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 globes. In the autumn or early winter these internal globes 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 parthenogonidia 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 parthenogonidia 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, Parthenogonidia 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 parthenogonidia, 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-

out 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 (gynogonidia of Cohn) are at first undistinguishable from the parthenogonidia, 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 parthenogonidia 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.

a spherical form (Fig. 1, *b*), and may then be designated oospheres, each being enveloped in a gelatinous membrane or oogonium. The male cells, or androgonidia, present at first a still closer resemblance to the parthenogonia, since, when they have attained about three times the size of the sterile cells, they begin to divide; but they are of a lighter color, from containing a smaller quantity of chlorophyll. The divisions also take place only in two instead of in three directions, thus developing, not into a sphere, but into a plate of cells. They ultimately resolve themselves into a bundle of naked primordial cells (Fig. 1, *a*), each consisting of a thicker but elongated body, in which the chlorophyll has been transformed into a reddish-yellow pigment, and of a long colorless beak, to the base of which are attached two very long vibratile cilia, and where also is a red corpuscle or eye-spot (see Figs. 4, 5, 6). The whole androgonidium may now be considered as an antheridium inclosed in a gelatinous envelope, each of the naked protoplasmic bodies being a motile antherozoid or spermatozoid. About the same time that the gynogonia have matured into oogonia, and their protoplasmic contents into oospheres, the movements of the vibratile cilia attached to the antherozoids begin to set the whole antheridium in motion, in the positions indicated in Fig. 1, *a*, *a'*; the antheridium soon breaks up, and the separate antherozoids are seen in rapid independent motion within the gelatinous envelope of the antheridium (Fig. 1, *a''*), which they ultimately break through, and then move about rapidly in all directions within the cavity of the mother-colony. Their movements are described by Cohn as being remarkably beautiful, the constant curvings of the elongated neck of the antherozoid being compared by him to those of the neck of a swan. They assemble in large numbers round the oogonia, and some of them finally penetrate through their gelatinous envelopes (Fig. 1, *b'*, Fig. 7), and coalesce with their protoplasmic contents or oospheres. The fertilized oosphere is now an oospore, and develops a new cell-wall, the epispor, which is at first smooth, but afterward covered with conical elevations, giving a section of it a stellate appearance (Fig. 8). A second perfectly smooth membrane, the endospore, is subsequently formed within the first. The chlorophyll gradually disappears, and is replaced by an orange-red pigment dissolved in oil, so that the mature oospore, while still inclosed within the mother-colony, is of a bright red color, giving the red tinge which *Volvox* often presents, even to the naked eye, at certain periods of the year. Individuals containing oospheres still enveloped in their spiny coatings were described by Ehrenberg as a distinct species, under the name of *V. stellatus*. The number of sexual reproductive cells in a colony of *Volvox* varies greatly; Cohn has observed five or more male and about forty female cells.

Soon after the oospore reaches maturity the mother-colony breaks up, single cells escaping from the combination and swimming about freely in the water; their further history is unknown; while the oospheres fall to the bottom and there hibernate. Their further development has only been observed by Cienkowski, who states that the contents of each spore break up into eight spheres which ultimately swarm out.

Ehrenberg described two species of *Volvox*—*V. globator* and *V. stellatus*—both of which he considered to be infusorial animalcules. These have been determined by Cohn to be different stages of the same species, the former in its parthenogenetic, the latter in its sexually reproductive condition; Ehrenberg's *Sphaerosira volvox* is also another form of the same species. His *Volvox aureus* and Stein's *V. minor* are considered by Cohn to form a distinct sub-species of *V. globator*, differing from the typical form in the colonies being of a smaller size, and dioecious instead of monœcious, and in the epispor of the oospore being smooth. The mode of fertilization of the latter form has not yet been directly observed. The genus is cosmopolitan, having been found throughout Europe, in North Africa, India, and North America.

