REPORT ON ROTATORIA FROM PANAMA WITH DESCRIPTIONS OF NEW SPECIES.

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INTRODUCTION.

This report is based on a large number of collections made by Dr. C. Dwight Marsh during the months of January and February, 1912. That no complete picture can be given of the rotatorian fauna of the Isthmus of Panama is self-evident, as all the collections were made during the dry season and but very little material was narcotized, so that the contractile forms were with few exceptions unrecognizable. However, the loricate species were abundant and furnished interesting material. The Isthmus is not a specially favorable collecting ground for aquatic invertebrates, as there are no lakes and but few permanent pools; nevertheless it will be seen from the list of Rotatoria that when suitable conditions are present the fauna is both abundant and varied.

The following extract from Marsh [1] will give some idea of the environment:

> The continental divide is close to the southern shore of the Isthmus. From the summit of the divide to high tide on the Pacific side is only about 6 miles. The slope consequently is very steep and whatever water falls runs away almost immediately. During the season when the collections were made there was practically no rain on this slope, so that it was difficult to find any fresh water. Consequently nearly all the collections on the southern slope within the limits of the Canal Zone were made either in water which had been artificially impounded or in the standing water in the deeper parts of streams that were otherwise dry.
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> The northern slope extends from the divide to the Atlantic, a distance, in a straight line, of something over 30 miles. Two considerable rivers come into the Canal Zone from this slope, the Rio Chagres and Rio Trinidad. On the lower reaches of these rivers, and this is especially true of the Trinidad, are extensive swamps. The Chagres is a swift-flowing stream, sometimes torrential in character, and does not furnish a suitable environment for any extensive development of plankton organisms. The swamps form a suitable environment for plankton, but, connected together as they are, would not lead one to expect any great variety.
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> Gatun Lake will eventually be a large body of water with a surface of 164 square miles and a depth of 47 feet. At the time the collections were made the lake was very

[1] Marsh, C. Dwight, Report on fresh-water Copepoda from Panama with descriptions of new species. Smiths. Misc. Coll., vol. 61, No. 3, 1913.

small. Especially careful collections were made in this lake and in the neighboring waters and in sufficient numbers to give a good idea of its flora and fauna.

There are no natural lakes in the Canal Zone; the Canal Commission, however, has built for sanitary purposes a series of reservoirs and these, having been in existence for a considerable period, may be considered as lakes. Only the following three yielded Rotatoria in any considerable number: Rio Grande, built in 1906, elevation 240 feet, depth 50 feet; Camacho, built in 1907, elevation 370 feet, depth 45 feet; and Carabali or Gorgona, built in 1906, elevation 76 feet, depth 10 feet. While the Rio Grande is considered as constructed in 1906, it is really an old French reservoir which was built some time between 1882 and 1889 and has had a continuous existence since that time; it covers an area of 72.77 acres.

These reservoirs were made by constructing dams in places where the waters of small streams could be impounded. The beds were cleared and after construction the shores were kept clear of vegetation to a distance of 50 or more feet from the margin. The reservoirs were all "plankton-poor." This is what would be expected from the environment, which produces permanent bottom stagnation. In cold climates the bottom waters of lakes have a more or less complete stagnation in the summer and in winter, the stagnation being more complete in the smaller bodies of water in which winds have no opportunity to produce bottom currents, but in spring and in fall, because of the change in temperature, there is a complete overturning of the water. No such change, of course, takes place under the constant temperature conditions of the Canal Zone, so that only the surface water contains the oxygen which is necessary for the life of plankton organisms. While the foregoing statement is true in regard to the general conditions of the waters of the reservoirs, it must not be understood as meaning literally that the oxygen content always diminishes in exact ratio to the depth; local and meteorological causes may produce some modifications of the general statement. This has been discussed by Downes, who gives a series of charts of dissolved oxygen.[1]

For preserving the collections two different mixtures of alcohol and formalin solution were used by Doctor Marsh, one of equal parts of 50 per cent alcohol and 5 per cent formalin, another of equal parts of 75 per cent alcohol and 5 per cent formalin. In the matter of producing recognizable material of the illoricate species of Rotatoria they are on the same footing; only narcotizing will do that. But an alcoholic mixture is far better for the subsequent sorting out of the material, which necessarily contains a certain amount of plant débris; if a straight formalin solution is used, this débris sticks to the animals so that it is almost impossible to clean them. An alcoholic preservative, on the contrary, leaves everything free and it is a comparatively simple matter to pick out the animals. The strength of the alcohol does not appear to be very important; probably 75 per cent alcohol is as good as any.

To facilitate reference the localities yielding large collections of Rotatoria are numbered as below and the number added in parenthesis after the record of each species.

1. From the railroad bridge over water in Black Swamp; now submerged in Gatun Lake.

[1] Downes, J. R., A study of the water supplies of the Isthmus of Panama. Proc. Canal Zone Med. Ass., Mount Hope, C. Z., vol. 3, pp. 133–150, 7 pls.

2 Pool covered with algae, near the railroad, between Black Swamp and Gatun; now submerged in Gatun Lake.

3. Creek flowing into Camacho Reservoir; clogged with weeds covered with Nostoc, etc.

4. Stagnant pool at the end of Canal cut, Empire. At the time the collections were made it was nearly dry and green with algae; when filled the pool is probably 5 or 6 feet deep.

5. Rio Grande Reservoir, near the railroad bridge.

6. Rio Grande, collections from the river.

7. Pond west of Rio Chagres at Bohio. Formed by a dam built by the French. Water lilies along shore; the collections were made in the middle, where the water was clear.

8. Pond east of the Canal, east of Empire. About 2 acres in area; surrounded by grass growing out from the shore in such masses that it will nearly support the weight of a man.

9. Rio Trinidad, below Agua Clara, about 1 mile from mouth; now part of Gatun Lake.

10. Rio Trinidad, just above Agua Clara; now part of Gatun Lake.

11. Rio Trinidad, opposite Escoval, in weeds along shore; now part of Gatun Lake.

12. Pond north of fill work at Miraflores; really back water of Rio Camitillo.

LIST OF THE SPECIES COLLECTED.

NOTOMMATA AURITA (Müller).

A single recognizable specimen in a collection from a pond north of the fill work at Miraflores, formed by back water of Rio Camitillo (2).

NOTOMMATA CERBERUS (Gosse).

Several specimens, of which one was fully extended, occurred in a creek flowing into Camacho Reservoir (3).

NOTOMMATA COPEUS Ehrenberg.

Common in a slow stream in garden of Isthmian Canal Commission, Empire; also in a collection from the railroad bridge over Black Swamp (1).

NOTOMMATA PSEUDOCERBERUS de Beauchamp.

A single specimen from a pool near the railroad, between Black Swamp and Gatun (2); another from Rio Trinidad, collected just above Agua Clara (10).

NOTOMMATA TORULOSA (Dujardin).

One specimen, identified by the trophi, from a stagnant pool by the railroad, north of bridge over Black Swamp.

PLEUROTROCHA SORDIDA (Gosse).

Proales sordida Gosse, Hudson and Gosse, Rotifera, 1886, vol. 2, p. 37, pl. 18, fig. 7.

A single specimen, with some doubt referred to this species, from a pool near the railroad, between Black Swamp and Gatun (2).

DIASCHIZA AURICULATA (Müller).

Diaschiza lacinulata Levander, Acta Soc. Flora Fauna Fennica, vol. 12, No. 3, 1894, p. 43.

A few specimens from Rio Trinidad, just above Agua Clara (10).

DIASCHIZA FORFICATA (Ehrenberg).

Diaschiza caeca Dixon-Nuttall and Freeman, Journ. Royal Micr. Soc., 1903, p. 134, pl. 4, fig. 11.

A few specimens from each of the following localities: Creek flowing into Camacho Reservoir (3); Rio Trinidad, in weeds along shore at Agua Clara (10) and Escoval (11).

DIASCHIZA GIBBA (Ehrenberg).

In creek flowing into Camacho Reservoir (3); not abundant.

DIASCHIZA GRACILIS (Ehrenberg).

A few specimens in the same collection as *Diaschiza gibba* (3).

MONOMMATA ORBIS (Müller).

Monommata longiseta Bartsch, Jahresh. Naturk. Württemberg, vol. 26, 1870, p. 344.

A few specimens from a pool near the railroad, between Black Swamp and Gatun (2); also from creek flowing into Camacho Reservoir (3) and in Rio Trinidad, at Escoval (11).

DICRANOPHORUS FORCIPATUS (Müller).

Diglena forcipata Ehrenberg, Abh. Akad. Wiss., Berlin (for 1831), 1832, pp. 137, 154, pl. 4, fig. 10.

?*Diglena grandis* Ehrenberg, Abh. Akad. Wiss., Berlin (for 1831), 1832, p. 137.

Typical specimens of this species occurred in the following localities: Slow stream in garden of Isthmian Canal Commission, Empire; pool between Black Swamp and Gatun (2); creek flowing into Camacho Reservoir (3); stagnant pool at Empire (4); Rio Grande Reservoir (5); Rio Grande, river (6). Specimens with straight toes, about 55 μ long, agreeing with published figures of *D. grandis*, were found in Rio Trinidad (9) and a stream in garden of Isthmian Canal Commission, Empire. As far as could be determined from the partly contracted specimens, they agreed with a single specimen collected near Boston and sent me for comparison by Mr. Rousselet, who informs me that he has always considered *D. grandis* a synonym of *D. forcipatus*. The trophi of the Panama specimens are identical with those of typical specimens of *D. forcipatus*.

ENCENTRUM FELIS (Müller).

Vorticella felis MÜLLER, Verm. Terr. Fluv., vol. 1, pt. 1, 1773, p. 108.
Diglena felis BILFINGER, Jahresh. Naturk. Württemberg, vol. 50, 1894, p. 46.

Common in a stagnant pool, Empire (4). While the specimens were partly contracted, the trophi make the determination reasonably certain.

BRACHIONUS ANGULARIS CAUDATUS Barrois and Daday.

From the following localities: Stagnant stream under old bridge, Old Panama (probably Rio Alcorobo), common; Gatun Lake, enormous numbers; pond at Bohio (7), very abundant; Carabali (Gorgona) Reservoir, common; Bayou of French Canal, about 2 miles south of Gatun, common; pond at Miraflores (12), common.

BRACHIONUS BUDAPESTINENSIS Daday.

Specimens agreeing with material collected here at Washington were common in Carabali (Gorgona) Reservoir.

BRACHIONUS CAPSULIFLORUS Pallas.

The form with posterior spines (*B. bakeri* Müller) is common on the Isthmus; the strongly asymmetric foot tube is abnormally developed, the left spine being sometimes as long as the postero-lateral spines; the median anterior spines are also longer than usual. This form occurs in the following collections: Stagnant stream under old bridge, Old Panama, common; Gatun Lake, enormous numbers; Mindi Reservoir, few; Rio Grande Reservoir (5), few; Rio Grande (6), few; pond at Miraflores (Rio Camitillo) (12), common.

The spineless form (*B. urceolaris* Müller) occurred in great abundance in a sluggish stream partly filled with grass, in the savannas between Panama and Old Panama.

BRACHIONUS DOLABRATUS, new species.

Plate 16, figs. 1–2.

While showing a certain resemblance to *B. angularis* Gosse, this species has a number of peculiarities that entitle it to specific rank. At the junction of the dorsal and ventral plates of the lorica there are two blunt lateral spines or knobs and a similar pair at the postero-lateral angles. They are always slightly asymmetric and very variable; the form figured may be considered an average one. On each side of the foot opening is a hammer-shaped spine, frequently with small posterior spicules or setae; it is possible that they are always present in the living animal, and that they may have been destroyed by the preservative. The egg is carried by the parent and always rests upon the dorsal points of the foot spines, as shown in the lateral view. The anterior edge of the dorsal plate is strongly convex and has a single pair of spines at the side of the antennal sinus; the ventral edge has a wide and shallow median notch. Both dorsal and ventral plate is moderately convex. The lateral antennae are unusually stout and project through simple holes in the dorsal plate, very close to the edge of the lorica.

Total length of lorica, 105 μ; width over lateral spines, 100 μ; width of anterior edge, 60 μ; depth of body, 42 μ.

Type.—Cat. No. 16570, U.S.N.M., from a pond west of Rio Chagres, at Bohio, where the species is common.

BRACHIONUS FALCATUS Zacharias.

This excessively variable species occurs on the Isthmus in an almost infinite variety of forms. It is recorded from the following localities: Stagnant stream under old bridge, Old Panama, abundant; Gatun Lake, enormous numbers; Mindi Reservoir, few; bayou of French Canal, 2 miles south of Gatun, common.

BRACHIONUS PATULUS Müller.

Brachionus militaris Ehrenberg, Abh. Akad. Wiss., Berlin (for 1833), 1834, p. 199.

A very small, but otherwise normal form occurs occasionally on the Isthmus: Stagnant stream under old bridge, Old Panama, few; stagnant pool at Empire (4), common; back water of Rio Chagres at Las Bocas del Gatun, few.

BRACHIONUS PATULUS MACRACANTHUS (Daday).

Plate 17, fig. 1.

Noteus militaris macracanthus Daday, Zoologica, Heft 44, 1905, p. 119, pl. 7, figs. 3–5.

This form is common in weedy ponds everywhere in the Canal Zone. A peculiarity in the position of the lateral antennae deserves notice; in the typical, short-spined form the antennae are on the inner edge of the lateral spines, as figured by Cohn, while in *macracanthus* they are on the spines, about one-third the length of the spine from the posterior end, where there is a decided "knee." In Daday's figure a projecting knob is shown, which is no doubt the antenna, or rather, it is in the position of the antenna. The form *macracanthus* was found in collections from: Stagnant stream under old bridge, Old Panama (probably Rio Alcorobo), common; slough in savannas near police station on road to Old Panama, common; Gatun Lake, abundant; creek flowing into Camacho Reservoir (3), common; Rio Cocoli, above reservoir, few; stagnant pool at Empire (4), abundant; Rio Grande (6), few; pond at Bohio (7), few; pond at Miraflores (12), common.

BRACHIONUS MIRABILIS Daday.

A single specimen in a collection from the railroad bridge over water in Black Swamp (1).

PLATYIAS QUADRICORNIS (Ehrenberg).

Noteus quadricornis EHRENBERG, Abh. Akad. Wiss. Berlin (for 1831), 1832, p. 143.

