CRETACEOUS MOLLUSCA FROM NORTH CHINA.

By A. W. Grabau.

(With 2 Text-Figures.)

The Mollusks described in this paper were obtained from three separate localities in North China, as follows:

1: Yan Lui-T'un, Yi Hsien, Fêngtien. Collected by Mr. H. C. T'an (Loc. 1901). Approximate location: Long. 121° E., Lat. 41° 20' N.

2: Ling Yuan Hsien, Jehol (Chengtefu). Collected by Mr. T. O. Chu (Loc. 2103). Approximate location: Long. 117° 58' E., Lat. 41° N.

3: Near An Chun, Hun-Yüan-Hsien, N. Shansi. Collected By Dr. J. G. Andersson (Loc. 59). Approximate location: Long. 113° 35' E., Lat. 39° 40' N.

All three localities lie to the northwest of the mid-Mesozoic mountain ranges (Yenshan Range* or ancient Nankou, etc., ranges, and ancient Tsingling ranges) and in a series of basins which very probably lay within the same general intermontane region. The Jehol locality lies between the other two, the following being the approximate distances in a straight line, in general from N. E. to S. W.

Yi-Hsien to Jehol..... ....130 miles.

Jehol to Hun Yüan.....200 miles.

Yi-Hsien to Hun Yüan.....330 miles.

So far as the present collections permit us to judge, the two extreme localities belong to essentially the same geological horizon, the only species found in the south-western region, *i. e.,* Hun-Yüan in Shansi, namely *Corbicula anderssoni* Grabau, also occurring in the north-easternmost region, *i. e.,* Yi-Hsien in Fêngtien, the distance between the two localities being about 330 miles. The intermediate locality in Jehol apparently belongs

* This name has been applied to the late Mesozoic predecessor of the modern Nankou Range by Dr. W. H. Wong.

to a distinct, and I believe somewhat older horizon, though we have at present only one specimen of *Corbicula* (*C. jeholense* Grabau) to show this.

Stratigraphy and Age of the Beds

Jehol: Beginning with the intermediate locality, the horizon of which we believe to be ascertained, we find here the following succession according to Dr. Andersson and Messrs. Chu and Tung*.

Upper Porphyry beds.

Jehol series. Shales, slates, and sandstone with subordinate conglomerates. In the upper part occur thin-bedded paludal beds, forming platey layers of rock resembling the "Flinze" in the lithographic limestone series of Solnhofen, and these carry a rich fish fauna.

Thickness of entire series.....50 to 100 meters

Lower Porphyry beds.

In other sections the fish-bearing beds are found lying unconformably on siliceous limestone and gneiss (C. Tung).

The only abundant fossils in these beds are two fish, the larger of which has been described as *Lycoptera jeholense* Grabau, and the smaller, which is also the most abundant, as *L. jeholense* var. *minor* Grabau**. These small fish are often so numerous that a slab of about 1 foot square will show from 50 to 100 individuals. Besides the fish a few plant remains provisionally referred to the genus *Czekanowskia,* fragments of insects, and *Estheriæ* have been found, and the single molluscan shell herein described as *Corbicula jeholense* Grabau.

The age of these beds was formerly held to be Jurassic, but the evidence afforded by the plants, insects and mollusks of the corresponding fish-beds of Shantung, the fish of which were clearly contemporaneous with the Jehol fish, and apparently derived from them, has led us to assign a Lower

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* C. Tung–1923. Bull. Geol. Soc. China, Vol. 2, No. 1, p. 6, and J. G. Andersson, Museum Explanations.

** A. W. Grabau–Lower Cretaceous Fishes from North China. Palæontologia Sinica, Series C, Vol. III.

Cretaceous or Wealden age to these deposits. This has been fully dicussed for the Shantung formations in the preceding paper.

These deposits were laid down in a shallow playa basin formed on the gently warped surface of the late Jurassic peneplane, to the north of the subdued Yenshan mountain range, which was formed near the end of Jurassic time, and which had essentially the location of the present Nankou Ranges north of Peking. This formed the divide between the northern basin and those of Shantung.

