The Committee on the following paper by Mr. Charles Girard, of Washington, reported in favor of publication in the Proceedings:

A Revision of the North American Astaci, with observations on their habits and geographical distribution.

By Charles Girard.

According to recent investigations,* the crawfishes or Astaci, have been distributed into several genera: thus, the genus *Astacus* proper includes all the species of Europe and Asia, and two of Australia; the genus *Astacoides* is composed of two species—one from Madagascar and another from Van Diemen's Land; the genus *Cheraps* comprehends three species peculiar to New Holland; the genus *Engæus* embraces two species confined to Van Diemen's Land; and finally, the genus *Cambarus* includes the American species: one from Chili, another from Cuba, two from Mexico and six from the United States.

Investigations of a still more recent date,† the results of which have not yet been given to the scientific world, refer to the genus *Astacus* a species from the Columbia river, thus giving again that genus to North America.

At the request of Dr. Baird, we have examined critically the Astaci preserved at the Smithsonian Institution, collected chiefly by himself. Our researches have made us acquainted with several new species within the limits of the United States, and which we now characterise briefly, deferring to another opportunity more full descriptions, accompanied with necessary graphic illustrations.

First group.—Rostrum subquadrangularly elongated, terminated anteriorly by three conical and acute spines, the two lateral smaller than the middle one, which forms the tip. Extremity of the anterior pair of abdominal legs (in the male) straight and acute.

1. Cambarus pellucidus, Erichs. Arch. f. Naturg. 1846, i. 95.
   Astacus pellucidus, Tellk. in *Müll.* Archiv, 1844, 383.
   Locality.—Mammoth Cave, Kentucky, (Tellkampf, &c.)

2. Cambarus affinis, Erichs. Arch. f. Naturg. 1846, i. 96.
   Astacus affinis, Say, Journ. Acad. Nat. Sc. Philad. i. 1817, 168 and 443.—Harl. Med. and Phys. Res. 1835, 230, fig. 2.
   A. Bartonii, M. Edw. Hist. Nat. Crust. ii. 331.
   A. limosus, Rafin. Amer. Month. Mag. ii. 1817, 42.
   Localities.—Schuylkill, at Reading (Baird), Delaware (Say and Rafinesque).

3. Cambarus oreganus, Erichs. Arch. f. Naturg. 1846, i. 375.
   Astacus oreganus, Rand. Journ. Acad. Nat. Sc. Philad. viii. 1, 1839, 138, Pl. vii.
   Locality.—Columbia River (Nuttall).

4. Cambarus Pealei, Girard.—Differs from *C. affinis* in having longer antennæ, and a broader area between the dorsal lines of suture of the carapace. The lateral spine of the rostrum are also much less developed. The color is greenish brown above, with small green dots on the claws, and sometimes on the cephalo-thorax. A green line or narrow band is observed along the outer edge of the big claws, the tips of which, as well as the tips of the other legs, are orange, preceded by a deep green, almost black circle or ring. On each articulation of the tail there is a double, irregular and transverse blood-red band, which extends to the lateral appendages of the caudal rings. Underneath, the body is whitish and rusty.
   Locality.—Potomac, at Washington (D. C.)

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* Erichson (W. F.) Uebersicht der Gattung Astacus. — *Wiegm.* Archiv für Naturgeschichte, 1846, i. 86.

† Proc. Acad. Nat Sc. Philad. vi. 1852, 20.

5. CAMBARUS RUSTICUS, Girard.—Rostrum narrower than in both *C. affinis* and *C. Pealei*, and besides, concave on the sides. Terminal point shorter than in either of the preceding species; anterior pair of abdominal legs (in the male) elongated, slender, with their tip curved inwards, whilst the same tips are straight in *C. affinis*, and twisted in *C. pellucidus*. The dorsal area is broader than in *C. Pealei*.

Locality.—The Ohio, at Cincinnati.

6. CAMBARUS PROPINQUUS, Girard.—Closely allied to *C. affinis*, from which it differs, as well as from *C. Pealei*, by a proportionally shorter rostrum, and from *C. rusticus* by a much broader one. The area between the dorsal sutures of the carapace is still broader than in either *C. affinis*, *C. Pealei* or *C. rusticus*. There are also differences in the structure of the anterior pair of abdominal legs of the male.

Localities.—Lake Ontario, four miles from the shores, opposite to Oswego, found in the stomach of *Lota maculosa;* Garrison Creek, Sackett's Harbor; Four-mile creek, Oswego (Baird).