The Isthmian form of this species has very long toes; the average measurements of a considerable number of specimens from Washington are: Length of lorica without anterior or posterior spines 225 μ, toes 37 μ; from Panama, lorica 217 μ, toes 60 μ. In words, the toes in the latter form are relatively nearly twice as long as in the local form. There are no other important differences; the lorica in the Panama specimens is less irregular in outline, almost circular; the posterior spines are similar, possibly a trifle longer, and the points are identical; the spines are very slightly blunted at the extremity and end in a short, very fine and needlelike point. The species was found in the following collections: From railroad bridge over water in Black Swamp (1), common; pool near railroad, between Black Swamp and Gatun (2), few; pond at Miraflores (12), few.

KERATELLA STIPITATA (Ehrenberg).

Anuraea stipitata EHRENBERG, Infusionsth., 1838, p. 507, pl. 62, fig. 11.

As this species is common here at Washington, the Panama material was gone over carefully in order to determine the distribution of the two closely related species *K. stipitata* and *K. cochlearis*. All the Isthmian specimens belong to *K. stipitata; K. cochlearis* was not found at all. The latter has been repeatedly recorded from South America; it would be interesting to know whether it is really found there or whether the not very conspicuous difference in the dorsal pattern has been overlooked. The distribution of the two species in North and South America is still an unsolved problem; personal observations indicate that Washington is on the border line of the respective territories, but the evidence is too fragmentary to warrant any definite conclusion. With all due respect to Doctor Zelinka, the re(?)discoverer of this species, the writer believes, until confronted with the "corpus delicti" from the neighborhood of Berlin, that Lauterborn was correct in his opinion, that Ehrenberg drew the *quadrata* (=*aculeata*)—tesselation in the *cochlearis*—outline. This is not inexplicable, as Ehrenberg does not record *K. cochlearis* at all. Now, it is well known, through the work of later investigators, that this species is to be found nearly everywhere in Germany, and the supposition is not unreasonable that Ehrenberg, finding a *Keratella* (=*Anuræa*) with a median spine and a dorsal tesselation of some sort, concluded without any careful examination that it was the, to him, familiar *quadrata* pattern. In favor of this assumption is the fact that in a later paper [1] Ehrenberg figures under the name *stipitata* what is evidently a typical *cochlearis.*

Keratella stipitata was found in collections from: Gatun Lake, abundant; Brazos Brook Reservoir, collected in the middle, abundant; creek flowing into Camacho Reservoir (3), few; Camacho Reservoir, common; stagnant pool at Empire (4), few; Rio Grande (6), few; pond at Bohio (7), very abundant; Rio Grande Reservoir (5), common; pond at Miraflores (12), common; the form without posterior spine (*tecta*) in a bayou of the French Canal, 2 miles south of Gatun, few.

KERATELLA QUADRATA (Müller).

Anuraea aculeata EHRENBERG, Abh. Akad. Wiss., Berlin (for 1831), 1832, p. 145.

In creek flowing into Camacho Reservoir (3), few.

NOTHOLCA LONGISPINA (Kellicott).

A single specimen from a pond near Rio Chagres at Bohio (7).

ANURAEOPSIS FISSA (Gosse).

Anuraea fissa GOSSE, Ann. Mag. Nat. Hist., ser. 2, vol. 8, 1851, p. 202.

Carabali (Gorgona) Reservoir, common; Rio Grande Reservoir (5), few.

MYTILINA TRIGONA (Gosse).

Diplax trigona GOSSE, Ann. Mag. Nat. Hist., ser. 2, vol. 8, 1851, p. 201.

A single specimen in a collection from the railroad bridge over Black Swamp (1); stagnant pool at Empire (4), abundant.

MYTILINA VENTRALIS (Ehrenberg).

Salpina ventralis EHRENBERG, Abh. Akad. Wiss., Berlin (for 1831), 1832, p. 133, pl. 4, fig. 7.

This species appears to be rare on the Isthmus; only single specimens were found, in the following collections: Pool between Black Swamp and Gatun (2); Rio Grande Reservoir (5); Rio Grande (6); Rio Trinidad, above Agua Clara (10).

EUCHLANIS DILATATA Ehrenberg.

From a slow stream in garden of Isthmian Canal Commission, Empire, common; stagnant pool by the railroad, north of bridge over Black Swamp, few; pool between Black Swamp and Gatun (2), few; stagnant pool at Empire (4), common; Rio Grande (6), few; Rio Trinidad, at Escoval (11), few; pond at Miraflores (12), common.

EUCHLANIS OROPHA Gosse.

From a creek flowing into Camacho Reservoir (3), common; Rio Trinidad, at Escoval (11), few.

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[1] Abh. Akad. Wiss., Berlin (for 1841), 1843, pp. 291–446, pls. 1–4.

EUCHLANIS PLICATA Levander.

While this species is rather common in the collections, all the specimens are partly contracted, so that no satisfactory figure can be given of it. From a pool between Black Swamp and Gatun (2), common; stagnant pool at Empire (4), few; Rio Grande Reservoir (5), common.

EUCHLANIS TRIQUETRA Ehrenberg.

It is not without hesitation that the Panamanian specimens are listed under this name; the dorsal keel is absent, the two lateral plates simply coming together at an approximately right angle. However, the resemblance to *E. triquetra* is otherwise very close, and considering the present unsatisfactory status of the genus, it seems advisable to refer this form to *triquetra* until the limits of variation in this genus are better known. It occurred in a collection from the railroad bridge over Black Swamp (1), common; Rio Alcorobo, under bridge on road from Panama to Old Panama, few.

DIPLEUCHLANIS PROPATULA (Gosse).

Isthmian specimens of this species resemble closely the form figured by de Beauchamp from the Lofu River.[1] In collection from railroad bridge over Black Swamp (1), few; creek flowing into Camacho Reservoir (3), few; stagnant pool at Empire (4), common; Rio Grande Reservoir (5), few; Rio Grande (6), few; pond at Miraflores, back water of Rio Camitillo (12), common.

LECANE CREPIDA, new species.

Plate 22, figs. 4–7.

The body is parallel-sided for one-half of its length and tapers rapidly to the foot; it is strongly gibbous posteriorly and has a very flexible lorica. The anterior dorsal margin is slightly convex, the ventral a trifle concave; the anterior spines are stout and slightly incurved. The dorsal plate is strongly convex and much smaller than the ventral; its limits are rather ill-defined and the markings are limited to two pairs of divergent, wavy ridges, beginning near the anterior margin. The ventral plate is moderately convex and has two broken series of ridges extending the greater part of its length; there is a well-marked transverse fold immediately in front of the foot. As shown in the cross section of the body (fig. 8), there are no lateral sulci; the section of the lorica connecting the dorsal and ventral plates is very slightly concave and marked with three ridges, one posterior, and a pair immediately in front of the lateral antennae, which are just above the edge of the ventral plate. The posterior segment merges without any definite anterior limit with the body; ventrally it has a large, circular opening for the foot.

[1] Bull. Soc. Zool. France, vol. 38, 1913, p. 184, fig. 2.

The first foot joint is large and bulbous; it is at least possible that this really corresponds to the posterior segment of the body in other species of *Lecane.* The second foot joint is square and unusually long; it projects for nearly its entire length beyond the lorica. The toes are long, slender, and tapering, slightly curved at the base; the claw is nearly one-third the length of the toe, conical and not curved.

Total length, 135 μ; length of lorica, 90 μ; width of anterior points, inner edges, 52 μ; length of dorsal plate, 75 μ, width, 45 μ; width of ventral plate, 60 μ; toe without claw, 30 μ, claw, 9 μ; depth of body, 43 μ.

Type.—Cat. No. 16578, U.S.N.M., from a stagnant pool at Empire (4), where the species is common; it occurred also in a pool near the railroad, between Black Swamp and Gatun (2), common; Gatun Lake, among water plants near the railroad bridge, few; creek flowing into Camacho Reservoir (3), abundant; Rio Grande Reservoir (5), abundant; Rio Grande (6), few.

This is no doubt the animal recorded by Jennings[1] and figured under the name *Distyla gissensis* Eckstein, from specimens collected in a swamp near the fish hatchery on South Bass Island in Lake Erie. The original description does not fit *L. crepida* any better than it does any other known *Lecane;* it is doubtful whether Eckstein's species is now identifiable.

Lecane crepida has but one close relative, *L.* (=*Cathypna*) *hastata* (Murray); the similarity is not, however, so close that there can be any question of identity. Whether these two species represent a primitive branch of the genus or a highly specialized one is uncertain; that they may have retained more of the ancestral characters than any other known species is not improbable.

LECANE LUNA (Müller).

Cathypna luna Gosse, Hudson and Gosse, Rotifera, 1886, vol. 2, p. 94, pl. 24, fig. 4.

From a pool near the railroad, between Black Swamp and Gatun (2), common; creek flowing into Camacho Reservoir (3), common; stagnant pool at Empire (4), abundant.

LECANE PAPUANA (Murray).

Cathypna papuana Murray, Journ. Royal Micr. Soc., 1913, p. 551, pl. 22, fig. 2.

This species is widely distributed on the Isthmus, but usually in small numbers: Gatun Lake, near railroad bridge, few; stagnant pool at Empire (4), few; Rio Grande Reservoir (5), few; Rio Grande (6), few; bayou of French Canal, about 2 miles south of Gatun, abundant; Rio Trinidad, at Escoval (11), few; pond at Miraflores (12), few.

[1] Bull. U. S. Fish Comm., vol. 19, 1900, p. 91, pl. 20, figs. 33, 34.

LECANE SIBINA. new species.

Plate 23, figs. 5–7.

The body is broadly ovate and its thickness more than two-thirds of the width. The anterior margins are very nearly coincident and slightly concave, with two lateral triangular projections, but without true spines. The dorsal plate is very broad and ovate in outline; while without any facetting whatever, it has two deep anterior, diverging folds, the limits of a strongly convex lobe. At the sides of this lobe the dorsal plate is concave, making it possible for the anterior dorsal and ventral margins to meet and close the lorica when the head is retracted. The ventral plate is slightly narrower than the dorsal, oval and without facetting; some inconspicuous transverse folds are present near the posterior end; the anterior margin has a very small median sinus. The lateral sulci are moderately deep and do not reach the anterior margin; they are indicated by dotted lines in figure 7. The posterior segment of the body is very large and prominent, projecting quite a distance over the toes; it is noticeably emarginate at the outer angles of the coxal plates, which are large and obtusely triangular. The first foot joint is minute, the second short and broad. The toes are in dorsal view nearly parallel-sided, a trifle narrowed immediately beyond the base and widest at the beginning of the posterior third, where there are some obscure annular constrictions. The claw is half the length of the toe, unusually slender, conical, and very slightly decurved. At its base there is a small spine, separated from the claw by a deep notch.

Total length, 200 μ; length of lorica, 165 μ; length of dorsal plate, 130 μ, width, 125 μ; width of anterior points, 78 μ; width of ventral plate, 116 μ; length of toe without claw, 42 μ, claw, 20 μ; depth of body, 93 μ.

Type.—Cat. No. 16582, from a stagnant pool at Empire. It is not common.

This species has considerable resemblance to *Lecane ungulata* (Gosse). The latter is not as thick at *L. sibina*, and the body is relatively longer; its absolute dimensions are also considerably greater and the anterior margins are not coincident, the dorsal being nearly straight, while the ventral margin has a deep sinus.

LECANE UNGULATA (Gosse).

Cathypna ungulata Gosse, Journ. Royal Micr. Soc., 1887, p. 361, pl. 8, fig. 1.

A single specimen from a pool near the railroad, between Black Swamp and Gatun (2).

LECANE CURVICORNIS (Murray).

Cathypna curvicornis Murray, Journ. Royal Micr. Soc., 1913, p. 346, pl. 14, fig. 22.
? *Cathypna nitida* Murray, Journ. Royal Micr. Soc., 1913, p. 347, pl. 14, fig. 24.
Cathypna lofuana Murray, Journ. Royal Micr. Soc., 1913, p. 551, pl. 22, fig. 1.

Apparently these three names designate one and the same species. A specimen labeled *Cathypna curvicornis* was given me by Mr. Murray;

while this does show a smooth lorica and is without the three indentations of the posterior body segment, these characteristics occur frequently among Isthmian specimens which are undoubtedly specifically identical with Mr. Murray's *C. curvicornis*. The dorsal facetting figured for *C. nitida* is nearly always present; the posterior indentations of *C. lofuana* are less frequent, but occur in otherwise typical specimens, as does also the partly retracted anterior margin of this species.

The most distinctive peculiarities of *Lecane curvicornis* are best seen in a lateral view, compare plate 17, figure 3. The ventral plate is divided by a transverse fold, in front of which it is very deep and convex; the posterior section is nearly flat and correspondingly shallow. The toes have a short, sharp double curvature at the base; the posterior portion is slightly decurved. The spines at the base of the claw are at an angle of about 45 degrees with the body, so that a slight displacement makes them invisible, especially as they are very small and indistinct.

LECANE LEONTINA (Turner).

Canthypna leontina TURNER, Bull. Denison Univ., vol. 6, 1892, p. 61, pl. 1, fig. 12.

In Black Swamp, near the railroad bridge (1), few; stagnant pool north of the railroad bridge over Black Swamp, few; pool near the railroad, between Black Swamp and Gatun (2), common; sluggish stream in savannas between Panama and Old Panama, rare; creek flowing into Camacho Reservoir (3), common; Rio Cocoli, above lake, rare; stagnant pool at Empire (4), abundant; pond east of canal at Empire (8), few.

LECANE NANA (Murray).

Cathypna nana MURRAY, Journ. Royal Micr. Soc., 1913, p. 353, pl. 14, fig. 29.

From a pool near the railroad, between Black Swamp and Gatun, abundant.

LECANE PLOENENSIS (Voigt).

Distyla ploenensis VOIGT, Zool. Anz., vol. 25, 1902, p. 679.
Cathypna affinis MURRAY, Journ. Royal Micr. Soc., 1913, p. 346.

A small variety of this species, about two-thirds the usual size, with rather indistinct markings, occurs on the Isthmus. My specimens were identified by Mr. Murray as identical with the animal he found at Rio de Janeiro. It was found in the following collections: Slow stream in the garden of the Isthmian Canal Commission, Empire, rare; pool near the railroad, between Black Swamp and Gatun (2), rare; creek flowing into Camacho Reservoir (3), few; stagnant pool at Empire (4), few; pond east of canal at Empire (8), rare; Rio Trinidad, about a mile from mouth (9), rare.