The old family of Volvocineæ, which included the genera *Volvox*, *Eudorina*, *Pandorina*, *Gonium*, and *Staphanosira*, is placed by Sachs, in the 4th edition of his "Lehrbuch," under the *Zygosporeæ*, and in the section characterized by the conjugation of zoogonia (swarm-spores or zoospores). It is evident, however, that the family, as so constituted, cannot be maintained, and Rostafinski's classification must be accepted as preferable, retaining those genera which exhibit the conjugation of swarm-spores as a family of *Zygosporeæ*, under the name of *Pandorineæ*, while the true Volvocineæ are placed in the class of *Oosporeæ*,* in which the process of impregnation consists in the coalescence of one or more minute spontaneously motile antherozoids, which escape from an antheridium, with a comparatively large oosphere contained in an oogonium. The process indeed bears a very close analogy to the mode of fertilization in one of the highest families of *Oosporeæ*, the *Fuaceæ*. The family Volvocineæ, as thus constituted, includes at present only the two genera *Volvox* and *Eudorina*. The structure and developmental history of the latter have been described by Carter.†

RESULTS OF THE RECENT ECLIPSE.

In a letter to the New York Times, Prof. C. A. Young says:

It is early, as yet, to estimate the full scientific meaning and value of the observations made during the recent solar eclipse (July 29, 1878), but it is already evident that, though in some respects disappointing, they are yet, on the whole, of an importance quite equal to those obtained on any similar occasion.

One brilliant discovery will probably date from this occasion, and hold a conspicuous place in the annals of science. The planet Vulcan, after so long eluding the hunters, showing them from time to time only uncertain tracks and signs, appears at last to have been fairly run down and captured. At least it seems to us that the observations of Prof. Watson at Rawlins, and Swift at Denver, must for the present be taken as conclusive, though perhaps not settling the question beyond the possibility of reopening or dispute. The gentlemen are both astronomers of repute, accustomed to sweep for faint objects, and provided with excellent instruments. The negative results of Profs. Newcomb, Wheeler, Holden and others, who, with similar instruments, went over the same ground and found nothing, are, indeed, unsatisfactory and puzzling; but they can hardly outweigh the positive evidence on the other side, though they certainly justify a certain reserve in accepting the conclusion.

Assuming as correct Prof. Watson's estimate of the planet's brightness (four and a half magnitude), it would be more

than forty times fainter than Mercury, and considering its proximity to the sun (which would make it much brighter than if at the same distance as Mercury), it would seem that its diameter must be somewhere between 200 and 400 miles. If really thus minute, it is easy to see how it has so long escaped discovery; indeed, the question at once arises whether there must not be several such Vulcans, to account for that peculiar behavior of Mercury, which led Leverrier, on purely mathematical grounds, to assert the existence of a planet or planets between Mercury and the sun. Mr. Swift, in fact, claims to have seen two bodies—Watson's and another near it.

It is unfortunate that the single observation of Prof. Watson cannot give definite information as to the orbit and motions of the planet; but for this purpose at least three observations are needed, and unless (as Prof. Watson hopes to do) he succeeds in identifying some of the many recorded transits of small black objects across the solar disk, as observations of his planet, it may be long before we shall know anything further about it. There is, however, a bare possibility that it may be recovered in full daylight by arming a large telescope with a very long tube, projecting beyond the object glass, and thus enabling the observer to examine the sky within a degree or two of the sun without letting the sunlight fall upon the lens. If the experiment could be tried at a considerable altitude, where the atmospheric glare is at a minimum, the chance of success would be greatly improved.

As regards the physics of the sun and the corona, the principal and most important result of all the observations bearing upon this subject is to demonstrate a decided sympathy and connection between the condition of the sun's visible surface, as indicated by the number and character of the sun's spots, and the constitution of the corona.

At the present time the sun's spots are at their minimum; whole months have passed without the appearance of a single one. The chromosphere, or colored envelope of hydrogen and other gases which immediately surrounds the sun, has also been correspondingly quiescent, and the so-called "prominences" have been few and small. Of course, it was a question of interest whether the corona also would show a corresponding difference of condition from that indicated in 1869 and the later eclipses, when the sun's surface was in full activity, and the question has received an emphatic and affirmative answer.

As to the brightness of the corona at the recent eclipse, there is considerable difference of opinion. The writer, and he thinks a large majority of those who also saw the eclipse of 1869, is strongly of the impression that in 1869 the corona, though perhaps less extensive, was many times more brilliant, while the corona in 1870 seemed to him intermediate between those of 1869 and 1878. Some of the best observers, however, are of quite the contrary opinion, and it is frankly to be admitted that one's judgment as to the brightness of an object like the corona depends so much upon the condition of the eye at the moment of observation, and that condition so depends upon what the eye has been doing for the last few moments preceding, that no very great weight is to be assigned to such impressions. The writer feels, however, considerable confidence in his estimate of the relative brightness of the three eclipses, because in all three cases his observations were made under almost precisely similar circumstances—near the middle of the eclipse, and after about a minute of close spectroscopic work.