7. CAMBARUS FOSSOR, Girard.—*Astacus fossor*, RAFIN. Amer. Month. Mag. ii. 1817, 42.

This species we have not seen, but if Rafinesque's description is correct, "rostrum short, one toothed on each side," there can be no hesitation in referring it to this group. He further states that its vulgar name is "burrowing lobster," and that "it burrows in meadows and mill-dams, which it perforates and damages." This would indicate habits similar to a species of the second group, which we describe hereafter, under the name of *C. diogenes*. We cannot help, however, from expressing some apprehension that on the examination of authentic specimens from the same localities whence Rafinesque had obtained his, the rostrum should be found without lateral tooth, in which case the *C. fossor* might not differ from our *C. diogenes*.

Localities.—Virginia, Pennsylvania and New York (Rafinesque.)

Second group.—Rostrum generally broad, conical and short, with margins entire and toothless, terminated anteriorly by an acute and comparatively short point. Anterior pair of abdominal legs (in the male) recurved on their extremity, the tip of which is rounded.

8. CAMBARUS BARTONII, Erich. Arch. f. Naturg. 1846, I, 97.

Astacus Bartonii, FABR. Ent. Syst. Suppl. 407.—LATR. Gen. Cr. and Ins. v, 240.—Bosc, Hist. Nat. Cr II, 62, pl. II, fig. 1.—SAY, Journ. Acad. Nat. Sc. Philad. I, 1817, 167 and 443.—HARL. Med and Phys. Res. 1835, 230, fig. 3.—GOULD, Rep. Inv. Mass. 1841, 330.—DE KAY, N. Y. Fauna VI, 1844, 22, pl. viii. fig. 25.

Astacus ciliaris, RAFIN. Amer. Month. Mag. II, 1817, 42.

Localities.—Foxburg, Carlisle and Berwick (Pa.); New York (De Kay); Massachusetts (A. A. Gould). Brooks near Fishkill, Newburg, &c. (Rafinesque.)

9. CAMBARUS CAROLINUS, Erich. Arch. f. Naturg. 1846, I, 96.

Astacus affinis, M. EDW. Hist. Nat. Cr. II, 332.

Localities.—Carolina (Erichson); Anderson, S. C.

10. CAMBARUS MONTANUS, Girard.—Antennæ more elongated and more filiform than in *C. Bartonii*. Rostrum intermediate in shape between the latter and *C. carolinus*, being proportionally longer than in *C. Bartonii* and shorter and less tapering than in *C. carolinus*. Dorsal sutures of the carapace more apart than in both of the latter species.

Localities.—Within the Alleghany ranges in Virginia and Maryland: tributaries of James river in Rockbridge Co. (Va.); Shenandoah river in Clarke Co. (Va.), and Cumberland (Md.) of the hydrographical basin of the Potomac; Sulphur Spring, Greenbrier river, an affluent of Kenhawa river (Va.) of the Ohio basin.

11. CAMBARUS DIOGENES, Girard.—Rostrum proportionally the most elongated and the most conical amongst all the species of this group. Dorsal lines of

sutures of the carapace almost contiguous. Body uniform yellowish brown above and below, greenish on the sides and on the claws, the tips of which are red.

This species, like *C. fossor*, burrows in the meadows. Such places we have visited in the neighborhoods of the city of Washington, in order to study its peculiar habits. The holes, as they appear at the surface of the ground, are nearly circular, from seven-tenths of an inch to one inch and one inch and a half in diameter. The depth of the burrows varies according to the locations; this, we generally found to be from sixteen inches to two feet, and sometimes to three feet and more. The construction of the burrow itself is often exceedingly simple: from the surface of the grouud the excavation exhibits a gradual slope, in direction more or less undulating for a distance from five to ten inches, when it becomes vertical for six or eight inches, and then terminates in a sudden bottle-shaped enlargement in which the animal is found. The bottom of the burrow having no subterraneous communication, no other issue except towards the surface; it is entirely isolated from its neighbors, and leaves no chance for escape to its inhabitant. The same burrow may have several external holes connected with it, several inclined channels, which, however, meet at the depth where it becomes vertical. We found constantly the cavity full of water, but this was in March and April; the bottom, for several inches, was filled with a soft and pulpy mud.