LECANE LUDWIGII (Eckstein).

Distyla ludwigii Eckstein, Zeitschr. Wiss. Zool., vol. 39, 1883, p. 393, pl. 26, fig. 37.

From a creek flowing into Camacho Reservoir (3), few; pond east of canal at Empire (8), few; Rio Trinidad, at Escoval (11), rare.

LECANE MARSHI, new species.

Plate 18, figs. 1–3.

The outline of the lorica is a bluntly pointed oval; the anterior margins of the dorsal and ventral plates are coincident and slightly excavate. The anterior spines are long, slender, and slightly tapering; the point is curved back as a conspicuous hook, in lateral view nearly semicircular. The dorsal plate is ovate and unusually narrow at the posterior end; its markings are quite regular and prominent. The ventral plate is narrower than the dorsal and of approximately the same outline; the lateral sulci are deep. The posterior segment of the body is roughly triangular in outline, slightly narrowed at the base of the rounded posterior lobe, which curves downward; on the dorsal side there are two parallel, transverse ridges on each side of the median line. The first foot joint is barely distinguishable and the second, movable joint is smaller than usual. At the sides of the foot joints there are two semicircular rounded plates, free posteriorly and slightly movable. These plates, for which the term coxal plates is used in this paper, are present in all the species of the genera *Lecane* and *Monostyla*, even when no other trace of the lorica remains; in some cases they are produced into posterior spines. The toes of *L. marshi* are fairly long, straight and parallel-sided, ending in bluntly conical points without any claw. The body is of a little more than average depth.

Total length, 173 μ; length of lorica, 138 μ; width of anterior edge over spines, 54 μ; height of hook, 9 μ; length of dorsal plate, 114 μ, width, 84 μ; width of ventral plate, 76 μ; length of toes, 45 μ; depth of body, 60 μ.

Type.—Cat. No. 16571, U.S.N.M., from a stagnant pool at Empire (4); it is apparently not common. It has been named for Dr. C. Dwight Marsh, of Washington City.

LECANE ERCODES, new species.

Plate 18, figs. 4–6.

The lorica is oval in outline, ending posteriorly in a blunt, rounded lobe; the anterior dorsal and ventral edges are coincident. The dorsal plate is oval and truncate posteriorly; its markings are prominent and, with the exception of the first row, fairly regular. The ventral plate is slightly narrower than the dorsal and marked with longitudinal folds as shown in the figure. The anterior margin of the lorica is deeply excavate and produced into two long, stout anterior spines, slightly incurved and upcurved. The posterior segment of the body is broadly triangular, ending in a rounded lobe, slightly narrowed at the base and decurved; on the dorsal side there are two parallel, transverse ridges on each side of the median line. The first foot joint reaches down on the movable joint as a pointed lobe; the coxal plates are broad and rounded. The toes are fairly long, straight, and parallel-sided, ending in bluntly conical points without any claw. The body is of average depth.

Total length, 165 μ; length of lorica, 135 μ; width of anterior edge inside of spines, 48 μ; length of dorsal plate, 110 μ, width, 81 μ; width of ventral plate, 75 μ; length of toes, 42 μ; depth of body, 48 μ.

Type.—Cat. No. 16572, U.S.N.M., collected in a pool between Black Swamp and Gatun (2); only two specimens were found in the collection.

This species is closely related to *Lecane marshi;* it is noticeably broader posteriorly and the depth of the body is less; the anterior spines are, however, sufficient to distinguish the two. With *Lecane stokesii, L. ludwigii,* and *L. ohioensis* they form the most closely related group within the genus, differing principally in the form of the posterior segment of the body; the lorica is very firm in all of these species and the dorsal pattern differs only in the first row of markings.

LECANE FLEXILIS (Gosse).

Plate 19, figs. 1–3.

Distyla flexilis GOSSE, Hudson and Gosse, Rotifera, 1886, vol. 2, p. 97, pl. 24, fig. 7.

? *Distyla lipara* GOSSE, Journ. Royal Micr. Soc., 1887, p. 867, pl. 15, fig. 16

? *Cathypna brevis* MURRAY, Journ. Royal Micr. Soc., 1913, p. 555, pl. 22, fig. 8.

The lorica is very nearly circular; the small posterior segment is almost covered by the dorsal plate of the lorica and the anterior margins are coincident. The dorsal plate is subcircular and its anterior margin convex with two short, very stout, slightly incurving frontal spines. The markings of the dorsal plate are very prominent and of an unusual pattern; there are four transverse rows of ridges, the first row broken, the other three fairly regular with 7, 8, and 7 ridges respectively. The ventral plate is considerably narrower than the dorsal and quite flexible, with ill-defined lateral edges; the markings are constant in front, becoming more variable toward the foot. The posterior segment of the body is rounded and projects but little beyond the dorsal plate; the coxal plates are nearly semicircular. The first foot joint is elongate-oval and the movable joint broad and rhomboid. The toes are short, with a well marked, recurved claw; their inner edges are straight, while the outer edge has a double curve, so that the toe is a trifle broader in the middle than just beyond the base. From the middle the toe tapers gently to the claw; in lateral view it is slightly decurved and tapering; there is a minute, but distinct spine projecting dorsally over the claw. The depth of the body is greater than that of any other described species of the genus; the lateral sulci are almost obliterated in retraction; on account of the flexibility of the membrane connecting the dorsal and ventral plates, its appearance is very variable.

Total length, 96 μ; length of lorica, 76 μ; length of dorsal plate, 72 μ, width, 66 μ; width of ventral plate, 50 μ; anterior spines 55 μ; toes without claw 19 μ, claw, 4 μ; depth of body, 50 μ.

While the contracted animal does not resemble Gosse's figure very much, the agreement is in the extended condition so striking that there can be no doubt of the identification. When fully extended and swimming, the length is very nearly twice as great, the body is slender and flattened dorso-ventrally and the dorsal markings become much more prominent. While Gosse's figure of the toes is not correct, the same may be said of the majority of the species of this genus, with which he had occasion to deal.

Lecane flexilis is widely distributed; in the Panama collections it was found in a creek flowing into Camacho Reservoir (3), common; stagnant pool at Empire (4), common. Mr. Rousselet has sent me specimens collected by Mr. Murray in Brazil; it is found here at Washington and in great abundance in collections from Loch Raven, near Baltimore, Maryland, also in material from the Bureau of Fisheries station at San Marcos, Texas; I have found it in Sphagnum sent me from various localities in England by Mr. David Bryce.

Cathypna brevis Murray shows considerable resemblance to this species; if the toes are correctly described it is, however, a good species.

LECANE ARCULA, new species.

Plate 19, figs. 4–6.

Cathypna aculeata MURRAY, Journ. Royal Micr. Soc., 1913, p. 350, pl. 14, fig. 28; not *Distyla aculeata* Jakubski.

The general form of the lorica is ovate and but little longer than broad; the body is unusually thick. The dorsal and ventral anterior margins of the lorica are both straight and nearly coincident; they are produced laterally into two small, pointed spines, which are broad at the base and directed slightly upward and outward. The dorsal plate of the lorica is ovate and rounded posteriorly; it is strongly gibbous and projects over the posterior segment of the body so far that it nearly conceals it in a dorsal view. The dorsal markings are rather faint; there are the usual four transverse rows of ridges, which are fairly regular. The exact pattern can perhaps better be understood from the figure than from any description. These ridges do not form true facets in any of the species of the genera *Lecane* and *Monostyla;* some species do have facets, but the limiting lines do not project as ridges above the surface of the lorica. The majority of the species having prominent ridges on the dorsal plate change their form considerably in retraction; the species with true facets or without any dorsal markings do not as a rule change much. This does not refer to the virtually illoricate species, all moss-dwellers, which do not assume any fixed, recurring outline in retraction. The ventral plate of *Lecane arcula* is of nearly the same outline as the dorsal and of equal width; it has rather conspicuous markings. The posterior segment of the body is prominent, but nearly covered by the dorsal plate. The first, immovable foot joint is nearly parallel-sided and pointed posteriorly, where it reaches down over the movable second foot joint; this is quite broad at the base and suddenly narrowed immediately behind the lorica. The toes are short, rather slender, and in dorsal view parallel-sided; in lateral view they are broad at the base and taper rapidly. The claw is of moderate length, very slender and recurved.

Total length, 96 μ; length of lorica, including spines, 68 μ; length of dorsal plate, including spines, 63 μ, width, 55 μ; width over anterior spines, 47 μ; length of spines, 5 μ; length of toes without claw, 18 μ, claw, 5 μ; depth of body, 45 μ.

Type.—Cat. No. 16573, U.S.N.M. It was taken from a stagnant pool at Empire (4), where it was very abundant; it is common and widely distributed on the Isthmus: Pool between Black Swamp and Gatun (2); creek flowing into Camacho Reservoir (3); Rio Grande, (6); Rio Trinidad, 1 mile from mouth (9), and above Agua Clara (10), also at Escoval (11).

Murray identifies this species with *Distyla aculeata* Jakubski. While there is no doubt a certain general similarity, it does not extend to details; Jakubski's animal is more elongate and widest in front, the body is very thin and the dorsal plate smooth, the anterior spines measure 14 μ, while in the South American species they are only 5 μ long. The conclusion that the two are different species is therefore unavoidable.

LECANE COMPTA, new species.

Plate 20, figs. 1–3.

Cathypna flexilis? Murray, Journ. Royal Micr. Soc., 1913, p. 351, pl. 14, fig. 27; not *Distyla flexilis* Gosse.

The general form of the body is a slightly elongate oval; the anterior margins of the dorsal and ventral plates are straight and coincident, the anterior spines minute. The depth of the body is moderate and the entire lorica very flexible. The dorsal plate is oval, truncate in front and narrow posteriorly; the dorsal markings are prominent, but in the three anterior rows only the median fields are regular. The ventral plate is slightly narrower than the dorsal and has prominent markings of the pattern shown in figure 1. The posterior segment is large and bluntly pointed; the coxal plates are small and semicircular. The first foot joint is well marked; the movable joint is large and subsquare. The moderately long toes are parallel-sided, slightly decurved and taper abruptly to a fine point, but there is no true claw.

Total length, 115 μ; length of lorica, 80 μ; length of dorsal plate 70 μ, width, 60 μ; width of ventral plate 56 μ; width of anterior spines, 54 μ; width of anterior edge of dorsal plate 45 μ; length of toes, 30 μ; depth of body, 45 μ.

Type.—Cat. No. 16575, U.S.N.M., from a stagnant pool at Empire (4), where the species is abundant; common in a pool between Black Swamp and Gatun (2) and in Rio Trinidad, above Agua Clara (10).

Murray identifies this animal with some misgivings with *Distyla flexilis* Gosse. His figure seems to have been drawn from an abnormal (dried ?) specimen, at least none of the numerous specimens in the Panama collections resembles it very much.

LECANE PUSILLA, new species.

Plate 20, figs. 4–6.

The body of this small species is but little longer than broad and very thick; the anterior margin of the dorsal plate projects beyond the ventral plate. Both are straight; they do not meet even in complete retraction, but leave the lorica widely open in front; no spines are present at the antero-lateral angles of the lorica. The dorsal plate is nearly circular; the markings are of an unusual pattern, as one pair of ridges overlap from the second to the third row. The ventral plate is parallel-sided in its anterior half and rounded posteriorly; only the central markings are conspicuous. The lateral sulci are deep. The rounded posterior segment projects considerably beyond the dorsal plate; the coxal plates are of moderate size and semicircular. The first foot joint is barely distingusihable, while the second is unusually large. The toes are short and nearly straight with a slender, recurved claw, which is occasionally directed slightly outward, as shown in fig. 4; usually they are in the axis of the toe. (See fig. 6.)

Total length, 75 μ; length of lorica, 60 μ; length of dorsal plate, 54 μ, width, 52 μ; width of anterior edge, 38 μ; width of ventral plate, 45 μ, anterior edge, 50 μ; length of toes without claw, 15 μ, claw, 5 μ; depth of body, 40 μ.

Type.—Cat. No. 16574, U.S.N.M., is from a stagnant pool at Empire (4), where it is common; also in Rio Grande (6).

This species is closely related to *Lecane nana* (Murray); it differs mainly in having fairly strong markings on the lorica, while *L. nana* is smooth; in the latter the toe is without any claw.

LECANE AEGANEA, new species.

Plate 21, figs. 1–3.

The body is moderately elongate-oval and not very thick; the anterior dorsal margin is slightly convex and the ventral margin straight; they do not meet when the head is retracted, but leave the lorica partly open; no anterior spines are present. The dorsal plate is oval and rounded posteriorly; the markings are fairly regular and not very conspicuous. The ventral plate is larger than the dorsal and projects beyond it, except in front; its markings are prominent, especially on the posterior half. The lateral sulci are not very deep and the entire lorica quite flexible. The posterior segment of the body is inconspicuous; the coxal plates are very small and semicircular. The first foot joint is very long, but almost obliterated near the middle; the second joint is large and has a sharp constriction immediately in front of the toes, which are moderately long, slender, and nearly straight, and end in a very long, slightly recurved and delicate claw.

Total length, 110 μ; length of lorica, 76 μ; length of dorsal plate, 70 μ, width 56, μ, width of anterior edge, 42 μ; width of ventral plate, 60 μ, anterior edge, 50 μ; toes without claw, 24 μ, claw, 10 μ; depth of body, 36 μ.

Type.—Cat. No. 16577, U.S.N.M., is from a pool near the railroad, between Black Swamp and Gatun (2); it is not common.

LECANE DORYSSA, new species.

Plate 21, figs. 4–6.

The body is but little longer than broad and excessively thick and clumsy. While the outlines are wavy and somewhat indefinite, the lorica is nevertheless quite firm and may perhaps best be described as leathery. The anterior dorsal margin is slightly convex and sinuate, as the dorsal ridges reach to the edge; the ventral edge is almost straight and there are no frontal spines. The dorsal plate is nearly circular, slightly truncate posteriorly, and is very deeply marked; the anterior row of ridges is somewhat irregular, while the second row is entirely broken up with the exception of the median field; the two posterior rows are regular. The ventral plate is slightly narrower than the dorsal and nearly parallel-sided in its entire length, but narrows abruptly to the posterior segment. The ventral markings are very prominent, especially so on the median field, which in outline approximates a reversed shield. The lateral sulci are shallow and much wrinkled. The posterior segment is large and projects considerably beyond the dorsal plate; the coxal plates are large and rounded. The first foot joint is prominent, much constricted near the middle, and reaches down on the second joint as a broad lobe with a blunt point. The second joint is subsquare and very large; it projects beyond the lorica for more than two-thirds of its length. The toes are short and slightly compressed; the claw is nearly as long as the toe, very slender and straight.

