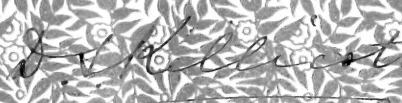
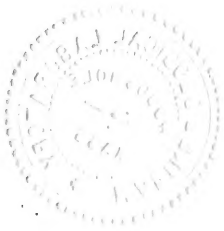


THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL



THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL

EDITOR

ROMYN HITCHCOCK, F. R. M. S.

VOLUME VI

WASHINGTON
GIBSON BROS., PRINTERS AND BOOKBINDERS
MDCCCLXXXV

THE AMERICAN

MONTHLY MICROSCOPICAL JOURNAL

INDEX TO VOLUME VI

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., FEBRUARY, 1885. No. 2.

The Microbe of Yellow Fever—Preventive Inoculation.

BY M. M. D. FREIRE AND REBOURGEON.*

In 1880 Dr. Domingo Freire, professor of biology in the medical faculty at Rio Janeiro, in a memoir which appeared based on his scientific work, had already published the result of his first discoveries regarding the microbe of yellow fever and regarding the employment of salicylate of soda as a curative means. Since that time M. Freire has not ceased to study the question, regarding it indeed from the true point of view, namely, the microbial nature of this fever, the possible culture of the microbe, its physiological and chemical transformations, and finally its attenuation. To-day, after a rigorous experimentation, M. Freire gives the proofs of the contagion, and demonstrates the existence of *ptomaine* in the cases of yellow fever, of which he indicates the character. The culture of the micro-organism and the artificial reproduction of the blackish matter of the vomiting, the infecto-contagious nature of the malady, and finally the inoculation-preventive by aid of a liquid attenuated by culture, have been the object of his researches.

When the blood of a subject recently deceased from yellow fever is examined, or, better still, the blood of an inoculated animal at the point of death by the same disease, there may be seen in the field of the microscope: 1. A considerable quantity of extremely small micrococci, hyaline in appearance. 2. Cellular bodies attaining only one-fourth the volume of a blood-corpuscle. 3. The same cellular bodies larger and more opaque. 4. Large cellules affecting the form of an epithelial cellule of a blackish aspect, showing their torn enveloping coats and permitting to escape a quantity of the above described micrococci.

On the other hand, if in a bouillon devoted to culture by surrounding it with the required precautions, we seek to cultivate the micrococcus found in the blood, at the temperature of 38° to 39°, we see in a few hours its successive transformations and passage through all the states which have been just indicated. If we leave the liquid in repose the inferior part becomes entirely blackish; microscopic observation demonstrates that this deposit is only formed of the cellular envelopes of the micro-organism which has reached the last period of its action. Chemical analysis demonstrates besides that this cellular envelope is transformed into *ptomaine*. It is then easy to deduce from this series of observations that the yellow fever is determined by the presence in the blood of a cryptococcus which follows rapidly all its phases of evolution, and that the blackish matter of the vomiting, or of the dejections of sick persons, is formed only of the debris of this same cryptococcus which has become poison by its transformation into *ptomaine*, and not by the removal of the blood corpuscles through hemorrhage as has been believed for a long time.

Encouraged by his successive discoveries, and proceeding always with

*A paper presented to the French Academy by M. Bouley. Translated by A. N. Skinner from *Comptes Rendus*, November 10th, 1884.

the necessary experimental rigor, M. Freire has accomplished the attenuation of the virus of the fever in a culture liquor, and the transformation of it into a mild or vaccinal virus. In the month of last November the Emperor of Brazil, that illustrious Mæcenas of science, assisted by the ministry of the Empire and the principal members of the medical faculty, wished to perpetuate the work of M. Freire, and authority was given to begin the vaccination of human beings. The facts given by us have not been tardy in producing results, and in four months the number vaccinated exceeded four hundred.

The phenomena observed to follow vaccination are only those which are noticed in a very mild yellow fever: intra-orbital and supra-orbicular pains; very intense cephalalgia; loss of appetite; elevation of temperature; lassitude in the limbs. But all these symptoms cease at the end of two or three days at the most, and the subject returns to health. If the blood of a vaccinated case is examined some hours after inoculation, the micrococcus of yellow fever is found in the blood, but its enveloping coat is no longer transformed into *ptomaine;* it is consequently no longer a poison, and is absorbed little by little and finally disappears.

The experimenattion has not yet been able to demonstrate for how long a time the immunity conferred by this preventive inoculation will continue; but this immunity at the outset is absolutely certain, and examples the most striking have demonstrated it to us. Amidst us large numbers of those inoculated have been able to live in localities positively contaminated, seeing every day around them the yellow fever thinning out the ranks without experiencing the slightest attack of the malady. We have seen likewise in the course of our experiments at that time, under the influence of the high temperatures of these regions, the laboratories to become literally invaded by the microbe, animals recently purchased as subjects of experiment to die of yellow fever spontaneously and in a few hours, while certain others inoculated for prevention have perfectly resisted, giving all the signs of perfect health.

I close by claiming to establish for M. Freire the question of priority, and in promising to give very soon new details, supported always by experiment.

——o——

The Study of Vegetable Fibres.

In the National Museum there is a large and valuable collection of textile fibres, which shows that the world is by no means dependent upon the best known fibre-yielding plants, cotton, hemp, flax, and jute, for its textile fabrics. Cotton and linen cloths are so common and so cheap among us that we scarcely think of the possibility of any substitutes for them. Yet in other lands the conditions may be very different; and it is interesting to look back among the early inhabitants of the world, and trace the progress of the textile industry through its various stages. We see how each nation has learned to utilize the materials nature has provided; where cotton was abundant it was woven into cloth, where the flax and hemp flourished their valuable fibres were extracted; fine linen is a very ancient fabric. This part of the subject, however interesting, cannot be dwelt upon here, nor can we refer to the circumstances which have led many persons to spend much time and money in the cultivation of other fibrous plants, and inventing machinery to extract the fibres from them. It would seem that nothing could supersede cotton for spinning and weaving such fabrics as are most constantly in demand. Yet it may be that the time is not far distant when it can no longer be said that 'cotton is king.' Even now it has a rival in the ramie, the Chinese nettle, *Bœhmeria nivea*, in the fineness to which it can be spun, for the pure white, silken fibres of the ramie,

some beautiful specimens of which are in the National Museum, have furnished a thread so fine that one pound of it would measure 77,000 yards.

For experimental purposes cotton has been spun very much finer. The finest cotton thread of which we have any knowledge was mentioned on page 217 of vol. ii of this JOURNAL where it is stated that a pound of cotton has been spun into a yarn over 715 miles in length. This represents 1,258,400 yards, and would correspond to number 1500 thread. Where this was done we do not know, as the record we have does not specify the mill. The Willimantic Linen Company, of Connecticut, has spun some thread almost as fine. This company has spun cotton thread as fine as number 1,100, which would give 924,000 yards to the pound.

The extreme fineness of this thread may be better appreciated when it is said that the finest thread in demand is number 200, and few persons use anything finer than 150. We have some specimens of 400 three-cord thread, 112,000 yards to the pound, from the Willimantic Company which measures about 100μ or .0039 inch in diameter. This represents the diameter of three threads twisted together, from which some idea of the extreme fineness of the higher numbers may be formed.

There are many plants growing in different parts of the world which are of more or less value as sources of textile fibres; some of them are only useful where they grow for making ropes, or nets for fishing, others have already acquired more or less commercial importance, and are used in the manufacture of paper or for mixing with more valuable fibres in spinning.

It becomes, then, a matter of considerable importance to be able to distinguish fibres of different kinds in woven fabrics, and this is only possible by the aid of the microscope.

The microscopical examination of fibres also leads to more than a knowledge of the peculiarities of fibres and the means of distinguishing between them. In the hands of experienced persons the microscope throws much light upon questions of practical importance to spinners of yarns and to dyers. This is a branch of the subject that is too technical for this place. It may be said, however, that the value of a fibre for spinning depends upon its fineness, suppleness, length, and strength. In the case of wool we have the further qualities of natural curliness and imbricated surface, which causes the fibres to cohere and mat together. The ramie is exceedingly well adapted to spinning, the fibre being very soft, averaging about 120mm. in length. Obviously it has a great advantage over cotton in respect of length. The cotton fibre, however, makes durable garments by reason of its great softness and flexibility, due to the purity of the cellulose of which it is composed.

In this article we shall confine ourselves to the examination of fibres from the vegetable kingdom.

The best authority upon the microscopical characters of vegetable fibres is M. Vétillart, whose valuable work, 'Etudes sur les fibres,' is the most complete yet published, although it only treats at length of a comparatively small number of the textile fibres now more or less used. M. Vétillart examines fibres in several ways, and one cannot do better than follow the course he has laid down. We shall give the method of examination as carried out in the National Museum for the examination of fibres, and the method of mounting specimens for microscopical study, or for reference and comparison.

The fibres are first separated from each other, so that single ones can be readily collected and isolated. In most cases a simple soaking or boiling in water suffices to effect the separation, but if not, boiling in a weak solution of washing soda soon removes the resinous or gummy ma-

terial which binds them together, and makes them readily separate when pulled apart with needles. The soda should be thoroughly washed out, when the fibres may be allowed to dry.

The microscopical examination is conducted in a mixture of equal parts of water and glycerin. The fibres are placed in the mixture or on a slide, a $\frac{1}{8}$-inch cover-glass applied, and the examination conducted with a $\frac{3}{5}$ and a $\frac{1}{3}$ objective. The general character of the fibre is thus quickly made out, and if it should be one of the more common forms, it would be immediately recognized. If it should be a fibre with which the observer is not familiar, it is first examined carefully, the diameter of the fibres measured, and the appearance of the ends particularly noted. The next step is to treat it with reagents, unless it should seem desirable to measure the length of the fibres at this stage. The length is measured by stretching some of the fibres out on a slip of glass, in water or glycerin, and measuring their length in any convenient way.

Two reagents are used in the examination of fibres, one a solution of iodine, which is allowed to act for a few moments, and then followed by the second, which is sulphuric acid of a certain strength.

The iodine solution is prepared by dissolving one gramme of potassium iodide in 100 c. c. of water, and adding iodine to saturation, leaving a portion of iodine undissolved in the fluid to maintain its strength.

The sulphuric acid solution is made by mixing two volumes of glycerin and one of water, and to this mixture, kept cool by surrounding it with cold water, is added with constant stirring three volumes of commercial sulphuric acid.

When a fibre is treated in the manner to be described with these two reagents, it becomes colored either blue or yellow, depending upon the purity of its cellulose. Pure cellulose is colored blue, but when mixed with matters which frequently accompany vegetable fibres, particularly such as are hard and inelastic, the blue color is concealed by the impurities, and various shades of yellow result.

The strength and suppleness of a fibre depends upon the purity of the cellulose. The yellow color indicates that the fibres are of a woody nature, short, and brittle when bent, although they may be strong in a longitudinal direction. Among the most valuable fibres giving a yellow reaction are the New Zealand flax, *Phormium tenax*, the bowstring hemp, *Sansiviera zeylanica*, and the pita of our southern countries, obtained from some of the agaves, specimens of which can always be obtained from the leaves of the common century plant. Most of the fibres from the palms also give the yellow color.

These reactions afford a ready means of separating fibres into two classes, those which are colored blue and those which are colored yellow. M. Vétillart has made a further division, separating the mono- and dicotyledonous plants, certain ones of each division taking the blue and others the yellow.

To apply the reagents a portion of the dry fibre is placed on a slide, and a few drops of the iodine solution added to it. After a few moments the liquid is removed by the use of blotting-paper, which is caused to absorb as much moisture as possible by pressing it gently upon the fibres.

The cover-glass is then applied, and the sulphuric acid solution allowed to flow under one side while a piece of blotting-paper absorbs it on the opposite side. The characteristic color soon shows, even to the naked eye, and the appearance of the fibres under the microscope is almost sure to lead to their identification.

Among the fibres giving a yellow reaction jute is the most common, and will serve well for experimental trials. Much of the coarse bagging or sacking, burlaps, gunny-cloth, etc.,

contains jute, or is made entirely of that fibre, which also enters into the composition of the cheaper grades of ingrain carpets, matting, twine, and rope.

M. Vétillart has arranged a scheme for the systematic examination of fibres, which gives the distinctive features of the different ones in a very concise form. It is intended to aid the observer in identifying unknown fibres. The arrangement will be translated and published in our next number.

When a typical specimen of any fibre is examined, it is usual to prepare several permanent mounts for the microscope, to be used in comparing different fibres. To be useful such mounts must show the fibres precisely as they appear when examined in water and glycerin. They are therefore mounted in the same mixture. The mounting is very quickly done, and the preparations are permanent.

The slides are first prepared with thin rings of shellac, of the proper size to receive $\frac{3}{8}$-inch cover-glasses, and set aside for use as required.

