ART. XII.—*New Discoveries in Devonian Crustacea*; by JOHN M. CLARKE.

IN continuation of the notice of some new Devonian Crustacea which was published in this Journal for June, 1882 (3d ser., vol. xxiii, p. 476), I have to add a description of some new and extremely interesting forms allied to those there noticed, with a few remarks on their affinities and distribution. The species there described as *Spathiocaris Emersonii* appears on more careful investigation to have an unusual and remarkable vertical range through the rocks of the Chemung Period. The original examples were found in considerable abundance in the Portage shales, in the town of Naples, Ontario Co., N. Y., but at the time of description were confined, as far as my knowledge went, almost exclusively to one stratum, 550 feet above the top of the "Transition shales,"* between the Genesee and Portage.

My companion in the field, Mr. D. D. Luther, and myself have, during the past summer, found the fossil with the following distribution :

1. In the "Lower Black Band" of the Portage, 50 feet above the "Transition shales," Bristol, Ontario Co.
2. About 150 feet above the "Transition shales," in the town of Naples.
3. Approximately the same horizon in the town of Richmond, Ontario Co.
4. In the "Upper Black Band" of the Portage, 540 feet above the "Transition shales," Naples.
5. In approximately the same horizon, in the "Upper Black Band," $1\frac{1}{2}$ miles south of the Shaker Settlement, along Cashaqua Creek, Livingston Co.
6. In approximately the same horizon in a cut on the Delaware, Lackawanna & Western R. R., in the town of Sparta, Livingston Co.
7. In the shales immediately overlying 4.
8. In the Upper Portage sandstones, Portageville, Wyoming County.

* The term "Transition shales" is applied without liability to misinterpretation to passage beds of slightly arenaceous shales lying between the highest horizon of the fossils belonging distinctively to the Genesee, and the lowest stratum of undoubted Portage age. These beds measure usually between 30 and 60 feet and have a wide distribution in the counties of Ontario, Yates, Livingston, and I believe them to be well defined on the Genesee River at Mt. Morris. They contain a fauna which is a commingling of these fossils: *Cardiola spectosa* H., a lamellibranch diagnostic of the Portage, *Lumulacardium fragile* H., equally diagnostic of the Genesee, with *Coleolus aciculum* H., of the Portage, *Goniatites complanatus* H., of the Hamilton and Portage, *Styliola fissurella* H., abundant from the base of the Hamilton to the base of the Chemung proper, and a *Pleurotomaria* of undescribed species, abundant in the Portage.

9. In the lowest stratum of the Chemung proper, Naples.

10. In the sandstones of the Lower Chemung in the town of Canadice, Ontario Co.

This very wide range of *Spathiocaris Emersonii* without specific variation is the more remarkable on account of the complete differences in the character of the faunæ of which it makes a part in the different strata. In the lower muddy shales, its associates are the more commonly occurring fossils of the Portage rocks, *Goniatites complanatus* H., *Coleolus aciculum* H., *Cardiola speciosa* H., *Lunulacardium ornatum* H., *Cardiomorpha* (*Paracyclas*) *suborbicularis* H. In the bituminous shales of the "Upper Black Band," it appears with remains of the genus *Paleoniscus* and other undetermined fish relics, and also with an abundance of plant remains of doubtful affinities, spores of ferns or Lycopods, and with "Conodonts" and Annelidan teeth; in the Chemung in the lowest horizon with *Leiorhynchus mesacostalis* Hall, and in the upper only with crustacean forms allied to itself, presently to be described. Such a capability of adaptation to environments so markedly different, a muddy or a sandy sea-bottom, or an in-shore, brackish water swamp, such as might have produced the bituminous shales, or if we accept Newberry's suggestion a deep-water, sub-sargossan bottom, and all this without any apparent specific variation, is highly interesting, for in the modern allies of these Crustacea we find a very marked susceptibility to such changes.

I have in my possession a number of fragmentary and ill-defined crustacean remains from the same beds with these fossils, some of which have more or less resemblance to, and may prove to be, abdominal segments, but I should hesitate to describe any as such.