Total length, 106 μ; length of lorica, 70 μ; length of dorsal plate, 58 μ, width, 60 μ, width of anterior margin, 52 μ; width of ventral plate, 58 μ, width of anterior margin, 56 μ; length of toe without claw, 17 μ, claw, 13 μ; depth of body, 45 μ.

Type.—Cat. No. 16576, U.S.N.M., is from a pool near the railroad between Black Swamp and Gatun (2); it is not common.

The nearest relative of this species is *L. hornemanni*, which rivals it in thickness of body and also resembles it in general appearance. The lorica of *L. hornemanni* has deeper wrinkles of a different pattern; the toes are quite different, and the peculiar coxal plates, ending in points close to the foot, also distinguish it from *L. doryssa*.

LECANE HORNEMANNI (Ehrenberg).

Cathypna hornemanni MURRAY, Journ. Royal Micr. Soc., 1913, p. 349, pl. 14, fig. 26.

From a pool near the railroad, between Black Swamp and Gatun (2), few; from water plants near railroad bridge, Gatun Lake, common; creek flowing into Camacho Reservoir (3), few; Rio Grande Reservoir (5), abundant; Rio Grande (6), few; Rio Trinidad, above Agua Clara (10), few.

LECANE TENUISETA, new species.

Plate 22, figs. 1–3.

The outline of the body is a slightly elongate oval; the anterior margins are parallel and usually a trifle convex in the median half of their width; they leave the lorica partly open in retraction, as they do not quite meet. The body is fairly thick. The dorsal plate is oval, rounded posteriorly, and without markings; it is strongly gibbous and bends down considerably even in front. The ventral plate is of the same width as the dorsal and similar outline; its markings consist of a few ridges, shown in figure 1. The lateral sulci are very shallow. The posterior segment of the body is broad and rounded and projects considerably beyond the dorsal plate; the coxal plates are large and semicircular. The first foot joint is narrow and parallel-sided, and reaches down on the second joint as a bluntly pointed lobe. The second joint is broad, rounded anteriorly, and constricted immediately in front of the toes, which are slender, slightly compressed, and rather short. The claw is more than two-thirds the length of the toe, very slender, recurved and outcurved. The lorica is membranous and very flexible.

Total length, 106 μ, length of lorica, 73 μ; width, 56 μ, length of dorsal plate, 64 μ, width of anterior edge, 45 μ; width of anterior edge of ventral plate, 52 μ, length of toe without claw, 20 μ, claw, 13 μ.

Isthmian specimens are from a creek flowing into Camacho Reservoir (3), where the species is common.

Type.—Cat. No. 16579, U.S.N.M., from Kenilworth, District of Columbia, where the species occurs in Sphagnum. It is found also in material collected near the Bureau of Fisheries station at San Marcos, Texas. As the Washington specimens are better preserved, the description and measurements are taken from these. Isthmian specimens are considerably smaller, but do not otherwise differ materially.

This species bears considerable resemblance to *L. aeganea;* the difference in the toes and the markings of the lorica are sufficient to distinguish the two.

LECANE AMORPHA, new species.

Plate 23, figs. 1 and 2.

This species is virtually illoricate and on account of the great flexibility of the integument the contracted animals vary very much in appearance. The body is unusually elongate and nearly parallel-sided; the anterior margin is the irregularly puckered edge resulting from the inversion of the head. The posterior half of the body shows rudimentary lateral sulci. The posterior segment of the body is normally developed, broad and rounded; the coxal plates are large and semicircular. The first foot joint is narrow and parallel-sided, the second subsquare, slightly wider posteriorly. The toes are short, straight, and slender; the claw is nearly as long as the toe, slender, tapering, obtusely pointed, and slightly recurved.

Total length, 105 μ; length of body, 80 μ, width, 40 μ; length of toes without claw, 14 μ, claw, 10 μ; depth of body, 30 μ. These measurements are only average; owing to the flexibility of the integument any number of different measurements may be obtained.

Type.—Cat. No. 16580, U.S.N.M., from Rio Trinidad at Escoval (11), in weeds along shore, where it is common. It is also found here at Washington in Sphagnum from Kenilworth.

LECANE ELEGANS, new species.

Plate 23, figs. 3 and 4.

The body is elongate, slender, and parallel-sided; the dorsal plate is very flexible, the ventral much less so. The anterior margin of the ventral plate is nearly straight and of fairly constant form; the dorsal margin is irregularly puckered by the inversion of the head. The dorsal plate is strongly convex, nearly semicircular in cross section. Lateral sulci are barely indicated on the posterior third of the body;

the ventral plate may be said to be joined directly to the dorsal; it has prominent longitudinal ridges. The posterior segment of the body is very large and unusually prominent; it may be considered as beginning near the middle of the ventral plate and is, seen from the ventral side, ovate, broadest posteriorly. Coxal plates are not present. The first foot joint is extremely long, tapering posteriorly to half its anterior width; the elongate second joint is parallel-sided and strictly terminal. The toes are very long, slender, and slightly recurved in the posterior third. The claw is nearly half as long as the toe, strongly outcurved and slightly recurved; at the base of the claw there is a conspicuous, laterally directed spine.

Total length, 170 μ; length of body, 108 μ, width, 45 μ; toe without claw, 36 μ, claw, 15 μ; depth of body, 48 μ.

Type.—Cat. No. 16581, U.S.N.M., from Rio Grande Reservoir (5); but few specimens were collected.

MONOSTYLA CORNUTA (Müller).

Monostyla robusta Murray, Journ. Royal Micr. Soc., 1913, p. 557, pl. 23, fig. 21.

Murray considers this species different from *Trichoda cornuta* Müller, as it has a shorter toe and a nearly straight anterior margin. It is quite true that the toe is a trifle shorter than in Müller's figure, but the specimens studied by Mr. Murray were not fully contracted, and so did not show the lunate anterior margin, which is normally as deep as in *Monostyla lunaris*. There can be no doubt about the identity of this form and the one figured by Ehrenberg as *Monostyla cornuta*. That Ehrenberg's identification was incorrect is quite possible; as there is no positive proof that he was in error, he is entitled to the benefit of the doubt. *M. cornuta* has been repeatedly ruled out because Müller figures the claw as double; as a matter of fact, a careful examination of large amounts of material of both species demonstrates that the claw is really double in both species, although the two parts are very rarely separated in *M. lunaris* and seldom in *M. cornuta*.

In the Isthmian material two forms of this species occur; one which may be called the normal measures: Length of body 126 μ, of toe 42 μ, of claw 9 μ, and a diminutive form with a relatively much longer claw, which measures: Length of body 85 μ, of toe 23 μ, of claw 9 μ.

The normal form occurs: In a pool near the railroad, between Black Swamp and Gatun (2), few; creek flowing into Camacho Reservoir (3), abundant; stagnant pool at Empire (4), common; Rio Grande Reservoir (5), abundant; Rio Grande (6), few; pond east of canal at Empire (8), few; Rio Trinidad, about 1 mile from mouth (9), common; above Agua Clara (10), common; at Escoval (11), a single specimen. The long-clawed form was found in Rio Grande Reservoir (5), common.

MONOSTYLA LUNARIS Ehrenberg.

This supposedly cosmopolitan species is, strange to say, rare in the Isthmian collections; a single specimen from a creek flowing into Camacho Reservoir (3) and two from Rio Grande Reservoir (5) is the total number of observed specimens. This contrasts strongly with the remarkable abundance of other species of the genus, as well as of *Lecane*.

MONOSTYLA VIRGA, new species.

Plate 24, figs. 1–3.

The body is ovate and strongly gibbous posteriorly. The anterior margins are nearly coincident; the anterior sinus of the dorsal plate is not quite as deep as that of the ventral, and at the bottom it has a short straight line, while the ventral sinus is rounded; both have their sides slightly convex; anterior spines are not present. The dorsal plate is oval and but little longer than broad; the anterior margin is considerably narrower than that of the ventral plate. The outline of the ventral plate is nearly the same as that of the dorsal; it is slightly narrower and somewhat angular posteriorly, with a conspicuous transverse fold. The lateral sulci are deep, as indicated by a faint line in figure 3; the lorica is not tesselate. The posterior segment of the body is small and rounded; it projects but little beyond the lorica. The coxal plates are small and obtusely triangular. The first foot joint is pyriform, the second large and rounded. The toe is long, parallel-sided, fairly stout and slightly decurved; it has two obscure annular constrictions. The claw is short and stout; it is distinctly double, although the two parts are only rarely separated.

Total length, 138 μ; length of lorica, 84 μ; width of anterior edge of dorsal plate, 32 μ, of ventral plate, 42 μ; length of dorsal plate, 78 μ, width, 72 μ; width of ventral plate, 66 μ; length of toe without claw, 48 μ, claw, 6 μ; depth of body, 45 μ.

Type.—Cat. No. 16584, U.S.N.M., from Rio Grande Reservoir (5), where the species is abundant. The species occurs also in a pool between Black Swamp and Gatun (2), few; pond at Bohio (7), few; pond east of Empire (8), few; Rio Trinidad, above Agua Clara (10), few; at Escoval (11), few.

This species has considerable resemblance to *Monostyla crenata* and was at first supposed to be a small variety of the latter; this, as it proved later, erroneous assumption is the basis of the record in the original description [1] of *M. crenata* as common in Isthmian collections. The lateral view of *M. virga* shows at once that it is a different species. In *M. crenata* the lorica is widely open in front, when the head is completely retracted.

[1] Proc. U. S. Nat. Mus., vol. 46, 1913, p. 399.

MONOSTYLA PYRIFORMIS Daday.

Monostyla truncata Murray, Journ. Royal Micr. Soc., 1913, p. 358, pl. 15, fig. 38.

Partly contracted specimens agree perfectly with Daday's figure, while the fully contracted material corresponds with Murray's. The name given by Daday is used here, in preference to Turner's; while the possibility that they may be the same species is not excluded, positive evidence is lacking. *M. truncata* Turner is here listed as a probable synonym of *M. closterocerca* Schmarda. It seems to the writer inadvisable to simply "use up" the names given in the past without sufficient description to enable one to form any definite opinion as to the identity of the animal actually before the original observer, as such "resurrections of the dead" tend to befog the question of distribution. If we use Turner's name for this South American species, it will of course figure in all lists as being common to both North and South America. That such is really the case is very doubtful; *M. pyriformis* was described by Daday from Paraguay, Murray found it in Brazil, and it is not rare on the Isthmus. Taken together, this indicates that the species is common and widely distributed in South America. To give it an "all-American" distribution merely on the strength of Turner's unrecognizable figure is unwarranted and misleading in the face of an abundance of presumptive evidence that the species of the genera *Lecane* and *Monostyla* usually have a rather circumscribed distribution.

This species occurs: In a pool near the railroad, between Black Swamp and Gatun (2), few; creek flowing into Camacho Reservoir (3), few; stagnant pool at Empire (4), few; Rio Grande Reservoir (5), common; Rio Grande (6), rare; Rio Trinidad, about 1 mile from mouth (9), rare; above Agua Clara (10), rare.

MONOSTYLA BULLA Gosse.

In a pool near the railroad, between Black Swamp and Gatun (2), common; sluggish stream in savannas between Panama and Old Panama, few; Gatun Lake, few; creek flowing into Camacho Reservoir (3), abundant; Rio Cocoli, above lake, few; stagnant pool at Empire (4), abundant; Rio Grande Reservoir (5), common; Rio Grande (6), few; pond east of Canal at Empire (8), few; Rio Trinidad, above Agua Clara (10), abundant.

MONOSTYLA QUADRIDENTATA Ehrenberg.

This species was found only in the following collections: Stagnant pool at Empire (4), common; Rio Grande Reservoir (5), few; Rio Trinidad, above Agua Clara (10), few.

MONOSTYLA CLOSTEROCERCA Schmarda.

Monostyla closterocerca Murray, Journ. Royal Micr. Soc., 1913, p. 357, pl. 15, fig. 39.

? *Monostyla truncata* Turner, Bull. Denison Univ., vol. 6, 1892, p. 62, pl. 1, fig. 11.

From a pool near the railroad, between Black Swamp and Gatun (2), common; creek flowing into Camacho Reservoir (3), common; Rio Grande Reservoir (5), few; Rio Trinidad, above Agua Clara (10), few; at Escoval (11), few.

This species does not have the fusiform toe figured by Schmarda and Murray; the toe is parallel-sided for about half its length and from there tapers rapidly to a long, slender point.

MONOSTYLA HAMATA Stokes.

In collection from a creek flowing into Camacho Reservoir (3), common; stagnant pool at Empire (4), common; Rio Grande Reservoir (5), few; Rio Trinidad, above Agua Clara (10), common; at Escoval (11), few.

MONOSTYLA DECIPIENS Murray.

In a pool near the railroad between Black Swamp and Gatun (2), few; creek flowing into Camacho Reservoir (3), rare; Rio Grande Reservoir (5), few.

MONOSTYLA FURCATA Murray.

Abundant in a pool near the railroad, between Black Swamp and Gatun (2); creek flowing into Camacho Reservoir (3), rare; stagnant pool at Empire (4), abundant; Rio Grande (6), rare; Rio Trinidad, about 1 mile from mouth (9), few; above Agua Clara (10), few; at Escoval (11), few.

MONOSTYLA OBTUSA Murray.

Among water plants near the railroad bridge, Gatun Lake, rare; stagnant pool at Empire (4), common; Rio Grande Reservoir (5), common; Rio Trinidad, above Agua Clara (10), few.

MONOSTYLA RUGOSA, new species.

Plate 24, figs. 4–6.

The ovate body is short, very broad, and excessively thick. The anterior margins of the lorica are nearly straight and almost coincident; there are no anterior spines. The broadly ovate dorsal plate is slightly truncate posteriorly; the width is greater than the length and its anterior margin is narrower than that of the ventral plate. The dorsal markings are very deep and the fields of the two anterior rows irregular, while the third and fourth row are fairly regular.

