapidly expanding whorls with small protoconch. Apical angle about 50 degree, sides of the spiral whorls slightly convex. Shoulder broadly rounded.

Aperture subquadrate, continuous, and with nearly straight labral profile. Inner lip slightly thickened. False umbilicus distinct and slit-like.

This species is markedly distinct from all the known Chinese species of the *"Viviparus"* group. It can be readily distinguished from the other species by its larger apical angle, rounded and broad shoulder, high body whorl, and more quadratic aperture, especially on the basal side. The thick and smooth surface and thickened inner lip of the shell seem to justify the assignment of the specimen to a new species of *Campeloma.*

Another less well preserved specimen of a probably younger shell with larger apical angle, more expanding body whorl and indistinct false umbilicus may be referred to the same species.

Horizon and locality: Wangshih formation, Lower Cretaceous. It is found by

Mr. T. S. Liu in a matrix of greenish and red silty clay in association with dinosaurian bones at Chinkongkou, Laiyang, Shantung.

Genus *Lanistes* Montfort

Lanistes? sp.

A crushed medium-sized gastropod with thin smooth shell and sinistral whorls may be assigned to this genus.

Genus *Bulimus* Scopoli

Bulimus aff. mengyinensis (Grabau)

Bithinia mengyinense Grabau, 1923. Bull. Geol. Surv. China. No. 5(2); p. 160, figs. 7a-b.

Shell turbinate, small, about 5-6 mm. high, largest diameter of the body whorl about 3.8 mm. With 4-5 rapidly expanding and relatively thick-shelled whorls. Surface smooth. Succeeding whorls little embracing, suture rather deep. Spire high, with apical angle of about 40 degrees; side of spiral whorls convex. Aperture rounded. Umbilicus relatively large.

The Shensi specimens are essentially identical with *Bithinia mengyinense* from Mengyin, Shantung described by Grabau. The only differences between the two are that the Shantung specimen has larger apical angle (between 54 and 60 degrees) and larger shell. According to Grabau the smaller shell usually has larger apical angle, so it seems reasonable that the Shensi specimens have smaller apical angle. As to the small size of the shell, because the Shensi material is represented by hundreds of specimens it may be interpreted as being either the dwarfed form of the same species or really a new species or subspecies of the former with smaller shell and smaller apical angle.

Horizon and locality: Anting Formation, Upper Jurassic, Heisuissu, Huluho, Fuhsien, Shensi. Field No. An 27.

Genus *Valvata* Muller

Valvata aff. suturalis Grabau

Valvata sutrualis Grabau, 1923. Bull. Geol. Surv. China, No. 5(2), p. 161, figs. 73-g.

As in the case of the proceeding species, the Shensi specimens are almost identical with those from Shantung described by Grabau except that the Shensi specimens are much smaller in size. It is about 3 mm. in height and nearly so wide. This species differs from the proceeding one in having larger body whorl, more depressed spire and larger umbilicus. The specimens are represented only by numerous siliceous internal molds.

Horizon and locality as the proceeding species. No. An. 28.

Genus *Hydrobia* Hartmann

Hydrobia? sp.

Pl. I, fig. 3

Three more or less crushed small turreted gastropod shells with high spires of 4-5 whorls and smooth surface and relatively deep suture may be referred to the present genus.

PELECYPODA

Genus *Unio* Retzius

Unio shensiensis, sp. nov.

Pl. I, fig. 5, 5a.

Shell small, moderately convex, greatly elongate and inequilateral. Beak anterior, about one fifth from the anterior end of the straight hinge line. Umbo not inflated, posterior umbonal ridge distinct, running diagonally from behind the beak to the postero-ventral border. Anterior end narrowly rounded. Ventral border broadly curved. Posterior end regularly truncated and form an angle of about 55 degrees with the ventral margin. Surface of shell ornamented with numerous fine lines of growth, more crowded together at the anterior.

The shell is small, being only about 22 mm. long and 7.5 mm. high. The regularity and finenss of the growth-lines seem to indicate that the shell is probably not a mature one. The new species resembles to some extent *Unio ogamigoensis* Kobayashi and Suzuki from the Upper Jurassic Tetori Series of Japan. It differs from the Japanese form in having more anteriorly placed beak, narrower anterior end and the larger angle between the hinge line and the posterior umbonal ridge. The elongate and apparent edenthlous shell with prominent posterior umbonal ridge approach those in certain "*Mycetops*" from the Lower Cretaceous of China and Japan.

Horizon and locality: Yenchang Formation, Triassic (?). Yuanliuhwan, Yungping, Yenchuan, Shensi.

Unio suni, sp. nov.

Pl. I. fig. 4 and text fig. 2

Shell medium in size and thickness, nearly as long as high, about 40 mm. in the largest specimen. Umbo incurved, twisted and in contact with that of the opposite valve above the hinge. Right valve with two bifurcating pseudocardinal teeth and a long posterior lateral tooth, parallel with the external ligmental groove.

Outline of shell subtriangular, anterior end broadly rounded and somewhat subtruncated in the larger specimens; posterior bruntly angular and its margin forming an angle of about 60 degrees with the ventral margin.