The fibres having been prepared as described above, by boiling in soda, and separated by needles, are then selected for mounting. It is desirable to show all parts of a fibre on each slide. Suppose we have a fibre ten inches in length, and desire to mount it for study. The mount must show both ends of the fibre and different parts along the length. Several such fibres are therefore chosen, placed together in the hand, and pieces cut off from the ends half an inch long. Then at various places along the length other pieces of the same length are cut off and the rest rejected. Thus a good set of specimens for mounting is obtained, which is sure to give all the needed characters—the appearance of the ends, the diameter in different parts, etc. The pieces are placed in the glycerin and water mixture, while the slide to receive them is made ready.

One of the prepared slides is now selected, placed on the turn-table and a coat of thin shellac laid over the hardened ring. Almost immediately a few drops of the mounting medium are placed within the cell, the specimens to be mounted transferred to it, the cover-glass applied, pressed down gently on the fresh shellac, to which it becomes quickly attached. As the excess of liquid is forced out it is absorbed by pieces of blotting paper. The slide is now set aside and others mounted in the same way. In the course of ten minutes the glycerin can be washed away from the surface, under a tap or, as we prefer, by directing a fine stream of water upon it from a chemist's wash-bottle. It is then partly dried with blotting-paper, and in a few moments will be perfectly dry. A ring of shellac is then run around the cover-glass to ensure against leakage, and the slide set aside until a convenient time for finishing it, which may not be for several weeks.

The finishing consists in a coat of asphalt and gold size in equal parts, followed by a ring of asphalt alone.

—o—

Revivification of Infusoria.

BY JABEZ HOGG.

The mysterious revivification of many of the minuter forms of infusorial life, notably rotifers, or as they are more commonly called, wheel animalcules, cannot fail to surprise and interest those who may for the first time witness their evolution from a few small particles of earth or dust. A drop of water is sufficient to awaken from their longest sleep whole colonies of desiccated rotifers—will in a few minutes restore them to life and vigor and send them on their way rejoicing, just as their ancestors had gone in ages past.

I have previously described a series of observations made under the microscope which seemed to show the indestructibility of those delicately and

exquisitely organized animals, rotifers. To me it appeared that these wonderful infusorial animalcules enjoyed life all the more keenly for being subjected to a prolonged state of suspended animation, for on each occasion of revivification they instantly resumed their functional activity all the more eagerly, and precisely at the point where it was so rudely broken off or interrupted. My experiments, now extending without a break over a third year, have been slightly varied from those of previous years, inasmuch as several members of the Ciliata and Tardigrada families have been included in them, and these have, although not to the same degree, exhibited a remarkable tenacity of life. I have likewise brought the intervals of sleep and vigorous life into strict accord with the durations of dry and wet periods of the year, so that my pets have been kept in a perfectly dry condition during the whole of the long drought which characterized the past summer. Moreover, some older dried specimens were subjected to an artificial process of desiccation. They were kept for a time in a hot-air chamber, the heat in which was raised to 200° F., and subsequently the miniature aquarium in which they were inclosed was plunged into a freezing mixture. Neither process killed them nor greatly diminished their vital powers, their revivification in both cases being somewhat delayed.

Certain toxic agents known to exert a baneful influence over animals standing higher in the scale of life were added to the water supplied to the rotifers, but in no way did they produce discomfort; on the contrary, portions were taken into the stomach and partly digested. On the other hand, a drop of sewage water caused marked discomfort; they immediately retracted their rotating organs and sank down to the bottom of the cell. These were, so far as I can ascertain, poisoned, and this was probably owing to the free sulphide of hydrogen which my nose told me was being evolved by the putrescent sewage. I lay more stress on this fact because it is said that these and other forms of infusorial life live and thrive in stagnant water. Nothing of the kind: they require a free supply of oxygen, as do other aquatic animals. The wheel-like organs surmounting the elongated body of *Rotifer vulgaris*, and which are seen constantly in motion when the animal is in health, have a treble task assigned to them—that of furnishing a supply of food, renewing the fresh air, and assisting in locomotion. From my observations I am led to infer that rotifers will live and multiply on a very scanty supply of organic matter, provided only that the water is fairly well oxygenated. One other noteworthy change I ought to mention, the greatly diminished or no longer developed eye, due, no doubt, to the withdrawal of the stimulus of light, my rotifers being nearly always kept in the dark. Of the sexes, the females greatly preponderate over males.

In some considerable colonies not a male can be seen. The remarkable power the rotatoria and some few other infusorial families have of resisting, as already pointed out, the extremes of heat, cold, and long-continued drought on desiccation, must excite a desire for a closer acquaintance with these monads, these curious specks of organization.

So far as I can make out, the preservation of the rotifer under ordinary circumstances is due to two especial adaptations. The outer integument or skin, although composed of a firm material, is divided, like a coat of mail, into four or five segments; these are under the control of a set of longitudinal muscles, which, when called into action, enable the little creature to shut itself up, telescopic fashion, and, sinking down, it assumes an ovoid form. As the water in the cell dries up a secreting organ is brought into play, and exuding a gelatinous kind of fluid, covers it with an insoluble envelope, and secures it from

further change. Thus we are furnished with an example of organized matter which for months or years shows no evidence of life; indeed merely possessing a property which, when acted upon by an appropriate agent, gives rise to a series of actions which we recognize as life.—*English Mechanic*, from *London Times*.

—o—

A Solid Watch-Glass.

Our readers have already heard of the solid watch-glass, devised some time ago by Dr. A. C. Mercer, and now favorably known to many investigators as the Syracuse solid watch-glass. The illustration, Fig. 11, represents the glass. It is made of a solid piece of glass, one surface deeply concave and the other slightly so. They are furnished either plain or with surfaces polished, as may be desired. The most desirable form, probably, on account of utility and moderate cost, has upper and lower edges and concave bottom, cut and polished.

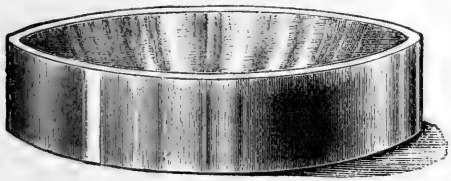


FIG. 11.—The Syracuse Solid Watch-Glass.

The good features of this glass are thus set forth in the circular advertising it:

'The Syracuse solid watch-glass rests solidly upon the table, or microscope stage, and is not liable to be overturned and its contents spilled.

'It is transparent and can be used over black, white or colored paper, enabling the student to use such backgrounds to his work as will permit him to watch its progress to best advantage.

'In it, on the microscope stage, can be examined from time to time, or dissected and studied, transparent tissues while in water, alcohol, oil of clove, or other bath, enabling the student to reject unsatisfactory specimens at any step in the process of preparation.

'When the top and bottom edges are cut, one watch-glass rests dust-tight upon another or receives accurately a piece of plate-glass as a cover. In such a watch-glass, covered, specimens may remain for long staining or soaking without becoming dirty and without loss of fluid by evaporation.

'When the concave surfaces are polished, the watch-glass is as clear as a lens and becomes a perfect receptacle for transparent dissecting material on the microscope stage.'

Having used some of these glasses ourselves, and seen them in use in laboratories, where they have given the utmost satisfaction, we take pleasure in commending them to microscopists. They may be obtained from Dr. Mercer, Syracuse, N. Y.

—o—

Colored Rains.

The following memoranda of colored rains are, presumably, reliable, but we have no clue to the compiler. They are taken from a newspaper clipping, and seem to be records of observed phenomena of some kind. The dates may prove of value to those who have occasion to look up the matter more fully:—

On the 5th and 6th of November, 427 A. D., there was a fall of black dust in the neighborhood of Constantinople, and the atmosphere seemed to be on fire. Marcellus ascribed it to Vesuvius.

Again, in 625 A. D., red dust fell in Constantinople.

At Brixon, in the Austrian Tyrol, in 869 A. D., red rain fell for three hours.

A red sand fell in Bagdad, in 929 A. D., and for many hours previous and subsequently the atmosphere was tinged with red.

In 1056 A. D. there was a fall of red snow in Armenia.

In 1110 A. D., in the province of

Vaspouragan, in Armenia, a flaming body fell into Lake Van, and the water became the color of blood.

In 1219 or 1222 A. D. (the date is uncertain) a red rain fell in Bohemia. At the same time there was a fall of fine sand and a mass like coagulated blood.

On November 6th, 1548 A. D., in Thuringia, a ball of fire fell with great noise, followed by a reddish substance like coagulated blood, which remained covering the ground for a long time.

In Pomerania, in 1557, there fell large flakes of a substance resembling blood.

On December 24th, 1560, at Lillebonne, in Lower Seine, France, a meteor fell, followed by a red rain.

At the close of a terrible tempest, on July 5th, 1582, there fell in Rockhausen, in Prussia, a quantity of fibrous matter resembling human hair.

On December 3d, 1586, there fell in Verden, in Hanover, large quantities of matter, black and red, accompanied by lightning and thunder.

In August, 1618, a meteor fell in Styria, accompanied by a blood-red rain.

In 1638, at Tournay, in Belgium, a red rain fell.

In January, 1643, a blood-red rain fell in Voehigen and Weinsberg, in the kingdom of Wurtemberg.

On March 28th, 1663, there fell near Laucha, Prussia, a shower of fibrous substance like blue silk.

On January 31st, 1663, there fell in Norway a great quantity of membranous substances friable and like half-burnt papers. Baron Gotthaus analyzed a portion of the substance, and found in it silex, iron, lime, carbon, magnesia, a trace of chrome and of sulphur, but not a particle of nickel, which is always present in aerolites.

On March 24th, 1718, on the Island of Lathy, in India, a ball of fire fell, and after it a gelatinous red substance.

On October 14th, 1755, a blood-red rain descended at Locarno, Switzerland. Nine inches of rain fell, and it was ascertained that the red matter contained in this shower was an inch deep by actual measurement. The same storm reached Swabia, on the Alps, and there changed into a reddish snow, which fell to the depth of nine feet.

In March, 1808, at Corniola, Germany, there was a fall of five feet of red snow.

In 1813, according to Von Humboldt, there was a fall of red-colored hail in Palermo.

The same year, according to the same authority, there was a fall of orange-tinted hail in Tuscany.

A brick-colored snow fell in Italy in 1816.

On August 13th, 1819, a mass of gelatinous matter fell in Amherst, Mass.

In 1841 two blood-red rains are mentioned—one in Massachusetts, the other in Tennessee.

In 1843 a man named Ingelow and his sons were picking cotton on a plantation in Laurens district, near Eurole river, South Carolina, when out of an almost cloudless sky great particles of red gelatinous matter fell in a shower.

In 1867 a similar rain fell in Albany, and the late lamented Dr. Jacob T. Mosher, of happy memory, made an analysis of it. He found it contained germs of marine growth, likely *Fucus platycarpus*.

——o——

Photomicrography at the Health Exhibition.*

At the same table will be seen a beautiful little aëroscope connected with chronometric clockwork, which causes the rotation of a leading central screw attached to a frame that carries a piece of glass like an ordinary microscope slide, divided by lines into twenty-four hours and one extra. This is smeared with a sterilized viscous material and turned face down, so that when the experiment is begun the extra line corresponds with the

* From the *Brit. Journ. Phot.*

aperture in the funnel opening beneath. The clock, being allowed to act for an hour, brings the line of the next division into registration at midday. The instrument being attached to an aspirator and air-meter, the air is sucked through the funnel, leaving the germs, bacteria, fungi, &c., on the glass as it traverses centrally across the orifice of the funnel at the rate of an hour between each graduation. This is a most useful and ingenious instrument, but rather costly.

There is another of a somewhat similar function, consisting of a bell glass inverted over another with a ledge, which can be filled by vaseline, glycerin, or oil to render the inner space air-tight, whilst a disc divided into separate spaces and covered with a sticky material is made to rotate by a drum clock beneath, so that the divisions are brought opposite to a long slit ground out in the upper part of the bell glass for the air to enter. At the conclusion of the experiment the glass plate is removed and examined by the use of the microscope, though the naked eye can detect differences between the hourly deposits.

There is another small nickel-plated aëroscope attached to an ordinary water aspirator; a portable aspirator, consisting of two large glass jars, for drawing over a moderate but definite quantity of air, and an ordinary water aspirator; also a mercurial one for the drawing over fractional portions of air. Likewise on two pillars at the corners of the table are the modified forms of the Maddox aëroscope, as used at sea and on land. There are different forms of sterilizing apparatus both for hot and cold filtration, and several flasks with readily alterable fluids which have thus been sterilized, and remain perfectly clear. There are some useful little glass culture cells—a modification of Van Tieghem and Lemmonier's cell—and delicate pipettes for infecting the droplet of sterilized fluid placed on the thin cover glass for microscoipc examination under culture.