FÊNGTIEN: A similar warp-basin, lying 130 miles farther to the northeast, is that of Yi-Hsien, in Fêngtien. The stratigraphy of this basin has been studied in some detail by Mr. H. C. T'an from whose notes the following section is reproduced (in descending order):

FÊNGTIEN VOLCANIC SERIES. Lavas, tuffs and tuff-conglomerates with intrusions.

Disconformity

YIHSIEN FORMATION. Gray sandstones and conglomerates at the top, passing downward into yellow and gray sandstones and clays, and consisting at the base of gray and yellow sandstones and gray and greenish clayey shales. Some distance below the middle are yellow and gray thin-bedded sandstones, white-gray and greenish clayey shales, and dark-gray shales containing the gastropods and pelecypods herein described, together with coal-seams, and igneous intrusions. Total thicknes exposed.....900 meters.

SUBJACENT BEDS—not exposed.

The fossiliferous beds of the Yihsien Formation exposed at Yang-Lui-T'un, consist in part of dark gray rather massive clay shales, crowded with pelecypods and rarely with specimens of gastropods. Only a single species of pelecypod seems to be common in these shales, this being the species herein described as *Corbicula anderssoni* Grabau. The specimens range from young individuals to adults, the measurements of which are given below. All the shells are more or less crushed and flattened, but the shell-surface is

generally preserved. With these occur occasionally small shells which may be referable to *Pisidium,* but they are too imperfectly preserved for description. The only gastropod noted in these shales is too much crushed for determination, but appears to be referable to the genus *Vivipara (Paludina).*

With these shales, and apparently interbedded with them, are calcareous beds several inches in thickness, and composed almost entirely of shells of several species of the fresh-water gastropod *Campeloma* embedded in a fine argillaceous calcilutyte. These Campeloma beds are structureless, the shells lying in all positions, and they evidently represent local accumulations of dead shells in the shallow waters of the basin. They are not worn, though occasionally specimens were crushed subsequent to entombment. The lime of the mud which cements these beds is not derived from the wear of the shells themselves, but is of extraneous origin, and probably represents chemical precipitation. It may, of course, be due to segregation by calcareous algæ, the structure of which has been entirely obliterated, as is commonly the case in modern *Chara* marls. The presence in the matrix of minute particles suggestive to some extent of spore-capsules, may bear out this supposition.

While shells of *Campeloma* predominate, there are also occasionally present pelecypod shells apparently of the same species as those found in the shale. Other fossils have not been noted. The species of *Campeloma* described are as follows:

1: *Campeloma clavilithiformis* Grabau (sp. nov.)

2: *C. fengtienensis* Grabau (sp. nov.)

3: *C. yihsiensis* Grabau (sp. nov.)

4: *C. tani* Grabau (sp. nov.)

Of these no. 3 appears to be the most abundant, the others being of occasional occurrence. All the forms are closely related and they may represent merely mutations of a common stock. However, for the sake of emphasizing the distinctive features they are described as separate species.

The character of the fauna suggests an Upper Cretaceous age for the formation in question. The nearest allies of our forms are found in the

Laramie beds of western North America, and while it is not believed that the horizon is necessarily as late as that of the Laramie beds, the Upper Cretaceous age seems to be indicated. Nevertheless, because of the limited number of species, we must concede the possibility of an early Cretaceous, if not late Jurassic age.