The ventral plate is subsquare and much narrower than the dorsal. As it is very flexible, the lateral margins are undulate and not very distinct. The wrinkling of the median portion of the ventral plate is constant and of the pattern shown in figure 4. The lateral sulci are indistinct and shallow. The posterior segment of the body is very short and broad; it is almost concealed by the dorsal plate. The coxal plates are large and semicircular. The first foot joint is very small and parallel-sided, the second also rather small. The toe is of moderate length and has a long, double claw, the two parts of which are rarely separated.

Total length, 84μ; length of lorica, 57μ; length of dorsal plate, 54μ; width 62μ; width of ventral plate, 56μ; anterior edge of dorsal plate, 34μ, of ventral plate, 45μ; length of toe without claw, 21μ; claw, 6μ; depth of body, 42μ.

Type.—Cat. No. 16583, U.S.N.M., from Rio Grande Reservoir (5), where the species is abundant. It also occurs in the following collections: Pool near the railroad, between Black Swamp and Gatun (2), common; Rio Grande (6), few; Rio Trinidad, above Agua Clara (10), few.

MONOSTYLA BIFURCA Bryce.

From a creek flowing into Camacho Reservoir (3), common.

LEPADELLA PATELLA (Müller).

Metopidia emarginata Hudson and Gosse, Rotifera, Suppl., 1889, p. 46, pl. 34, fig. 6.

While recorded only from Rio Trinidad, at Escoval (11), it is quite probable that many specimens have been overlooked, as the collections nearly all contained a considerable amount of floccose, diatoms, desmids, etc.

LEPADELLA SOLIDUS (Gosse).

Metopidia solidus Gosse, Ann. Mag. Nat. Hist., ser. 2, vol. 8, 1851, p. 201.

In a creek flowing into Camacho Reservoir (3), common; Rio Trinidad, above Agua Clara (10), rare.

LEPADELLA TRIPTERA Ehrenberg.

From Rio Grande Reservoir (5), common; Rio Grande (6), few.

LEPADELLA IMBRICATA, new species.

Plate 16, figs. 3–5.

The body is subovate, a little broader anteriorly. The lorica is strongly gibbous with a very faint dorsal ridge; the ventral plate also has a faint ridge, which only extends for about two-thirds of its length. Two shallow longitudinal depressions extend the length of the body, half way between the dorsal ridge and the lateral margins of the lorica. The ventral plate has an indistinct groove on each side, close to the lateral margin, as shown in the cross section of the body, figure 5. The anterior dorsal margin is straight, the ventral has a deep, V-shaped sinus. The foot opening is long, narrow, and nearly parallel sided. The foot is long and slender; it has four joints, the posterior being nearly as long as the three anterior joints. The toes are straight, excessively long, and taper gradually to acute points.

Total length, 128 μ; length of lorica, 86 μ, width, 54 μ; depth, 39 μ; width of anterior sinus, 29 μ, depth, 18 μ; length of foot opening, 25 μ, width, 15 μ; length of foot, 39 μ, of last joint, 15 μ; length of toes, 27 μ.

Type.—Cat. No. 16586, U.S.N.M., from Kenilworth, District of Columbia, where the species occurs in weedy ponds, not very common. Isthmian specimens are from a stagnant pool at Empire (4), few; Rio Trinidad, at Escoval (11), few.

LEPADELLA CYRTOPUS, new species.

Plate 16, figs. 6–8.

The body is broadly oval and evenly rounded dorsally; the ventral plate has near each lateral edge a very shallow longitudinal depression. The anterior dorsal margin is nearly straight; the ventral plate has a very deep, evenly rounded anterior sinus. The foot opening is short, very broad, and widest posteriorly. The moderately long foot has four joints; the first, second, and fourth are nearly equal in length and the third joint equals the combined length of the first and second. The moderately long toes are asymmetric; the right toe tapers rapidly for half its length and ends in a very slender, acute point; the left toe tapers gradually to the point and is strongly decurved. The last joint of the foot is twisted, so that the curved left toe is almost directly under the right.

Total length, 98 μ; length of lorica, 70 μ, width, 56 μ, depth, 29 μ; width of anterior sinus, 24 μ, depth, 19 μ; length of foot opening, 17 μ, posterior width, 15 μ; length of foot, 32 μ, of third joint, 11 μ; length of right toe, 16 μ.

Type.—Cat. No. 16585, U.S.N.M., from a creek flowing into Camacho Reservoir (3), where the species is common. It also occurs in a pool near the railroad, between Black Swamp and Gatun (2), few; stagnant pool at Empire (4), few; Rio Grande Reservoir (5), common; Rio Grande (6), few.

COLURELLA BICUSPIDATA (Ehrenberg).

In a creek flowing into Camacho Reservoir (3), few; Rio Grande Reservoir (5), few.

COLURELLA UNCINATA (Müller).

In a creek flowing into Camacho Reservoir (3), common; stagnant pool at Empire (4), few; Rio Grande Reservoir (5), few; Rio Grande (6), few.

SQUATINELLA MUTICA (Ehrenberg).

Stephanops muticus Ehrenberg, Abh. Akad. Wiss., Berlin (for 1831), 1832, p. 138.

A single specimen from a creek flowing into Camacho Reservoir (3).

TRICHOTRIA TETRACTIS (Ehrenberg).

Dinocharis tetractis Ehrenberg, Abh. Akad. Wiss., Berlin, 1830, p. 47.

In a pool near the railroad, between Black Swamp and Gatun (2), rare; Rio Trinidad, above Agua Clara (10), few.

MACROCHAETUS COLLINSII (Gosse).

Dinocharis collinsii Gosse, Int. Obs., vol. 10, 1867, p. 269, fig.

In a pool near the railroad, between Black Swamp and Gatun (2), few; creek flowing into Camacho Reservoir (3), few; Rio Cocoli, above lake, rare; stagnant pool at Empire (4), common; Rio Grande (6), rare.

SCARIDIUM EUDACTYLOTUM Gosse.

A single specimen from a pond east of Canal at Empire (8).

SCARIDIUM LONGICAUDUM (Müller).

In a creek flowing into Camacho Reservoir (3), few; stagnant pool at Empire (4), few; Rio Trinidad, above Agua Clara (10), few.

TRICHOCERCA BICRISTATA (Gosse).

Rattulus bicristatus Jennings, Bull. U. S. Fish Comm., vol. 22, 1903, p. 330, pl. 9, figs. 77–80.

From a pond east of canal at Empire (8), rare; Rio Trinidad, at Escoval (11), few.

TRICHOCERCA PUSILLA (Jennings).

Rattulus pusillus Jennings, Bull. U. S. Fish Comm., vol. 22, 1903, p. 339, pl. 9, figs. 81–85.

From a stagnant pool at Empire (4), few; Rio Grande Reservoir (5), few; pond at Miraflores, back water of Rio Camitillo (12), few.

TRICHOCERCA NITIDA, new species.

Plate 17, fig. 2.

The body is moderately long, straight on the ventral side and gibbous dorsally. The head sheath is set off from the body by a faint constriction; it has a number of obscure longitudinal folds. The anterior margin is sinuate and without any teeth or spines. The striated area is a little less than one-third the length of the body. The posterior opening of the lorica is large and the bulbous foot projects some distance through it. The toe is half the length of the body, slightly recurved at the base and straight posteriorly; it is accompanied by two minute substyles. The dorsal antenna is on the striated area, opposite the constriction separating the head sheath from the body; the left lateral antenna is on the posterior third of the body; the right antenna has not been observed.

Total length, 182 μ; length of body, 122 μ, depth, 45 μ; length of toe, 60 μ.

Type.—Cat. No. 16587, U.S.N.M., is from a pond at Bohio (7); the species also occurs in a stagnant pool at Empire (4) and Rio Trinidad, at Escoval (11); only a few specimens were found in each of the collections mentioned.

This species has some resemblance to *Trichocerca pusilla* (Jennings); the body is, however, much more slender.

TRICHOCERCA RATTUS (Müller).

Rattulus rattus JENNINGS, Bull. U. S. Fish Comm., vol. 22, 1903, p. 333, pl. 11, figs. 100, 101.

From Rio Grande Reservoir (5), rare; Rio Trinidad, at Escoval (11), few; pond north of fill work at Miraflores, back water of Rio Camitillo (12), rare.

DIURELLA BRACHYURA (Gosse).

In a creek flowing into Camacho Reservoir (3), few; pond west of Rio Chagres, at Bohio (7), rare; Rio Trinidad, at Escoval (11), few.

DIURELLA WEBERI Jennings.

In a creek flowing into Camacho Reservoir (3), few; Rio Grande, (6), rare.

DIURELLA VOLUTA Murray.

Owing to an insufficiency of material, the measurements were not given by Murray in the original description. The length of the lorica is 135 μ; length of toes, from 36 to 42 μ; depth of body, 54 μ; width of body over keel, 54 μ; of body alone, 45 μ.

This species occurred in collections from Rio Grande Reservoir (5), not common.

DIURELLA STYLATA Eyferth.

From Rio Grande Reservoir (5), few; Carabali (Gorgona) Reservoir, common; Rio Trinidad, at Escoval (11), few; pond at Miraflores, back water of Rio Camitillo (12), few.

DIURELLA TIGRIS (Müller).

From a creek flowing into Camacho Reservoir (3), common; Rio Grande Reservoir (5), few; Rio Grande (6), few; pond east of canal at Empire (8), rare.

DIURELLA TENUIOR (Gosse).

From Rio Trinidad, at Escoval (11), few.

DIURELLA DIXON-NUTTALLI Jennings.

From a pond at Miraflores, back water of Rio Camitillo (12), few.

POLYARTHRA TRIGLA Ehrenberg.

Polyarthra platyptera EHRENBERG, Infusionsth., 1838, p. 441, pl. 54, fig. 3.

In Gatun Reservoir, few; Camacho Reservoir, few; Rio Grande Reservoir (5), common; Carabali (Gorgona) Reservoir, few; Rio Trinidad, at Escoval (11), few; pond at Miraflores, back water of Rio Camitillo (12), common.

ASPLANCHNA BRIGHTWELLII Gosse.

Isthmian specimens from both localities have trophi of a pronounced *amphora* type,[1] with a strongly developed inner tooth on the rami. It is improbable that this is of any special significance; in a pond at Fourmile Run, near Washington, where this species is abundant, all the material collected in 1913 had the *amphora* type of trophi, while this year the normal *brightwellii* type, without the inner tooth, is the only one found. It should be explained that the character of this pond has changed; last year it was without any fixed vegetation and the fauna practically limnetic in its composition. This year there is an abundance of vegetation, mainly *Potamogeton crispum*, which in places forms large tangled masses, and the fauna is now a characteristic stagnant-pond fauna.

This species occurred in a stagnant stream under the old bridge, Old Panama, probably Rio Alcorobo, common; Gatun Lake, abundant.

TESTUDINELLA INCISA (Ternetz).

Pterodina incisa TERNETZ, Rot. Umg. Basels, 1892, pp. 20, 41, pl. 3, figs. 19, 20.

In creek flowing into Camacho Reservoir (3), few; Rio Trinidad, above Agua Clara (10), rare.

? TESTUDINELLA TRILOBATA (Anderson and Shephard).

Pterodina trilobata ANDERSON and SHEPHARD, Proc. Royal Soc. Victoria, vol. 4, 1892, p. 79, pl. 12, fig. 7.

Among material collected from the railroad bridge over Black Swamp (1) a single specimen of a very large *Testudinella* occurred. It corresponds closely with the figure in Kirkman's paper [2] with one exception, the median lobe of the anterior dorsal margin is produced as a long, slender spine. The length of the lorica, measured from

[1] Compare Powers, A case of polymorphism in Asplanchna simulating a mutation. Amer. Nat., New York, vol. 46, 1912, pp. 441–462, 526–552.

[2] Kirkman, Th., List of some of the Rotifera of Natal. Journ. Royal Micr. Soc., 1901, pp. 229–241, pl. 6.

the rounded lateral lobes, is 300μ, width, 275μ; length of spine, 40μ. *T. mucronata* (Gosse) has an anterior spine, but in specimens of this species from Mexico City it is broad at the base and without the lateral lobes of *T. trilobata*. Mexican specimens measure 150 μ (Gosse and Weber give the size as 140 μ), which would hardly appear compatible with the specific identity of the two forms. Whether Kirkman's specimens really belong to *T. trilobata* is a matter of some doubt. It is not evident from the original description that *T. trilobata* differs materially from *T. intermedia* Anderson and both are probably synonymous with *T. patina* (Hermann). The peculiar structure of the ovary described by Rousselet in a note to Kirkman's paper is not mentioned by Anderson and Shephard; it is even more pronounced in the Black Swamp specimen, the left half of the ovary having three distinct branches. This species occurs also in collections made by Dr. Chancey Juday, of the University of Wisconsin, at Los Amates, Guatemala. Daday found it in Paraguay, describing it as *Pterodina mucronata* Gosse;[1] he notes the resemblance in the structure of the ovary to Kirkman's animal.

TESTUDINELLA PATINA (Hermann).

Pterodina patina EHRENBERG, Abh. Akad. Wiss. Berlin, 1830, p. 48.

In a collection from the railroad bridge over Black Swamp (1), rare; creek flowing into Camacho Reservoir (3), rare; stagnant pool at Empire (4), few.

PEDALIA MIRA (Hudson).

Pedalion mira HUDSON, Monthly Micr. Journ., vol. 6, 1871, p. 121, pl. 94, figs. 1–4.

Abundant in Gatun Lake; Rio Grande Reservoir (5), rare; Carabali (Gorgona) Reservoir, rare; pond at Miraflores, back water of Rio Camitillo (12), common.

FILINIA LONGISETA (Ehrenberg).

Triarthra longiseta EHRENBERG, Abh. Akad. Wiss. Berlin (for 1833), 1834, p. 222, pl. 8, fig. 1.

In Gatun Lake, few; back water of Rio Chagres at Las Bocas del Gatun, few; bayou of French Canal about 2 miles south of Gatun, few.

FLOSCULARIA RINGENS (Linnaeus).

Melicerta ringens SCHRANK, Fauna Boica, vol. 3, pt. 2, 1803, p. 310.

From Rio Trinidad, above Agua Clara (10), few.

LIMNIAS CERATOPHYLLI Schrank.