To the exhibits is added a very valuable list of disinfectants, and such articles as prevent the rejuvenescence of bacteria in readily-putrescible fluid, the biniodide of mercury heading the list; 0.025 of a gramme preventing the putrescence of one litre of neutral beef broth—a thousand times less in weight than what is required of crystalized phenic acid. This list alone suffices to particularize Dr. Miquel's patience and industry. (See *La Semaine Médicale* for 30th August, 1883.) It may be stated that the mildews, which are constant in the air, interfere largely by their rapid growth in the culture chamber if the sterilized liquid be at all acid; hence care is needed to neutralize, or even render slightly alkaline, the liquid in use. Dr. Miquel has raised an important point, much overlooked, as to the death and reviving points in different liquids, and the same liquids at different degrees of density. There are also M. Certes' exhibits of water analysis by coloring the different living organisms.

At the same table are other exhibits, and notably some microscopes by Verrick, and large model microscopes by Nachet, accompanied by a photomicrographic camera. This differs from any we are acquainted with, in that it contains a side tube carrying a prism, used in the examination and placing of the object, and which allows of the prism being withdrawn out of the field prior to exposure, so that a person seated at the side can manipulate the apparatus with ease. The camera is of a fixed length, and carries at the side the focussing rod, connected by a pulley and cord with the fine adjustment. We rather object to the position of the focussing-rod, which, like that made by Siebert, we fear may be somewhat in the way.

We must not longer linger over the interesting objects of this exhibit, which we heard a gentleman say was one of those of the greatest interest in the Exhibition, but pass to the table of M. Pasteur—a name too widely

known and appreciated for us to attempt to further eulogize. His valuable contributions to the study of vinegar formation by aërial germs; his work on beer, with studies of the different yeast ferments, and the part they, with other more minute organpisms, lay in giving various flavors to beer; his mode of heating wine, (Pasteurizing); his extensive studies on the silkworm disease; his experiments on the cholera of fowls; his efforts to lessen the dire mortality in animals from cattle plague, by the inoculation of a modified form of the virus—all commercially attest to his genius and the value of the microscope. A list is given of the number of animals vaccinated, compiled from the combined labors of his assistants—Chamberland, Roux, Thullier, and others.*

The above will suffice to induce those interested to examine the various forms of apparatus used in the culture and preparation of sterilized fluids. Among numerous flasks filled with such liquids, notably there stands a large flask—one of historical date—with which he confronted Baron Leibig's theory of fermentation, and showed that the minute living yeast cell was capable of inducing molecular changes in inorganic media. In 1848 he was led, through the discovery of left-hand tartaric acid, to the constitution of racemic acid. There are bottles of the right and left-hand tartaric acids—pasteboard models of the same—'the one, if seen reflected from a mirror, being the image of the other.' In 1858 M. Pasteur found that the right-hand tartaric acid in neutral media will ferment through the action of living ferments, and that these act chiefly on the right-hand acid. There is a phial of tartrate of ammonia, procured from the fermentation of racemate of ammonia, the right-hand salt being decomposed and the left remaining intact. It was supposed by M. Pasteur 'that the molecular dissymmetry of organic substances might have an influence on actions of physiological and vital order,' and was so stated.

There is blood drawn from a healthy rabbit into a sterilized tube, which for years has remained unaltered; also various culture liquids; single and double branched tube-flasks. The doubly-branched tubes admit of the sterilized fluid being infected in one, while the other is kept normal for comparison. There are also a self-closing digester with manumometer for sterilizing liquids; an oven for heating flasks; Schloesing's temperature regulator for water bath, which works by the dilitation of mercury; funnels for the hot filtration of viscous liquids; water-bath and regulator; funnel and water-bath; Moitessier's regulator for gas pressure; D'Arsonval's stove and thermosyphon; D'Arsonval's stove, with constant level and temperature effected by means of the D'Arsonval regulator. This is made by Weisnegg, and admits of very minute estimation of temperature—'to the $\frac{1}{10}$th of a degree.' Possibly this might be useful, if modified, for gelatine emulsion making. There are other cultivating stoves.

Exhibited also is Pasteur's experimental brewing apparatus without the entrance of air; a gas stove for sterilizing and drying vessels, and hot bath for sterilizing by heat up to 120° C.; a biscuit porcelain filter for filtration in vacuo; a water filter, invented by Dr. Chamberland, for filtering through unglazed porcelain tubes at the normal water pressure. These can be readily removed, cleaned, and even rebaked for use when soiled. We must not omit the historical flasks opened by M. Pasteur at different mountain heights.

There are also various forms of apparatus which have been required for special purposes. There are beautifully-made transfusion and vaccinating instruments; the cautery of Dr. Pasquelin for bloodless operations; a

* Dr. Thullier unfortunately succumbed to cholera during his study of this epidemic in Egypt; Dr. Roux and Dr. Straus are now occupied at Toulon in the study of this serious malady.

modification of Dr. Roy's, and sliding microtomes; Yerrick's microscopes; large and medium stands; lithographs, plain and colored, of the silk-worm moths, caterpillars, internal organs, and figures of the disease corpuscles; figures of many figured ferments found in beer and wine; also drawings of the vinegar process; while adjoining will be seen the mode of examination of silk-worm moths, as carried out on a large scale, with much that is interesting in this fortunately recovered silk-worm rearing, the loss of which would have proved most serious to France; and close to this exhibit is a model apparatus and drawings of the mode of Pasteurizing wine by one of the large wine merchants—M. Houdart. Besides what we have enumerated, there are a few photomicrographs from negatives by Dr. Roux, which have a special claim for notice.

We had the pleasure of examining two small negatives about the size of a sixpence, which bore enlarging up to the ordinary lantern size of transparencies, and to the fidelity of these we can testify. These negatives go far to support what is not generally allowed—that better negatives of bacteria and very minute objects can be produced without the eyepiece, by obtaining more perfect small negatives, than by original large direct negatives. There is, of course, the additional trouble of copying and enlarging; but we must not let this stay our hand when we are seeking for the best work. The plan adopted by Dr. Roux, which is one to meet rapid laboratory work, was to fix a small camera or cell to the eye end of the microscope containing the little gelatino-bromide plate, the position of the focus and the image having been previously determined by placing a piece of plain glass in the slide, and on its upper surface a few scales of moth or butterfly. These are brought into focus by a low-power objective used as a focussing-glass, and the image of the object on the stage of the microscope and the image of the scales are made to coincide. Hence, by withdrawing the little camera and inserting the focussing objective, the focus of any object on the stage can be made to occupy the exact position of the scales on the transparent glass. In other words, the focus of these and the new image are coincident, and, the surface of the small gelatino-bromide plate falling exactly on to the same plane, there can be no error through the different thickness of the glass plate, as the focus of the scales, the image of the object, and the sensitized surface are in one plane.

The illumination is by a small paraffine lamp. The arrangement is simply removal of the eyepiece, insertion of the focussing objective, and then the fixing the little camera into position. There is no reason why a somewhat larger camera may not be used, and a rather longer and larger tube adapted to the working microscope, or the camera may be in part supported, as suggested by Dr. A. C. Mercer, of Brooklyn, U. S., by a strut from the stand of the microscope. For the most perfect work it would, perhaps, be preferable that the camera should be only loosely connected with the eye end of the microscope, though otherwise a fixture. The plan of development adopted by Dr. Roux was that, we believe, recommended by Colonel Stuart Wortley, of soaking the plate in weak ammonia before applying the pyro., and then adding ammonia, as required, to bring up the image. We would strongly recommend examination of these exhibits, and we must again remind those disposed to aid photographically in the study of the bacteria, that patience—the common virtue of the photographer of the infantile world—will be largely requisitioned, even under favorable circumstances.

There are other photomicrographs in the gallery of the Albert Hall; and in Dr. Cheyne's laboratory will be seen some of Dr. Koch's photomicro-

graphs of the bacteria of disease, and a Siebert's camera; but we must not further particularize.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol. III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

BEADING OF AMPHIPLEURA.—Doubtless many of our readers, especially those who read foreign journals, have of late heard more or less about the beaded structure of *A. pellucida*. Dr. Van Heurck has been trying to photograph the beads, which he claims to see, but with only indifferent success. Not much has been said in these columns about the matter, for the reason that we have not been quite prepared to accept all that has been said about the visible beading on the frustules.

It was our good fortune to have the pleasure of meeting Prof. Hamilton Smith during our recent visit to New York. We happened to meet in Mr. Woolman's store, where there was an opportunity for a few words about microscopy in general and his own recent work in particular. Prof. Smith freely expressed his doubts as to the reality of any beaded structure of the *A. pellucida* which he had seen. Being well acquainted with the Spencers, whose objectives he regards as equal to any in the world, and having the assistance of their skill in manipulation, being also, as we all know, himself a skilful operator, it would seem scarcely credible that a true beaded structure could escape their united efforts to discover it.

We hope to give a summary of Dr. Van Heurck's observations before long. When his photographs are published microscopists will be able to form an opinion of what he has observed. At present their attitude must be one of doubt concerning the reality of the appearance. Prof. Hamilton Smith asserts that he can at any time show a beaded appearance, which is purely an illusion, and is visible even with a $\frac{1}{4}$-inch objective. The diatoms coated with silver, prepared by Dr. A. Y. Moore, which Dr. Van Heurck has used, have failed to show any peculiarity of marking in the hands of other competent observers. We look with great interest to the forthcoming photographs.

—o—

POSTAL CLUB BOXES.—Box D^2 reached us December 16th, with the following preparations:—

1. Internal organs of beetle. Dr. W. W. Munson. Preparation made by S. N. Cowles.

2. Frond of fern showing sporangia, etc. E. L. Cheeseman.

3. Transverse section of stomach of frog. G. W. Worcester. Stained with eosin. Evenly cut but rather thick section.

4. Child's kidney, stained section. C. K. Wells. Not a very even section, but some parts show well.

5. Vertical section of tea-leaf. Fred. T. Aschman. A very interesting section; but its points of special interest should have been mentioned in the letter accompanying the box.

6. Transverse section of cat's tongue, injected. A. T. Veeder. This is the most attractive specimen of all to look at under the microscope, although not very neatly mounted.

Not one of the preparations in this box are described, and they do not possess the interest to the club they might otherwise have. We trust that as new slides are put in the boxes this year there will be a general im-

provement in this respect. We also hope there will be more preparations of real merit, which show care in selection and mounting. There are still a few slides in the circuits which we strongly suspect to be carefully selected from discarded or inferior lots. The club is worthy of one's best work on at least a single slide, every year.

Box CC, one of Cole's 'Studies,' was received in this circuit January 10th.

Box 28 came into this circuit January 19th, containing six preparations by Dr. T. B. Redding.

1. Alveolar sarcoma. Some doubt being expressed as to the true character of this growth, Dr. G. N. Krüder verifies the diagnosis, 'sarcoma is round-celled variety.' A drawing in color, with brief description and letters of reference, show the special characters of the preparation.

2. Transverse section through centre of foot of human fœtus.

3. Transverse section through posterior part of human tongue.

4. Human larynx and œsophagus, from fœtus.

5. Section of heel of human fœtus..

6. Preparation of human stomach.

These sections are all well cut, stained, injected, and mounted, and must prove of interest to histologists and others.

Box C^2 reached our circuit February 3d. It contained the following preparations:—

1. Diatoms covered with pyrites. H. Carvill Lewis. No further account of these diatoms is given, but it may be assumed they are from the deposit known as the London clay. The preparation would be none the less instructive were it less roughly mounted. Mr. A. C. Cole has mounted some fine specimens of these diatoms. Certain persons in England, not being able to obtain good specimens, started the novel idea that Mr. Cole had electro-plated them!

2. Dust from the Krakatoa eruption. H. C. Lewis. Collected on the barque 'William H. Blase.' The reader may refer to p. 101, Vol. V, for an account of the peculiarities of volcanic dust. The specimen is an excellent one for study.

3. This is marked 'Pollinia of?' It is from Mr. W. H. Walmsley, who seems to have been in a terrible hurry when he put it in.

4. Sections of sassafras wood. E. Pennock.

5. *Comatricha longa*. Geo. A. Rex. The thready skeleton of a myxomycetous fungus. A very interesting specimen. Owing to defect in the mounting, the following note is attached:—

'This object has been remounted by the Curator of the club's cabinet in a cell made of wax, covered with gold-size. The Curator would suggest to those who have not had much experience in mounting, that in order to make a fluid mount secure it is necessary to see that the top of the cell is perfectly even, so as to insure complete contact between the cover and cell all around. In the present mount the cell was made of a wax ring covered with gold-size, and allowed to become hard. The cell was then lightly ground on a piece of fine emery paper attached to an even surface of wood until it was perfectly level. At the time of mounting, the edge of the cell was lightly covered with gold-size, and the mounting medium and specimen placed within. The edge of the cover was then touched with cement and carefully placed in position. Pressure was then made at the edges of the cover only until complete contact was secured. The superfluous glycerin was then washed away and a ring of cement run over the edge of cover and cell to the surface of the slide.'

No doubt the mount is now a permanent one. The process may do well enough for persons who have time for it. Others had better use the shellac method described several times in these columns. A mount

can be secured in ten minutes one evening, finished in less time the next, and be absolutely secure.

