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COMPARATIVE PHYSIOLOGY AND PSYCHOLOGY.

BY S. V. CLEVENGER, M.D.

THE science of psychiatry will advance in proportion to the development of psychology based upon comparative microscopic anatomy and a physiology into which molecular physics shall enter more in the future. The entire fabric will be a triumph of monism, for if we set out on any other assumption, such as the dualistic affords, than that mind is a product of chemical energy and other natural forces, there is an end to inquiry.

The baleful influence of teleology hangs over the average physiologist as over the superstitious laity and debars him from seeing things as they really are. The inability to conceive of consciousness as a product of the motions of matter is on a level with the inscrutability of the nature of ultimate force and atoms. In dealing with the workings of the mental mechanism it is not necessary to define or attempt to explain consciousness any more than the practical electrician or chemist or optician finds it necessary to define or speculate upon the ultimate nature of the vibratory terms in which they deal. As the physicist increases his knowledge of *how* matter and motion act and react upon each other, he is willing the metaphysicians should quarrel over the unknowable, the lunar politics. With the dawn of comparative psychology the truth began to appear, theories became subordinated to facts and not facts to theories.

Not only are the laws which bind the social organism similar to and derived from those which govern the units of which it is composed, but the protoplasmic units are governed by the same processes down to chemical affinities.

ties of this substance consist mainly in its solubility by alkaline fluids and its affinity for oxygen, "which is linked to it by ties so easily broken that it can be transferred to other easily oxidizable bodies existing by its side, that it can be given up when its solutions are gently heated in vacuo or agitated at moderate temperatures with large quantities of inactive gases, as nitrogen or hydrogen."<sup>1</sup> This oxygen carrier next formed a cell especially adapted to its transportation.

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### SOME APPARENTLY UNDESCRIBED INFUSORIA FROM FRESH WATER.

BY ALFRED C. STOKES, M.D.

THE Infusoria whose descriptions are appended have as yet been observed only in the shallow ponds of Western New York, although they doubtless occur as plentifully elsewhere. Near the pretty village of Olean, in the bosom of the western hills, they pass their little lives amid attractive surroundings. Scarlet clusters of the cardinal flower and great bunches of yellow primroses make brilliant the shores of their aquatic haunts, while tall *Rubus odoratus* holds its purple roses aloft in the warm air, and *Anemone pennsylvanica* lifts its white blossoms above the "lush and lusty grass." A bird chirps in the shading maple boughs, a frog cries and splashes into the pool amid the Myriophyllum and Utricularia; a meditative cow gazes quietly at the intruding biped, and the blue sky bends above, and the blue mists rest in the hollows of the distant mountains. The placid water teems with life. A furrowed *Euglena*, hitherto undescribed and unseen by the eye of man, rotates like an animated screw in and out among the utricles and leaflets of the water weeds.

This green creature, which I have named *Euglena torta*, bears the remotest resemblance to any known member of its genus. The parenchyma is as usual uninterruptedly green, but the characteristic features are the spiral grooves or keel-like ridges traversing the entire body from anterior extremity to posterior acumination, where they are lost in the origin of that colorless caudal prolongation. The animalcule is but slightly flexible and apparently not changeable in shape during life. After death by poisoning the ridges and

<sup>1</sup>Gamgee's Phys. Chem. of the Animal Body, p. 91.

depressions disappear, and the body becomes smoothly subcylindrical. In life, however, it cannot be mistaken for any known species of the genus. Among the Euglenæ it is unique. Fig. 1 delineates it under a magnification of 360 diameters, and the subjoined description probably contains its essential specific characters.



FIG. 1.—*Euglena torta*, sp. nov.  $\times 360$ .

