THE RIVERS PARANA AND URUGUAY.

By JOHN J. J. KYLE, National College, Buenos Ayres.

For some years I have had occasion to analyze the water supplied to the city of Buenos Ayres, and in the year 1872 was employed to examine the water of the Rio de la Plata and of the River Parana, its principal tributary. The object of the latter investigation was to determine the most suitable locality whence to draw the increased supply which forms part of the City of Buenos Ayres Improvement Scheme, now being carried out under the direction of the eminent engineer, Mr. J. F. Bateman, F.R.S. I have very recently had an opportunity of analyzing the water of the other great river, the Uruguay, which, together with the Parana, supplies the enormous volume of water, estimated at 700,000 cubic feet per second of time, which the Rio de la Plata pours into the Atlantic Ocean.

I have not been able to find any reference to the composition of these great South American rivers in any of the standard works on chemistry, and for this reason I take the present opportunity of communicating a few particulars which appear to be of some interest.

The Rio de la Plata, or River Plate, is in reality the estuary of the Rivers Parana and Uruguay, is characterized by its muddy appearance, and always contains in suspension a considerable amount of "colloid" clay. This suspended clay is almost exclusively derived from the immense territory drained by the River Parana. The Uruguay is a river remarkable for its transparency and freedom from suspended matters. The following table shows the proportion and composition of the residue yielded by 1,000 c.c. of each of the three waters—the River Plate, at about five miles above the city of Buenos Ayres, the Parana, at about five miles above its termination in the Plate, and the Uruguay, in the middle of its stream in front of the town of Salto in the Republic of Uruguay:

	River Plate. Grm.	River Parana. Grm.	River Uruguay. Grm.
Sodic oxide.....	0.0212	0.0189	0.0020
Potassic oxide.....	0.0034	0.0046	0.0015
Calcic oxide.....	0.0078	0.0095	0.0055
Magnesian oxide ..	0.0050	0.0043	0.0019
Ferric oxide.....	0.0040	0.0030	—
Aluminic oxide.....	0.0060	0.0030	—
Silicic acid (SiO ₂).....	0.0193	0.0194	0.0185
Sulphuric acid (SO ₃).....	0.0058	0.0079	0.0013
Carbonic acid (CO ₂).....	0.0116	0.0122	0.0071
Chlorine.....	0.0114	0.0149	0.00247
Nitric acid (N ₂ O ₅).....	—	—	0.0019
Organic matters.....	0.0100?	0.0106?	traces.
	0.1055	0.1083	0.039947

Determined directly..... 0.1000 0.1000 0.039500

The three waters were examined by Wanklyn's process, and yielded per liter:

	River Plate. Mgms.	River Parana. Mgms.	River Uruguay. Mgms.
Free ammonia.....	0.07	0.16	0.07
Albuminoid ammonia.....	0.24	0.24	0.10
Hardness (1°=0.01 gm. per liter of CaCO ₃).....	4.00°	4.50°	2.25°

The minute quantities of nitric acid were not determined in the Plate and Parana waters; in the Uruguay water it was estimated by Thorpe's reduction method. Part of the silica and all the alumina belong to the clay which, as already stated, is suspended in the first two waters, and remains in this condition for many weeks. The water of both the Plate and Parana always yields, by Wanklyn's ammonia process, a very large amount of albuminoid ammonia, derived chiefly, I believe, from vegetable organic matters partly in solution and partly adherent to the suspended clay. In spite of this and its opaline, sometimes even muddy, appearance, the Plate water is highly esteemed as a drinking-water.

Beyond this the composition of these two rivers does not call for any further observations. The water of the River Uruguay is, however, in some respects very remarkable. It is probably one of the purest river waters in the world, containing rather less than 4 parts of solid matter per 100,000. It is almost free from chlorides; the determination of chlorine, made with every possible care, gave rather less than one-fourth of a milligram per liter, and this, be it remembered, at a distance of say five hundred miles from its source.

Still more noteworthy, in my opinion, is the fact that about 46 per cent. of the total solid matter consists of soluble silica, not suspended as in the other two rivers. A small proportion exists probably as alkaline silicate, but the greater part is undoubtedly present as hydrated silicic acid. In this circumstance may be found an explanation of the petrifying properties attributed to the water of the Uruguay. On one occasion a cart-wheel was fished up from its bed completely converted into stone. A considerable export trade in agates is carried on by the inhabitants on the Uruguayan shores of this great river, and the stones from the Uruguay are, I believe, those most esteemed by European lapidaries. The free silicic acid dissolved by this river among the mountains of Santa Catharina, in Brazil, is probably the raw material out of which are elaborated the agate mortars so invaluable to every analytical chemist.—*Chemical News*.

VOLVOX GLOBATOR.

By ALFRED W. BENNETT, M.A., B.Sc., F.L.S.

THE organism which we are about to describe has long been a favorite object for observation to microscopists, not only from the extraordinary beauty and delicacy of its structure, but from the remarkable phenomenon which it presents of a member of the vegetable kingdom endowed with a power of motion apparently as spontaneous as that possessed by any organisms belonging to the animal kingdom. The very location of the *Volvox* among plants has indeed been challenged. Like many others which are now placed, by almost universal consent, among the lower classes of Cryptogams, it was held by the distinguished naturalist Ehrenberg to be of animal nature. If, however, any doubt remained as to its true vegetable character, this has been completely set at rest by the researches of Professor Cohn,* who has only quite recently for the first time followed out completely the various stages of reproduction of this singular organism. In no English work will they at present

be found adequately described, although so many observers had before his time had it under their notice.