6. *Aphanomyces phycophilas*. Dr. L. Brewer Hall. A fungus penetrating and destroying a fresh-water alga, *Spirogyra crassa*. Found in 1883 in a pond in Fairmount Park, Philadelphia. A good specimen for study.

—o—

A New Journal.—The first number of the *Journ. New York Micr. Soc.* has reached us. It is a very neat pamphlet, which should receive liberal support from microscopists. It is edited by Mr. Benjamin Braman. The business address is Station E, New York City. We bespeak for this new periodical a cordial reception wherever it becomes known. It contains two articles in addition to the proceedings of the meetings of October, November and December, and an 'index of articles of interest to microscopists which have recently appeared in other journals.'

—o—

Pollen Tubes.—Our remarks in the December number of the Journal have received some attention from the Editor of the *Botanical Gazette*, who seems, however, disposed to criticise our remarks, rather than the hypothesis of which we wrote. The purpose of our few words was, obviously, to draw attention to the subject, and in this we have to some extent succeeded. Having always disclaimed any special knowledge concerning this subject, we are not particularly hurt by the allusions to our 'lack of information concerning botanical laboratories and methods of to-day.' It is just possible, however, that we are somewhat acquainted with the facts concerning botanical laboratories, and the work done in them. If not, is it not partly the fault of the Editor of the *Gazette*, of which we have long been a constant reader?

In spite of the boldness with which we are berated for our ignorance in this matter, we still think the facts are in our favor. The amount of scientific investigation in botanical histology that is being conducted in this country is not very great, and we have not a wonderful array of well-equipped botanical laboratories either. It is not our custom to make assertions in these columns that are not sustained by facts of which we are cognizant.

It should be observed that the fact of fertilization by the extension of the pollen tubes into the ovary has not been questioned by Mr. Kruttschnitt, so far as we recollect, certainly not by ourselves. The question is simply narrowed down to whether the process of fertilization takes place as described by Mr. Kruttschnitt in the plants which he has studied. It is unjust, therefore, to infer that that gentleman has undertaken to prove 'the descent of the pollen tube to the ovule is a myth.'

There is no reason why we should champion the work of Mr. Kruttschnitt, and we do not propose to do so. It must stand or fall upon its own merits. But our sympathies and interest have been drawn into it because we have seen the same spirit manifested in this case as has been obstructive to the progress of knowledge in every age—a spirit which the world will doubtless eventually outgrow, but which still lives in this century in full vigor. It is the same spirit which asked, so long ago, 'Can any good come out of Nazareth?'

Our critic asks, what notice a chemist would give to one denying that hydrogen and oxygen exist in water? The question is not pertinent. In this case we have the results of careful investigation. As such they are entitled to recognition. To us—although this is of no consequence in the discussion—they have seemed to bear out the hypothesis advanced. There are some arguments based upon them which seem very strong. They are enough to deserve attention, and to encourage further

research in order to settle the question. We are told that valuable work is appreciated by every botanist. Doubtless it is, but doubtless also a long time is required for botanists, as for other scientific persons, to learn just what is valuable.

A correspondent, who has given some attention to this subject, instances the common Indian corn, *Strammonium*, and other plants having very long styles, and says 'imagine the length of a pollen tube needed to reach the ovary!'

We would like to know what our critic would have us infer from the concluding sentence of his article? If he means that in Mr. Kruttschnitt's preparations he found pollen tubes in the ovaries, then he need only say so to settle the question. If he did not find them there it is unjust not to say so. If they are not there can he tell us why they are not there? We trust something more than the very non-committal verdict of 'not proven' has resulted from his observations.

Since this article was written a criticism of Mr. Kruttschnitt's papers by Mr. N. L. Britton has appeared in the *Journ. N. Y. Micr. Soc.* We commend this article to all who are interested in the subject, as an excellent review of the bibliography concerning it. We cannot believe, however, in spite of the great array of authorities, and the rather intolerant spirit of the author regarding Mr. Kruttschnitt's conclusions, that the field has been thoroughly explored. As suggested some time ago, we would like to know the different stages through which the process of fertilization has passed before it attained the perfection now observed in many plants. Is it not still possible that we shall find plants in which the fertilization is effected in a more primitive manner? Or, on the other hand, may it not be possible that a still higher organization will make pollen tubes unnecessary, and lead to their abortion in the plant? If these questions are speculative, they are still reasonable, and worthy of some thought, as could easily be shown did not our limited space preclude more extended discussion of the subject.

—o—

The Genera of Algæ.—A series of articles will be published this year, written by the Editor, entitled 'Key to the Genera of Fresh-water Algæ,' which, it is hoped, will prove of service to those who wish to study that interesting class of plants. The system of classification adopted is essentially that of O. Kirchner, although the arrangement of the genera corresponds to that of most older works, and follows closely that of Rabenhorst, and the later publication of Cooke, 'British Fresh-water Algæ.' Kirchner begins with the higher forms and leads down to the simpler ones. We have preferred to follow the other plan, which begins with the simplest and leads up to the more complex forms.

It is probable that during the present year the demands upon our time will prevent the regular publication of these articles. We can hardly expect to prepare one each month; for the work must be done very carefully if it is to be valuable for the purpose intended. We can only promise to do what time permits, and trust that our readers will find the articles of value. It is intended to represent most of the genera described by outline sketches.

—o—

Among the Dealers.—During the holidays we had occasion to visit Philadelphia and New York, which afforded an opportunity to call upon some of the well-known dealers, and to look over the new products of their factories. We first called upon Mr. Walmsley, who was busy enough with his holiday orders. He has one of the most attractive places on Chestnut street, and evidently does a large business in microscopes and photographic apparatus. Unfortunately, we are not quite at liberty to

mention some of the forthcoming announcements concerning the R. and J. Beck optical goods, but before long our readers will hear something to their advantage. Mr. Walmsley is agent for the Kingston photograph plates, made in England, which are to be highly recommended for microscopical photography, as well as for other purposes.

At Mr. Zentmayer's we found an article which should have a large sale. It is an Abbe condenser, mounted so that it can be fitted to almost any stand with a sub-stage, with a convenient and ingenious fitting for the diaphragms. This is undoubtedly the most convenient form of the Abbe condenser yet devised. It is thoroughly practical, and only costs $22.00. The new turn-table, described last year, has been in good demand, and the 'histological' stand is still as popular as ever.

Mr. William Wales has been busy enough, although trade is not very brisk with any of the opticians. He has lately made some half-inch objectives with an angular aperture of 50°, which have been highly spoken of and with which he is well pleased himself. One which he had on hand was most excellent. We saw with it some discoid diatoms, some muscular fibres and the podura-scale, but Mr. Wales significantly remarked, 'this lens will not resolve *Pleurosigma angulatum*.'

Mr. Emmerich says that trade in the objectives and apparatus of Zeiss has been very good during the past year, and he expects it to increase. We have already alluded to some preparations he offers for sale, but it may be added that he will also have some preparations of the tissues of the young salamander, which are prepared to show the various histological elements, elementary tissues, cells, etc., making a valuable series for study.

Mr. Woolman had a good supply of apparatus of different makers, and as he is not devoting his interests to any one make of goods, he is sure to have something of interest at all times.

Mr. J. Grunow is making some fine objectives of the oil-immersion type, which have been very highly spoken of. He makes now a $\frac{1}{8}$, a $\frac{1}{10}$ and a $\frac{1}{12}$ oil-immersion. A $\frac{1}{6}$ dry which he has recently produced appears to be a very excellent objective for general use. Its definition is sharp with a $\frac{1}{2}$-inch solid ocular, giving about 1300 diameters. The angular aperture of this lens is 165°; the price is $40.00. Mr. Grunow also makes an Abbe condenser, with either two or three lenses, which is very well mounted. Some new stands by Mr. Grunow are also excellent in design and construction. Mr. Grunow's work seems to be better known among medical men than among the microscopists throughout the country, but this is not due to its want of merit, but rather to the fact that his long-established business has led his trade in a certain direction. His improved camera lucida, Abbe condenser, oil-immersion objectives and well-designed stands, prove that he is well able to meet the most exacting demands of the time.

One of the last places we visited was the New York office of the Bausch and Lomb Optical Company. For a notice of the various fine stands and ingenious accessories they offer, we cannot do better than refer the reader to their well-illustrated catalogue We went especially to see the electric light which they have applied to the microscope. The result was in every way satisfactory so far as the general character of the light is concerned. A very small lamp was used and a brilliant illumination was the result, far superior to lamp-light of any kind, and more manageable. The battery was objectionable. We shall have something more to say upon this subject next month, as our space is now too fully occupied.

——o——

Examination of Dried Algæ.—It has long been known that by treat-

ing the dessicated specimens of algæ, such as are preserved on paper in the herbarium, with a solution of caustic potash, the cells resume their original size and shape, so that they may be studied microscopically. Any medium that will restore the forms of the cells adds greatly to the interest and value of such a collection, for the wrinkled, misshapen filaments one sees when water alone is used are far from attractive to the eye. Mr. G. Lagerheim has prepared a fluid for this purpose, which possesses some features worthy of note. It is composed of water 5 parts, in which is dissolved 1 part of fused potassic hydrate, and 5.5 parts of strong glycerin added. To examine dry desmids, œdogoniums or other algæ the specimen is moistened with water, transferred to a slide and a drop or two of the solution added. After spreading the algæ in the fluid it is heated gently over a flame. The algæ then swell and resume their natural form.

To mount the specimens, particular species may be easily selected under a low-power objective and removed to a solution of potassic acetate or glycerin. Should it be desired to mount the entire specimen under examination a little acetic acid may be added to the mixture, which will produce potassic acetate by combining with the potash, and the preparation sealed.

—o—

Quantitative Estimation of Micro-organisms in the Air.—A convenient method of determining the relative number of organisms in the air in different places and at different seasons is very desirable. Various methods have been described from time to time, in most of which a current of air is directed against a surface coated with glycerin, in which the germs or spores are caught and submitted to microscopical examination.

These methods have served very well, but it has alway seemed to us a very unsatisfactory means when the character of the spores was an important question, for the reason that it is not usually possible to distinguish spores generically or specifically by their appearance. Other methods have been in use in which the spores are collected in nutritive media in which they are cultivated. The latest form of apparatus for collecting spores for cultivation is that of W. Hesse. This consists of a long glass tube—about 70 cm. in length and 3.5 cm. wide, covered on the inside with sterilized gelatin. Through this tube a current of air is drawn at a regulated speed, and the volume that flows through is measured. The spores are deposited on the gelatin, and after a sufficient time they germinate and form colonies on the gelatin which become visible to the naked eye.

The relative number of spores in the air at any time can be estimated by counting the number of centres of growth. Each kind of growth can be isolated and cultivated by itself.

Having obtained the colonies in the tube, the organisms may be killed by passing sulphurous acid gas through it, and the appearance of the growing colonies thus preserved as a record for future comparisons.

NOTES.

— The first number of the *Journal of Mycology* has reached us, and we are pleased to welcome it among our exchanges. It is devoted to mycological botany, special attention being given to descriptions of North American species of fungi. It is edited by W. A. Kellermann, Ph. D., assisted by J. B. Ellis and B. M. Everhart, and published at Manhattan, Kansas. It promises to be a valuable scientific publication, and we trust it will receive ample support.

— One of the most successful operators in photo-micrography is Mr. Walmsley, who is continually adding to his store of fine negatives of microscopic objects. We would not like to say he photographs all the good specimens that pass through the postal-club circuits, but he certainly pre-

serves a record of some of them in that way. One of his latest productions is from a slide contributed to one of the boxes by ourselves, a hydroid zoophyte with extended tentacles, *Halecium halecium*. The cilia are plainly suggested by the photograph, although certainly not visible—probably not in the preparation itself. Among other good photographs, all taken with Beck's lenses, are the eye of a drone fly and a transverse section of a nerve.

— The best stage-micrometer we have seen has recently been made by Prof. W. A. Rogers for the National Museum. It is not better in ruling than others from the same source, but its peculiar excellence is due to the fact that it is mounted in Prof. Hamilton Smith's new medium of high refractive power. The result is, that the fine lines are far more visible and sharp than on ordinary micrometers. Very fine lines, which are scarcely visible otherwise, are readily seen when mounted in the new medium.

— Messrs. H. R. Spencer & Co. have issued a neat price-list of objectives made by them. They guarantee their objectives to be strictly as represented, and no goods will be sent on approval. This is good business policy for those who are sure their goods will satisfy purchasers. It shows a determination to send out first-class work. They offer also some cheap but well-made microscope stands, varying in price, with objectives, from $42.00 to $83.00.

— An excellent method of studying the minute forms of pond-life has been several times mentioned in these columns, both editorially and by correspondents who have adopted it. This is by suspending glass slips in ponds until they are covered with vegetation and infusoria. It is called to mind once more by the investigations of algæ by L. Kny. He suspends a slip of glass in a cylinder of water and allows it to remain until covered with the growths he desired to study. The plan has much to recommend it, as the organisms can be studied without disturbing or removing them from the sub-strata on which they grow.