*Euglena torta*, sp. nov.—Body elongated, subcylindrical and traversed by three longitudinal, spirally directed furrows, or three spiral, keel-like longitudinal elevations; anterior extremity rounded and slightly bilabiate; more or less tapering posteriorly and terminating in a colorless, acuminate, somewhat curved caudal prolongation; cuticular surface smooth; endoplasm green; amylaceous bodies usually two, cylindrical, situated one on each side of the spherical, centrally located nucleus; contractile vesicle and pigment spot conspicuous near the anterior extremity; flagellum subequal to the body in length; movement rotary on the long axis. Length of body  $\frac{1}{400}$  inch. Habitat: Among Utricularia in shallow ponds in Western New York.

In movement, but in little beside, a Phacus from the same pool resembles *Euglena torta*. This rotation on the longitudinal axis it has in common with *Ph. triquetter*, *Ph. longicaudus*, *Ph. pyrum* and *Ph. pleuronectes*, the other members of the genus, all of which are more or less abundant in still and shallow waters. It is represented in its lateral aspect in Fig. 2, magnified 280 diameters. It may be described as follows:

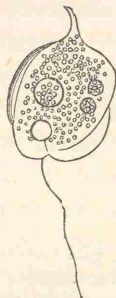


FIG. 2.—*Phacus anacelus*, sp. nov.  $\times 280$ .

*Phacus anacelus*, sp. nov.—Body broadly ovate or suborbicular, more or less compressed, the right and left sides concave, the dorsal and ventral margins each traversed by a deep longitudinal furrow, the body thus appearing to possess four keel-like ridges; caudal prolongation colorless, acuminate and curved toward the dorsal aspect of the body; eye-spot and contiguous contractile vacuole conspicuous; flagellum subequal to the body in length, inserted beneath a prominent lip-like projection; endoplasm green. Length of body  $\frac{1}{800}$  inch. Habitat: Shallow ponds in Western New York.

All of the Vorticellæ are attractive, but the most beautiful form I have yet met with is one that occurs in some profusion scattered over the rootlets of Lemna from this same rich little pond. At first I was disposed to identify it with Ehrenberg's *V. chlorostigma*, but subsequent study showed that such identification could be justified only by that zoöid's probable coloration. It is considerably more campanulate in form than

the Ehrenbergian species, and has not the densely granulated parenchyma of the latter. In color it is a translucent homogeneous emerald-green. It has a frequently exercised tendency to a characteristic change of form by retracting the borders of one side of the extended body so as to produce a deep depression, while the contracted zoïd exhibits a habit of some slight diagnostic value in the sheathing of the distal end of the pedicel by the posterior extremity of the body. The cuticular surface is transversely striated by depressions so fine that they are ordinarily visible only at the lateral borders or after manipulation of the mirror. Minute granules occasionally

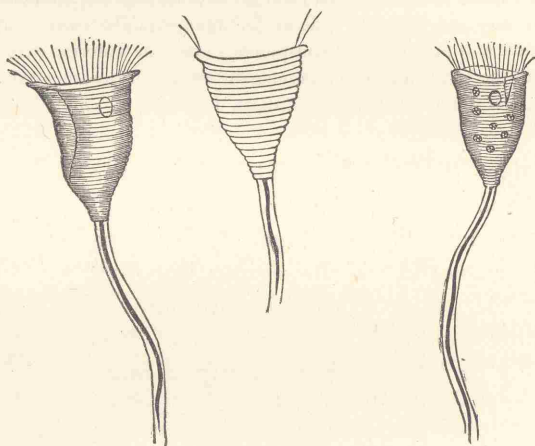


Fig. 3.

Fig. 4.

Fig. 5.

FIG. 3.—*Vorticella smaragdina*, sp. nov., showing lateral depression.  $\times 180$ . FIG. 4.—Diagrammatic outline of *V. smaragdina* when extended. FIG. 5.—*Vorticella macrocaulis*, sp. nov.  $\times 360$ .

roughen the surface and are barely visible under an amplification of 250 diameters, when they appear to add to the distinctness of the transverse striations without making themselves conspicuous. With magnification of 400 diameters they are seen to be minute, dark-bordered refractive particles arranged in no apparent order and having no connection with the surface striæ. They are not constantly present, and their absence seems to add to the beauty of this peculiarly attractive creature. When the infusorian is well and the surroundings are auspicious, but little of the contracted pedicel remains uncoiled, this atomic of living emerald then quivering at the summit of a crystalline spring, like a spherule of chrysoprase on a coil of silver thread.

