



A List of Protozoa

Observed at Greeley, Colorado.

With

Notes upon their Habits and
Modes of Reproduction.

By

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A Thesis...

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Introduction.

The collection of material for the preparation of this list, was begun in June, 1897, and was finally suspended about April 1, 1898. During the summer vacation, numerous collections were made from all places in the vicinity of Greeley, Colorado, which appeared to be favorable "fishing-grounds" for Protozoa. From the beginning of the present school year to the first of April, 1898, collections were made at less frequent intervals. Infusions of various substances were kept in the laboratory and examined from time to time.

The classification adopted is that of Doctor O. Bütschli in "Bronn's Klassen und Ordnungen des Thier-Reichs", upon which I have relied for nearly all my determinations as far as genera. Other works, which have been of great value in the determination of species, are Pénard's "Études Sur les Rhizopodes D'Eau Douce", kindly loaned me by Prof. Gardiner; Leidy's "Fresh-Water Rhizopods of North America", and Pritchard's "History of Infusoria".

The list contains 89 species of Protozoa, distributed

as follows:

Rhizopoda	10	genera	17	species.
Heliozoa	5	"	5	"
Flagellata	17	"	17	"
Ciliata	33	"	49	"
Suctoria	1	"	1	"
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Total	66	"	89	"

Several species not included in this list were seen but were not sufficiently studied to be accurately classified.

This list is the first attempt at an enumeration of the Protozoan Fauna of any portion of Colorado, and it is for this reason, if for no other, very incomplete. Any conclusions based upon it must, therefore, be held subject to modification upon further and fuller investigation. In however much it may be lacking as an indication of the total number of Protozoan forms which go to make up the Fauna of the district examined, it may be taken as indicating, with some degree of accuracy, the comparative abundance or scarcity of certain of the larger groups of these organisms. A few of the more noticeable of these

may be worthy of mention.

Among the Rhizopods, lobose forms have been constantly encountered, and 14 species, belonging to 7 genera, are enumerated in the List. Filose Rhizopods have, on the contrary, been seen in but a few instances. Only three species of these are enumerated, and it is uncertain whether one of these was obtained in the vicinity of Greeley, or from a more distant source.

Of the Flagellates, the 17 enumerated species all belong to the common Monads. No Choanoflagellate nor Dinoflagellate has been found.

Among the Völvocina, Völvox globator is said to occur throughout Europe and in most parts of the United States, as well as in the East Indies. It is found on the Atlantic Slope and on the Pacific slope and throughout the Mississippi valley as far West as the 100th meridian. It occurs at the level of the sea and in the mountain lakes of Switzerland and Norway. I have never been able to find it in Colorado, and the Family Völvocina appears to be represented, in the vicinity of Greeley, by Pandorina morum alone. No cause for this peculiar distribution has been assigned. A better knowledge of the cli-

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matic conditions which govern the distribution of the Protozoa may, in the future, provide an adequate explanation.

An examination of the list will show that all the larger groups (Sub-classes of Bütschli) of Protozoa living in fresh waters, excepting the Choanoflagellates and the Dinoflagellates, are here represented.

In the preparation of this list, no attention has been given to the Sporozoa; and, although several species have been seen, none are included in the list, their habitat as intercellular parasites excluding them from the limits of this investigation.

A.E.B.

Greeley, Colo.,

May 1, 1898.

PHYLUM Protozoa.

Class Sarkodinia.

Sub-class Rhizopoda.

Order Rhizopoda.

Sub-order Amoebaea.

Family Amoebaea Lobosa.

Amoeba proteus Auct.

Common among algae and on the surface of the mud in pools and swamps. Found in January among the algae and diatoms in the Park horse-trough in Greeley. Increase by fission was observed in one instance.

Diam. $\frac{1}{16}$.050/.080mm.

Amoeba limax Duj.

Smaller; slug-like in form and movement. Never throws out finger-like pseudopodia, but moves by means of a pseudopodial extension as wide as any part of the body.

Length $\frac{1}{16}$.030-.040mm.

Hab. Same situations as *A. proteus*.

Dactylosphaera radiosa Ehrbg.

(Syn. Amoeba radiosa Ehrbg.; A. Spatula Pénard.)