It is a fact of considerable interest, that not a single species of this fauna has been found in common with the Upper Cretaceous molluscan fauna of the Shantung basin described in the preceding paper. If they are of equivalent age, this may be explained by the fact that the two basins were separated by the ancient Yenshan mountain range which, though probably subdued in Upper Cretaceous time, nevertheless formed an effective barrier between the basins. The Shantung localities lie only about 260 miles southeast of Jehol or 240 miles south of the Fêngtien basin, yet the separation was complete. The same effectiveness of the barrier is noticeable in the character of the fish faunas of the Lower Cretaceous horizon of the Shantung basin when compared with the contemporaneous fish fauna of the Jehol basin on the north of the barrier. This is more fully discussed in the monograph on the fish faunas above referred to. On the other hand, the Shantung basins seem to have several species in common with the far distant Szechuan basin, from which they are separated by an interval of more than 800 miles. This Szechuan basin is, however, on the same side of the mountain barriers of the period as were the Shantung basins, i.e., to the south of them, so that inter-communication was apparently more easily effected.

N. SHANSI: The fossiliferous formation of this basin is exposed near An Chun in Hun-Yüan-Hsien, north Shansi, where the specimens herein described were obtained by Dr. J. G. Andersson in 1922. The formation is a compact argillutyte of dark purplish-gray color, very massive and with conchoidal fracture. The only fossil found abundantly is the pelecypod *Corbicula anderssoni* Grabau, these Shansi specimens being taken as the types of the species. The shells are well preserved, embedded in all positions in the mud, either as separate valves or with both valves in conjunction. They are usually brilliantly white in color forming a strong contrast with the rock. Occasionally, however, they are stained yellow by iron oxide. The

surface characters are well preserved and the internal structure is sometimes ascertainable.

Although somewhat smaller on the average than the Fêngtien shells, they agree with them in all essential characters, and I do not think that more than one species is represented. No other species have been recognized.

This specific identity suggests that the formations of the two locatities are essentially contemporaneous, and the Hunyüan formation of Shansi is therefore likewise referred to the Upper Cretaceous. As above noted, the two localities are 330 miles apart, with the Jehol region lying between them. They apparently belonged to the same general intermontane basin. The relationships of these strata to the other formations of the region, are as yet undermined.

Description of the Species

Class PELECYPODA

Order TELEODESMACEA Dall

Family CYRENIDÆ Gray

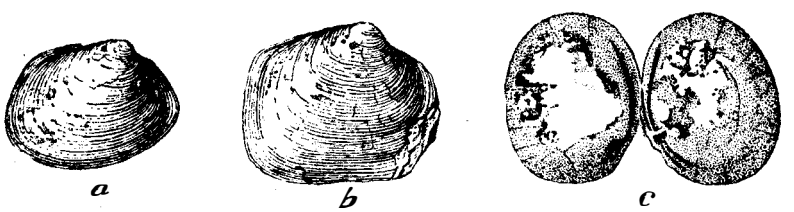
Genus *CORBICULA* Megerle

Corbicula anderssoni Grabau (sp. nov.)

(Text Figs. 1a-b.)

Shell small to medium-sized, moderately convex, the greatest convexity above the middle. Outline subelliptical with the beak below the umbonal line and turned forward to a somewhat more marked degree than in the common modern Chinese species of the genus. Its position is in the anterior third of the shell. In front of it is a marked, though not deep or broad depression, continuing as an oblique concavity to the front. Anterior end of less height than posterior, rounding regularly into the ventral margin. Hinge line straight, extending for the greater part of the length of the shell behind the beak, and bending rather abruptly into the posterior margin, which is broadly rounded or even faintly subtruncate, but passes with a regular rounding into the ventral margin.

In the right valve there are two well marked, rather narrow and sharp lateral teeth, seen in the posterior portion of the hinge, lying parallel to the hinge line, and with a somewhat broader channel between. The lower of these teeth is generally the stronger and more continuous, the upper one being somewhat thinner and not extending as far back as the lower (specimen cat. 418). Above the upper is a broad channel before the hinge margin is reached. In this respect the hinge is very similar to that of *C. subelliptica* Meek and Hayden of the American Laramie. In the specimens from the Yihsien shales, which are generally much flattened, the space between the two teeth of the right valve appears to be somewhat wider, the corresponding tooth of the left valve being stronger than either of those in the right valve. In a Shansi specimen (cat. 419-a) the lower of the posterior teeth continues as a low curved ridge for some distance parallel to the posterior margin. Anterior tooth simple.