The pencil can give hardly more of this exquisite creature's appearance than a diagrammatic outline, and little more has been attempted in the figures (Figs. 3 and 4). The translucent green coloration of the entire sarcode, the peculiar indentation of the side, the delicate poise of the contracted body at the summit of the closely coiled foot-stalk, the whole charm of the living creature is lost in the lines of black and white.

*Vorticella smaragdina*, sp. nov.—Extended body, conical-campanulate, changeable in shape, an irregular depression often formed on one lateral border; the width of the peristome nearly equal to the length of the body, the anterior margin dilated, somewhat constricted beneath the peristome border, the posterior body-half tapering to the pedicel; cuticular surface finely striate transversely and often roughened by minute, scattered granulations; peristome border everted, slightly revolute; ciliary disk very slightly elevated; the entire parenchyma translucent and colored emerald-green; vestibular bristle conspicuous; pedicel colorless, eight to ten times as long as the body, contracting in numerous close coils; contracted body subspherical, a posterior annulation sheathing the extremity of the pedicel. Length of body  $\frac{1}{300}$  to  $\frac{1}{300}$  inch. Habitat: Rootlets of Lemna in ponds in Western New York. Solitary or few together.

In external contour as well as in the length of the pedicel another species of the genus, which I have named *Vorticella macrocaulis*, resembles *V. longifilum* S. K. It is, however, immediately distinguished by its surface striations which, although fine, are distinct, and by the proportion borne by the length of the body to the width, the former, with *V. longifilum*, being twice the latter, while in the species under consideration these parts differ much less in relative size. No recorded member of the genus possesses a pedicel of so great a length as the one here referred to, except *V. longifilum* and *V. telescopica*, both of the latter having an unornamented cuticular surface. If this contractile foot-stalk were delineated under an amplification equal to that of the body in Fig. 5, it would necessarily be depicted from six to seven inches long, being ten to twelve times the length of the extended zooid.

*Vorticella macrocaulis*, sp. nov.—Body elongate-campanulate, one and one-fourth times as long as wide, attenuate and tapering posteriorly; peristome somewhat wider than the greatest width of the body, everted and thickened but not revolute; ciliary disk evenly rounded and elevated; cuticular surface finely striated transversely; contracted body obovate; pedicel ten to twelve times as long as the extended body, its entire length contracting into close coils. Length of body  $\frac{1}{300}$  inch. Habitat: Shallow ponds in Western New York, attached to Lemna rootlets. Solitary.

Still another species of *Vorticella* from the same habitat is that



shown in Fig. 6 under the name of *V. utriculus*, which resembles in form *V. striata* Duj., a salt-water infusorian. In its conspicuous surface striations it also suggests the marine animal, and in size, furthermore, the two somewhat closely correspond. In the comparative proportion of breadth and length they differ, also in width of peristome as well as in the length of their respective pedicels, that of the marine form being twice and that of the sweet-water species three times as long as the body. *V. utriculus* may be a fresh-water variety of *V. striata*. The coincidences of

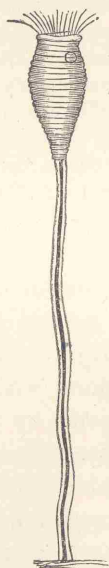


Fig. 6.

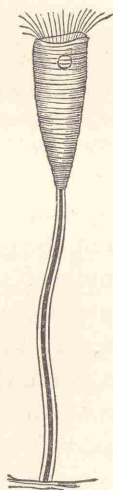


Fig. 7.