Among weeds in Rio Trinidad, at Escoval (11), few.

[1] Daday, E. von, Süsswasser-Mikrofauna Paraguays, 1905, p. 116, pl. 6, fig. 20.

PTYGURA LONGIPES (Wills).

Oecistes umbella HUDSON, Journ. Royal Micr. Soc., 1879, p. 1, pl. 1.

From Rio Trinidad, above Agua Clara (10), few.

PTYGURA PECTINIFER (Murray).

Oecistes pectinifer MURRAY, Journ. Royal Micr. Soc., 1913, p. 241, pl. 10, fig.14.

A single fully extended and numerous partially or completely contracted specimens from Rio Trinidad, above Agua Clara (10).

SINANTHERINA SPINOSA (Thorpe).

Megalotrocha spinosa THORPE, Journ. Royal Micr. Soc., 1893, p. 151, pl. 3, fig. 6.

From a stagnant pool by the railroad, north of bridge over Black Swamp, rare; pool near railroad, between Black Swamp and Gatun (2), few.

CONOCHILUS HIPPOCREPIS (Schrank).

Conochilus volvox EHRENBERG, Abh. Akad. Wiss. Berlin (for 1833), 1834, p. 224.

In a collection from railroad bridge over Black Swamp (1), few; pond west of Rio Chagres at Bohio (7), few.

COLLOTHECA POLYPHEMA, new species.

Plate 17, fig. 4.

The body is of moderate length and nearly cylindrical; it tapers gradually to the short foot and passes without noticeable constriction into the corona, which has five short, blunt lobes, the dorsal being a little longer than the others. The setae are confined to the tips of the lobes. At the base of the dorsal lobe is a large, rectangular eyespot, apparently formed by the fusion of the usual two, being twice as broad as it is long; occasionally a trace of a dividing line appears to exist. The internal organs are normal, with the exception of two round, thin, disklike glandular bodies at the base of the corona, not far apart and well toward the dorsal side. Their nature and functions are unknown; it is possible that they may be the subcerebral glands, but it should be noted that no trace of these has been found in any other species of the genus. Intra-vitam staining has not been tried. The jelly-case is, as usual in free-swimming Collothecidae, attached to the foot by a fairly long, hardened cement-thread, corresponding to the peduncle of the sessile forms. The resting egg is shown in the figure; the yolk-mass is covered with numerous, close-set conical projections, which are surrounded by the outer shell.

Total length, 240 μ.

Type.—Cat. No. 16588, U.S.N.M., from Kenilworth, District of Columbia, where the species is at times abundant. It has been found also in ponds at Lakeland, Maryland, and at Fourmile Run, Virginia. It was found in Isthmian collections, narcotized according to the de Beauchamp method, from a pond at Bohio (7), common; Rio

Grande Reservoir (5), common. The description and notes are based on local material.

This species forms a strange connecting link between the sessile and the previously described free-swimming species of the genus, which all have vibratile cilia on the corona, while this has rigid setae like the sessile forms. Its mode of locomotion is as surprising as it is unique. When the animal is fully extended, as in the figure, and a change of location is decided upon, the corona is spread out as far as possible, and, using it as a "floating anchor," the foot is contracted with a sudden jerk; the corona is then rapidly folded and shot forward by extending the foot to its utmost limits, the jelly-case now acting as anchor. The corona is then unfolded and the same laborious cycle repeated again and again, until the point of destination is reached.

It is evident that this species is much more closely related to the sessile than to the free-swimming forms and it also appears to unite these two sections of the genus into an inseparable whole.

ROTARIA NEPTUNIA (Ehrenberg).

Actinurus neptunius Ehernberg, Abh. Akad. Wiss. Berlin (for 1831), 1832, p. 145, pl. 4, fig. 23.

From a sluggish stream in savannas between Panama and Old Panama, few; pond at Miraflores, back water of Rio Camitillo (12), rare.

Contracted Bdelloids occurred in nearly all the collections; only those species are listed, which may be recognized by some structural peculiarity even in the contracted state.

ROTARIA MACRURA (Ehrenberg).

Rotifer macrurus Ehrenberg, Abh. Akad. Wiss. Berlin (for 1831), 1832, p. 145, pl. 4, fig. 22.

Among algae on the rocks in a stream flowing into Gatun Reservoir, common.

DISSOTROCHA MACROSTYLA (Ehrenberg).

Philodina macrostyla Ehrenberg, Infusionsth., 1838, p. 500, pl. 61, fig. 7.

In a pool near the railroad, between Black Swamp and Gatun (2), few; stagnant pool at Empire (4), few.

NOTES ON DISTRIBUTION.

To facilitate comparison and especially on account of its bearing on the origin of the as yet unrecorded rotatorian fauna of Gatun Lake in its present extent, the following list of the collections from the more important localities, arranged with reference to the Continental Divide, will be of interest.

ATLANTIC WATERSHED.

From the Railroad Bridge over Black Swamp (1).

Notommata copeus.
Brachionus mirabilis.
Platyias quadricornis.
Mytilina trigona.
Euchlanis triquetra (?).
Dipleuchlanis propatula.
Lecane curvicornis.
Lecane leontina.
Testudinella trilobata (?).
Testudinella patina.
Conochilus hippocrepis.

Pool near the Railroad, between Black Swamp and Gatun (2).

Notommata pseudocerberus.
Pleurotrocha sordida.
Monommata orbis.
Dicranophorus forcipatus.
Platyias quadricornis.
Mytilina ventralis.
Euchlanis dilatata.
Euchlanis plicata.
Lecane aeganea.
Lecane arcula.
Lecane compta.
Lecane crepida.
Lecane doryssa.
Lecane ercodes.
Lecane hornemanni.
Lecane leontina.
Lecane luna.
Lecane nana.
Lecane ploenensis.
Lecane ungulata.
Monostyla bulla.
Monostyla closterocerca.
Monostyla cornuta.
Monostyla decipiens.
Monostyla furcata.
Monostyla pyriformis.
Monostyla rugosa.
Monostyla virga.
Lepadella cyrtopus.
Trichotria tetratis.
Macrochaetus collinsii.
Sinantherina spinosa.
Dissotrocha macrostyla.

Gatun Lake.

Brachionus angularis caudatus.
Brachionus capsuliflorus (*bakeri*).
Brachionus falcatus.
Brachionus patulus macracanthus.
Keratella stipitata.
Monostyla bulla.
Polyarthra trigla.
Pedalia mira.
Filinia longiseta.
Asplanchna brightwellii.

Rio Trinidad, about 1 mile from mouth (9).

Dicranophorus forcipatus.
Lecane arcula.
Lecane ploenensis.
Monostyla cornuta.
Monostyla furcata.
Monostyla pyriformis.

Río Trinidad, above Agua Clara (10).

Notommata pseudocerberus.
Diaschiza forficata.
Diaschiza auriculata.
Mytilina ventralis.
Lecane arcula.
Lecane compta.
Lecane hornemanni.
Monostyla bulla.
Monostyla closterocerca.
Monostyla cornuta.
Monostyla furcata.
Monostyla hamata.
Monostyla obtusa.
Monostyla pyriformis.
Monostyla quadridentata.
Monostyla rugosa.
Monostyla virga.
Lepadella solidus.
Trichotria tetractis.
Scaridium longicaudum.
Testudinella incisa.
Floscularia ringens.
Ptygura longipes.
Ptygura pectinifer.

Rio Trinidad, at Escoval (11).

Diaschiza forficata.
Monommata longiseta.
Euchlanis dilatata.
Euchlanis oropha.
Lecane amorpha.
Lecane arcula.
Lecane ludwigii.
Lecane papuana.
Monostyla closterocerca.
Monostyla cornuta.
Monostyla decipiens.
Monostyla hamata.
Monostyla virga.
Lepadella imbricata.
Lepadella patella.
Trichocerca bicristata.
Trichocerca nitida.
Diurella brachyura.
Diurella stylata.
Diurella tenuior.
Polyarthra trigla.
Limnias ceratophylli.

Creek flowing into Camacho Reservoir (3).

Notommata cerberus.
Diaschiza forficata.
Diaschiza gibba.
Diaschiza gracilis.
Monommata orbis.
Dicranophorus forcipatus.
Brachionus patulus macracanthus.
Keratella quadrata.
Keratella stipitata.
Euchlanis oropha.
Dipleuchlanis propatula.
Lecane arcula.
Lecane crepida.
Lecane flexilis.
Lecane hornemanni.
Lecane leontina.
Lecane ludwigii.
Lecane luna.
Lecane ploenensis.
Lecane tenuiseta.
Monostyla bifurca.
Monostyla bulla.
Monostyla closterocerca.
Monostyla cornuta.
Monostyla decipiens.
Monostyla furcata.
Monostyla hamata.
Monostyla lunaris.
Monostyla pyriformis.
Lepadella cyrtopus.
Lepadella solidus.
Colurella bicuspidata.
Colurella uncinata.
Squatinella mutica.
Macrochaetus collinsii.
Scaridium longicaudum.
Diurella brachyura.
Diurella tigris.
Diurella weberi.
Testudinella incisa.
Testudinella patina.

Carabali (Gorgona) Reservoir).

Brachionus angularis caudatus.
Brachionus budapestinensis.
Anuraeopsis fissa.
Diurella stylata.
Polyarthra trigla.
Pedalia mira.

Pond west of Rio Chagres at Bohio (7).

Brachionus dolabratus.
Brachionus angularis caudatus.
Brachionus patulus macracanthus.
Keratella stipitata.
Notholca longispina.
Monostyla virga.
Trichocerca nitida.
Diurella brachyura.
Conochilus hippocrepis.
Collotheca polyphema.

Pond east of canal at Empire (8).

Lecane leontina.
Lecane ludwigii.
Lecane ploenensis.
Monostyla bulla.
Monostyla cornuta.
Monostyla virga.
Scaridium eudactylotum.
Trichocerca bicristata.
Diurella tigris.

STAGNANT POOL AT THE END OF CANAL CUT, EMPIRE (4).

Dicranophorus forcipatus.
Encentrum felis.
Brachionus patulus.
Brachionus patulus macracanthus.
Keratella stipitata.
Mytilina trigona.
Euchlanis dilatata.
Euchlanis plicata.
Dipleuchlanis propatula.
Lecane arcula.
Lecane compta.
Lecane crepida.
Lecane curvicornis.
Lecane flexilis.
Lecane leontina.
Lecane luna.
Lecane marshi.
Lecane papuana.
Lecane ploenensis.
Lecane pusilla.
Lecane sibina.
Monostyla bulla.
Monostyla cornuta.
Monostyla furcata.
Monostyla hamata.
Monostyla obtusa.
Monostyla pyriformis.
Monostyla quadridentata.
Lepadella cyrtopus.
Lepadella imbricata.
Colurella uncinata.
Macrochaetus collinsii.
Scaridium longicaudum.
Trichocerca pusilla.
Testudinella patina.
Dissotrocha macrostyla.

PACIFIC WATERSHED.

POND AT MIRAFLORES; BACK WATER OF RIO CAMITILLO (12).

Notommata aurita.
Brachionus angularis caudatus.
Brachionus capsuliflorus (bakeri).
Brachionus patulus macracanthus.
Platyias quadricornis.
Keratella stipitata.
Euchlanis dilatata.
Dipleuchlanis propatula.
Lecane papuana.
Trichocerca pusilla.
Trichocerca rattus.
Diurella dixon-nuttalli.
Diurella stylata.
Polyarthra trigla.
Pedalia mira.
Rotaria neptunia.

RIO GRANDE, RIVER (6).

Dicranophorus forcipatus.
Brachionus capsuliflorus (bakeri).
Brachionus patulus macracanthus.
Keratella stipitata.
Mytilina ventralis.
Euchlanis dilatata.
Dipleuchlanis propatula.
Lecane arcula.
Lecane crepida.
Lecane curvicornis.
Lecane hornemanni.
Lecane papuana.
Lecane pusilla.
Monostyla bulla.
Monostyla cornuta.
Monostyla furcata.
Monostyla pyriformis.
Monostyla rugosa.
Lepadella cyrtopus.
Lepadella triptera.
Colurella uncinata.
Macrochaetus collinsii.
Diurella tigris.
Diurella weberi.

RIO GRANDE RESERVOIR, NEAR RAILROAD BRIDGE (5).

Dicranophorus forcipatus.
Brachionus capsuliflorus (bakeri).
Keratella stipitata.
Anuraeopsis fissa.
Mytilina ventralis.
Euchlanis plicata.
Dipleuchlanis propatula.
Lecane arcula.
Lecane crepida.
Lecane curvicornis.

Lecane elegans.
Lecane hornemanni.
Lecane papuana.
Monostyla bulla.
Monostyla closterocerca.
Monostyla cornuta.
Monostyla decipiens.
Monostyla hamata.
Monostyla lunaris.
Monostyla obtusa.
Monostyla pyriformis.
Monostyla quadridentata.
Monostyla rugosa.
Monostyla virga.
Lepadella cyrtopus.
Lepadella triptera.
Colurella bicuspidata.
Colurella uncinata.
Trichocerca pusilla.
Trichocerca rattus.
Diurella stylata.
Diurella tigris.
Diurella voluta.
Polyarthra trigla.
Pedalia mira.
Collotheca polyphema.

Of the 109 species and distinct varieties recorded, 46 are common to the Atlantic and Pacific slopes, 55 occur only on the Atlantic, and 8 only on the Pacific slope. This group of 63 species includes but 20 occurring in sufficient numbers to be termed common—16 Atlantic and 4 Pacific species. It is questionable whether these figures demonstrate anything beyond the already known lack of suitable environments on the Pacific slope.

The closely related genera *Lecane* and *Monostyla* exhibit some interesting anomalies of distribution. Of the 13 species of *Monostyla*, 12 are common to the Atlantic and Pacific slopes; *Lecane* is represented by 22 species, only 7 of which occur in both watersheds.

Four species of these two genera, *Lecane amorpha*, *L. flexilis*, *L. tenuiseta*, and *Monostyla bifurca*, to which may be added a fifth, *Monostyla* (=*Diarthra*) *monostyla*, found by Daday in Paraguay, occur on the Isthmus in ponds, while here at Washington they are found only in Sphagnum. This change of habitat is without any obvious explanation; the reverse would have been more intelligible. If only one species had been involved it might have been passed over, but when the same peculiar environmental relation is found to apply to five species, there must be some definite cause for it, whatever that may be.