This, in its free-swimming or floating state, consists of a more or less spherical "body" .010-.012mm. in diameter of granular endosarc surrounded by a layer of clear, hyaline ectosarc; from this spherical "body" radiate three to six or seven long, slender, tapering, hyaline pseudopods, straight or variously curved, and reaching a length equal to 5 or 6 times the diameter of the central "body". A contractile vesicle is usually present, and a small, round nucleus may sometimes be made out. In this state it appears to agree in every particular with Leidy's description of Amoeba radiosa Ehrbg.

In the same jar and frequently on the same slide with the foregoing was observed a small Amoeba of spatulate form and slow movement; the anterior end broadly rounded, thin and hyaline; posterior half, granular, and more or less filled with food-vacuoles; one, or sometimes two or three contractile vesicles, which fill and empty very slowly; nucleus small, round, rarely visible without reagents. This form was at first provisionally identified with Amoeba spatula Pénard.

By subsequent observations, it was repeatedly shown that these two forms are merely different states of the same organism. The spatulate form, when about to change to the radiant form, projects from its posterior, thickened part, one or two long, slender pseudopods and at the same time the broad, hyaline, anterior extension is gradually withdrawn; then several pseudopods are thrown out from what was the anterior end, the animal frees itself from the slide and floats away. In changing from the swimming to the creeping form, this process is reversed; the long, slender pseudopods are withdrawn, the animal flattens itself upon the slide and assumes the spatulate form.

Reproduction not observed.

Hab. Common in same situations as *A. proteus*; abundant in Park horse-trough during winter.

Plakopus (sp. a).

Resembles amoeba quite closely when at rest, but instead of the ordinary form of pseudopodia, a continuous, circular, hyaline border surrounds the flattened creeping surface; this border may be looked upon as a circle of completely fused pseudopodia. Occasionally individuals

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were seen in the act of retracting the pseudopodial ring, in which portions of the ring that were in contact with other matter (such as algae etc.), remained for a time in the form of broad, flat pseudopods.

Form hemispherical, with flat, expanded border around the base of the hemisphere. Plasma hyaline, containing a rather large, spherical, granular nucleus, 1, or rarely 2 or 3 contractile vacuoles, and a varying number of minute crystallites.

Movement slow, gliding rather than flowing.

Food consists of diatoms, with which some individuals were so completely filled that the internal structure was made out with difficulty.

Diam. .010-.030mm.

Hab. Park horse-trough in winter, abundant.

Sub-order Testacea M. Schultze.

Tribe Imperforata Carpenter.

Family Arcellina Ehrbg.

Arcella vulgaris Ehrbg.

Abundant except during the winter months. In many cases two tests were seen adhering together, mouth to mouth.

These shells or tests were usually different in color, and sometimes slightly different in size, one being nearly always white or colorless, the other yellow or brown. The lighter colored test is apparently of more recent origin than the darker, suggesting the inference that a large "bud" maintains its connexion with its parent until its own test has been formed.

Arcella discoides Ehrbg.

Abundant throughout the warmer months in company with the last. Several very large specimens were found which agree in general with this species as described by Leidy, but the mouth is proportionately wider. I give below measurements of a test from Brown's slough and, for comparison, measurements of A. discoides from Dr. Leidy:

	Specimen from Brown's slough.	Dr. Leidy's measurements.
Breadth	.360mm.	.072-.261mm.
Height	.100 "	.020-.080 "
Diam. of mouth	.160 "	.020-.080 "

Diffflugia, Leclerc.

The genus Diffflugia is abundant in every pool of water in this region, as well as in the slimy ooze which adheres to the stones in the bottom of running streams. Those that have come under my observation have had tests made up of angular grains of quartz, quartz grains with diatoms, or of diatom tests alone. I have been able to recognize the following forms:

D. pyriformis Pértý.

D. acuminata Ehrbg.

D. lobostoma Leidy.

D. globulosa Duj.

D. corona Wallich.

D. constricta Ehrbg.

(Diffflugia) Centropyxis aculeata (Ehrbg.).

Common, in same situations as Diffflugia.

(Diffflugia) Nebela flabellum Leidy.

An empty test, obtained from the Park horse-trough in February, is doubtfully referred to this species. The test is depressed-globular in form, with smooth, circular mouth, and is covered with closely-set tests of diatoms.