FIG. 6.—*Vorticella utriculus*, sp. nov.  $\times 437$ . FIG. 7.—*Vorticella macrophyta*, sp. nov.  $\times 535$ .

form and other essential characters are at least interesting and suggestive.

In its habitat it is disposed to be solitary, although it does not object to neighbors if not too near. Usually when one is found others are to be noted arranged singly on the same *Lemna* rootlet, and at almost equal distances apart. When contracted the pedicel is coiled in close rings, and has its distal end sheathed by the posterior termination of the body in a manner similar to that of *V. smaragdina* when in the same inactive state. It is shown extended in Fig. 6, magnified 437 diameters, and may be described thus :

*Vorticella utriculus*, sp. nov.—Body vase-shaped or subpyriform, somewhat changeable in shape, twice as long as broad, widest centrally, tapering posteriorly, and slightly constricted beneath the everted and revolute border of the peristome, whose width is a little less than the greatest breadth of the body; cuticular surface strongly and conspicuously striate transversely; ciliary disk slightly and obliquely elevated; vestibular bristle conspicuous; pedicel three times as long as the body; contracted zoöid obovate or pyriform. Length of body  $\frac{1}{8\frac{1}{25}}$  inch. Habitat: Attached to Lemna rootlets in ponds in Western New York. Solitary or scattered.

Descriptions of several members of one genus must necessarily contain much repetition wearisome to the general reader. The records can be scarcely more than comparisons of contour and structure, resemblances and dissimilarities. The habits of the numerous kinds of Vorticellæ are essentially the same. This particular one that I have named the "long-shaped" Vorticella, *V. macrophyta*, bears a striking resemblance to *V. cucullus* From., and might justly be identified with that species, were it not for the presence of cuticular striæ and the absence of the cushion-like ciliary disk.

It is an interesting coincidence that this and two preceding forms from the same little pool, although they so widely differ, should so uniformly present, when contracted, the small annular sheath about the attachment of the pedicel. In every instance that portion of the zoöid which accompanies the distal end of the stem into the body remains included until the animal is otherwise almost completely expanded, when that part slips out quite suddenly and so completes the act of dilatation. The Vorticella is shown expanded in Fig. 7, magnified 535 diameters.

*Vorticella macrophyta*, sp. nov.—Body elongate-conical or obconic, twice to two and one-half times as long as broad, widest at the anterior margin and thence tapering to the attenuate posterior extremity; peristome border revolute, not everted; cuticular surface finely striate transversely; ciliary disk slightly and obliquely elevated; nucleus band-like, short, curved and situated in the anterior body-half; pedicel once and one-half to twice as long as the body, the muscular thread stout; contracted zoöid obovate, the posterior extremity sheathing the distal end of the spirally coiled pedicel. Length of body  $\frac{1}{8\frac{1}{7}}$  inch. Habitat: Attached to rootlets of Lemna from shallow ponds near Olean, Western New York. Solitary.

Jutting outward from the edge of Luna island on the American side of Niagara falls, within twelve feet of the curving brink of "the cataract which here shoots down the precipice like an avalanche of foam," projects a rock submerged and washed by the almost rhythmic flow of the reflex currents from that mighty flood. There tangled clusters of a deep green Alga clung by a single point of attachment. The ripples swept above and left

them anon streaming wildly as the waters sank below the stone, only to dash them upward again as the waves rushed back. Scarcely thinking to obtain any animal life clinging to a plant that rejoiced in such swirling turbulence, I gathered the weed while my friend adhered to the extremities of my coat as desperately as the Alga adhered to that limestone rock. The plant, as the Rev. Francis Wolle, of Bethlehem, Pa., tells me, is *Cladophora glomerata* Linn.; the undescribed form of Zoöthamnium, unexpectedly found in thrifty abundance on the lower branches, is *Zoöthamnium adamsi*, sp. nov., named for the Rev. J. E. Adams,