Figs. 1a–1b, *Corbicula anderssoni* Grabau. *a*, right valve, holotype from Shansi × 2; *b*, right valve from Fêngtien, × 2; 1c, *Corbicula jeholense* Graban. Internal molds of both valves showing the form and deep impressions of the lateral teeth. Jehol shales, Jehol, × $2\frac{2}{3}$

Left valve with 3 obliquely converging cardinal teeth and a single, rather sharp posterior lateral tooth. The crenulation of the teeth, characteristic of modern species of the genus, is not visible, though in a few cases it appears to be faintly indicated. This non-development of the crenulation is however, a feature characterizing many of the fossil species referred to this genus.

Measurements: The following measurements in millimeters show the variations in size and form of this species.

Specimen No.	Shansi Specimens							Fêngtien Specimens			Laramie Specimens
	1 (417)	2 (419a)	3 (419)	4 (420)	5	6	7	8	9 (421)	10	11
Length	11.	12.	10.	10.	12.	10.6	12.2	15.5	12.5	15.	20.
Height	8.	10.	7.	8.	9.3	7.6	9.5	14.	8.5	12.	15.5
Beak to front	3.	4.	2.5	2.5	3.4	3.2	3.5		3.5	3.5	16.
Length of hinge-line	6.	7.	6.	6.	7.5	.....	6.	.....	6.	8.	13.
Ratio length to height (=1)	1.34	1.20	1.43	1.25	1.29	1.40	1.30	1.10	1.47	1.25	1.30

No. 11 is a specimen of *Corbicula subelliptica* from the Laramie of North America. Nos. 8-10 are specimens from the Yihsien shale of Fêngtien and are more or less crushed, hence the proportions are not those of the original shell, but of flattened individuals. In spite of this it is probably true that the shells from the Yihsien shale are somewhat larger as a whole than those of the argillutyte from Shansi, where they are preserved in an uncrushed condition. No. 9 is the least crushed and corresponds fairly well with the dimensions of some of the larger specimens from Shansi. A specimen from the gastropod limestone of these beds, in which the original contour of the shell is preserved, has a height of 13.5 mm. which corresponds to a length of perhaps 16 mm. or more, though this is not fully preserved. An earlier stage of this shell however, measured on the growth-lines, has a length of 11.3 mm. and a height of 9.5 mm., giving a proportion of 1.19:1. while a still earlier stage measures 6.3 and 5.mm. respectively, giving a ratio of 1.26:1. All these specimens show the posterior subtruncate margin and in spite of the rather marked variations, I do not think that more than one species is represented.

Surface of the shell marked by very fine and subregular concentric variciform undulations and a few stronger growth interruptions. The surface-marking is like that of modern Chinese species of the genus but finer.

The species has the general form and proportions of *Corbicula subelliptica* Meek and Worthen, of the Laramie beds of western North America, though the slightly subtruncate character of the posterior end seen

in most of our specimens is not seen in the Laramie form so far as illustrations permit us to judge. The measurements of a typical form of the American species are given in column 11, from which it is seen that though larger, the proportions are like those of the Chinese species. The dentition, as already noted, appears also to be similar.

Horizon and Localities: The species is common in the Hunyüan argillutytes of Hun-Yüan-Hsien, Shansi, being mostly well preserved and uncrushed. There are scarcely any other organisms in this rock except what appears to be young shells of this species. A crushed gastropod and fragments of another larger shell *(Physa?)* have been found, but the characters of these are not determinable. These specimens were collected by Dr. J. G. Andersson in whose honor the species is named.

In the Yihsien shales of Fêngtien this species also appears to be common, but the specimens are all more or less crushed. The individuals are as a rule somewhat larger than the Shansi specimens but a part of this is due to the flattening of the shell. Associated with these shells is a large species of *Paludina* and a small *Sphærium?*. In somewhat more calcareous beds of the same formation four species of *Campeloma* occur, these shells being sometimes so abundant as to form a shell layer. These specimens were collected by Mr. H. C. T'an.

