the sphere from the liquid, the excess of the latter is allowed to drop off, after which the sphere, held by the cylindrical neck, is swung to and fro through the air, being rotated by wrist movement and turned in such a manner as to distribute the collodion as equally as possible over the surface. This treatment rapidly removes some of the alcohol-ether solvent and the black membrane gels. But drying must not go too far. As soon as the membrane has hardened slightly, the sphere is dipped again and the process is repeated. Generally three dippings are found to be best. Some experimentation is requisite to secure the right dilution of the liquid and the right manipulation. After the last treatment and before drying proceeds too far, the blackened sphere is placed under distilled water, to be kept so till it is to be mounted for use.

Collodion-coated spheres may be preserved under water and may be shipped from place to place in sealed pint "Mason" jars, a wrapping of wet filter paper being first applied, to prevent the membrane from coming into contact with the glass wall of the jar. If several layers of wet filter paper are used the jar need not be completely filled with water, but it is generally best to have it full, the sphere cavity being also filled.

The water-impregnated collodion-lampblack membrane will bear a surprising amount of rubbing and it may be cleaned from time to time in the operation of the instrument, by sponging with distilled water and an absorbent-cotton or soft-cloth swab. The membrane is not apt to be injured in ordinary handling. It should never be allowed to dry, for the gel alters on losing its imbibed water and the process is practically irreversible.

The coefficient of correction for a collodion-coated sphere may be slightly different from that for the same sphere before being coated. A blackened and a standardized white sphere placed side by side, in the open preferably and equally exposed to air currents, are read for a night period to secure information as to the coefficient of the blackened one. Both instruments are set after dark in the evening and they are read before sunrise the following morning. The loss from the white sphere is multiplied by its regular coefficient (as hundredths) and the product thus secured is divided by the corresponding loss from the blackened sphere. The quotient is the coefficient of the latter, by which its readings are to be multiplied.

It is doubtless true that the collodion film considerably diminishes the capacity of the sphere wall to transmit water from the supply within to the external evaporation surface, and it naturally follows that evaporation and sunshine conditions may at times be encountered so intense as to surpass the capacity of the coated instrument. But the conducting capacity of the collodion membrane (which should not be unnecessarily thick) appears to be ample for all evaporation and solar-radiation intensities apt to be encountered, excepting perhaps in the most arid climates. This possible difficulty has not yet been experienced, however. The collodion-coated spheres may of course be tested by comparison with similar spheres blackened with washed lampblack by the water method. The latter have proved suitable for the driest hours in the most arid regions. The two forms absorb radiation about equally.

The method here described provides black spherical atmometers that do not lose their coatings when exposed to rain. They can be easily kept clean by occasional wiping with distilled water and a soft swab. With collodion-coated spheres no mercury valve is necessary to prevent absorption of rain and dew. Neither of these desirable features is possessed by spheres blackened with lampblack and water.

Since mistakes may occur, we may add that a general summation of the evaporation conditions is secured from the white instrument alone, which absorbs but little radiation, and that the difference between corresponding corrected losses from the white sphere and from the black is an indication of the radiation influence. Total sunshine intensity, integrated throughout the period of observation, is nearly proportional to the difference just mentioned, as far as the influence of solar intensity upon evaporation from this sort of instrument is concerned. The combination of a blackened and a white sphere operated side by side and thus constituting a radio-atmometer is the most satisfactory means thus far available for measuring the total intensity of sunshine in ecological and physiological studies.

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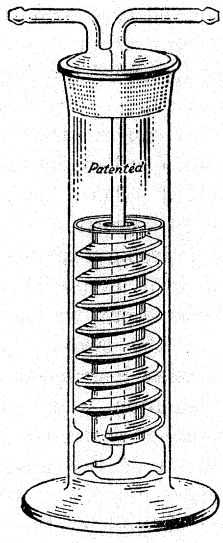
A NEW SPIRAL GAS-WASHING BOTTLE

A NEW spiral gas-washing bottle has been designed in order to meet severe requirements. The new bottle gives excellent contact for a long time between the gas and a definite volume of liquid so that there is good opportunity for complete absorption or saturation of the liquid with gas; the liquid is thoroughly circulated so that all of it is brought into contact with the gas; there are no dead spaces to trap any of the gas.