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One was observed attempting to swallow a diatom fully three times its own length; the attempt was finally given up and the diatom rejected uninjured.

Length, .0045 mm.

Habitat, Park horse-trough, Nov. '97. Rare; only two specimens seen.

Sub-class Heliozoa.

Order Aphrothoraca Hertwig.

Vampyrella laterita (Fresen.) Leidy.

(Syn. V. spirogyrae Cienk.)

Abundant at intervals, feeding upon Zygnema and spirogyra.

Nuclearia delicatula Cienk.

Abundant in Park horse-trough in January and February, 1898, feeding upon minute, unicellular algae (Pleurococcus). Form amoeboid with slender, branching pseudopods arising on all sides. Food is taken by being enveloped by a pseudopodium which then shortens; when the food-particle nears the body, a rounded mass of protoplasm arises at the base of the pseudopodium into which the particle sinks until it is completely enclosed, when the whole is

slowly withdrawn into the body-mass and is there slowly digested.

Diameter, .040 - .060 mm.

Actinophrys sol Ehrbg.

Common during warm weather, among Lemnae, Potamogeton, etc. Usually floating with rays extended.

Actinosphaerium Eichhorni Ehrbg.

Rare. A single individual was seen Apr. 20, 1893, among Lemnae from the mill-ditch, and a few have been seen in similar situations since that time.

Order Chalcothoraca F&L.

Raphidiophrys pallida F. E. Schultze.

A few individuals were obtained March 14, 1893, from a slough North east of Greeley. No others have been seen.

Diameter, .025 - .030 mm.

Class Mastigophora.

Order Flagellata.

Sub-order Monadina Bütschli.

Family Rhizonastigina Bütschli.

Mastigamoeba sp?

Monad-form spherical, often fixed by a delicate, thread-like posterior process. Flagellum single, its length equal to the diameter of the monad. The flagellum is frequently withdrawn and the amoeboid form assumed. Reproduction is by fission in the amoeboid state, and occupies from 30 to 60 seconds. After division, first one daughter-monad and then the other puts out a flagellum and swims rapidly away.

Diameter, .006-.008 mm. Colorless; no nucleus nor contractile vesicle observed.

Habitat, Water from Park horse-trough, after standing for a day or two in the Laboratory.

Family Cercomonadina Kent.

Cercomonas longicauda Duj.

In water from Park horse-trough; more abundant and larger after standing a few days in the Laboratory.

Sub-family Dendromonades Stein.

Anthophysa vegetans (O.E.M.).

Of common occurrence in larger or smaller colonies, float floating free or attached to various bodies by a slender stalk.

Sub-order Euglenoidina.

Family Euglenina Stein.

Euglena viridis Ehrbg.

Very common in ponds and slow streams during the warmer months.

Trachelomonas sp?

Closely resembles T. volvocina Ehrbg., and may be a variety of that species. Test elliptical, with distinct hexagonal reticulation.

Length, .020 mm. Width, .017 mm.

Hab. In same situations as Euglena. Common.

Family Chloropeltina Stein.

Phacus pleuronectes (Ehrbg.).

Flattened, cordate, posterior end of body twisted. Color, green. One long, delicate flagellum. Swims with constant rotation. Length, .020-.025 mm.

Hab. Ponds and slow streams, in spring; not common.

Family Peranemina.

Peranema trichophorum (Ehrbg.).

(Astasia trichophorus Kent.)

Common, creeping among debris at the bottom of ponds, or swimming by means of its long flagellum.

Length, without flagellum, .050 — .060 mm.

Sub-order Heteronastigoda Bütschli.

Family Bodonina Bütschli.

Bodo sp?

Common in ponds of fresh water, and often very abundant in infusions.

Family Anisonemina Kent.

Anisonema ovata Duj.

Not common; was found in considerable numbers in one gathering from the mill-ditch in Greeley, in October.

Sub-order Isonastigoda Bütschli.

Family Amphimonadina Kent.

Amphimonas sp?

Elongated, club-shaped, somewhat changeable in form, often becoming fixed by the posterior end. Flagella 2,

equal, nearly as long as the body, arising close together from the bluntly rounded anterior end.

Length, .007-.008 mm.