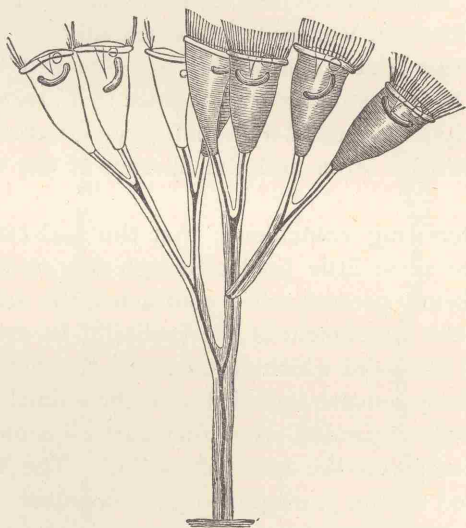


FIG. 8.—*Zoöthamnium adamsi*, sp. nov.

of Olean, N. Y., a cultured and eloquent gentleman, who assisted in its capture.

So far as external form is concerned the members of this colony resemble those of Saville Kent's *Z. simplex*, a company of elongated zoöids clustered at the summit of a smooth, unbranched stem. Both are conical, both are widest at the frontal border, both are tapering and attenuated toward the insertion of the pedicel, but here the resemblance ceases. The cuticular surface of the new form now referred to is not smooth, as is that of every other recorded fresh-water species, but is finely and delicately striated transversely. So closely approximated and so tenuous are these elevations that it is only after the most careful scrutiny under an amplification of not less than 400 diameters, that they

become apparent to a trained eye, and even then only as infinitesimal lines on the lateral borders of the extended bodies. No more careful adjustment of the objective, no more careful manipulation of the mirror is needed to study the markings of a diatom than is demanded by this little creature before its markings impress the observer's retina. In the figure (Fig. 8) they are represented by lines, fine it is true, but almost out of proportion to the elevations which Nature has placed on the living surface of the infusorial atomie, whose home was at the brink of that stupendous cataract of emerald and foam and spray-smoke, amid the eternal complaining of beaten rock and broken flood.

The supporting pedicel is usually simply bifurcated at a point distant from its algal attachment about twice as far as are the furcations of the branches from the extremity of the main rachis. Sometimes the pedicel throws off three branches from its summit, and more frequently four divisions. The prevailing form, however, is the dichotomous. Above the second series of bifurcations the branches become of diverse lengths, instances occurring in which the branchlet is twice as long as any other part. The length of the ultimate divisions, those immediately supporting the zooids, seems quite constant, being usually about one-half as long as the extended body. The whole pedicel is stout and robust, and is conspicuously marked by longitudinal striæ. Its contractions are comparatively slow and few. There is none of that sudden coiling, as with the *Vorticellæ*, when the expanded infusorian leaps back into quick contractions and momentary quiescence that often startles the rapt observer.

After the colony has been under observation for a prolonged period an action takes place that I have not seen recorded with any member of the genus, a movement recalling the contractile performances of the disconnected muscular threads of individual members of *Carchesium*. Two neighboring zooids fold together their ciliary apparatus, and their own private foot-stalks retract into coils without disturbing the general equanimity of the community. This has been observed repeatedly, the retracted muscular thread being, in every instance, in apparent connection with that of the remainder of the pedicel. This thread, however, seems to be delicate. For no visible reason it soon separates into numerous scattered fragments within the sheath. In those in-

stances just referred to, an inappreciable separation had probably taken place.