The bottle consists of four parts, which are rugged and can easily be taken apart for cleaning: an outer

cylinder (1), a cylindrical shield (2) fitting loosely into the outer cylinder and serving to support and fit closely to a heavy inner cylinder (3) the walls of which are pressed in the form of a spiral, and a gas inlet tube (4) integral with a ground-glass stopper and outlet tube. The bottle is filled with liquid up to just above the top of the spiral. The inlet tube serves to introduce the gas at the base of the spiral, and the gas bubbles travel slowly upward circling around the spiral in contact with the liquid until



they escape at the surface. The liquid circulates upward with the bubbles and then downward both through the center of the spiral and around the outside of the shield.

The important features of this bottle have been patented, and it is now available, of American manufacture, fitted with either a ground-glass stopper or a rubber stopper, under the name "Milligan gas-washing bottle."

LOWELL H. MILLIGAN

SPECIAL ARTICLES

SOME FEATURES OF STRUCTURE AND BEHAVIOR IN VAMPYRELLA LATERITIA[1]

DURING the past fall colonies of *Spirogyra Weberi* harboring numerous individuals of *Vampyrella lateritia* were obtained. The manner of feeding of this animalcule is such as to produce repeatedly and in almost precisely the same manner a surgical operation on individual cells of *Spirogyra*—upon which it feeds exclusively, as has long been known—of utmost nicety. Inasmuch as the behavior of the protoplast of the plant had a distinct bearing on certain other behaviors during its conjugation (Lloyd, 1924, 1926), I paid a good deal of attention to the matter and incidentally learned several things about the animal which, officially, I had no right to learn.

Vampyrella has been regarded as homaxial (Hoogenraad).[2] When viewed from above the animal is spherical during free movement, but some facts indicate that it has anterior-posterior polarity. If a central vacuole is present, this is not symmetrically situated. During movement forward the center of the vacuole is behind the topographical center of the animal, and kept thus, albeit the antero-posterior axis suffers oscillations. This movement is produced by long slender pseudopodia, the longest of which project much further than thought by Hoogenraad (1907), namely, about three diameters, and the laterally projecting ones always display characteristic curvatures, there being in each a delicate knee-like bend evidently produced by the strains attending ambulation. Aside from pseudopodia used in walking, long ones extend out in all directions while doing so.

On attacking a *Spirogyra* cell the apposing surface of the animal flattens, long pseudopodia are extended along the algal filament, and, becoming quite amoeboid, he spreads partly around the doomed cell. The long pseudopodia generally disappear (Hoogenraad), only short ones, often pin-headed, clothing the free surface. Within a minute or so the transverse walls of the attacked cell begin to bend gradually inward. By the time the limit of this buckling is reached, the animal suddenly swells. This results from the injection of algal cell contents into the animal through an oval opening effected by digestion of the cellulose (Cienkowski[3]). The stretching of the attacked area of the wall during the earlier period of hydrolysis relieves the turgor pressure—hence the bending inwards of the cell wall—due to the now superior pressure of the neighboring cells. The final bursting outwards of the hydrolyzed piece of wall permits the sudden blowing up of the animal and at the same time the punctured cell is disarticulated. As soon as the turgor pressure is relieved, the animal begins to actively suck out the protoplast. Adhesion of the algal cytoplasm to the wall prevents its ready displacement, but the chloroplast is much more rapidly drawn out. Within one and a half minutes after the hole has been made, the whole chloroplast swells and becomes

[1] Identification based on Leidy's description. "Fresh water Rhizopods of North America," Rep. U. S. Geol. Surv. of the Territory," *12*: (253–256) 1879.

[2] Hoogenraad, H. R., "Einige Beobachtungen an Vampyrella lateritia Leidy," *Arch. f. Protistenkunde, 8*: 216–224, 1907.

[3] Cienkowski, L., "Beitrage zur Kenntniss der Monaden," Archiv. f. mik. Anat. *1*: 203 (218–221, pl. 12–14) 1865.