Hab., Infusion of Amblystoma tigrinum in my laboratory.

Family Chlamydomonadina.

Chlamydomonas sp?

Spherical, very small. The chromatophore occupies nearly the entire cell; pyrenoid spherical. Flagella .006 mm. to .008 mm. long.

Diam., .005 mm.

Hab., Park horse-trough in winter, common.

Spondylionorum quaternarium Ehrbg.

Often abundant in pools formed by summer rains. In a few days, owing to the increasing "hardness" of the water, the development of competing organisms, or to some other cause, these organisms disappear.

Family Volvocina.

Pandorina morum Ehrbg.

Occurs under the same conditions as Spondylionorum and often in company with the latter; but it is apparently more hardy and resistant, as it usually persists for a

longer time in the pools of rain-water, and it also occurs in seepage water containing a large percentage of mineral salts in solution.

Family (Cryptomonadina . .

Chilomonas Paramoecium Ehrbg. .

Not common. I have seen it but once, in water from Brown's slough, in June. .

Class Infusoria.

Sub-class Ciliata.

Order Gymnostomata Bütschli.

Family Enchlina (Ehrbg.) Stein.

Sub-family Holophryina Perty.

Holophrya Ehrbg.

Two very distinct species belonging to this genus have been observed, neither of which agrees fully with any descriptions or figures at hand. Of these, the first is a member of section I, and the second of section II, as arranged by Bütschli.

Holophrya (sp. a).

Near to H. discolor (Ehrbg.), but the nucleus is oval or nearly spherical, and not at all like the nucleus of the latter as figured by Bütschli.

L. .030 .160 mm.

Hab. Freshwater, in ponds and streams among debris and algae, near the bottom. Common.

Holophrya (sp. b).

Near to H. Lieberkühni Bütschli, but with only a few (about 20) faint longitudinal striae. Nucleus oval, somewhat elongated, in mid-region. Contractile vesicle

single, near the posterior end. Cilia fine, longer near the anterior end. Locomotion slow, regular.

L.1 mm.

Hab. . . Mill-ditch, Greeley. . Not common.

Urotricha farcta Clap. & Lach.

Small, .012015 mm. in length by .010012 mm. in breadth; swimming quite rapidly with revolution on a longitudinal axis; occasionally springing quickly. Posterior cilium about twice as long as body. Two individuals, united together, with their long, posterior cilia extending backwards and parallel, were kept under observation for more than half an hour, when they were lost without my being able to make out their relations.

Butschli states that in the family Enchelina conjugating individuals unite by their anterior ends; this would bring the posterior cilia to point in opposite directions instead of lying parallel and side by side in the same direction. I have been unable to find any reference to self-division in the free state ^{in Urotricha} ~~among the Enchelina~~, but analogy with the more closely related forms would seem to indicate that such division would probably take place in a transverse, and not in a longitudinal plane.

If we consider these as presenting a case of conjugation, then it is abnormal as to position and it is difficult to understand how there could be any transference of nuclear substance since the oral apertures were separated by a considerable interval, and the parts which were in contact are normally covered with cuticle. On the other hand, longitudinal fission appears never to have been observed within the limits of this order, and the evidence presented by this case is insufficient to render such a hypothesis probable.

Another mode of reproduction, that of sporulation in the encysted state, is known to be of frequent occurrence in this family and throughout the order. The possibility is suggested that a "double spore" may have given rise to the two individuals, leaving them united together side by side like the "Siamese twins".

Urotricha (sp. a).

Form elliptical, slightly flattened. Body transparent, flexible; the cuticle obliquely and distinctly striated with ten or twelve striae which bear short, fine cilia. Mouth anterior, terminal, normally closed but may be widely distended in taking food. Nucleus rather large,

oval or nearly spherical, in the mid-region; contractile vesicle terminal, posterior. Movement regular and constant, slowly revolving on a longitudinal axis. Food consists of other infusoria: one was seen to seize and ingest a Cyclidium.

Length, .045 mm. Width, .030 mm.

Hab., Bottom of ponds, Rare.

Urotricha (sp. b).