I have discovered another variation from the type of *Spathiocaris* in certain specimens taken from the shales and sandstones of the Chemung proper, at several localities, and in one, Canadice, Ontario Co., associated with *Spathiocaris Emersonii*, with which it is allied in some points of the structure of the carapace. The differences are, however, very strongly defined and generic, as will be readily seen from this diagnosis of the genus.

DIPTEROCARIS (*δίπτερος*=two-winged, *καρίς*=a prawn).

Carapace in one piece, elongate, divided along the major axis into two more or less separated wings or *alæ*. Greatest width anteriorly through the apex or area of union of the *alæ* of the carapace. These *alæ* approach each other in planes which, normally, make an angle of about 120°, but the area of union is not acute but rounded. *Alæ* united medially for a distance equal to $\frac{1}{4}$ d or $\frac{1}{3}$ th the length of the carapace, in this union the *alæ* anchylosed and without hingement of any kind. Clefts

extend anteriorly and posteriorly from the ends of the area of union, the anterior cleft being the shorter and its sides making the larger re-entrant angle. The surface of the carapace is marked with fine concentric ridges, as in *Spathiocaris* but is without the radiating lines of that genus.

Of this genus I find three species, as follows:

DIPTEROCARIS PENNÆ-DÆDALI.

Area of union of the sides of the test, or *alæ*, extends about $\frac{1}{5}$ th the entire length of the carapace and is situated anteriorly. The antennal or cephalic cleft is $\frac{1}{8}$ d the length of the carapace, its sides generally straight, somewhat incurving toward the apex, and making an angle of radius and circumference where they meet the margin of the carapace. Posterior cleft a little less than $\frac{1}{2}$ the length of the carapace, margins curving slightly outward to meet the straight and parallel margins of the carapace at an angle of 46° . Dimensions: length, 50^{mm} , width of each *ala* across area of union, 18^{mm} . The surface is marked as in all of these species by low concentric ridges, somewhat crowded near the center, rather coarser in this species than in the others.

In the illustration (fig. 1) the form is given unintentionally somewhat larger than actual size, and one-half of the carapace is restored in its proper position.

In the light-greenish sandstones of the Lower Chemung, taken from a gully in the town of Canadice, Ontario Co., N. Y., six miles S.E. of the village of Hemlock.

DIPTEROCARIS PROCNE.

Area of union of the *alæ* midway between the anterior and posterior extremities, and reaching less than one-third the length of the test. Anterior and posterior clefts of the same length, the margins of the anterior having a somewhat greater inward curve as they pass to the margin of the carapace than those of the posterior.

The anterior angles made by the margins of the cleft, and the periphery are large— 120° —but rounded. Posterior angles sharp— 45° . Sides straight, anterior curvature abrupt. Dimensions: length, 23^{mm} ; width of each *ala*, 9^{mm} .

Fig. 2 shows a carapace which has been flattened between the layers of sandstone, from the same locality as the preceding.

Fig. 3 shows both *alæ* not flattened, but probably at nearly their normal angle. From the sandstones of the Middle Chemung at Haskinsville, Steuben Co., N. Y.

This species differs from *D. pennæ-Dædali* in these particulars:

a. The anterior marginal curvature is more abrupt and shorter.

b. The area of union is larger and medially situated.

c. The cephalic and abdominal clefts are of the same length.

d. The individuals are, as far as observed, much smaller.

These details of difference are all well shown in the figures.

1.

Dipteroecaris penna-Dædali.

2.

Dipteroecaris Procne.

3.

Dipteroecaris Procne.

4.

Dipteroecaris pes-cervæ.

5.

Dipteroecaris pes-cervæ.
(Enlarged 4 diameters.)

DIPTEROCARIS PES-CERVÆ.

Outline of carapace elongate lanceolate, area of union of *alæ* anterior, $\frac{1}{8}$ th the length of the test. Cephalic cleft short, margins divaricating at an angle of 68° in the typical specimen and making angles of 78° with the periphery of the test. Posterior cleft long and narrow, the margins making an angle of 6° with each other, and angles of about 23° with the periphery. Dimensions: length 11^{mm} , width of each *ala* $3\frac{1}{2}^{\text{mm}}$. From the sandy shales of the Lower Chemung in the cutting of the Delaware, Lackawanna & Western Railroad, at Dansville, Livingston Co., N. Y.

Fig. 4 represents the specimen natural size from which this species is described. Fig. 5, the same, enlarged 4 diameters.