The fauna of Gatun Lake at the time the collections were made was practically a normal pond fauna, as demonstrated by comparison with similar localities on the Isthmus. Rio Trinidad, in the region represented, was virtually stagnant. It is surprising to find so few species common to these two connected bodies of water. The lake fauna would be expected to be transplanted from Rio Trinidad; evidently this did not occur, and its origin must have been in the small ponds which existed in the territory before the construction of the lake and were gradually engulfed.

If the Isthmian list is compared with Murray's of the collections made by him in Chile, Argentina, and Brazil, a sufficiently close agreement will be found to warrant the conclusion that the rotatorian fauna of the Isthmus is South American. This is merely corroborative of the reports on other groups, which have established the agreement of the Isthmian fauna in general with that of South America.

The two lists record a total of 138 species, of which 35 are limited to South and Central America. As both lists are fragmentary by reason of the nearly complete absence of the illoricate species, a more accurate judgment may be arrived at by a study of the genera *Lecane* and *Monostyla*, in which all the species are recognizable, even when contracted. A total of 43 species belonging to these two genera occur in the combined lists, 21 of which are not known outside of the South American faunal region and 26 species are known only from the American continent. Naturally both Murray's and this list have their quota of rare species, but many of the exclusively South American species are abundant, such as *Lecane arcula, L. compta, L. crepida, L. curvicornis, L. nana, L. pusilla, Monostyla decipiens, M. furcata, M. pyriformis, M. rugosa*, and *M. virga*. No doubt some of these will eventually be found elsewhere, but on the other hand it is at least equally probable that many more undescribed species exist in South America, in view of the limited territory represented by the collections, and the conclusion that it is entirely proper to speak of a distinctly South American rotatorian fauna seems therefore irresistible.

The localization of so many species of Rotatoria should go far to disprove the importance of birds as agents of dissemination. No one will of course deny that birds do influence distribution to some extent, but it is extremely doubtful whether it amounts to more than equalizing the fauna of circumscribed localities. That any long-distance transmission takes place is a purely gratuitous assumption; it is rendered highly improbable, if not actually disproved, by the diversity of the rotatorian faunas of North and South America. It is well known that our migratory birds winter on the shores of the Caribbean and countless millions make the trip every year, so that the rotatorian fauna of America from the Equator to the Arctic Circle should be sensibly uniform, if birds were even accidental carriers. The indicated great diversity of the North and South American faunas flatly contradicts this.

While it has been frequently claimed that the Rotatoria are distributed all over the world with something approaching monotonous uniformity, the evidence upon which this assertion is based appears entirely too fragmentary to draw any such far-reaching conclusions from. And it would be necessary to bring forward irrefutable evidence, as a uniform, cosmopolitan distribution is unknown in any other subdivision of the animal world. It seems particularly out of place in the case of the Rotatoria, as it is in direct opposition to the better known facts of the distribution of the Entomostraca, which as far as we know ought to be sensibly parallel, at least the adaptation to and means for distribution are identical in both cases. It has long ago been demonstrated that some Entomostraca are cosmopolitan, while many are more or less localized, and there is every reason to believe that the same holds good for the Rotatoria. A majority of the species are, upon the basis of our present knowledge, limited to particular localities. That this localization may be in some cases only apparent is obvious; there is no doubt that many animals now considered rare will eventually be shown to have a wide distribution. But it should be evident that, if we begin by assuming universal distribution, it is unlikely that anything will be discovered to disprove it, not only because it is not searched for, but also on account of no attempt being made to correlate the acquired evidence.

That many species of Rotatoria undoubtedly do enjoy a world-wide distribution is certain. This is not surprising, considering the great age of this group, which, even if not demonstrated by paleontological evidence, may reasonably be inferred from the well known fact that the origin of Arthropods dates back to the unrecorded interval between the Archaean and Paleozoic eras; that all the major divisions of the lower Invertebrates originated long before the appearance of the Arthropods is now universally accepted, and on this basis it is not difficult to account for the extensive distribution of many species of Rotatoria. In this connection it may not be out of place to call attention to the fact that the earliest known bird, *Archaeopteryx*, is of Jurassic age, so that if the Rotatoria had been dependent on distribution by birds, they would have become extinct ages before dispersal could have occurred. It is also quite possible that bird migrations may be of comparatively recent origin.

For the reasons given, it would seem that the universal distribution theory is at least unsafe as a working hypothesis, if not actually harmful. A careful study of the rotatorian fauna of any locality whatever is still worth while, until we have far more complete records than we now possess. Systematic work, including faunal lists, may not be the most satisfying to the investigator, but both are the foundation upon which the whole structure must be erected.

One of the consequent drawbacks of the universal distribution theory is that many forms without doubt remain unrecorded, if showing a certain resemblance to some known species. As partly responsible for this one may also consider the imprecations so often hurled at the head of the unfortunate who happens to give a new name to an old species, surely a minor offense, provided the description and figure are both good. It is very much easier to relegate a name to synonymy than to sift out a number of species traveling under the same name, and if merely listed without description and figure it is obviously impossible to determine the identity of the animal which the observer had before him.

The crying need of rotatorian taxonomy is at present exact and full descriptions of all the known species. Too much stress can not be laid upon complete descriptions. It is not sufficient to differentiate the species from all others known to-day. It is quite evident that we know as yet only a small fraction of the total number of species of Rotatoria extant, consequently a description (and figure) should record all that can be ascertained in order to enable the future discoverer of a closely related animal to decide whether his specimen belongs to an old species or is really an undescribed form. This should not be construed as disparaging comparisons with known species. These are very useful, but should be only accessory. Our main dependence must be a detailed and full description. By description is to be understood not merely the word picture, but also the figure, which in the absence of a fixed terminology is absolutely necessary. It is indeed doubtful whether combinations of words will ever be sufficient to differentiate Rotatoria without being supplemented by an illustration.

EXPLANATION OF PLATES.

All figures are highly magnified. For actual measurements see text.

PLATE 16.

Fig. 1. *Brachionus dolabratus*, ventral view; page 529.
2. *Brachionus dolabratus*, lateral view.
3. *Lepadella imbricata*, ventral view; page 549.
4. *Lepadella imbricata*, lateral view.
5. *Lepadella imbricata*, cross section of body.
6. *Lepadella cyrtopus*, ventral view; page 550.
7. *Lepadella cyrtopus*, lateral view.
8. *Lepadella cyrtopus*, cross section of body.

PLATE 17.

Fig. 1. *Brachionus patulus macracanthus*, dorsal view; page 530.
2. *Trichocerca nitida*, lateral view; page 551.
3. *Lecane curvicornis*, lateral view; page 535.
4. *Collotheca polyphema*, lateral view; page 555.

PLATE 18.

Fig. 1. *Lecane marshi*, ventral view; page 537.
2. *Lecane marshi*, lateral view.
3. *Lecane marshi*, dorsal view.
4. *Lecane ercodes*, ventral view; page 537.
5. *Lecane ercodes*, lateral view.
6. *Lecane ercodes*, dorsal view.

PLATE 19.

Fig. 1. *Lecane flexilis*, ventral view; page 538.
2. *Lecane flexilis*, lateral view.
3. *Lecane flexilis*, dorsal view.
4. *Lecane arcula*, ventral view; page 539.
5. *Lecane arcula*, lateral view.
6. *Lecane arcula*, dorsal view.

PLATE 20.

Fig. 1. *Lecane compta*, ventral view; page 540.
2. *Lecane compta*, lateral view.
3. *Lecane compta*, dorsal view.
4. *Lecane pusilla*, ventral view; page 541.
5. *Lecane pusilla*, lateral view.
6. *Lecane pusilla*, dorsal view.

PLATE 21.

Fig. 1. *Lecane aeganea*, ventral view; page 542.
2. *Lecane aeganea*, lateral view.
3. *Lecane aeganea*, dorsal view.
4. *Lecane doryssa*, ventral view; page 542.
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PLATE 22.

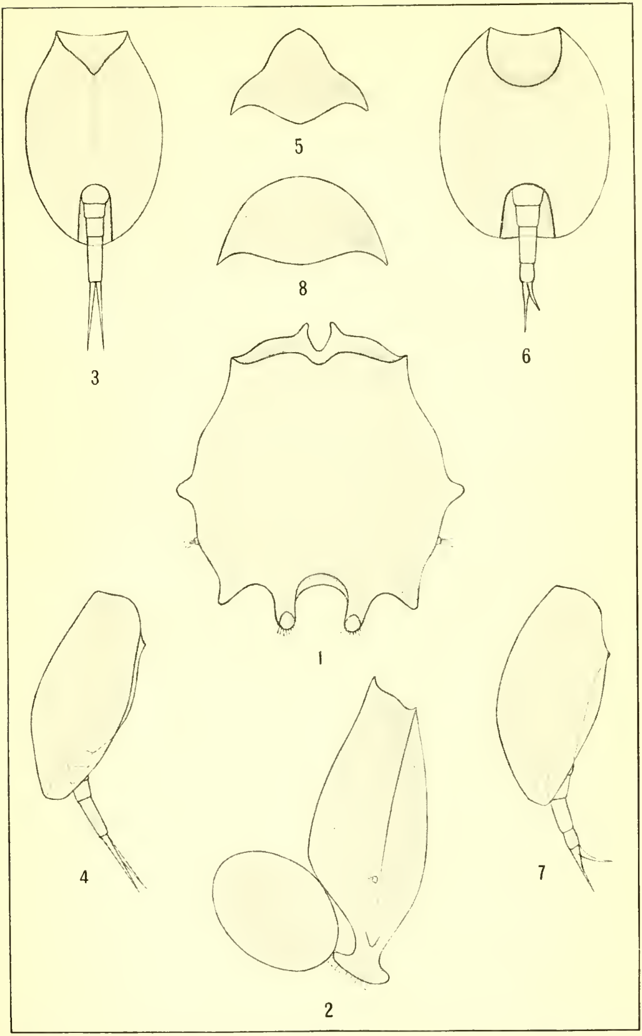
Fig. 1. *Lecane tenuiseta*, ventral view; page 543.
2. *Lecane tenuiseta*, lateral view.
3. *Lecane tenuiseta*, dorsal view.
4. *Lecane crepida*, ventral view; page 533.
5. *Lecane crepida*, lateral view.
6. *Lecane crepida*, dorsal view.
7. *Lecane crepida*, cross section of body.

PLATE 23.

Fig. 1. *Lecane amorpha*, ventral view; page 544.
2. *Lecane amorpha*, lateral view.
3. *Lecane elegans*, ventral view; page 544.
4. *Lecane elegans*, lateral view.
5. *Lecane sibina*, ventral view; page 535.
6. *Lecane sibina*, lateral view.
7. *Lecane sibina*, dorsal view.

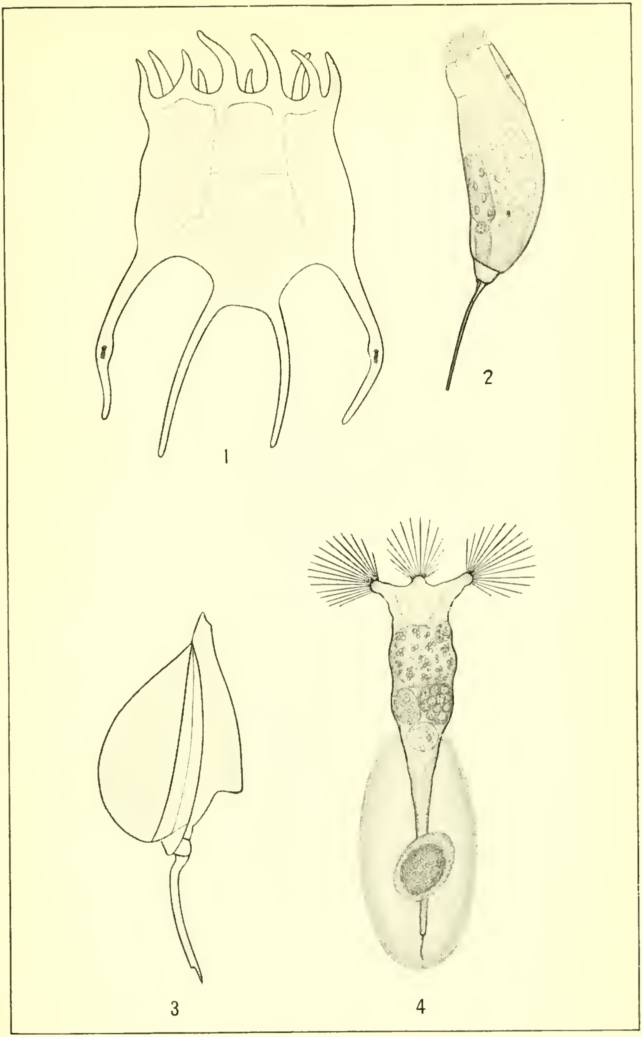
PLATE 24.

Fig. 1. *Monostyla virga*, ventral view; page 546.
2. *Monostyla virga*, lateral view.
3. *Monostyla virga*, dorsal view.
4. *Monostyla rugosa*, ventral view; page 548.
5. *Monostyla rugosa*, lateral view.
6. *Monostyla rugosa*, dorsal view.



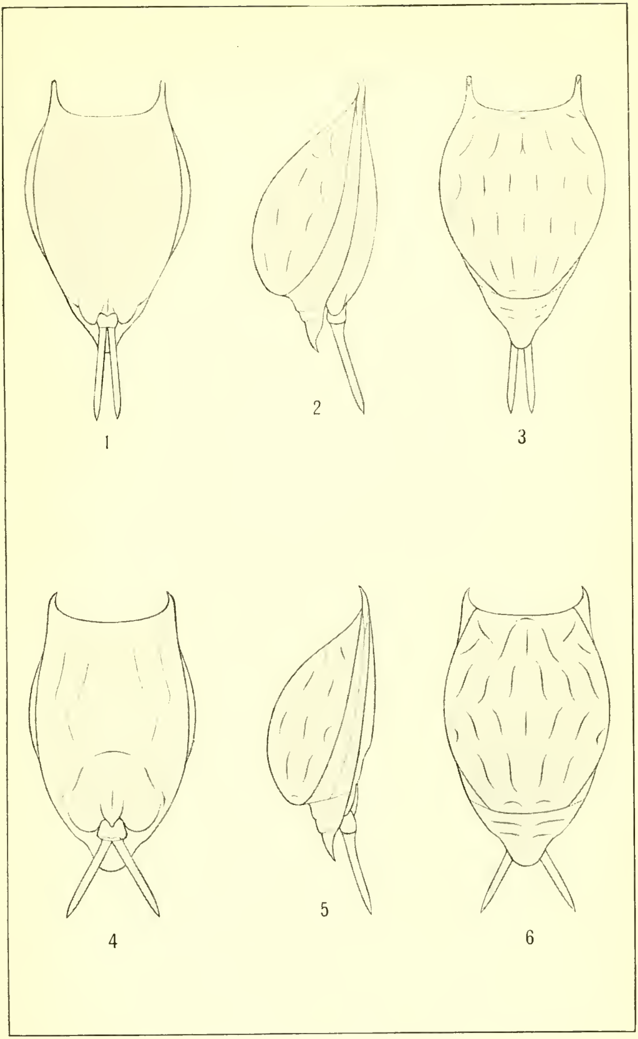
New Rotatoria from Panama.