Surface of he shell with rather coarse and irregularly spaced concentric ribs, more or less wrinckled at the dorsi-posterior border, and with small nodules along the umbonal ridge and its adjacent area.

This new species of *Unio* is markedly different from all the known Mesozoic forms of the group. Its general outline resembles *Unio chaoi* of Grabau, but the specimen of the latter species is so imperfectly preserved that a closer comparison is impossible. The most distinctive characteristics of the new species are its subtriangular shell, with almost equal length and height and highly twisting umbo. The new species shows strikingly structural resemblance to the Sanmenian *Lamprotula antiqua* Odhner. The chief differences between the two species are that the latter is twice as larger and elongated. It is quite probable that the Sanmenian species is phylogenetically closely related to or derived from the Mesozoic form *Unio suni*.

This new species is erected in honor of late Mr. C. C. Sun for his great contributions to the geology of the Northwestern Provinces.

Horizon and locality: Upper Jurassic Anting Formation. Heisuissu, Huluhu, Fu-hsien, Shensi. Found in association with *Bulimus mengyinensis*.

Genus *Cyrena* Lam.

Cyrena ? yenchuanensis, sp. nov.

Pl. I, figs. 6, 6a.

Shell of median size and convexity, longer than high. Umbo slightly inflated. Beak about one third from the anterior and slightly incurved. Anterior end rounded, ventral border broadly arched, posterior border distinctly truncated. Test thin, surface with numerous fine lines of growth and coarser growth interruptions.

A larger valve measures 22 mm. long and 13 mm. high.

Horizon and locality: Upper Triassic (?) Yenchang Formation. Yuanliuhuan, Yungping, Yenchuan, Shensi.

Genus *Sphaerium* Scopoli

Sphaerium anderssoni (Grabau)

Pl. I, fig. 7

Corbicula anderssoni, Grabau, 1923. Bull. Geol. Surv. China, No. 5(2), p. 188 figs. 1a-b.

Sphaerium anderssoni, Suzuki, 1943. Bull. Sigenkagaku Kenkunsyo, Vol. 1, no. 1, p. 62, pl. IV, figs. 1-4.

The Chaosui specimens are almost identical even in detail and size of the shells with the Shantung specimens described by Grabau.

Horizon and locality: Lower (?) Cretaceous. Northeast of Kweilingtsu. Chaosui Basin, Kansu.

Sphaerium anderssoni inflata, subsp. nov.

Pl. I, fig. 8

This new subspecies from Chaosui differs from the preceeding species in having much broader and larger umbo, and the beak is more central. There is a distinct posterior umbonal ridge with rounded top. The surface ornamentation is also coarser.

It is further distinguished from *Sphaerium anderssoni jeholense* in having rounded anterior end and distinctly truncated and broad posterior end.

Horizon and locality: same as the proceeding species.

B. Stratigraphical Considerations and Conclusions.

(1) The Wangshih formation of Laiyang, Shantung which yields *Campeloma liui*,, sp. nov., and two small *"Opeas"* like gastropod shells, as evidenced by the associated dinosaurian remains, is undoubtedly of Late Cretaceous age.

(2) The following three freshwater molluscan species are identified from the Lower Cretaceous of Kweilingtsu, Chaosui Basin, Kansu:

Hydrobia sp.

Sphaerium anderssoni (Grabau)

Sphaerium anderssoni inflata, subsp. nov.

Sphaerium anderssoni and its related forms had been found abundantly in the Cretaceous of Northeastern Provinces (Manchuria). According to the recent investigations of Kobayashi, Suzuki, and the others, the correlative formations are of Early Cretaceous age, although Grabau assigned them originally to the late Cretaceous.

(3) The Yenchang Formation of Yenchuan, North Shensi, yields the following species of freshwater mollusks:

Unio shensiensis, sp. nov.

Unio? yenchuanensis, sp. nov.

Corbicula? sp.

The nearest "relatives" of these species are from the lower Cretaceous of North America and Upper Jurassic of Japan. But, according to the recent investigation of the petroleum geologists working in northern Shensi the Yenchang formation is of Triassic age. The earliest record of the group *Unio* in the world is late Triassic, while that of the cyrenids is from the lower Jurassic Lias of Europe.

Therefore, the age of the Yenchang formation, at least its uppermost (?) part which yields the above species of *Unio* and *Cyrena,* is more probably of Jurassic rather than Triassic age.

(4) From the Upper Jurassic Anting Formation of Heisuissu, Huluho, Fuhsien, Shensi, the following three species of freshwater mollusks have been identified:

Bulimus aff. mengyinensis (Grabau)

Valvata aff. suturalis Grabau

Unio suni sp. nov.

The prst two species are hardly distinguishable from those described by Grabau from the Lower Cretaceous of Mengyin, Shantung. The age of the lower part of the Mengyin Series and its correlatives in Szechuan and western Hupei has long been questioned by some paleontologists, especially the vertebrate paleontologists, as being late Jurassic instead of Lower Cretaceous. Thus the discovery of these species in the Upper Jurassic beds of Shensi seems to support this inference. Judging from the great number of little worn shells of *Bulimus* and undisturbed valves of *Unio* preserved among the Fuhsien specimens, the environment under which the sediments were deposited may represent that of a quiet water body with abundant vegetation.