The genera *Spathiocaris* and *Lisgocaris*, which have been described by myself in this Journal as noticed above, show, neither of them, any evidence of a dorsal suture in the carapace. At the time of my description of the genus *Spathiocaris*, the existence of this suture seemed a matter of considerable doubt, as many of the examples in my possession were folded laterally along a median line. More abundant material, however, places beyond a doubt the absence of any hingement, and the fact that the carapace is in one piece. The genus *Lisgocaris* was then proposed to cover a species differing from *Spathiocaris* as then apprehended, in the undoubted absence of this suture, and though rather an aberrant form from the type of the genus *Spathiocaris*, I think it wise, in the light of the additional material obtained, to abolish the name erected for it, and to include it under the genus *Spathiocaris*, the species there described to be *Sp. Lutheri*. With my present conception of these genera, I should not expect to find (though diligent and careful search has been made) any traces of a "rostrum" or free valve to cover the single cleft in *Spathiocaris*, as it does in the genera *Discinocaris* Woodward and *Peltocaris* Salter, which are allied to *Spathiocaris* in some of the grosser features, or to cover the cephalic cleft in *Dipterocaris*. In *Spathiocaris* the cleft seems to be posterior and for the protrusion of the abdomen. In *Dipterocaris* I am inclined to believe, for lack of any evidence to the contrary, that both clefts were uncovered and allowed the protrusion of the cephalic appendages as well as the abdominal somites.

The statement of the absence of the hingement, or the dorsal suture, in *Dipterocaris*, depends on these observations:

1. There is no mark upon the carapace evincing such a suture.

2. One example of *D. Procne*, having the entire carapace in its normal position, has been subjected to pressure from above by accumulating sediment, in just such a manner as would be most likely to separate the carapace along a dorsal suture if any existed, but instead of such separation the carapace has yielded in concentric wrinkles parallel to its margin.

3. Another example of the same species, flattened in a thin laminated sandstone, has been broken across the area between the apices of the anterior and posterior clefts, and in such a way as to have been left *with a ragged edge*.

Mr. R. P. Whitfield, in this Journal for Jan., 1880 (vol. xix, No. 109, p. 33, "Notice of New Forms of Fossil Crustaceans from the Upper Devonian Rocks of Ohio,") has presented a synopsis of the *Ceratiocaridæ* based upon features of the "cara-

pace alone, independent of the changes which take place in the abdominal segments and in the caudal spines and appendages." Seven sub-divisions of the family are made, the seventh of which includes the forms already mentioned as allied to *Spathiocaris* and *Dipterocaris*, namely, *Peltocaris* Salter, *Discinocaris* Woodward, and also *Aptychopsis* Barrande and *Pterocaris* Barrande, with this characterization. "Carapace composed of three pieces, or apparently of three, two of which are semi-circular, with the anterior end of each obliquely truncate, forming, when the two are united, an anterior triangular notch into which the third or rostral plate is inserted; surface concentrically marked by growth lines; no nodes or ridges." None of the sections in this classification cover in as many particulars as this, the genera here and heretofore described by myself, and the description is quoted in full to emphasize the fact that, though the absence of the rostral piece can be regarded as only negative evidence, the unity of the carapace will preclude their admission to same footing as *Peltocaris*, *Aptychopsis* and *Pterocaris*. The genus *Discinocaris* stands apart from these three in the fact of its lack of a dorsal suture, as described (Quart. Jour. Geol. Soc. Lond., vol. xxii), and, with *Spathiocaris* and *Dipterocaris*, may stand as exemplifying a new type of carapace structure provided future investigation leads to the discovery of a rostral piece for the last two genera; otherwise they must remain apart from *Discinocaris* as well as from the other genera mentioned. All of the genera making the somewhat heterogeneous family of the *Ceratiocaridæ*, with the addition of their modern representative *Nebulia*, have been elevated by Packard to the value of an order with the name Phyllocarida.

I take this opportunity of acknowledging my obligation to Mr. C. E. Beecher, of the Geological Survey of New York, for kindness shown me in the confidence of his unpublished observations on new forms of the *Ceratiocaridæ* from the Pennsylvania Devonian, and in the loan of his beautiful drawings for comparative study.

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