For explanation of plate see page 563.



NEW ROTATORIA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 563.



NEW ROTATORIA FROM PANAMA.

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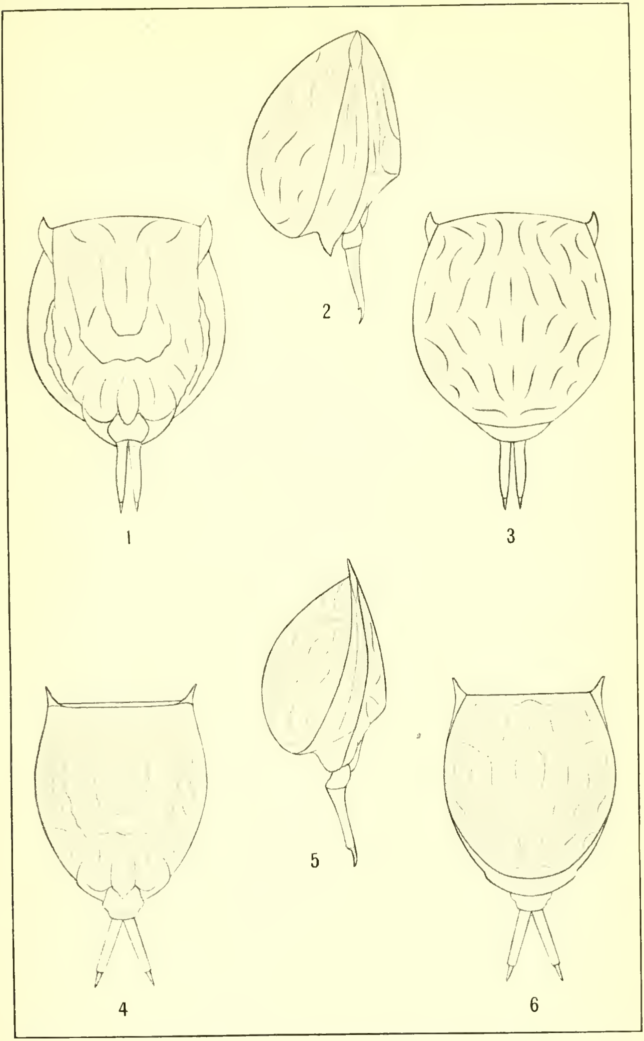
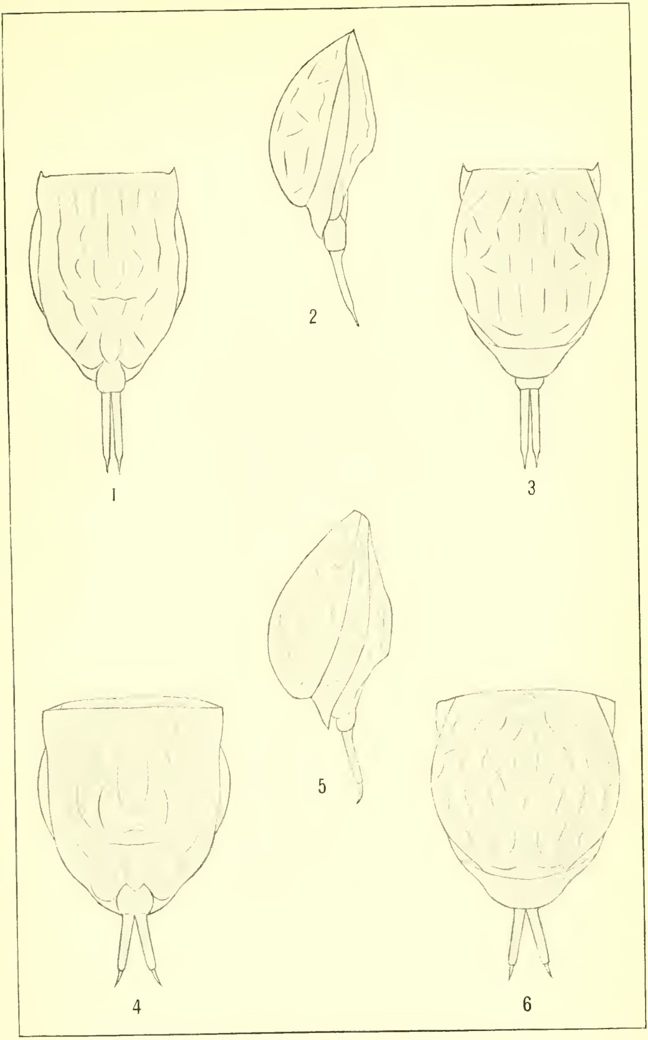


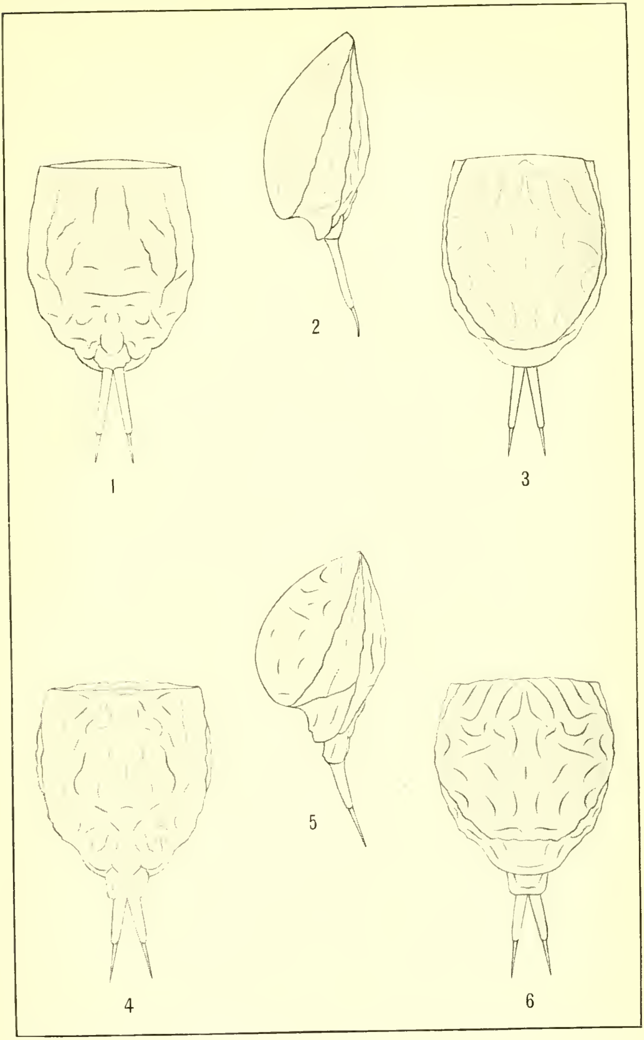
NEW ROTATORIA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 563.



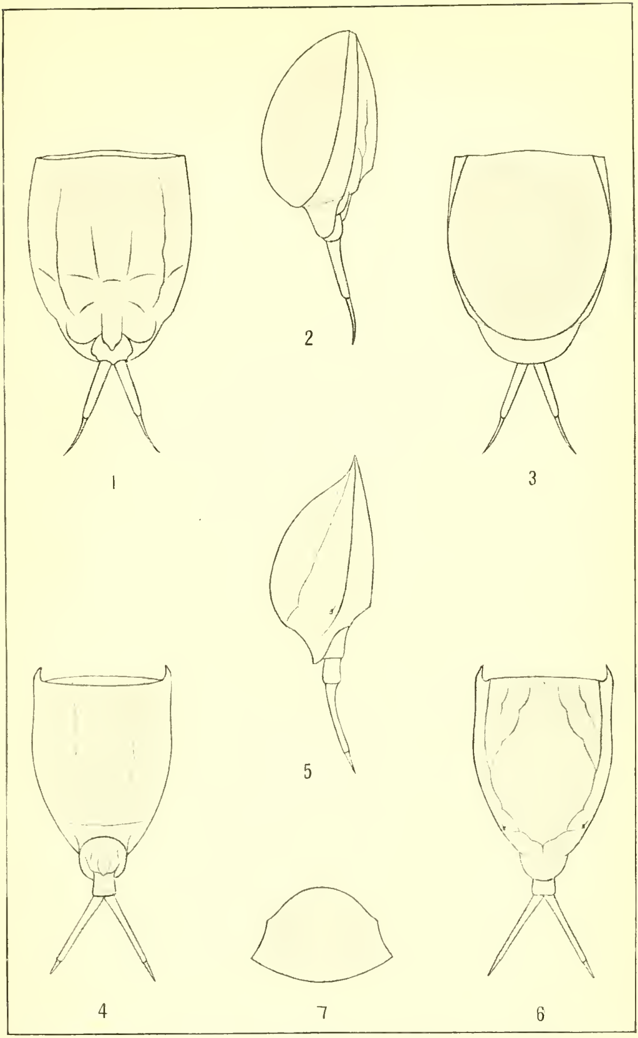
NEW ROTATORIA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 564.



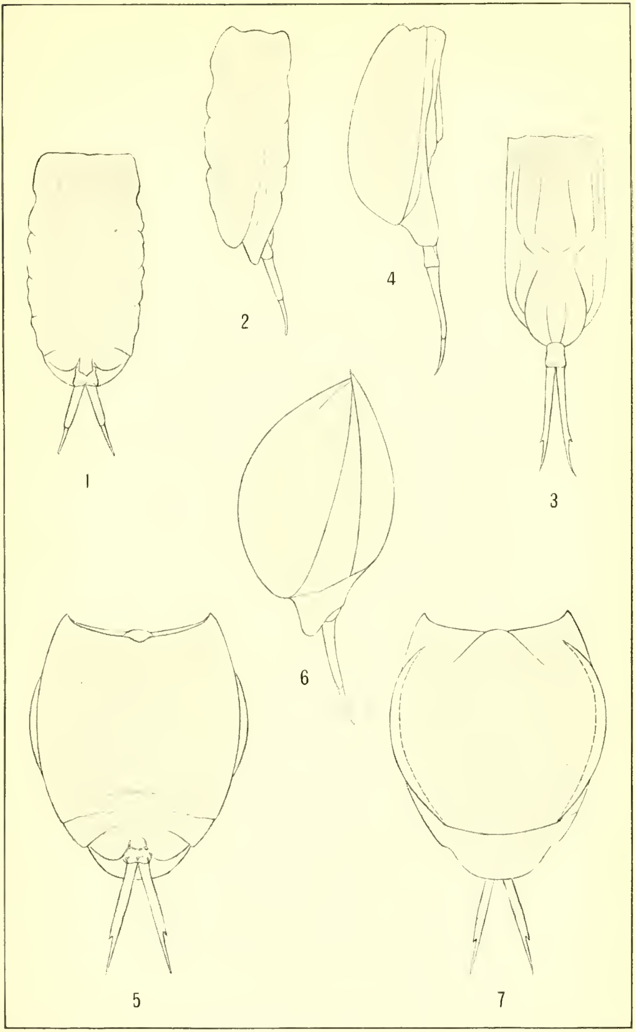
NEW ROTATORIA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 564.



NEW ROTATORIA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 564.



NEW ROTATORIA FROM PANAMA.

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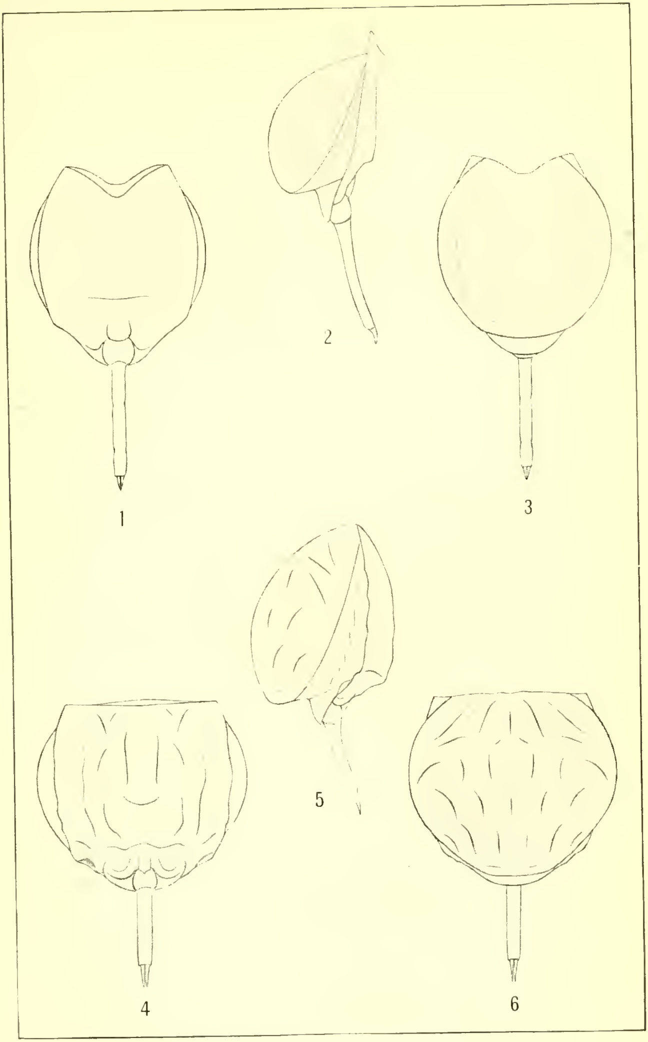

NEW ROTATORIA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 564.