

Article III.—GASTROPOD MOLLUSCA FROM THE TERTIARY STRATA OF THE WEST.

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A study of the Land and Freshwater Mollusca of the Rocky Mountain Tertiary strata leads to the expected conclusion that freshwater species have a greater range in time than terrestrial ones. More careful analysis of the evidence, however, indicates that this opinion is not so well supported as it at first seems to be. Successive groups of strata will contain representatives of the same genera of freshwater shells, while the land shell fauna found will usually show much generic diversity from period to period, in spite of the fact that most of the genera concerned have persisted down to the present day. This means, of course, that the terrestrial forms, though probably more numerous and diversified than the aquatic, are not so likely to be preserved. Thus we have in many cases a fairly representative showing of the freshwater genera, but only odds and ends of the terrestrial series.

It must also be noted that freshwater forms often fail to show very marked external features distinguishing allied species, and it is always possible that apparently long-lived types may in reality be composite, although we are not able to divide the material before us.

Three species of *Viviparus*, represented in the material before me, appear to extend from the Paleocene (whence they were described) well into the Eocene.

(1.) *V. trochiformis* (Meek & Hayden). Torrejon Formation, East Fork Torrejon Arroyo, New Mexico (Am. Mus. Nat. Hist., Exp. 1913); and also from the Wasatch at Ojo San José, New Mexico, many specimens (Stein; July 11, 1912).

(2.) *V. leidyi* (Meek & Hayden). Three lots from Clark's Fork Basin, Wyo., in the Sand Coulee Beds, collected by Granger and Stein. Three miles east, three miles southeast, and five miles southeast of the mouth of Pat O'Hara Creek.

One of the last lot is large, with aperture preserved; it is remarkable for the long aperture, which at once distinguishes it from *V. wyomingensis*. Aperture 23.5 mm. long; top of aperture to apex of spire 17.5 mm.; same length of spire on central axis 14.5 mm. Upper whorls only slightly convex.

(3.) *V. retusus* (Meek & Hayden). Many specimens, not very well preserved, from San Coulee Beds, head of Big Sand Coulee, Wyo. (Granger and Stein, Sept. 9, 1912).

Another species which seems to be long-lived is *Goniobasis tenuicarinata* (Meek & Hayden); a young but characteristic specimen was found by Granger and Stein in the Torrejon Formation, East Fork of Torrejon Arroyo, New Mexico, in July, 1912.

Goniobasis carteri Conrad (apparently a valid species) seems to be highly characteristic of the Wasatch; it was found both in the typical Knight Formation near Evanston, Wyo. (bluff north of railway at Knight Station, *G. Olsen*, June 14, 1906), and at Ojo San José, New Mexico (*Stein*, July 11, 1912). So far as we know at present, this shell does not appear before the Wasatch, and is therefore likely to be especially valuable for stratigraphical purposes.

Oreohelix megarche C. & H. and *Grangerella sinclairi* (Ckll.) are the best indicators of the Sand Coulee Beds (Lower Eocene). *G. sinclairi* is very abundant, and comes from three miles east and five miles southeast of mouth of Pat O'Hara Creek, and from the head of Big Sand Coulee, all in Clark's Fork Basin, Wyo. (*Granger and Stein*). *O. megarche* is also common at the various localities, but occurs also in the Wasatch of Big Horn Basin.

TERRESTRIAL SPECIES.

Grangerella n. g. (Bulimulidæ.)

Shell conic-subglobose, with about seven whorls; spire obtuse, sutures scarcely impressed; body-whorl broadly rounded, not at all keeled or angulate; umbilicus small but distinct; sculpture consisting of fine oblique riblets, about 6 to a mm. a short distance before the aperture. The last whorl broadens and is deflected upwards at the end, and the wide aperture is directed obliquely upwards, having about the same direction as the outer side of the shell; the thick lip, surrounding the aperture, has its upper angle produced, and actually extending a little above the level of the apex of the spire, while the lower inner corner extends a little below the periphery of the last whorl. Whether there are teeth in the aperture cannot be ascertained. There is no constriction on the outer side of the last whorl.

Grangerella megastoma n. sp.

Alt. 9 mm.; diam., max. 14, min. 9.75 mm.; aperture (outside measurement), long. 8, lat. 6 mm.