Linseed-shaped, flattened; anterior end tapering, pointed; posterior end broadly rounded. Cilia fine and equal; the single posterior cilium about half as long as body. Body transparent, faintly striate with about ten longitudinal striae. Nucleus spherical, central; contractile vacuole posterior. Swims rapidly and smoothly, without revolving. Body flexible and contractile.

Length, .050 mm.

Hab., Slough North-east of Greeley. Not common. Only one specimen seen.

Prorodon (sp. a).

Elongated, tapering; posterior end broadly rounded; mouth terminal, on the narrow anterior end; oesophagus distinct, nearly straight, about $1/4$ length of body; cilia

fine, equal. Nucleus spherical, central; contractile vacuole posterior, terminal. Animal flexible and contractile, movements rapid.

Length, .1 mm.

Hab. Mill-ditch, Greeley.

Lacrymaria (Frachelophyllus) apiculatus Peñtv.

Common among the debris at the bottom of ponds and slow streams in November and December, apparently rare at other seasons.

Lacrymaria olor (Ehrbg.).

(Frachelocerca olor Ehrbg.).

Frequent in debris in ponds. Reproduction by transverse fission was observed in one instance.

sub-family Colepina C. & L.

Coleps hirtus Ehrbg.

Common among algae and in the debris in ponds and streams; often very abundant in infusions. Reproduction by transverse fission frequently observed.

Sub-family Cyclodinia Stein.

Didinium nasutum (O.E.M.) Stein.

Not common; occurred abundantly in Brown's slough in June, after a heavy rain.

Didinium Balbiani Bütschli.

With the preceding but less numerous.

Mesodinium (sp. a).

Form nearly spherical, slightly truncated orally; mouth surrounded by (about) 8 long, tentacle-like cilia which are directed forward and used in creeping about among algae etc., and probably also in feeding; just behind these, a ring of short, fine, vibratile cilia surrounds the body which is otherwise naked. Food consists of diatoms, with which the examples seen were completely filled.

Nucleus apparently horse-shoe shaped, but not clearly made out among the diatoms. Contractile vacuole posterior terminal, single.

Length, .020 mm.

Hab. Sand Arroyo, Greeley, in a spring filled with Spirogyra. April.

Family Trachelina.

Sub-family Loxodina Bütschli.

Loxodes rostrum O. E. Mueller.

This widely distributed species appears to be rare in the vicinity of Greeley as a usual thing, although I have once or twice found it abundant late in the autumn.

family Chlamydodonta Stein.

Sub-family Nassulina Bütschli.

Nassula aurea Ehrbg.

Common at the bottom of ponds and streams. Reproduction by transverse fission frequently observed. Feeds upon diatoms.

Sub-family Chilodontina Bütschli.

Chilodon cucullus (O.E. Mueller).

One of the most abundant forms of Infusoria. Occurs in running water, in ponds, and in infusions. Moves by creeping, and occasionally by swimming with a rotating, cork-screw movement. Feeds upon diatoms.

Order Trichostomata Bütschli.

Sub-order Aspirotricha Bütschli.

Family Chilifera Bütschli.

Glaucoma scintillans Grbg.

Abundant in running streams and perennial ponds, creeping over submerged plants and debris at the bottom; occasionally swimming with an irregular rotary motion.

Transverse fission has been frequently observed.

Frontonia (sp. a.).

Form elliptical, slightly flattened anteriorly; ends equally rounded; body finely and evenly ciliated, very flexible, not at all contractile. Striation fine, longitudinal; trichocysts numerous, evenly distributed. Mouth and post-oral groove on second and third fifths of body. Mouth elliptical, about half covered by the left undulating membrane. Contractile vesicles two, with distinct afferent radiating canals. Anus postero-lateral. Macro-nucleus large, globular, with imbedded micro nucleus in anterior half. Food consists of diatoms.

Length, .115-.150 mm.

Hab. Mill ditch. Not abundant.

Colpidium colpoda Ehrbg.

Occurs sparingly in the Mill ditch; and I found it very abundant in a jar containing a spray of decomposing *Cladophora* in my Laboratory.

Colpoda cucullus (O.E.M.).

Occurs sparingly at times in ponds containing a considerable amount of decomposing vegetable matter. I found it very abundant in a jar containing a sprig of *Tradescantia* from the green-house, the lower leaves of which were decomposing, in April, 1893.

Family Microthoracina Wrzesn.