It is difficult to determine the precise age of these faunas. That they are Cretaceous admits probably of little doubt, though both the genera *Corbicula* and *Campeloma* have Jurassic representatives. Nevertheless, the character of the pelecypods and the presence of a number of species of *Campeloma* points rather to a Cretaceous age. The *Corbicula,* as already noted, resembles most closely an American Laramie species, while some of the species of *Campeloma* also show relationships to Upper Cretaceous species of America Until further evidence then is obtained for more precise parallelization, we may regard these formations as representing a fresh-water Upper Cretaceous horizon.

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* U. S. Geol. Surv. Terr. Vol. 9, and 3d Ann. Rept. U. S. Geol. Surv. Pl. 20, Figs. 10, 11.

Corbicula jeholense Grabau (sp. nov.)

Text-Fig. 1c.

This species is represented only by the internal molds of both valves of one specimen, the valves, still in conjunction, having been spread apart. The form and character of the hinge are well shown.

This form is smaller than the preceding species and of proportionately greater height. Greatest length a little above mid-height. The beak is situated about one third the length of the shell from the anterior margin, and is slightly curved forward. In front of it, the shell margin descends rather rapidly to the line of greatest length, while behind the beak the hinge margin is gently curved to within a short distance of the posterior extremity of the shell. Posterior end of the shell regularly curved, showing no signs of truncation such as is found in *C. anderssoni*. Frontal margin of the shell curved to about the same degree, both frontal and posterior margins passing without any abrupt change into the somewhat more broadly rounded ventral margin. Contour of shell moderately and regularly convex, the greatest convexity at about two-thirds the height, and slightly in front of the mid-length.

Left valve with a strong gently convex (dorsad) posterior lateral tooth and an equally strong slightly concave (dorsad) anterior lateral. In the right valve the anterior socket is defined by a rather pronounced, gently concave lateral tooth below, and by a fainter one above. The posterior socket is likewise bounded below by a rather strong gently convex tooth which extends from the beak to the posterior margin of the shell, but is most pronounced in the median area. The bounding ridge or tooth above is less sharply defined. The sides of the lateral teeth, and the borders of their sockets in the right valve, appear to be faintly notched transversely. Cardinal teeth not well preserved, apparently two in each valve, not, or only very faintly bifid. Muscle scars not determinable. As the shell is only represented by internal molds, the surface sculpture is not shown, but from the inpressions it appears that the shell was thin and marked only by fine concentric growth-lines.

Measurements: The following measurements have been obtained Length 7.5 mm., height 6.3 mm., distance of beak from front 2. mm

Length of posterior lateral tooth 4.5 mm. As shown by these measurements, this species has somewhat different proportions than those of *C. anderssoni*. In that species the proportion of height to length ranges from 1:1.20 to 1:1.43 for the Shansi shells, with an average in seven individuals of 1:1.32 and from 1:1.10 to 1:1.47, in the Fêngtien forms, with an average in four individuals of 1:1.28. The ratio in the present specimen is nearly 1:1.2. On the whole then the present species appears to be proportionately shorter than is the case in *C. anderssoni*, although the proportions fall within the range shown by that species. The most marked difference however, is the rounded posterior margin of *C. jeholense* as compared with the subtruncate margin of *C. anderssoni*.

Horizon and Locality: In the Jehol fish-beds of Lower Cretaceous age at Jehol in North China (Cat. 633). Only one specimen, and that an internal impression, has been found.

Class GASTROPODA

Fam. VIVIPARIDÆ Gill.

Genus *CAMPELOMA* Rafinesque

Campeloma clavilithiformis Grabau (sp. nov.)

(Text-Figs. 2a, b.)