While, however, there may be room to question the conclusion that the corona this year was uncommonly faint, there can be no question that its spectrum was profoundly modified.

The bright lines which come from its gaseous constituents were conspicuous in 1869 and in all the subsequent eclipses until the present one, but this year they were so faint as to be seen by only a few of the observers, while the great majority missed them entirely, seeing only a continuous spectrum. This was especially remarkable in the case of the green corona line (known as "1474" from its position upon Kirchhoff's map of the solar spectrum). Many observers saw it plainly just at the beginning and end of totality, but during the middle of the eclipse nearly all entirely lost sight of it. That it was really present all the time, however, though faint, is proved by the observations of Prof. Eastman, Mr. Thomas and the writer, the former of whom traced it all around the sun to a distance of from 10' to 20', going twice over the ground, and keeping it in sight all the time. With the hydrogen lines the case was similar; the writer had one or other of them in the field continually, and they never quite disappeared, though at times very faint.

Of course, the slitless spectroscopes, both ocular and photographic, from which so much had been expected, failed to give any satisfactory results. In 1871, when the instruments were first used, the observers saw a series of colored images of the corona. Mr. Lockyer, for instance, saw four such images, one red, one green, one blue, and one violet. This year nothing of the kind appeared. At the moment, indeed, when totality began there was an exquisite exhibition, first of the darkness of the solar spectrum, and then for an instant of a multitude of bright colored segments—the spectrum of the chromosphere; but when the moon had covered the chromosphere there was only a disappointing, continuous band of color, unmarked by rings of any kind.

Those, also, who were looking for new bright lines in the corona spectrum were equally unsuccessful, whether they employed the ordinary spectroscope or worked by photography. Some of the observers, the writer among others, used a so-called "fluorescent eye-piece," which brings the otherwise invisible light beyond the extreme violet end of the spectrum within the range of human eyes, by the action of a film of fluorescent liquid (æsculia solution) inclosed between thin plates of glass. But, although before totality the apparatus worked perfectly, disclosing to the eye dark lines innumerable in the portion of the spectrum invisible without its aid, after the darkness came on it failed to show a single bright line. The most carefully prepared and sensitive photographic apparatus succeeded no better, except that Dr. Draper, Mr. Lockyer, and one or two others perhaps, did obtain by means of a slitless spectroscope, an impression of a faint continuous spectrum in the ultra violet, without rings or markings of any kind. Evidently no lines existed to see or photograph on this occasion.

One or two observations were made of some interest in their relation to previous work. Prof. Rockwood, of the Princeton party, using a double-barreled slitless spectroscope, observed at the beginning of totality a bright red line in the chromosphere spectrum very near to B. This explains an observation of Mr. Pogson in 1868, who then insisted that he saw B reversed in the spectrum of a prominence, but as all the other observers had C instead of B, his record was generally regarded as a mistake.

The line is probably one well known to solar spectroscop-

ists, at 534 of Kirchhoff's scale—a line exceedingly difficult to see in the spectrum of the chromosphere under ordinary circumstances, but still invariably present, and exhibitable (if one may coin a word) with proper appliances. Its conspicuousness in Prof. Rockwood's instrument is a matter of some surprise, but there could be no mistake, as C was even more brilliantly conspicuous at the same time. What the substance which causes it may be is quite unknown. Like the so-called D₂ line, it has no corresponding dark line in the solar spectrum.

The same observer, and the writer also, saw both H lines (calcium) brightly reversed in the spectrum of the chromosphere; thus confirming observations made six years ago at Sherman, but never corroborated since, except by the photographic spectrum obtained by the Siam expedition in 1875.

The exquisite reversal of the dark Fraunhofer lines at the moment of totality was seen by many of the observers. One observer, at least (and we believe some others), Prof. Barker, at Rawlins, was able to confirm Janssen's observation in 1871 by seeing the principal dark Fraunhofer lines in the corona spectrum, thus showing that a considerable percentage of the coronal radiance is mere reflected sunlight. The dark lines were, however, so faint as to be seen by very few, and this shows equally clearly, we think, that the particles which reflected the sunlight are themselves also self-luminous, as, of course, they ought to be so near the sun.