Cinetochilum margaritaceum Ehrbg.

Abundant, creeping over the debris in running streams in company with *Glaucoma scintillans*. This active little species may be likened to an animated painter's palette, which it closely resembles in outline while the clear, contractile vesicle gives the appearance of a hole for the thumb.

Reproduces by transverse fission.

Length, .017 to .020 mm.

Family Paramecina Bütschli.

Paramecium caudatum Ehrbg.

Abundant in infusions. Frequently met with in ponds of stagnant water containing decomposing organic matter.

Reproduces by transverse fission. Conjugation was frequently observed.

P. aurelia.

Entirely similar to the last with the exception of the posterior brush of long cilia which is wanting in this species. Perhaps it is not entitled to rank higher than a variety of the last. A few specimens were seen in pond-water.

Family Urocentrina O. & L.

Urocentrum turbo (O.E.M.).

In habit and appearance has much resemblance to a small active rotifer. Often found in considerable numbers with spirogyra and other algae.

Family Pleuronemina Bütschli.

Cyclidium glaucoma Ehrbg.

Most abundant of our Infusoria. Occurs in all our waters and in infusions, often in immense numbers. Swims very

rapidly then suddenly comes to rest, the long and rather sparse cilia projecting on all sides. The large oral-membrane or "lip" is usually seen with some difficulty, as is sometimes the long, slender, caudal cilium.

Conjugation has been observed in several instances, and transverse fission very frequently.

Length, .018 to .021 mm.

Sub-order Spirotricha Bütschli.

Section Heterotricha Stein.

Family Plagiotomina C. & L.

Blepharisma (sp. a).

Form compressed, flax-seed shaped; posterior end somewhat narrowed and rounded or slightly truncated; anterior end acutely pointed. Body slightly contractile, colorless. The dorsal and ventral borders equally curved, or in some instances the anterior half of the dorsal border is nearly straight, while that of the ventral border is obliquely truncated. Sides longitudinally finely striate, the striae approximately parallel with the dorsal border. The peristomial groove extends along the ventral border from the pointed anterior end, becoming somewhat wider and deeper posteriorly where it is twisted slightly to the right side. The mouth opens into a short oesophagus about the middle of the hinder half of the body. Ingested food is gathered into an actively revolving spherical mass at the inner end of the oesophagus before it enters the internal protoplasmic body-mass, as in *Paranaecium*. The peristomial undulating membrane extends along the posterior fourth of the peristomial groove. Macro-nucleus

large, round, in mid-region or slightly anterior. Contractile vesicle single, near the posterior end.

Body-cilia short, fine and even; those of the prostomial large. Food minute, algae and monads. Movements usually slow, sometimes rapid, regular.

Length, 1.1 to 1.2 mm.

Hab., Swampy pools, among cat-tails and rushes, near Greeley, Common but not abundant.

Metopus sigmoides C. & L.

Swims rapidly, revolving upon a longitudinal axis. Not common; occasional specimens have been found in the Mill-ditch, in Greeley.

Spirostomum ambiguum Ehrbg.

The largest of our common free-swimming Infusorians; it lives among the debris in the bottom of ponds and slow streams.

Length, 1.5 to 2 mm.

Family Stentorina Stein.

Stentor coeruleus Ehrbg.

and

S. polymorphus Ehrbg.

Both of these are common in still water amongst moss and algae. The former species is relatively more abundant in the spring and autumn, the latter species during the summer.

Family Gyrocoryna Stein.

Caenomorpha medusula Perty.

Very active, swimming with revolution upon a longitudinal axis, and darting in sweeping curves like a falcon.

This rare and beautiful form is occasionally found in the slough east of Greeley, and it occurred in great abundance in November, 1897, in a jar of Lemna in my laboratory, in company with Paramecium.

Section Oligotricha Bütschli.

Family Halterina C. & L.

Halteria grandinella O.F.M.

Abundant in still, open waters during the spring months.
I have rarely seen it in summer or autumn. Reproduction by
transverse fission was observed in one instance.

Section Hypotricha.

Family Oxytrichina (Ehrbg.) Stein.

Sub-family Pleurotrichina Bütschli.

Urosoma (sp. a).