Shell of medium size, high-spired, with the whorls embracing to the ambitus; apical angle of young about 59°, of adult 42°. Apex decollated above a septum, leaving 5 whorls. First preserved whorl rounded, low, and embraced by the next up to the ambitus; exposed part about half as high as the diameter. Second preserved whorl also rounded above, more than twice as high as first. Both first and second preserved whorls marked by delicate fine regular riblets, seen only under high magnification. The riblets stand vertically but are gently concave forward in the centre and they average four or five to 1 mm. (Fig. 2b). The next two whorls are so gently convex as to appear nearly flat, and the suture between them is scarcely depressed. The last half of the body-whorl develops a distinct subsutural shelf, while the shoulder of the whorl becomes quite flat but not vertical. The shoulder is separated from the lower part of the whorl by a blunt and not pronounced,

though distinct, angulation. The last three whorls show lines of growth only.

Length of shell, exclusive of decollated apex, 14 mm., length of body whorl 7.5 mm., greatest diameter of body whorl 7.8 mm.

This species resembles *Campeloma multilineata* Meek and Hayden from the Laramie of western North America, which has the same subsutural shelf developed in the last whorl. That species has, however, a greater apical angle (50° or more) and is also a much larger shell. It also shows spiral lines which are not visible in our shell.

Horizon and Locality: In a calcareous layer in the Yihsien formation of Upper? Cretaceous age, Yang-Lui-T'un, Yih-Hsien-Fêngtien. H. C. T'an Coll. (Mus. G. S. Ch. Cat. 422-(1)).

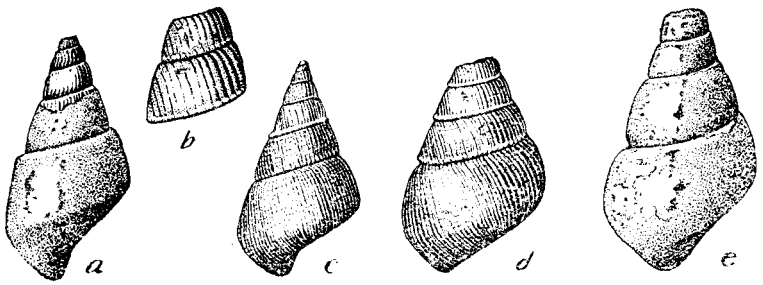
Campeloma fengtienensis Grabau (sp. nov.)

(Text-Fig. 2c.)

Shell high-spired, similar to the preceding in general form, with seven whorls including the minute apical whorl. Apical anglo of adult 42°, the young somewhat higher. Apical whorl minute, rounded; second whorl rounded; third somewhat flatter, embracing the second to below the ambitus, thus producing a deeper suture than in succeeding whorls. Succeeding whorls flattened, only the shoulder exposed, each whorl embracing to the ambitus of the preceding whorl, which is characterized by a blunt shoulder-angle. In the fourth whorl begins a faint keel-like projection of the shoulder angle, appearing as a thickened spiral line which is seen just above the suture In the fifth whorl this keel becomes pronounced, forming a thick ridge above the suture. In the 6th whorl it has again become faint and disappears in the seventh or body-whorl where only a blunt angulation remains. The flattened shoulders with the faint impression of the sutures, produce a slender trochoid form of spire. Below the shoulder-angles the body-whorl is regularly rounded to the umbilicus which is, however, covered by the inner lip.

The fine ribbing of the early whorls is scarcely shown in this species. Exceedingly fine spiral lines are discernable on the body-whorls but the shell is chiefly marked by very delicate, subregular growth-lines.

Several other specimens, apparently of this species, have a slightly greater apical angle in the adult, this ranging from 44° to 45°, while the young has an apical angle ranging as high as 54°. The keel of the 4th and 5th whorls is well shown. The growth-lines in the adult are also somewhat coarser than in the type, resembling in this respect the growth-lines of the next species. It may be that these two grade into each other and the forms described represent only extremes of variation.



Figs. 2 a, b, *Campeloma clavilithiformis* Grabau, *a*, shell with apical whorls wanting × 2; *b*, uppermost two whorls preserved, enlarged × 6 to show the fine ribbing; *c*, *Campeloma fengtienense* Grabau, entire shell × 2; *d*, *Campeloma yihsiensis* Grabau, shell with apical whorls wanting × 2; *e*, *Campeloma tani* Grabau, internal mold of shell with apical whorls wanting × 2.