The contracted body, when certain adjuncts of the entire colony are taken into consideration, affords some points that may be of diagnostic value. The creature probably affects running water, or water agitated by proximity to a current, but that it is restricted to the restless waters beating the shores of Luna island and pouring a resistless flood to make that terrific plunge, is not to be thought of; there only was its original habitat so far as the writer is concerned; and when it is found, as it probably will be, in swift streams far beyond the sound of the "Thunderer of the Waters," its contracted form may offer some characters to aid in its identification. When the frontal region is folded together, and the whole body contracted, the zoöid bears some resemblance to the bodies, when in a similar condition, of *Opercularia plicatilis*, described by the writer in the *American Monthly Microscopical Journal* for December, 1884. The anterior snout-like projection, the radiating cuticular elevations, the posterior annulations, are all similar. With the *Zoöthamnium*, however, the conspicuously crenulated border of the projection and its longitudinal plications, of the *Opercularia*, are absent or obscure, while the radiating ridges on the shoulder of the *Zoöthamnium* are much more prominent though fewer, and the posterior annulations, though as numerous, are less marked.

The short, curved, band-shaped nucleus is constantly present in the anterior body-half, but its relative position is inconstant. At times its concavity is presented directly forward toward the ciliary disk, at others it is nearly perpendicular, with the convexity directed outwardly, and in rare instances it is transversely placed near the center of the body.

A colony of this attractive infusorian is delineated in Fig. 8. The cuticular markings, as before intimated, are chiefly shown to emphasize the fact of their existence, not to exhibit their tenuity or number.

*Zoöthamnium adamsi*, sp. nov.—Body elongate-conical or conical-campanulate, twice as long as broad, widest anteriorly, tapering to the pedicel, and slightly constricted beneath the peristome border; cuticular surface very finely striate transversely; peristome border wider than the body, revolute; ciliary disk rounded and elevated; contractile vesicle single, situated beneath the peristome border; nucleus short, band-like, curved and anteriorly placed; main rachis of the pedicel usually bifurcate, frequently quadrifid, occasionally tripartite; branches dichotomous, un-

equal in length, commonly shorter than the main stem, the ultimate divisions less than one-half the length of a single zoöid, each division supporting a single animalcule; entire pedicel stout, longitudinally striate; contracted zoöid obovate or subpyriform, the frontal border projecting in snout-like manner, and the anterior body-half thrown into prominent longitudinal plications, the posterior body-half into several annulations. Length of body  $\frac{1}{417}$  (0.0024) inch; height of main stem  $\frac{1}{334}$  (0.0030); of the entire colony  $\frac{1}{112}$  (0.0090) inch. Habitat; Attached to *Cladophora glomerata* on the shore of Luna island in the rapid water of the Niagara river.

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## NOTES ON THE PHYSICAL GEOGRAPHY OF THE AMAZONS VALLEY.

BY HERBERT H. SMITH.

**M**OST of our common maps indicate a triple division of the Amazons, the Peruvian portion being called Marañon, the Middle Amazons, Solimoens, while all below the junction of the Rio Negro is distinguished as the Lower Amazons. Geographers have treated this division as one of custom and convenience only, and so far as the Peruvian portion, or Marañon, is concerned, they are right; its distinction from the Solimoens is merely nominal, Brazilians and Peruvians speaking of both portions as the Upper Amazons. But this *Alto Amazonas* is constantly and clearly distinguished from the lower or main river. "The Amazons," say the river pilots, "is formed by the junction of the Solimoens and the Rio Negro; the Solimoens is called Upper Amazons because it is longer and has more important settlements on its banks, but it is really a branch like the Negro. Indeed, at the junction it is the Solimoens which forms an angle, while the Negro is directly in a line with the Lower Amazons, so that it appears to be the main river." This idea is universal among the river people, and it has led to many important results. The "Amazons" and "Solimoens" are well recognized in commercial affairs, and they have even formed the basis of a political division, the limits of the provinces of Pará and Alto Amazonas corresponding pretty nearly with those of the Lower and Upper Amazons.

The division is, in fact, much more significant than geographers have supposed. Whatever may have led to the distinction of names, there is a real and well-marked physical division, not only of the river itself, but of the country and its fauna and flora. Mr. Bates is, I believe, the only traveler who has clearly indicated