— The medium of high refractive index discovered by Prof. Hamilton Smith, and mentioned from time to time in these columns, has engaged his attention for a long time. He now believes it can be made perfectly permanent. Heretofore it has become cloudy after a time, and specimens mounted in it spoiled. The composition has not been made public, for good reasons, although it is not a secret with himself alone, being known to several persons. It will be made known in due time. The experiments made by Prof. Smith in the course of his work to find very highly refractive media have led to the discovery of several preparations of this character, which may yet be used with great advantage. They are easily prepared, and are sure to be employed when the method of making them is published.

— In *Dental Cosmos*, November, 1884, Dr. J. L. Williams has an interesting and valuable article 'On Certain Disputed Points in the Development and Histology of the Teeth.' It is illustrated by woodcuts and two heliotype plates. The subject is rather too technical to be noticed at length without giving more space than can be spared in these columns. Dr. Williams, it will be remembered, has prepared some fine sections of teeth by the method described in vol. v, p. 142.

— Some time ago a gentleman in Paris purchased a one-inch objective of very wide angle of American manufacture, and as it may be of interest to know the estimate put upon it in Paris we quote a few words from a private letter recently received. 'After careful examination and showing it to friends, we do not find that it has any advantage over a Nachet, which he supplies for 25 francs, ($5.00). There is more light, a point of very little importance in so low a power, it has not any greater defining power on test plates, but its great defect is want of aplanatism —the edges of objects are dreadfully distorted.'

— Mr. H. G. A. Wright recently described a preparation of the proboscis of a blow-fly mounted without pressure in a solution of biniodide of mercury in iodide of potassium, which was said to reveal details of structure in the pseudo-trachea not hitherto observed. Without entering into particulars, we draw attention to the fact, which suggests a more extended use for this highly refractive medium.

— Mr. A. D. Michael has described a new acarus of the genus *Myobia*, which was found on bats, particularly the *Rhinolophus hipposideros*. The description is published, with plate, in the *Jour. Quekett Micr. Club*, Ser. 2, vol. ii, p. 1.

— A gentleman in Europe, who has recently obtained a $\frac{1}{10}$ homogeneous immersion by H. R. Spencer & Co., writes

to us as follows: 'It is the finest glass I ever saw, beats Powell's $\frac{1}{12}$ quite away—is the admiration of everyone.'

CORRESPONDENCE.

White Zinc Cement.

To the Editor:—I have been an interested reader of all that has appeared in the Journal, both pro and con, concerning the use of white zinc as a cement in dry mounts. And I mail to you herewith four slides of dry mounts which, with the two previously sent, please add to your collection, with a view to testing the reliableness of the cement. In common with many preparers, I have been disgusted with the amount of trash in circulation as exchanges, and have not always found the work of even professional preparers infallible as to running in. So, when I commenced mounting, I was the more determined that none but first-class, durable work should leave my hands. White zinc was the cement I selected for dry mounts of diatoms, etc., and I have never had occasion to regret my choice. My experience has been that white zinc cement properly prepared, not the work of a tyro, the rings to be made at least 48 hours, and preferably several weeks in advance, will not run in. I shall regard it as a favor if any person who has received any of my slides, either by purchase or exchange, which have not kept well will return such slides, and I will cheerfully replace them with perfect slides.

M. A. Booth.

Longmeadow, Mass.

[It would afford us great pleasure to testify to the excellence of the preparations kindly sent by our correspondent could we do so conscientiously. Unfortunately they are all defective, and the specimens are already ruined. The white zinc cement has been unable to withstand the conditions incident to travel. Every slide was literally smashed to pieces, so that the glass was almost powdered.

As regards the different experiences of workers with this cement, however, there is this much to be said: That if one has time enough to wait for a cement to harden thoroughly any of the cements in common use will undoubtedly serve perfectly well. We have no more doubt of the possibility of making durable mounts with white zinc cement than we have that they could also be made with gold-size, which eventually would dry hard and never run in. It is purely a matter of time in this case. The point we have urged against the use of white zinc is not that it is impossible to use it successfully, but that, as experience has shown, in the hands of a considerable number of workers it is unreliable. Contrary to the opinion of a somewhat discourteous critic, our opinions upon this matter are not based upon what we have done so much as upon what we have seen of the works of others; so that we have discarded it for our own use. The trouble is that we—like many other workers—must work rapidly, and a cement that hardens slowly will not do. Thus, on Christmas day we found a specimen of such interest that we wished to send a mounted preparation abroad. By the use of shellac, on a perfectly plain slide, a ring was made, the specimen mounted within it in water, and sealed up within ten minutes, and had we not wished to put a ring of black varnish on it the preparation could have been safely mailed the same evening, and we could gurantee it against running in or leakage. Quick and sure work like this is impossible with the white zinc cement.—Ed.]

—o—

Mounting Urinary Deposits.

To the Editor:—In response to the inquiry of your correspondent, in the December number of the Journal, I offer the following formula for a mounting fluid for urinary deposits: Glycerin and distilled water each four fluid drachms, chloral hydrate five grains, creosote five drops, gum camphor two grains. Mix, shake thoroughly, and filter.

As far as I have tried this, it preserves epithelium, casts, and to a limited extent crystals.

To prepare casts, place the urine in a conical vessel, and when the sediment is well settled remove the supernatant fluid with a syphon, dilute the sediment with distilled water, let settle, and again remove the supernatant fluid as before, and repeat as often as is necessary. When the sediment containing the casts is sufficiently clean, add to it a few drops of carmine solution, let stand five or ten minutes, again dilute with an equal amount of distilled water, and remove the supernatant fluid down to the sediment. Now add of the mounting fluid above named a quantity equal to that of the sediment, and mount in cells made by running rings of asphaltum on clean slides. If used within half an hour any irregularities of their surfaces will yield when the

cover is pressed down, requiring no furthur leveling. Place two drops of the mixture in a cell so that it may be a little more than full when the cover is applied to avoid air bubbles, ring with white zinc, first tacking the edges of the cover to avoid moving it with the brush.

A. G. FIELD.

—o—

Pteratomus Phaseolus.

TO THE EDITOR:—In the month of October last, while examining the pollen of flowering bean (*Phaseolus multiflorus*), I discovered a hymenopterous insect which appeared to be feeding upon the pollen grains. As far as I can discover, this is hitherto undescribed. It belongs to the genus *Pteratomus*. I propose for it the name of *Pteratomus phaseolus*, and submit the following description:

Order *Hymenoptera*. Family *Proctotrupii*, Lat.

Pteratomus phaseolus, n. s.?

♂♀ Total length $\frac{1}{20}$-inch, breadth $\frac{1}{8}$ of length. Antennæ 6-jointed. The 5 basal joints each armed with a short spine. Joints similar except terminal, which swells slightly before tapering to point. Head and thorax armed with a few stiff spines. Abdomen about 3 times length of thorax, about same breadth, with stiff hairs from each segment. Clearly divided into seven segments of about equal length, except anterior, which is about one and one-half times the length of the others, having two rows of spines. Legs armed with a spine on last joint. Wings transparent, fringed, and covered with minute hairs. Color uniformly ochreous brown. Eyes large and black. The anal claspers of male very large, much serrated. Habitat—flower of bean. Larval stages unknown. October.

JNO. B. BETTS.

CAMDEN, N. J.

—o—

Photo-Micrography.

TO THE EDITOR:—I have become quite interested in the subject of photo-microscopy; but I know nothing of the relative value of the various instruments on the market. I should be glad to see in your paper a review of the different apparatus. I think this would come in very opportune, as there are to be papers on photographic methods.

[We shall have something to say upon this subject before long, if we are not anticipated by some contributor who will favor us with his experience. It is a subject of growing importance; and we would be glad to receive an article upon the apparatus offered by various makers.—ED.]

—o—

Spongilla.

TO THE EDITOR:—That fresh-water sponge mount now on its travels in the postal club boxes, which you kindly noticed, was labeled *Spongilla*, not to indicate the genus, but simply because the term, by common consent, means a fresh-water sponge. As it may interest those who have seen the mount, and those who will see it, to know the correct name, I would like to say it is *Heteromeyenia Rideri*, it having been determined by Edward Potts, the able specialist.

S. LOCKWOOD.

December 20th, 1884.

NOTICES OF BOOKS.

Ceratiocaridæ from the Chemung and Waverly Groups at Warren, Pennsylvania. By Chas. E. Beecher. With two plates. Harrisburg: Lane S. Hart, Printer. 1884. (Pamphlet, pp. 24.)

The Fresh-Water Flora and Fauna of Central Park. Preliminary paper, with bibliography. By L. P. Gratacap and A. Woodward. New York: Macgowan & Slipper, Printers. 1884. (Pamphlet, pp. 19.)

This is a useful, although, being a preliminary paper, not by any means a complete, record of the fauna and flora of the lakes in Central Park, New York. A list of organisms found is given, and a 'Contribution to the bibliography of fresh-water flora and fauna of the United States, mostly microscopical,' which covers several pages. Doubtless the pamphlet can be obtained by addressing Mr. Woodward, at the Museum of Natural History, New York City.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Exchanges by list of all kinds of first-class material for mounting solicited. A. M. BOOTH,
Longmeadow, Mass.

Unmounted material and labels for slides in exchange for good slides.
EUGENE PINCKNEY,
Dixon, Ill.

Fossil Diatomaceous Earth, (a new find), very interesting forms for other material.
J. WALKER,
810 Twelfth Ave., South Minneapolis, Minn.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., MARCH, 1885. No. 3.

Staining Tissues for Photography.

BY GEORGE A. PIERSOL, M. D.

Satisfactory results in photographing histological tissues depend largely upon two conditions:—

1. Having a section so thin and even that little more than a single layer of cells is included;

2. Having such thin section properly stained—especially sufficiently differentiated.

Regarding the first condition, but little difficulty is experienced in these days of sliding microtomes, whose advent has marked a new era in section cutting.

The successful completion of the second condition for photography, is not always as readily accomplished. By most workers, probably, the stains ordinarily employed and valued for general use are borax-carmine and hematoxylin; of the two, the latter is usually the more highly prized—the simple manipulations required and the unsurpassed results justly giving hematoxylin a recognized pre-eminence.

These sections stained with borax-carmine (properly used) yield often excellent negatives; in their strata the red color being sufficiently non-actinic to give a vigorous contrast on the plate. In well differentiated carmine staining, however, little else than cells is colored, and frequently delicate details of the connective-tissues are wanting on account of their transparency.

Hematoxylin stainings, in very thin sections, while all that can be desired under the microscope, are usually very disappointing when photographed; the delicate layer of tissue offers almost no actinic contrast when monochromatic sun-light is obtained by the ammonio-sulphate of copper cell.

Since hematoxylin is so extensively employed in all lines of work, a ready modification of this staining to meet the needs of photography is of advantage. Such a result is obtained by a modified use of a formula of Wiegert, already commended to the readers of the JOURNAL by Dr. Councilman* for the study of the brain and spinal cord. While especially intended for nervous tissues, the modified use furnishes specimens of all organs admirably adapted for photography.

No especial formula for hematoxylin is needed, using one which is capable of staining deeply and giving standard results. In the usual course of work the sections are stained; a few very thin ones, however, are allowed to remain in the solution, after those for ordinary preparation, until they are of an intense dark purple, when they are transferred, one by one, to a capsule containing a solution composed of the following constituents:—

Borax	1.
Potassium ferricyanide	2.5
Water	100.

In this they are kept moving until the intense color is gradually discharged, and the purple tint is replaced by a bronze-yellow, shading to saffron. Before the sections reach the latter color they should be washed in water; the further usual steps in mounting are then completed.

* The Microscopic Investigation of the Brain and Spinal Cord, vol. v, p. 201.

Sections so stained, and mounted in balsam, will be found to possess all the differentiation given by hematoxylin, with a change from the purplish blue color to the subdued tones of brown—a substitution often most pleasing and grateful to the eye.

While in general appearance these sections resemble successful Bismarck brown staining, there are differences in color, the modified hematoxylin possessing a peculiar grayish brown tint, in addition, the differentiation being better marked, and much more readily obtained than with the Bismarck brown, which is sometimes rebellious.

For photography, these modified stainings are well adapted, since the thinnest possible layers are sufficiently non-actinic to yield a vigorous picture. A comparison of the results obtained from delicate sections stained with carmine or hematoxylin, as usually employed, and ones colored as suggested, will convince that in the modified hematoxylin we possess a really useful and very convenient method of preparing tissues for photography.

——o——

Beading of Amphipleura and Photo-Micrography.

BY THE EDITOR.