This species is characterized by the marked shoulder angulation, which, in the intermediate (neanic) whorls, is furnished with a stout keel; by the flat shoulder of the later whorls, which embrace to the shoulder angle, and by the smooth character of the adult except for growth lines. Length of type 13 mm., greatest diameter of body-whorl 7.5 mm.

This shell may be compared with *C. producta* White from the Laramie beds of western North America. That species, however, grew to larger size and shows a very faint constriction of the whorls just below the suture.

Horizon and Locality: Associated with the preceding. (Type Mus. G. S. Ch. Cat. 422-(2)).

Campeloma yihsiensis Grabau (sp. nov.)

(Text-Fig. 2d)

Shell similar to the preceding but more robust with an apical angle of 52°-53°. Earliest whorls not preserved in the type, which shows only four whorls. The first of these is rounded above, showing that the suture above

it was rather strongly impressed. This is shown to be the case in a specimen in which part of the preceding whorl is preserved. It becomes somewhat flattened towards the ambitus, which is characterized by a moderate angulation. The second preserved whorl (probably the 5th of the entire shell) has its shoulder flattened, and embracing to the angle of the preceding whorl, the suture being scarcely impressed. The shoulder angle of this whorl is strongly marked and in places constricted into a faint, or even pronounced keel, by a delicate impressed line above it. The next whorl is again more rounded, embracing to immediately below the shoulder-angle of the preceding whorl, the suture being slightly impressed. The final or body-whorl is still more strongly impressed, and the shoulder angle faint or almost obsolete.

Surface marked by rather coarse irregularly spaced growth-lines, which, however, are more uniform and regular in the earlier whorls. A few faint spiral lines are discernable on the last two whorls, these being scarcely pronounced enough to be called spirals.

This species resembles *C. fengtienensis* in the general character of the whorls and the development of an incipient keel in the neanic whorls, a feature much more pronounced in *C. fengtienensis*. The present species has, however a much larger apical angle, and the surface is marked by much coarser and more strongly curved growth-lines. These differences may of course be due to difference of sex. Length of shell exclusive of apical whorls, 13 mm. (original length perhaps 16 mm.), greatest diameter of body-whorl 8. mm.

Horizon and Locality: Associated with the preceding in the Yihsien formation of Yang-Lui-T'un, Yih-Hsien, Fêngtien. Coll. H. C. T'an; several specimens. The age is probably Upper Cretaceous. (Type Mus. G. S. Ch. Cat. 422-(4)).

Campeloma tani Grabau (sp. nov.)

(Text-Fig. 2e)

Shell high-spired when complete, with 6 or 7 volutions (only 4 preserved in the type specimen); apical angle 40°. Whorls gradually and regularly increasing in size, rounded, with no demarkation of a shoulder, and

embracing slightly below the ambitus, with the result that the suture is of moderate depth. Surface smooth, growth lines very fine.

This shell is readily distinguished from the others previously described by the round whorls, well-marked suture, and absence of angulation especially in the young. In the last whorl a faint angulation may occasionally develop. The apical angle varies somewhat, being in some cases as high as 45° and appearing even greater in slightly crushed specimens. On the other hand a more slender shell with an apical angle of only 38° otherwise shows the characteristics of this species.

Length of type, exclusive of apical whorls, 16 mm.-original length perhaps 19 mm; greatest diameter of body-whorl 9.5 mm. The species is the most primitive of those so far described, the young (neanic) whorls being rounded, whereas, in the preceding two, they are already angulated, a feature which does not appear in the present species until the adult (in some cases), while the keel never develops.

Horizon and Locality: Associated with the preceding. The species is named after Mr. H. C. T'an who collected these faunas. (Type, Mus. G. S. Ch. Cat. 422-(3)).

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