The *Volvox globator* is not uncommon in clear pools on commons, and in similar situations, and is visible to the naked eye as a minute pale-green globule rolling through the water, passing rapidly across the field of view under the microscope, its full diameter being perhaps $\frac{1}{16}$ of an inch. Under the microscope it is seen that the rotatory motion is caused by innumerable fine transparent vibratile cilia, with which the surface is studded. The appearance presented by the entire body is that of a globular, transparent, hollow membranous sac, through which these cilia protrude, and studded with bright green points, while in the interior are seen a small number of dense green globules. In the autumn or early winter these internal globules have often assumed an orange color, giving to the whole globule a red tinge. The vibratile cilia already described are arranged in pairs, each pair belonging to a separate peripheral corpuscle or cell. These peripheral cells contain each a green protoplasm-body, varying in shape according to the age of the individual, as shown in Fig. 2, a, b; they usually contain a minute starch-granule, a reddish-brown "eye-spot," analogous to that of swarm-cells (zoospores) and of the Flagellate Infusoria, and one or two contractile vacuoles, the cilia being borne at the narrow hyaline end. Each is surrounded by a gelatinous envelope, which is pierced by a number of canals, all lying nearly in one plane, and filled by green or colorless extensions of the protoplasmic interior. Since the canals of ad-

ply by bipartition, and all the cells in the same colony or sphere are usually at one time in the same stage of development. This division has been followed by Cohn through four stages, as shown in Fig. 3, a-e, the fourth stage consisting of sixteen cells, beyond which he was unable to trace it, owing to the difficulty of the observation. At this stage it is described as having somewhat the form of a blackberry, each segment possessing a single chlorophyll-granule containing starch. The young colony is surrounded by a transparent membrane, which it at length breaks through, and carries on an independent existence within the cavity of the mother-colony, each of its cells developing a pair of cilia; finally it escapes from its confinement in the mother-colony into the surrounding water. The normal number of parthenogonia which thus develop into colonies within the mother-colony is eight, corresponding to the eight cells into which each of them breaks up on its third segmentation. The young colonies complete their growth in a few days, attaining a diameter of from 0.10 to 0.15 mm., and have by this time absorbed the greater part of the chlorophyll and starch of the mother-colony.

The sexual reproductive cells, male and female, are very few in proportion to the sterile cells. While the non-sexual reproduction by parthenogonia takes place during the whole year, the sexual cells are apparently formed only in the autumn. The two kinds are found either in the same or in different colonies, establishing the classification of the genus into monœcious and dioecious sub-species, as first pointed

VOLVOX GLOBATOR.

Fig. 1. A monœcious colony of *Volvox globator*—a, a², a³, antheridia; b, b², gynogonidia; b³, b⁴, oospheres. Fig. 2. Ciliated peripheral cells. Fig. 3. a-e, Parthenogonia in successive stages of division. Fig. 4. Complete antheridium. Figs. 5 and 6. Antherozoids. Fig. 7. Oosphere containing antherozoids (see also Fig. 1, b⁴). Fig. 8. Fertilized oosphere. All the figures highly magnified.

joining cells correspond, the corpuscles appear as if connected together by a network of fine reticulations. The outer gelatinous wall of each cell is also perforated by two pores, through which the two vibratile cilia protrude into the surrounding water. They constitute a single peripheral layer enveloping the entire organism, corresponding to the plate which is characteristic of many Chroococcaceæ; each one by itself would be undistinguishable from an ordinary swarm-cell of many filamentous Algæ, or from the entire individual of *Chlamydococcus* or *Pleurococcus* in its motile stage. They have, however, so far as is known, no reproductive function, and in this respect stand almost alone among cells endowed with a spontaneous power of motion.

Besides these non-reproductive or sterile cells, there are in each *Volvox* colony three kinds of reproductive cells—non-sexual (neuter), male, and female. The neuter reproductive cells, or parthenogonia, as Cohn terms them, are similar in structure to the sterile cells, but two or three times their size, i. e., from 0.006 to 0.009 mm. in diameter. Very early in the development of the young colony they begin to multi-

plied by Cohn. Fig. 1 represents a monœcious colony. The two modes of reproduction do not take place simultaneously in the same colony, the sexual generation forming the close of a longer or shorter series of non-sexual generations. *Volvox* presents, in fact, one of the earliest instances in the ascending series of the phenomenon known as alternation of generations, which attains its highest development in plants in the Vascular Cryptogams. The female cells (gynogonia of Cohn) are at first undistinguishable from the parthenogonia, but are much more numerous. On their first appearance they are about three times the size of the sterile cells; their protoplasm-body increases rapidly, and becomes of a dark green color from abundance of chlorophyll. They have at first a frothy appearance (Fig. 1, b) from the formation of vacuoles, but afterward appear to be filled with protoplasm; and they are now at once distinguishable from the parthenogonia by their never dividing. They soon become flask-shaped (Fig. 1, b²), their narrow end touching the periphery of the sphere, and the larger end hanging free into the cavity. When ready for impregnation they round themselves off into

* "Beiträge zur Biologie der Pflanzen," vol. i., heft 3, 1875.