Dr. Henri Van Heurck, who has been investigating the structure of the frustules of *Amphipleura pellucida* with great care, with the best objectives, has favored us with a photograph showing a portion of a valve resolved into dots. It was made with a $\frac{1}{18}$-inch homogeneous objective of Zeiss; the illumination was with an incandescent electric lamp and vertical illuminator; amplification 3,000 diameters.

The print shows what may be called a beaded structure clearly enough, although as a whole the picture lacks the sharp definition which is seen in the excellent prints made by Dr. Woodward. This, however, is probably a natural consequence of the method of illumination employed. The median line seems not to be in focus, and the margin of the valve on one side—the side on which the markings are seen—is very irregular and ill-defined. The portion of the valve on the other side of the median line is almost wholly lost. A small portion only, probably what was in the middle of the field of view, shows the markings.

It can scarcely be expected that a photograph of such a difficult object—so extremely difficult to resolve that the markings have escaped the closest scrutiny of many competent observers who have sought to find them—should be sharp and entirely satisfactory. The appearance actually presented is of a series of longitudinal lines crossed at right angles by transverse lines. Closer examination shows an approach to a dotted structure, such as one observes in other diatoms with coarser markings just before they are perfectly resolved into dots. The two systems of lines are clearly seen, however, and the only question that can now be raised against the conclusions of Dr. Van Heurck, is whether the structure represented in the photograph is real, or a result of diffraction caused by the particular method o illumination. This question can only be answered by actual work with the microscope, and even then it may not be easily decided.

Accompanying the photograph was a letter from Dr. Van Heurck, which we have translated and now publish below. It contains information concerning photographic work with the microscope that is of great interest.

Dr. Van Heurck writes as follows:

'The print I send you was made from a preparation of silvered diatoms similar to those which Dr. Moore sent to the Royal Microscopical Society of London. I do not know what process Dr. Moore employed, but my method of silvering is simple and easy. It gives perfect results and always the same. I give the process in the "Synopsis of Diatoms." I

have already used it a number of years for silvering prisms and other articles for my scientific researches.

'The preparations being opaque, I naturally have employed the vertical illuminator for lighting them. The photograph was made with a $\frac{1}{18}$-inch homogeneous objective of Zeiss, with a magnification of 1,000 diameters, and the picture afterward enlarged to 3,000, which is not too much for the most delicate details.

'The photograph is very difficult to obtain, first because in the light employed the valve appears green and the details are shown with difficulty; secondly, because details so fine disappear with the slightest movement of the apparatus.

'The first proofs, obtained with a large microscope of Messrs. Powell & Lealand, which is however a model of admirable precision, were very defective. I did not obtain better ones until I had replaced the mechanical moving stage by a rigid stage. Dr. Maddox has suggested the idea that the difficulty of obtaining these proofs may be due to dilatation of the cover-glass during the exposure.

'As source of light I employ exclusively, for my microscopical researches, the incandescent electric lamp, and that since the month of November, 1881, when I applied it to the microscope. My electric installation is very complicated, for it lights not only my microscope, but also a portion of the house, and especially my cabinet of work, which is very large and occupies all the second and third floors of my house. The light is produced by an Otto gas engine of $1\frac{1}{2}$ horse-power; it actuates a Siemens dynamo machine which charges large accumulators.

'I use Swan lamps exclusively. I have tried all the electric lamps possible and have finally concluded that the Swan are the only good ones, for they alone permit one to obtain a white light without injury. It is well known that the blue and violet rays which exist in abundance in white light permit the resolution of difficult details. This is one of the advantages which I proclaimed in 1882 in favor of the electric light.

'At times I use the small lamp for the microscope (micro-lamp A) of Swan, but generally I give preference to the lamp of six volts, a very perfect form of lamp which Mr. Swan had the kindness to make for me in 1882. This lamp gives white light with three accumulators, but one can operate it very well with three Bunsen elements.

'As concerns the photographic apparatus, the simplest is the best. I first commenced with an outfit like that of my friend Dr. Woodward, that is to say, I devoted an entire perfectly dark room to the photographic apparatus, where the microscope could receive at will light from electricity, the oxyhydric light, or from the sun with the aid of a heliostat, but I soon found that it was not what I wanted and that, save in very rare cases, photography should be, for the micrographer, not an end but a means; that is to say, that one should employ photography not for the pleasure of producing pictures, but to replace the camera lucida and the pencil, in case the latter could not render excessively delicate details sufficiently well, or when it is desirable to show a certain and undeniable proof in support of a newly asserted or controverted fact.

'For all that the installation of Woodward is not what is required. One is not certain when an object with very fine details is taken from the microscope that it can be placed under another microscope in the same conditions of illumination. In any case this cannot be done without great loss of time.

'My second apparatus consisted of a camera as perfect as possible (a model of Watson's), quarter-plate size, carrying in place of the photographic objective a tube containing a Tolles amplifier. This camera was mounted on an elevated inclined plane,

and so disposed that, an object being in the field of the microscope, to photograph it one has only to remove the ocular, place the photographic apparatus against the tube and make the photograph. This arrangement served very well, and it is thus that I made my first good photographs of the beads of the amphipleura.

'Finally I constructed a still more efficient device, which I have named my automatic apparatus. This consists of a very small mahogany camera, extremely light, receiving at its posterior part a gelatino-bromide plate of $4\frac{1}{2}$ centimetres wide by $5\frac{1}{2}$ in length. Anteriorly the camera carries a copper tube $5\frac{1}{2}$ cm. in length terminated by an amplifier of Zeiss, which is much better than that of Tolles. The copper tube enters the tube of the microscope a short distance. I call this apparatus automatic because I have nothing to do with it in any way. It is so regulated that the object is perfectly in focus with the No. 1 ocular of Powell & Lealand and also on the sensitive plate.

'This effect is, naturally, only obtained with certain objectives. As it is, my apparatus works admirably with the $\frac{1}{12}$ and the $\frac{1}{18}$ homogeneous objectives of Zeiss, and it gives with the former a magnification of 300 and with the latter of 450 diameters. For considerably greater magnifications one should make enlargements from the plate, which offers less difficulty.

'With this small apparatus I have been able to photograph, without trouble, very difficult things, for example, diverse groups of Nobert's test, including the 19th band.'

Since writing the above we have received a communication from Dr. Van Heurck, which he has desired us to publish. We do so with pleasure in this connection. He writes as follows:

'I have received No. 62 of the *Am. Micr. Journ.* You certainly have the right not to admit the photography of the pearls of *Amphipleura pellucida* before having seen the proof; but it appears to me that you should, however, believe me sufficiently expert in micrography and experienced in studying diatoms, to not presume that I would take for beads illusory lines which are easily seen upon *Amphipleura*, but which are always parallel to the margins of the valve.

'I would only say that the striæ which I have photographed are absolutely identical with those of *Amphipleura Lindheimeri*, which I have likewise photographed, and in all respects analogous to those of *Van Heurckia rhomboides*, a genus which leads to *Amphipleura* by the variety *amphipleuroides*-grun., of New Zealand.

'I would add, finally, that eminent diatomists, such as Messrs. Cox and Kitton, admit that there is not the least doubt. Mr. Cox has written to me that "There ought to be no question as to the complete conclusiveness of the evidence. It is as plain as in the case of *Van Heurckia rhomboides*." Mr. Kitton says, "There is no mistake, the granules are distinctly visible; not that I ever doubted their presence." Finally, Prof. Abbe authorizes me to state that, in his opinion, there is not the least reason to doubt the reality of the pearls (restrictions made as to the real nature of what diatomists have designated as "pearls"); that the structure is analogous to that of many other diatoms, and that my photographs clearly show the typical image que doit donner, avec nos microscopes actuels, une structure périodique double (dans deux directions placées à l'angle droit) à intervalles si petite qu'il ne peut pénétrer, dans le microscope, au maximum, que trois des faisceaux des plus interieurs que donne une pareille structure.'

We despair of rendering the latter part of the concluding sentence in good English, and therefore transcribe the original French. The question of the reality of the beaded

appearance is now definitely settled by the photograpic record. It remains for some of our experts with fine objectives to repeat the observations of Dr. Van Heurck, and we hope to hear from them before long.

—o—

Bulloch's Combination Microtome.

The method of cutting serial sections has, almost, it seems, within a few months, brought about a wonderful change in the methods of microscopical research in biology and embryology and to some extent also in pathology. The great importance of this method of investigation has led to the designing of various forms of microtomes in Germany and England. Mr. Bulloch now offers one which he regards as an improvement over all the others. He has already sold several of them, which seem to have given perfect satisfaction.

The illustration, fig. 12, is one-fourth the natural size, but the height seems to be somewhat exaggerated in proportion to the length, owing to the perspective of the view. The price of the complete instrument is $65.00. Mr. Bulloch has prepared the following description for this JOURNAL :—

This microtome, which has lately been constructed by W. H. Bulloch, is claimed to be a combination of the best points of the German and French instruments with some of his own improvements. The illustration will give a general idea of the construction. The main slide for the knife-carrier is 10½ inches long ; the height to the cutting edge of the knife 5½ inches ; the knife-carrier is made with eight ivory bearings—four on each side—which provide a smooth and easy running surface, which does not require to be lubricated. At each end of the main slide there is a stop with rubber cushions to prevent the carrier passing over the end. The upper surface of the knife-carrier is made adjustable ; so the knife can be made to cut at whatever inclination is found best. The knife can also be placed at any angle for cutting, or adjusted to cut at right

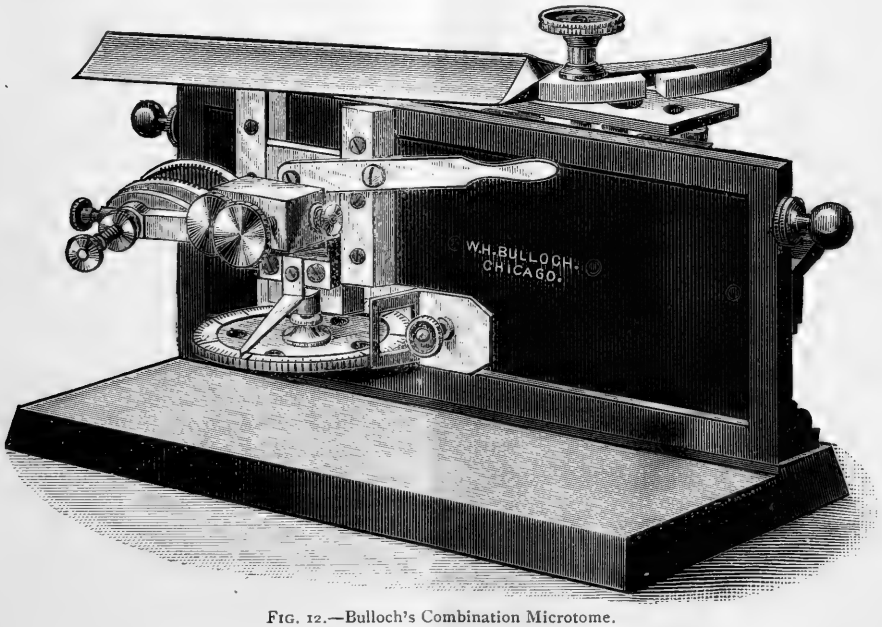


FIG. 12.—Bulloch's Combination Microtome.

angles for cutting sections in ribbons.* The screw for elevating the slide and holder is graduated to $\frac{1}{200}$ mm, about $\frac{1}{5000}$ of an inch, and with a spring click for registering. The spring click can be turned aside when not required.

The holder for material to be cut has universal motion, so that the specimen can be adjusted to be cut at any plane. Each movement is independent of the others, and all are so combined that the specimen is not raised or lowered in adjusting. For the convenience of using the knife square, or at a right angle to the direction of motion of the knife-carrier, and also for cutting sections in ribbons, the holder is reversible, in which position the specimen is in about the center of the slide. There is also the German freezing attachment, with atomizer.

The base and upright are of japanned iron, the other parts of brass, nickel plated. The case is so made that it is not necessary to remove the instrument when operating, as it unfolds and will lie flat on the table.

* Some authorities claim that for cutting fibrous tissue or hard sections a long sliding cut is preferable, whereas for cellular or soft tissue a cut square across is best.

—o—

Pseudo-Cyclosis.

BY SAMUEL LOCKWOOD, PH. D.

A bottle holding scarcely more than an ounce of water, which is occasionally replenished, has had a place for several months in the full light of my study window. When first placed there it contained a little ooze, which was skimmed from the surface of the mud at the bottom of a field pond. For microscopical uses it is really a miniature pond, so prolific has it proved in the numbers and forms of pond-life, for it teems with protococcus and other algæ of a little higher rank, as well as desmids and diatoms, also rhizopods and infusoria.