Sand Coulee Beds (Eocene); head of Big Sand Coulee, Clark's Fork Basin, Wyoming; Sept. 6 to 7, 1912 (*W. Granger*).

This remarkable species resembles *Boysia sinclairi*, from the same beds, but has the spire less elevated, and the aperture reaching to the apex, instead of to the fourth whorl. It is also a larger shell.

Only one specimen is before me, but it is possible that some of the very imperfect specimens referred to *B. sinclairi* belong here.

It seems advisable to regard this as a distinct genus of *Bulimulidæ*.

It agrees with *Boysia* in many respects, but the aperture is different, and more like that of some of the neotropical genera, such as *Zaplagius*, especially *Z. navicula* (Wagn.). The orientation of the aperture suggests an alliance with *Anostoma* and *Tomigerus*.

The species described as *Boysia sinclairi* and *B. phenacodorum* may be known as *Grangerella* (?) *sinclairi* (Ckll.) and *G.* (?) *phenacodorum* (Ckll.), since they are more likely to be congeneric with the genus now described than with true *Boysia*. Specimens with complete apertures would enable us to place them more exactly.



Fig. 1. *Grangerella megastoma* n. sp.
Three views of type.

***Eucalodium eophilum* n. sp.**

Shell (as preserved) broadly conoid, decollate, showing six whorls; whorls scarcely inflated; last whorl preserved strongly angulate at the periphery until about 7 mm. of the aperture, when the angulation is lost. Length 15.25 mm., width of last whorl 11, of penultimate whorl 9 mm.; length of aperture (measured obliquely) 9 mm. Surface of shell not preserved. In the apical region it can be seen that there is a spiral thickening, presenting a sharp edge around the axis, apparently much in the manner of the modern shells.



Fig. 2. *Eucalodium eophilum* n. sp. Type.

Sand Coulee Beds (Eocene); three miles east of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyoming; Sept. 18, 1912 (W. Granger).

Although this is evidently immature, and lacks the surface sculpture, it appears to be a true *Eucalodium*, related to the living *E. decollatum* (Nyst). The apex was doubtless decollate in life.

***Helix veterna veterrior* n. subsp.**

Alt. 11.5, max. diam. 17 mm.; whorls nearly five, last whorl large, broadly rounded, not keeled or angled; spire low, about as in *Helix hortensis*, which the whole shell resembles in shape; surface smooth, without any spiral lines, and with only very

weak oblique striae marking the lines of growth; apex quite smooth, without riblets; lip thin, but columella rather stout; no umbilicus.



Fig. 3. *Helix veterna veternior* n. subsp. Showing variation; the middle one is the type.

Variety a. Spire depressed.

Variety b. Spire elevated, conoidal. Sand Coulee Beds (Eocene); five miles S. E. of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyoming: 1912 (*Granger and Stein*).

In its typical form, of which two specimens are before me, apparently more or less immature, this looks like a distinct species. Variety b, however, is much like *H. veterna*. There is a series of species, consisting of *veterna* Meek & Hayden, from the Wind River Eocene, *riparia* White, from the Green River Eocene, and *leidyi* Hall and Meek, from the Oligocene, which are so closely related that from the shells alone they are scarcely separable. I examined the types of these in the U. S. National Museum, and made the following notes:

***Helix leidyi* Hall & Meek.**

2012 (Types). White R., Nebraska. Agree with those discussed and figured in Bull. Amer. Mus. Nat. Hist., xxxi, p. 232, pl. xxii.

13303. Determined as *leidyi* by Marcou. Salt Lake City, Utah. Seems correct.

***Helix veterna* Meek & Hayden.**

1975 (Types). Wind River Valley. I could not distinguish this from *leidyi*. Both species show the same variation in the height of the spire as was noted in the Amer. Mus. N. H. series of *leidyi*, but each presents all necessary intermediate forms, and the difference is partly due to compression, though not wholly so by any means.

***Helix riparia* White.**

8881 (Type). Eight miles below Green River City, Wyoming. Internal cast, with fragments of outside, indicating rather coarse flattened ribs. Looks like a young *veterna-leidyi*, of the form with higher spire; perhaps differs by less elongated aperture, and outline of upper side of last whorl in front view seems more oblique than in *veterna*. On the whole, this appeared not to be a distinct species.