There are other instances of burrows somewhat more complex. Their direction may be oblique throughout their whole extent, and composed of a series of chambers or ovoid enlargements succeeding each other at short intervals. Sometimes also, and connected with one of the chambers, a narrow and nearly vertical tubuliform channel extends downwards to a much greater depth, and appears to us as a retreat either during the cold winters or else during the dryness of the summer, when water is low. That it is not for the mere purpose of escaping pursuit, we infer from the fact that we repeatedly caught the animals in the chambers above, where they remained quietly instead of attempting to disappear into the apartments below.

We generally found a single individual in one burrow, it being either a male or a female, the latter in March and April, carrying under the tail a bundle of her eggs. Sometimes, when numerous individuals are gathered on a small space, it may happen that the windings of the upper part of their burrows will accidentally meet and have in this case a communication which was not contemplated. Each individual, however, remains in its own apartment; so at least we constantly found to be the case.

To accomplish the act of breeding, males and females must come together at one particular time. In one of the burrows which we examined we found a male and a female. We are inclined to believe that the male quits its retreat and goes in search of the female, as one individual of the former sex was found, at one time, walking over the surface of the ground.

In the spring, and we are told in the fall also, the burrowing crawfish builds over the holes of its burrow a chimney of the maximum height of one foot, but most generally lower. This chimney, circularly pyramidal in shape, is constructed of lumps of mud, varying in size, irregularly rolled up, and piled up, one upon each other, and intimately cemented together. Its exterior has a rough and irregular appearance; whilst the interior is smooth and as uniform as the subterraneous channel, having the same diameter as the latter. The cementing of the successive balls of mud is easily accounted for when we bear in mind that the latter are brought up in a very soft state, and that their drainage and subsequent solidification on their exposure to the atmospheric air and rays of the sun, is all that is required to unite these parts.

The animal works during night. How the work is performed has not yet been ascertained by actual observations. As to the question of the manner in which the mud is modelled into rolls or balls, either the tail, or perhaps the big claws might perform that part of the work. An observation made by John D. Godman* leads us to suppose that the mud is brought up embraced between the chest and the large claws. On an examination of these chimneys we detected the

* Rambles of a Naturalist. Philadelphia, 1833, pp. 40, 41.

imprints of the second and third pair of claws, which indicate, evidently, that the parcels of mud, once brought to the surface in the manner just stated, are arranged and fixed in their definitive place by means of these organs.

When the work has thus been carried on towards completion, the last touch consists in shutting up the aperture. This is accomplished by means of several balls of mud, brought up from underneath, deposited temporarily on the edge of the chimney and drawn back in close contiguity, so as to intercept all communication with the external world.

The number of such chimneys is sometimes very great in one particular locality, distributed without any geometrical regularity, and recalling to mind the scattered habitations or village of a newly settled colony.

Whether *C. diogenes* is to be found in other places besides the meadows, we are not prepared to state definitively. We have seen localities where the holes could be traced from the edge of the rivulets to the middle of the meadows, still, there being no subterraneous communication from one burrow to the other, the animal, at any rate, would have to crawl out of the water and walk over land. Colonies of burrowing crawfish are found, we are told, in the interior of lands, far away from any rivulets or waters, a circumstance which would lead to the supposition that these at least pass their entire life in such localities instead of spending one season in the waters and another in dry lands. For, one fact must be very apparent, the existence of several species of crawfishes with burrowing habits, even in the hypothesis of an identity between *C. fossor* and *C. diogenes*. For we learn from Mr. T. R. Peale, of Washington, that chimneys of mud, in all points similar to those just described, were observed by him in New Grenada, along the Rio Magdalena, several hundred miles from the sea shore, and consequently indicating the presence there of a species of crawfish which we do not hesitate in pronouncing distinct from *C. diogenes*.

It remains now to ascertain how many such there are, and whether some of them are not to be found both in the running waters of the rivulets and in the meadows.

12. CAMBARUS LONGULUS, Girard.—Rostrum of the same proportional length as in *C. diogenes*, but it is narrower and slightly concave on the sides. The dorsal area between the sutures of the carapace is very broad, a character which at once distinguishes it from the preceding species. From *C. Bartonii* it differs by a much more elongated and narrower rostrum.

Locality.—Uncertain; labels having been accidentally lost. Its range, however, is within the middle States of the Union.

13. CAMBARUS PUSILLUS, Girard.—*Astacus pusillus*, RAFIN. Amer. Monthly Mag. II, 1817, 42.

This species comes nearest to *C. montanus*, but the antennæ are still longer and the rostrum more tapering, and terminated by a more elongated point. The dorsal area between the sutures of the carapace is likewise narrower.