To-day, Jan. 30th, I took a drop from the surface of the mud and put it under the microscope. A fine *Rotifer vulgaris* popped into view. But this attractive object was deserted for another less showy, but more interesting on account of a weird-like novelty of its own. It seemed to be a translucent tube with a stream of minute objects coursing along its entire length. At first sight the semi-transparent body was mistaken for a uni cellular plant, and the streaming bodies for globules of protoplasm. In a word, such was the perfect delusion, that the movement was taken for the phenomenon of cyclosis. A $\frac{1}{12}$ water immersion and B ocular were at last employed. The bluish-green of the moving bodies, denoting phycocrome, 'a mixture of chlorophyl and phycocyanin,' did not favor the cyclosis view—and the high powers now patiently used swamped the entire hypothesis. The containing body was not a cell, but a minute particle of limpid living gelatine. Whereas the tinier green bodies were hyaline cellules, each one being a uni cellular plant. The movement of these tiny globules was in one direction only. There was no return path to complete the cycloidal track, as in the movement of the protoplasmic pellets in a growing vegetable cell.

The conclusion is now patent to all. It was *Amœba diffluens;* yet in the numbers I had seen only this had produced such a delusion. The contained bodies were one-celled algæ. As the scene held me almost fascinated an entire hour, let me tell what I saw, and in such way that the tyro may go along.

Our amœba is very active, progressing with a gliding or flowing motion, as a drop of tallow on a warm glass. True, life is manifestly present, but it is life actuating an infinitesimal speck of amorphous protoplasm. There is no appearance of organized tissue or fibre. Hence there cannot be anything like muscle. Occasionally may be seen one or two contractile vacuoles—really pulsating vesicles. Let us here premise that

these little bodies, nearly thirty in number, are amœba's dinner. It is gorged, and the work in hand is to digest the rich repast. As amœba advances the green bodies are left in a cluster at its hinder part. Now the amœba's movement stops, and now the little spheroids begin rushing in a well-defined stream towards the advanced portion of the protoplasm. They seem tiny greenings bowling along a grassy way. Again the containing body advances, and those contained recede—that is, are left at the hinder part of the protoplasm. We notice also a resting of the host, and the rush forward of the smaller bodies. The amœba again advances, this time but a very little. It seems even to recede. Really it contracts, then spreads out unsymmetrically on two sides, producing an object not unlike the ankle and foot. Now comes the usual rest, succeeded by the movement of the contained bodies, which this time start in two streams, the smaller group towards the heel and the larger to the toes of the so-called foot. This alternating of the two kinds of activities is quite interesting to witness: the streaming inner movement always obeying two facts—following a rest of its own, and taking the occasion of a rest of the amœba.

As to this rest of the amœba, is it actual or only apparent? As to progression, it is an actual rest, but I cannot imagine this throbbing and rapid streaming to be due to any osmotic force. Its regularity really suggested a systole and diastole contractility of the pulsating vesicle. Says Gegenbaur: 'Any place in the protoplasm can act as a digestive cavity by enveloping and absorbing nutritive matter, and at any neighboring part of the surface the undigested substances can be expelled.' Hence the object of this streaming of the little bodies into every projected lobe or new pseudopodium, thus bringing the food into actual contact with every molecule of the gelatin body, making the entire body to take part in the digesting, and securing to the whole an equal alimentary distribution.

This microscopic speck of life-stuff, or, as Clarke calls it, 'transparent sarcode—structureless animal tissue,' has no composition of parts. The exterior is likely a little denser than the interior, in which is that little cavity which may come and go, that is, be and not be, which is called a vacuole. Hence such terms as endosare, ectosare, endoplast, and others, are rather too subtle and refined. Yet Clarke describes and figures his structureless being as revolving its food in true cycloidal movement. The scene I have described was witnessed for one entire hour. In every instance the food propulsion was a movement in the direction of the outward or forward flow or progression of a part of the amœba, and this was always followed by an illusory recession, that is a seeming stream of the little algæ backward, caused by the advancing protoplasm leaving these objects behind until the new pseudopodium rested, when the trend of the little bodies immediately advanced. For this phenomenon I have used the word pseudo-cyclosis. My desire was to watch until digestion had become complete, but this privilege was denied.

—o—

Method of Analysis of Fibres, Tissues, Etc.*

By testing all the fibres we have enumerated, and using the indications we have given, one is able to identify them with certainty and without difficulty, whether they are alone or mingled with others, in the form of a tissue, or any product of agriculture or industry. But inquiries of this kind are often simplified and much facilitated by working methodically. We think, then, we are rendering a service by furnishing a table in which we have arranged in a certain order the more

* From 'Etudes sur les Fibres,' by M. Vétillart. Translated for this JOURNAL by Rufus W. Deering.

prominent characteristics which permit us to distinguish fibres from each other.

To simplify this mode of analysis, and permit the reader to thoroughly understand it, we shall take into consideration only a limited number of plants the fibres of which we have studied; they are those which are to be found in thread, tissues or cordage which may be met with to-day in the markets of Europe.

The results obtained will be plain at first sight only in proportion as the specimen be crude or imperfectly bleached. In both cases it will be necessary to boil it in a solution of carbonate of soda and to disintegrate it by braying in a mortar, as we have already explained. The analysis of white or dyed tissues gives results quite as accurate, but demands a certain experience in these researches, and the most scrupulous care.

The mode of procedure is the same whether the specimen be composed of filaments of one kind or of a mixture of many textiles. This process differs from the method of chemical analysis in that the latter necessitates the employment of many reagents in succession, each test indicating the presence or absence of one or more substances; while the method which we propose employs only a single reagent, complex, it is true, but the same in all cases, and which, added to the indications given by the microscope, permits us to identify the filaments enumerated, or the presence of a number of them at the same time in one specimen.

We divide the fibres into two classes:—

Class A embraces those which are colored blue by the reagents;

Class B, those which take a yellow color under the same conditions.

The letter L indicates the average length of the fibres; D, the average diameter; R, the proportion of the average length to the average diameter. Each class will be divided into two sections: Section I will contain the fibres obtained from the dicotyledonous plants; Section II, those from the monocotyledonous.

CLASS A.

SECTION I.

Dicotyledons.

This section includes Flax, Hemp, Hop-fibre, the common Nettle, the Chinese Nettle, the Paper Mulberry, the Sunn Hemp, the Broom and the Cotton plant.

1. Sections blue or violet, not enclosed in or surrounded by a yellow border; with yellow in the inner cavity.

a. Sections polygonal with straight sides, having angles more or less acute; in the center a yellow point; concentric layers of growth slightly indicated.

Fibres of a blue color, transparent, regular, smooth or slightly striated; folds of a blue color somewhat depressed by the swelling of the body of the fibre; central canal represented by a narrow yellow line, granulated; with slender, sharp points.

L. 25^{mm} to 30^{mm}; D. 0^{mm}, 020;
R. 1200 . . . . . FLAX.

b. Sections oval, flat or with re-entrant angles; partitions somewhat thick; concentric layers of growth well marked, many individual ones showing radiating striæ in the interior layers; central cavity often filled with a yellow granular substance.

Fibres blue or violet, irregular, often striated, folded, or in ribbons; central canal generally large and containing yellow granular masses; slender points, rounded at the end, sometimes truncated or bifurcated.

L. 27^{mm}; D. 0^{mm}, 05;
R. 550 . . . COMMON NETTLE.

c. Sections polygonal or irregular, of very large size, often with re-entrant angles; the inner opening large and irregular, sometimes containing masses of yellowish-brown granules; many well-marked concentric layers of different tints; radiate striæ in the interior layers of growth in many sections.

Fibres blue or violet, some of them

of great size, irregular in form and thickness in the same specimen; sometimes full, smooth or striated, sometimes flattened, folded, or in ribbons, the central canal visible, often containing isolated masses of yellow or brown grains; points elongated, terminating in spade or lance-like or rounded forms.

L. 120^{mm}; D. 0^{mm}, 05;
R. 2400 . . . Chinese Nettle.

d. Sections blue or violet, always isolated, rounded, oval, kidney-shape, *etc*. . . . ; central cavity often containing yellow granular masses.

Fibres blue or violet, never in bunches, ribbon like, striated, in folds, twisted upon themselves, presenting on each side a round border like a hem . . . . . Cotton.

2. Sections blue or violet, polygonal, rounded, or of irregular form with re-entrant angles, circumscribed by a yellow thread.

a. Irregular groups of polygonal sections with central linear opening, simple or with many branches or of irregular form with re-entrant angles and large opening, entangled with each other in groups where they appear in close contact; concentric layers with growth very plainly marked and often of different tints. No yellow granulations in the interior.

Fibres blue, of a greenish or dirty yellow color, of irregular diameter, frequently collected in compact bundles, striated or grooved, showing a few small fibres, detached or still adhering; marked by cross lines, almost black and very fine; central canal somewhat difficult to recognize, large, flat points, terminating in the form of a spade, etc. . . .

L. 22^{mm}; D. 0^{mm}, 022;
R. 1000 . . . . . Hemp.

b. Numerous groups, compact, well arranged, frequently taking the form of a cross; composed of sections which have great analogy to those of hemp; although the entire sections, polygonal or oval, very often have a small round cavity, not linear; this cavity is sometimes garnished with yellow granulations. Many fine, well-marked growth-layers are seen, those on the outside sometimes colored yellow, while those on the inside are blue. Yellow network, usually thick, enclosing the sections. Frequent openings cross the walls of the fibres and join corresponding openings of neighboring fibres. The hollow part of the cross is sometimes adorned with round or oval groups composed of network of a subdued yellow, with large or small meshes.

Fibres blue, green or yellow, some nearly full, sometimes containing yellow or brown granular masses; others flattened, in ribbons of which the interior is empty. The body of the full fibres presents folds in the form of a cross, and swellings like flax, but the central canal attains dimensions that are not found in flax; ends like those of hemp.

L. 7^{mm} to 8^{mm}; D. 0^{mm}, 03;
R. 260 . . . . . Sunn.

c. Groups not large, composed of small blue sections, quite uniform in size, enclosed in a yellow network to which they adhere slightly and whose meshes are sometimes empty; their form has great resemblance to that of hemp; but with more compact walls, marked by a few concentric layers, generally not very distinct; central cavity almost always open containing a yellow substance like grain.

Longitudinal bunches not easily divided with a needle; fibres blue, very fine, of uniform size, separated, distinct even in bunches; color sullied sometimes by a yellow envelope which then appears on each side of the fibre like a straight, brilliant yellow line.

There are two kinds of fibres: one full, smooth and clear; central canal indistinguishable except when it contains masses of yellow granulations, points sharp and slender; the other, flat, deeply striated, ribbon like; interior canal empty, scarcely ever visible; the points of the latter large and rounded.

L. 10mm; D. 0mm, 016, for the full ones;
R. 620 . . . . . Hops.

d. Groups presenting two types; one containing sections of ten, very large, full or with thick walls; polygonal in form, with obtuse or re-entrant angles and rounded contours. The other quite voluminous, composed of very small sections of a clearer blue, their forms rounded, but sometimes irregular and distorted These two kinds of sections are enclosed in a yellow network slightly adherent, whose meshes are often empty. The isolated sections separated from the meshes appear like sections of cotton, but they present to view many well-marked concentric layers which sometimes distinguish them; the central opening often contains a yellow granulated substance or one which remains without color.

Longitudinally, bundles easily divided with needles into a confused mass of large and very fine fibres, well separated from each other; these are full, smooth or striated, with plainly marked folds of flexion, or else they are in ribbons; the central canal rarely apparent, or indicated by detached masses of yellow granulations which show themselves toward the points; the latter fibres have rounded ends usually large.

L. 15mm; D. 0mm, 025, p. the largest;
R. 430 . . . . Paper Mulberry.

c. Small groups of not very large blue sections, separated by a yellow, generally thick, network; forms rounded, some with salient angles, very full, with central opening very small, pointed or linear, often filled with yellow grains. Concentric layers few, but plainly marked; the outer layer paler than the interior and sometimes tending to a yellow color. The other sections irregular, like those of the hemp but much smaller, having a less pronounced tint than the full ones; central cavity linear or open, sometimes garnished with yellow grains. Groups of woody fibres are frequently present, recognized by their yellow color.

Fibres blue, violet or yellow, short, curly, full, round, regular, and of very small diameter; the central canal is indicated by a very fine line; the yellow envelope often overlaps the points which are not usually slender, but rounded at the end, bifurcated and sometimes furnished with lobes.

L. 5mm; D. 0mm, 015;
R. 400 . . . . . The Broom.

SECTION II.

Monocotyledons.

This section includes the *Alfa* (embracing under this name the *Lygeum Spartum* as well as the *Stipa tenacissima*) and the Pine Apple (*Ananassa sativa.*)

1. Irregular groups composed of blue intermingled with yellow sections; the concentric layers often plainly marked, the outer one sometimes colored yellow, the inner ones being blue; forms rounded or oval, rarely presenting straight surfaces or sides; in the center a point, often of a yellow color, indicates the inner canal. These sections are accompanied by groups showing the yellow fibro-vascular bundles.

Fibres short, blue, fine, very full, smooth, curly and of a uniform and regular diameter; having a very fine yellow line in the middle representing the central canal; the points are rarely slender, but rounded, truncated, and bifurcated or notched.