A great deal of attention has been paid to the polarization of the coronal light in past eclipses, and while on the whole there has been an overwhelming weight of evidence in favor of radial polarization, yet at every eclipse some observer of reputation has obtained anomalous results quite at variance with all the others. This year Dr. Hastings, of Baltimore, comes out with strong tangential polarization as his result. That he must be the victim of some mistake is almost certain, since all the rest of the observers—Wright, Ranyard, Harkness and others—are emphatic and clear in their contrary conclusion.

Experiments with the tasimeter or new heat measure of Mr. Edison showed, as was ascertained many years ago, that the heat of the corona is quite sensible. With a thermopile attached to a peculiarly arranged spectroscope Mr. Anderson, of the Princeton party, obtained a doubtful result, which may indicate a bright heat-line in that part of the chromosphere spectrum below the red.

It has been represented in some quarters that the results of this eclipse require a fundamental reconstruction of the theories hitherto held regarding the constitution of the corona. This is, however, an entire misapprehension. The same constituents appear in the corona as hitherto, only in altered proportions, as might have been and was expected by students of solar physics. In 1869, 1870 and 1871 the gaseous elements of the corona—the hydrogen and "1474 stuff," whatever they may be—were in such quantity and condition and rose so high above the solar surface that their lines were conspicuous in the coronal spectrum, and attracted the attention of observers far more forcibly than the feeble continuous spectrum of the light emitted from and reflected by the minute solid or liquid particles which also constitute an essential element of the corona. At present the condition is reversed. The gases are either too small in quantity or too cool to be conspicuous. The lesson, and it is an important one, is simply, as has been said, that, to a certain extent, the corona sympathizes with the sun-spots.

It certainly looks probable, also, that while the gaseous elements of the corona are strictly solar, the non-gaseous matter—the coronal dust or haze—is of extraneous and very likely meteoric origin. At any rate, the extent of the corona was certainly not less than on former occasions, whatever may have been the case with its brightness. In fact, it has never been traced quite so far from the sun before as this time by Langley and Newcomb, who followed it out for 6° along the ecliptic, a success partly, of course, due to the clearness of the air at their elevated stations. Now, this is quite consistent with the theory that meteor streams furnish the hazy matter of the coronal envelope, since, so far as we can judge, they have nothing to do with sun-spots.

A very interesting problem relates to the effect of solar forces upon this meteoric matter, if such it really be, and the material for the study is furnished in rich abundance by the numerous drawings made by Langley, Abbe, Penrose, Boss, and others, and by the photographs, which in excellence and number excel those obtained on any previous occasion. Among the best which we have seen are the magnificent series made by Rogers at La Junta, those of Draper at Rawlins, and those of the Princeton party at Denver; undoubtedly there are others of at least equal excellence.

To sum up: The eclipse of 1878 has added a new planet to the system, and has demonstrated that the unknown cause, whatever it may be, which produces the periodical sun-spots at intervals of about eleven years, also affects the coronal atmosphere of the sun.

This undoubtedly adds a certain measure of probability to the idea that these solar periods may produce some effect upon the earth, such as may be felt in our meteorological conditions; and though the writer by no means concurs with Mr. Lockyer in considering that Meldrum's investigations upon Indian cyclones have already demonstrated connection between the sun-spots and the weather, but, on the other hand, thinks the connection almost disproved by results of other investigators, still there can be no question that the subject deserves thorough study.

The result of the late eclipse goes to show such a periodical change in the state of the solar atmosphere as might very possibly produce a sensible effect upon the earth; whether it does or not is a question which can be settled only by a careful and systematic investigation of the facts.

C. A. YOUNG.

Princeton, N. J., Thursday, Aug. 15, 1878.

CURRENT WORMS.

M. B. BATEHAM of Ohio says he destroyed currant worms by the following application:

Having no soft-soap on hand, we took about one-fourth of a pound of hard soap, cut in slices and dissolved in warm water, then stirred in an ounce of crude carbolic acid (costing a dime), and stirred the whole into half a pailful of water. With this liquid we sprinkled the bushes, using a whisk broom, so as to wet all the worms visible. Scarce a live one could be found the next day.

G. WALKER proposes to make up an oil for painters by mixing linseed oil, or some other vegetable oil, with refined petroleum and fish-oil. The mixture is then to be heated with manganese.

* This is the course followed in McNab's recent class-book of botanical classification.

† "Annals of Natural History," 3d series, vol. II., 1858, p. 237.