Very active; closely resembles Oxytricha except that the posterior end is drawn out into a slender tail which is without the large bristle-like cilia of the latter.

Only a few examples have been seen, and these under circumstances which precluded a careful and complete examination.

Length, .080 — .100 mm.

Hab. Mill-ditch and Sand arroyo, Greeley.

Oxytricha pellionella (O.F.M.) Ehrbg.

Common, creeping over debris in the bottom of ponds; also in infusions. reproduces by transverse fission.

Length, .050 — .100 mm.

Stylonichia mytilus (O.F.M.)

Common, creeping amongst the debris on the bottom of ponds and streams. Reproduces by transverse fission.

Family Euplotina (Ehrbg.) Stein.

Euplotes patella O.F.M.

Frequent in still water, creeping over water plants and along the bottom.

Length, .10-.14 mm.

Euplotes? (sp. a).

Form broadly elliptical, nearly as wide as long. Dorsum strongly convex, 5-ribbed, granulose. Anal cirri very long, projecting well behind the body. Lateral cirri (Randcirren) apparently wanting. Head-cirri concealed in dorsal view.

Length, .025 mm.

Hab. Ponds and streams around Greeley. It was abundant in the Park horse-trough in January, 1898.

Euplotes ? (sp. b).

Elliptical, nearly twice as long as wide. Anterior end slightly truncated. Dorsum convex, 5-ribbed; ribs smooth, without granules. About 5 head-cirri visible from above, projecting considerably beyond the head; anal cirri entirely concealed; border cirri (Randcirren) wanting. Mouth close to left border, in front of the middle of body.

Length, .04 mm.

Hab. With the preceding species.

Euplotes ? (sp. c).

Form ovate-elliptical, twice as long as wide; anterior end produced into a bluntly conical, bear-like process; Head-cirri projecting; anal cirri concealed; border cirri wanting. Adoral zone visible through the transparent body. Mouth near the left border, posterior. Dorsum longitudinally 5-ribbed; ribs not reaching front border, but ending at the base of the conical process already described.

In conjugation, the oral regions are in contact, the bodies lying parallel and the flat ventral surfaces overlapping for about $1/3$ their width, the right and the middle third of each ventral face being exposed.

Length, .04 .045 mm.

Hab. With the two preceding.

The genus Euplotes, as defined by Butschli, comprises forms having the five anal cirri projecting "considerably beyond the hinder end", together with two border cirri on the hinder end and two (or more) on the left posterior border. I have been unable to make out any border cirri whatever in any of the last three forms above des-

cribed, and only in the first do the anal cirri project at all beyond the body.

Possibly these species ("a", "b", and "c") should not be included in the genus Euplotes but should be formed into a new genus . . . Further research will be necessary before a satisfactory disposition of them can be made.

Section Peritricha Stein.

Family Vorticellina (Ehrbg.) Bütschli.

Sub-family Vorticellidina Bütschli.

Tribe Contractilia.

Vorticella Linn.

Abundant everywhere, attached to floating water-plants, shells of *Lymnaea* and *Physa*, small crustaceans, etc. The great amount of variation which is observable in size, shape, color, length of pedicel, etc., necessitates either the recognition of a great number of species, or the grouping of the numerous forms about a few definite and well-marked types which shall be denominated "species", while the others are to be considered as varieties. In their treatment of this genus, Stokes apparently adopts the former, Bütschli the latter plan. I have observed forms which agree fairly well with descriptions given by Pritchard of the following species, to wit:

- V. nebulifera O.F.M.
- V. microstoma Ehrbg.
- V. convallaria "
- V. patellina O.F.M.

A considerable number of forms have been observed which vary widely from any description at hand. Owing to the

extreme variability of forms in this genus, I have not deemed it advisable to attempt to classify them as species, or to determine their relations with in any way at the present time.

In April, 1898, several individuals of *V. convallaria* were seen to cast off their pedicels and, after swimming about freely for a time, to encyst themselves, forming each a spherical cyst with a loose and apparently wrinkled membranous wall. I was unable to follow their development further.

Binary fission has been frequently observed, resulting in the production of two similar individuals, one of which detaches itself from the pedicel and becomes temporarily free, swimming by means of a posterior circlet of cilia. After a short time the animal fixes itself by the posterior end to some convenient support, selected according to the preference of the particular species. The circlet of cilia is withdrawn, and the posterior end of the body, which has now become the fixed end, is gradually drawn out into a long, spirally contractile pedicel.