We thus have a general type extending from the Sand Coulee Beds

(Lower Eocene) through the Wind R. and Green R. into the Oligocene. Selected specimens look like very distinct species, but there seems to be a great amount of variability, which is about the same in character and degree in the oldest as in the latest representatives. We are not in a position to assert positively that all these shells represent a single species (for which the oldest name is *veterna*), and it is better to treat them as distinct, or at least to give them subspecific rank.

Helix peripheria White (8882 = type), from the Eocene, Valley Range west of Gunnison, Utah, is an internal cast, with fragments of shell showing irregular flattened rib-striae. It looks immature; there are only about four whorls; apex lost. It is not the young of *Glyptostoma spatiosum*; the upper whorls are too small by far.

***Pleurodonte eohippina* n. sp.**

Shell flattened, lenticular, very acutely keeled; aperture rather narrow, columella and inner wall with a heavy callus; no umbilicus; peristome with a well-developed basal lamina. Alt. 5.5, max. diam.

12.5 mm.; length of aperture about 6.5 mm.; spire about 1.5 mm. The spire has been worn down, so that the number of whorls cannot be ascertained; at first sight the spire seems to be covered by a thin callus, but this is surely the effect of wearing.

A small part showing the sculpture, of rather well-marked but irregular riblets, about five to a mm., is preserved just behind the aperture. The outer upper part of the peristome is lost.



Fig. 4. *Pleurodonte eohippina* n. sp. Type.

Sand Coulee Beds (Eocene); head of Big Sand Coulee, Sept. 9, 1912 (*Granger and Stein.*)

This appears to be a true *Pleurodonte*, of the *Labyrinthus* type, now confined to the Neotropical Region.

FRESHWATER SPECIES.

***Physa bridgerensis* Meek, variety a.**

Imperfect specimen, 15 mm. long; three miles east of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyo., Sept. 18, 1912 (*W. S.*).

Imperfect, crushed, specimen, 17.5 mm. long; head of Big Sand Coulee. Wyo.; Sept. 6-7, 1912 (*W. G.*). These have very fine, weak, vertical striae; They probably represent a species of the type of *P. bridgerensis*, but smaller, they are however too imperfect to permit the recognition of any satisfactory diagnostic characters.

I examined a *P. bridgerensis* (9001, near Fort Bridger) in the U. S. National Museum. It has a form rather suggestive of the *P. acuta* group; length 38 mm.; quite distinct from *P. pleromatis* by the long spire; vertical growth striæ fine, not inclining to large flat bands as in *pleromatis*; a heavy callus on inner side of aperture.

***Campeloma calamodontis* n. sp.**

Shell about 33 mm. long and 23 broad; whorls about five, strongly shouldered, the suture deep, outer face of whorls vertical, flattened; lip (as shown by lines of growth) not markedly sinuous; shell rather thin, smooth, without evident sculpture; no trace of spiral lines or ridges.

In purple-stained rock, Wasatch (Eocene), at Ojo San José, New Mexico (Stein, July 16, 1912). Several specimens.

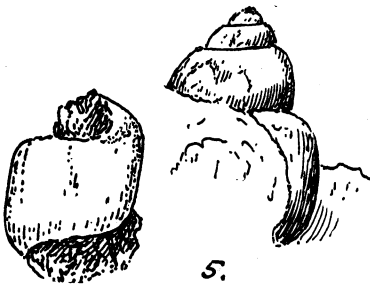


Fig. 5. *Campeloma calamodontis* n. sp.

This has all the appearance of a *Campeloma*, rather closely resembling the modern *C. ponderosum* Say, but apparently thinner, with much more flattened whorls.

It resembles *C. multilineatum* (Meek & Hayden), but the whorls are more broadly shouldered, and although the surface is well preserved, there are no spiral lines. The lip is straighter than in some of the species (e. g. *C. macrospira* Meek), but not more so than may be seen in living shells. In one specimen the whorls appear not to be shouldered, but this is due to compression and fracture.

There is a curious resemblance to White's figure of an internal cast of *Viviparus panguitchensis* White, but our shell shows the surface, without the sculpture or subbasal angulation of that species.