Localities.—Lake Ontario, three miles from shore opposite Oswego, taken in the stomach of *Lota maculosa* (Baird).—Brooks near Saratoga, Lake George, Lake Champlain, Utica, Oswego, (Rafinesque).

14. CAMBARUS ROBUSTUS, Girard.—Differs from *C. Bartonii* by stouter antennæ, composed of shorter articulations and by proportionally more elongated and more conical rostrum and a more acute terminal point. From *C. pusillus* it is distinguished by having shorter antennæ, besides a difference in the shape of the rostrum. The dorsal lines of suture of the carapace, on the other hand, do not approximate as much as in *C. diogenes*, although nearer than in both *C. Bartonii* and *C. pusillus*. It differs from *C. longulus* by a broader rostrum and a narrower dorsal area. The anterior pair of abdominal legs in the male, moreover, is flattened and twisted.

Locality.—Humber River, near Toronto (Canada).

15. CAMBARUS GAMBELII, Girard.—Antennæ, about the length of the body, from the tip of the rostrum to the origin of the tail. Rostrum proportionally long and conical as in *C. diogenes* and *C. longulus*, but is bordered on each side with a row of minute and conical tubercles. Anterior claw very stout, bearing

tufts of fine hairs. Anterior pair of abdominal legs, elongated, resembling somewhat in shape those of *C. robustus*, to which it bears a close relationship.

Locality.—California. Collected by the lamented Dr. William Gambel, to whose memory we inscribe the species. Specimens are deposited at the Academy of Natural Sciences of Philadelphia.

16. CAMBARUS NEBRASCENSIS, Girard.—Rostrum intermediate, in form between that of *C. robustus* and *C. diogenes*. Dorsal lines of suture of the carapace in close contiguity. Large claw nearly conical, giving to the species a very peculiar aspect.

Locality.—Fort Pierre (Nebraska); collected in 1850 by Thaddeus Culbertson.

Third Group.—Rostrum very much elongated, conical, tapering, provided on both sides and rather near the extremity with a small and acute spine, sometimes, however, but very slightly developed.

17. CAMBARUS BLANDINGII, Erichs. Arch. f. Naturg. 1846, I, 98.

Astacus Blandingii, HARL. Faun. Amer. & Trans. Philos. Soc. Philad. N. S. III, 1830, 464; Med. & Phys. Res. 1835, 229, fig. 1.

Localities.—Marshes and rivulets of Southern States (Harlan); Summerville, S. C. (Girard).

18. CAMBARUS CLARKII, Girard.—Antennæ long and slender, nearly as long as the body and tail. Rostrum tapering, but very gradually from its base to the lateral spines, though the terminal point is more elongated than in *C. Blandingii*. Anterior pair of abdominal legs terminated by two nearly equal and rounded tubercles.

Locality.—Between San Antonio (Texas) and El Paso del Norte; collected by John H. Clark, Esq., under Lieut. Col. J. D. Graham, late head of Scientific Corps U. S. Boundary Commission.

19. CAMBARUS ACUTUS, Girard.—Rostrum proportionally shorter than in both *C. Blandingii* and *C. acutissimus*; very broad at its base, and tapering very suddenly towards its extremity. The lateral spines of the rostrum are scarcely to be seen in this species; the tip is likewise very short although very acute. The structure of the anterior pair of abdominal legs in the male, differs from that of *C. Blandingii* and *C. Clarkii*, by the more slender shape of the terminating tubercles. The antennæ have nearly the same proportional length as in *C. Clarkii*.

Locality.—From an affluent of Mobile river in Kemper Co., Miss.; specimens received from D. C. Lloyd, Esq.

20. CAMBARUS ACUTISSIMUS, Girard.—Rostrum much more elongated than in any of the species of the same group; very much tapering and very acute, with slight indications of the lateral spines which are so well developed in *C. Blandingii*. The anterior abdominal pair of legs is terminated by a slender and recurved tip.

Locality.—Found with the preceding and sent by the same gentleman to Professor Baird.

The Committee on Dr. Leconte's Synopsis of the Anthicites of the United States, reported in favor of publication in the Proceedings:

Synopsis of the Anthicites of the United States.

By JOHN L. LECONTE, M. D.

Although it is but three years since M. de la Ferté Sénectère published his very beautiful and elaborate monograph of Anthicus, yet the species known to inhabit our territory have almost doubled in number. Most of these have been published by me already in the Annals of the Lyceum of Natural History of New York, and in Prof. Agassiz's work on the Physical Character of Lake Superior. The object I had in view in the beginning of my study of this group,