In some of the forms observed, I was able to determine that the individual has the power to release itself from its substratum or support, and, after swimming about for



a time, to again fix the base of the pedicel to a support. It is probable, however, that this power is possessed only by the young individual, and that it is lost before, or as soon as the pedicel has attained its full development.

The fusion of a microzooid with a megazooid was observed in but one instance. The production of the microzooid has not been observed.

Carchesium polypinum Ehrbg.

Rare; only two or three colonies have been seen, from Brown's slough.

Tribe Acontractilia Bütschli.

Epistylis digitalis Ehrbg.

Abundant on Cyclops, in March and April.

Epistylis umbellaria (Linn.).

Common upon submerged stems, leaves of grass, etc., in pools formed by summer rains.

22388-16 m. 70-84.

Tribe Cothurnia Bütschli.

Cothurnia crystallina Ehrbg.

Not rare. Occurs fixed to Spirogyra, Draparnaudia, Cladophora, etc.,.

Fission, resulting in the production of two individuals one of which becomes for a time free-swimming, as in Vorticella, was observed on several occasions. The posterior circlet of cilia arises near the middle of the long, cylindrical body, vibrating at first very slowly, and gradually travels or migrates backwards along the sides to the fixed extremity, when the zooid detaches itself and swims out of the lorica.

Cothurnia tinctoria Ehrbg.

Lorica brownish-yellow, urceolate. Not common.

Hab. On Zygnema and Spirogyra.

C. (Thuricola) valvata (Wright).

With a valve in the cylindrical lorica, which closes when the zooid contracts.

Hab. On Cladophora in the Cache La Poudre river, near Greeley.

Vaginicola decumbens (?).

Lorica ovate, depressed, procumbent and attached by the lower side, brown, often opaque with age, about .08 mm. in length. Mouth of lorica opening obliquely upward, slightly contracted or not. Zooid cylindrical, tapering below, when fully extended is about twice the length of the lorica. Peristomial disk circular, very oblique when expanded; cilia few, long. Two zooids are often found in the same lorica, fixed side by side at the base, probably the result of fission.

Hab. On Vaucheria. Common.

Sub-class Suctoria.

Family Pötophryina Bütschli.

Genus Sphaerophrya Clap. & Lach.

Sphaerophrya (sp. a).

Form spherical, fixed by a slender, flexible pedicel. Body transparent, with granular protoplasm, or more or less opaque. Tentacles of two kinds; the one very long and slender, bearing a knob at the end, can be withdrawn or quickly moved sideways; the other, very much stouter, and only half as long, are inflexible, cylindrical, tubular(?) and permanently extended. Contractile vacuoles one or several. No nucleus seen.

Feeds upon other infusoria. One was seen feeding upon Halteria grandinella. The Halteria was paralyzed and drawn close against the side of the Sphaerophrya, into the body of which the protoplasm of the Halteria was passing. In reproduction, the tentacles are all withdrawn; the body elongates until it is half longer than wide, then gradually constricting in the middle, divides into two approximately equal, spherical zooids, the basal one fixed, the other free. The free zooid becomes oblong, about twice as long as wide, acquires a clothing of cilia

by means of which it swims about for a time, then, coming to rest, draws in its cilia and throws out on all sides short tentacles, each tipped with a spherical knob.

During the free-swimming, ciliated stage, a very active contractile vesicle could be seen near the anterior end; near the opposite extremity, a pedicel, which is at first indistinguishable from the tentacles, now appears, by which the zooid becomes attached. It soon assumes the spherical form and extends its tentacles; the pedicel gradually elongates until it equals or exceeds the diameter of the zooid.

Diameter, .020 — .050 mm.

Hab., Brown's slough, July.

In the same gathering with the preceding were a number of larger individuals which closely resemble those described except in size, in the absence of a pedicel, and in the deeper coloring, these being more nearly opaque. In some of these, simple binary fission was seen to take place without retraction of the tentacles, the resulting zooids being in all respects like the parent except in size. Diameter, .06 — .100 mm. Whether these belong to the same species with those above described, was not determined.

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