L. 1mm, 5; D. 0mm, 012;
R. 125 . . . . . Alfa.

2. Groups very compact, quite voluminous, and often in the form of a cross; very small sections of the fibres of a blue or very pale violet tint only appearing when they are very thin. These sections are enclosed in a quite thick yellow network; their forms are usually rounded, but sometimes polygonal; the cavity appearing in the form of a point or a very short line. The thick sections are greenish or even yellow. Among these groups are found sections of fibro-vascular bundles, in which the tissue which fills the center is of a blue color and surrounded by a border formed by one

or two rows of thick fibres of a subdued yellow color.

Longitudinally, fibres very fine, regular, full, smooth, pliable, and curling easily; the central canal is rarely visible in the smaller ones, appearing in the larger like a very fine line; fibres very distinct in the bundles, from which they are easily separated; points elongated and sharp. Color not very marked, often entirely wanting. Among these almost colorless fibres are found larger ones, very stiff and not so long, protruding from the inner line of the fibro-vascular bundles.

L. 5^{mm}; 0^{mm}, 006;
R. 830 . . . . . PINE APPLE.

CLASS B.

SECTION I.

Dicotyledons.

This section is composed of the Hibiscus, the Flag, the Jute and the Daphne.

1. Polygonal sections with straight sides, the central orifice rounded or oval with smooth edges.

a. Sections yellow, polygonal, with straight sides and sharp angles, enclosed in a network of a rather subdued yellow, forming compact groups of rectangular shape; central opening generally small, always rounded, smooth and empty; concentric layers sometimes of marked thickness; fissures in the walls, perpendicular to the exterior and interior contours.

Longitudinally, fibres yellow, stiff, broken, very irregular in diameter; with slender points rounded at the end, some having notches or sinuosities; fibres frequently found having very thin partitions and in ribbons.

L. 5^{mm}; D. 0,021;
R. 240 . . . . . HIBISCUS.

b. Sections generally very small, polygonal, with straight sides and sharp angles, collected into compact groups, enclosed in a network of a rather subdued yellow, with very fine meshes, which they exactly fill; central orifice very small, punctiform.

Longitudinally, fibres, very short, fine, stiff, very full, with sharp or irregularly formed points.

L. 2^{mm}; D. 0^{mm}, 016;
R. 125 . . . . . FLAX.

c. Polygonal sections with straight sides and sharp angles, forming very compact groups, or else found in close contact; central orifice generally quite large, round or oval, with smooth edges, always empty.

Longitudinally, fibres of a golden yellow color, collected into compact bunches, very short, stiff and smooth, not striated, but often presenting notches or curves on the edges, especially near the points. The central canal appears in the form of a distinct band in the center of the fibre; on each side borders of a subdued yellow indicate the thickness of the partitions, defined by very plain lines; the ends terminate abruptly, being rounded or of irregular shape.

L. 2^{mm}; D. 0^{mm}, 022;
R. 90 . . . . . JUTE.

2. Round, oval, or bent sections, like those of cotton, to which they are very similar in form, but from which they are distinguished by their yellow color; interior cavity elongate, linear and empty.

Longitudinally, fibres, very fine, yellow, smooth and not adhering to each other; many specimens very large toward the center, tapering rapidly to slender, rounded ends; the swelling sometimes very marked in the folds.

L. 5^{mm}; D. 0^{mm}, 01;
R. 500 . . . . . DAPHNE.

SECTION II.

Monocotyledons.

This section contains *Phormium tenax*, Abaca, the Coco, the Sanseviera and the Pita or Aloes.

1. Sections the forms of which are more often rounded than polygonal, and whose central orifice is also rounded; with traces of fibro-vascular bundles.

a. Very small sections, of a pale yellow when thin; those which have polygonal forms have obtuse angles;

they do not adhere much to each other; the central orifice is small, round or oval, with smooth edges.

Longitudinally, fibres, fine, regular, smooth, straight and stiff, easily separated from each other in the bundles; thickness of the partitions very uniform; central canal small but very distinct; points elongated and sharp.

L. 9^{mm}; D. 0^{mm}, 016;

R. 560 . . . . . PHORMIUM.

b. Polygonal sections with very obtuse angles or oval shapes; very close contact between the groups; partitions generally of moderate thickness; central orifice large, resembling in its form that of the outer perimeter, but the angles are so small that the opening appears nearly round or oval; it sometimes contains brown granulations.

Longitudinally, fibres, smooth, regular, of a very uniform but inconsiderable thickness; central canal large and plain; points tapering regularly and gradually, sharp or slightly rounded at the end.

L. 6^{mm}; D. 0^{mm}, 020;

R. 250 . . . . . ABACA.

c. Sections of a yellowish brown color, round or oval, scarcely touching in the groups, enclosed in a network of thick meshes, which unites them into very compact groups, having in their center an empty space or gap of irregular form; the central orifice of the fibre very large, round or oval.

Longitudinally, fibres, very short, stiff, with quite thick partitions, not equalling, however, the size of the interior canal; the exterior contours often sinuous or toothed; walls sometimes interrupted by solution of continuity (pores ?); points rounded or abruptly terminating; brown bundles very compact and easily separated.

L. 0^{mm}, 7; D. 0^{mm}, 020;

R. 35 . . . . . COCO.

2. Sections polygonal, clearly defined; central orifice equally polygonal, with angles more or less diminished, and traces of fibro-vascular bundles.

a. Polygonal sections, often with obtuse angles, partitions not very thick; central orifice polygonal, with smooth and angular perimeter, always empty. Longitudinally, bundles, very compact, almost indivisible, composed of fine fibres, smooth, stiff, with thin partitions, of uniform thickness; central canal large; points sharp, slender.

L. 3^{mm}; D. 0^{mm}, 020;

R. 150 . . . . . SANSEVIERA.

b. Polygonal sections, with straight sides and angles sometimes a little blunted; central opening very large, polygonal, with angles less pronounced than the outer ones; fissures in the walls, perpendicular to the exterior and interior contours.

Longitudinally, fibres, short, stiff, with thin walls swelled toward the centre; thickness of the walls very unequal; the outer profile often wavy or toothed down to the large point shaped like the scabbard of a sabre and sometimes bifurcated.

L. 2^{mm}, 5; D. 0^{mm}, 025;

R. 100 . . . . . PITA.

Vorticellæ with two Contractile Vesicles.

BY DR. A. C. STOKES.

Recently I sent to the *American Naturalist* a communication to the effect that not only does *Vorticella Lockwoodii* Stokes possess two pulsating vacuoles, but that the same number is apparent in *Vorticella monilata* Tatem, and I expressed surprise that this fact should have been for so long overlooked, since the last-named form is not uncommon in Europe nor rare in our own waters. My wonderment at such an oversight is not now so great as it was, for hardly had the manuscript to the *Naturalist* passed out of my hands when I captured two individuals of *Vorticella vestita* Stokes, which had not been previously obtained since its description in this JOURNAL of November, 1883, and I found that

the observers of *V. monilata* were not alone guilty of an oversight, for in *V. vestita* there are also two contractile vesicles. It then occurred to me to repeat the examination of *V. rhabdophora*, described in *The Microscope* for February, 1885, and in it also two pulsating vacuoles were now observed. To have overlooked them in this case is peculiarly annoying, for when the species was first obtained from the vegetable infusion where it appeared in abundance, this possibility was borne in mind and the double organ searched for. In all these instances, however, the contractile spaces are usually placed directly opposite each other and, unless the vorticella is in a certain position, a single one only is visible as one obscures the other, the lower being so far beyond the focus of the objective that its pulsations are not noticeable.

The presence of the double vesicles is not only an interesting and important structural point, but it is especially worth of note since the two have thus far been observed only in such members of the genus as possess some form of cuticular investment, or of surface ornamentation rather than transverse striæ, *V. vestita* being surrounded by a well-marked cellular coating, *V. rhabdophora* having an apparently mucilaginous covering enclosing minute bacteriform bodies, *V. monilata*, as the name signifies, bearing solid bead-like bosses over its entire surface, and *V. Lockwoodii* possessing similarly arranged but conspicuously nucleated cuticular elevations. As these species are apparently more highly organized and presumably somewhat higher in the scale than are the smooth or simply striated forms, so are they slightly more complex in structure.

TRENTON, N. J.

—o—

A Growing Slide.

Many are the working hints I receive from the columns of the JOURNAL, yet, after all, I am often, like every working microscopist, thrown upon my own resources. One of my devices has proved to be so useful that I will describe it. It is a growing slide, made as follows:—Arrange the specimen on an ordinary glass slide, with a drop of water and cover-glass as usual; then confine the cover by slipping a light rubber band over it on the slide, and place the slide in a dish of water of sufficient depth to completely immerse the specimen. In this simple manner I have kept fresh-water algæ for weeks in a growing condition, enabling me to observe the process of conjugation from its commencement to the final rupture of the spores and formation of new filaments. E. L. CHEESEMAN.

KNOWLESVILLE, N. Y.

—o—

Structure of Diatoms.*

[23806.] — The daily-increasing number of disputable or, at all events, disputed questions connected with the intimate structure of the diatom valve and frustule will, I hope, be accepted by your readers as a sufficient reason for the present attempt on my part to determine the point raised by Dr. Flögel, and answered in the negative (erroneously in this instance, as I venture to believe) by my valued correspondent Mr. J. D. Cox, of Cincinnati, Ohio.

Flögel maintains, on the strength of sections which I have seen and very carefully examined, in conjunction with these accompanying photographs, that in such genera as Triceratium and Coscinodiscus, the little hexagonal or cylindrical cavities, though completely closed by a silicious film on the internal surface of the valve, are *not* closed by any such membrane on the outer surface of the valve. Mr. Cox, on the other hand, strongly insists on the cellules being closed by a silicious film externally as well as internally. Of course, if Mr. Cox's view be correct, we have here to deal with minute hermetically-sealed cavities.

Now, to my mind, the objections

* From *English Mechanic*.

to Mr. Cox's supposition are insuperable, irrespectively of the visible evidence obtainable from broken-up specimens which I have been in the habit of studying ever since I began to write on the diatoms some five-and-twenty years ago.

If the cellules are closed at both their extremities during the life of the organism, each individual cellule must be full either of protoplasm or some other more or less fluid substance, unless, indeed, each contains a gas, or constitutes a perfect vacuum, which is scarcely within the bounds of possibility. If each chamber contains protoplasm, it is obvious that the remains of this, during the preparation and mounting of the specimen, would be recognizable amongst the larger species, either by the employment of optical or chemical tests—that is to say, during the boiling in acid, or burning on mica, the fluid contents would burst the films, and in many cases leave behind the evidence of their former condition. Now, in my experience, such evidence has ever been forthcoming, and, judging from what is known of cellular structure in organic life generally, whether animal or vegetable, there are no examples of truly vacuous cavities, inasmuch as all organic tissues whatever are pervious to dialytic or osmotic action.

It is no doubt true that the organic silica of the diatom, perfectly hyaline as it looks, is in reality a 'colloid,' and hence, as it contains an infinitesimal percentage of water, just as flint itself does, dialytic action may take place through the film under notice.

But even then the perviousness to moisture of the diatom, if it really keeps the chamberlets full of fluid during the vitality of the organism, would not suffice to settle the present question; for, if any fluid whatever remained in the little cellules, should the specimens have been but recently taken from their element, it would burst the film on the application of heat, and inevitably burst the walls, whilst traces of the disruption would occasionally be visible under the microscope. Again, if the chamberlets contained gas of any kind, and in spite of the effects of the boiling in acids, this gas were too minute in quantity to burst the walls, we should certainly be able to detect gas bubbles in some of the chamberlets. But, as is well know, the bubbles so common in mounted specimens are not due to the cellules having originally contained gaseous material, but to the accidental admission of air during mounting.

The only remaining alternative is that the cellules cannot be considered closed cavities, and hence that the alleged presence of an external investing and closing film is illusory—a fact of which I have never yet had reason to entertain a doubt.

G. C. Wallich, M. D.

London, Jan. 25.

—o—

The Working Session of the American Society of Microscopists.

The Executive Committee of the American Society of Microscopists having placed in my hands the work of organizing the Working Session at the meeting of the Society to be held in Cleveland, Ohio, next August, I have prepared the following scheme of work for demonstration at that session, which, though far from being as complete as could be desired, is submitted as approximating the maximum of work that can be successfully elaborated and demonstrated in the limited time of the working session—one-half day.

SCHEDULE OF WORK.

1. The use of the micro-spectroscope and its application to original research.

2. The use of the polariscope in original research.

3. Micro-photography and its applications as an aid to research.

4. The use of the camera lucida, various styles and methods.

5. Micrometry, exposition of different methods.

6. Cultivating bacteria, exposition of different methods.

7. Injecting vessels and tissues, demonstration of various methods.

8. Staining tissues in mass, simple and compound stainings.

9. Staining sections, simple and compound stainings.

10. Section cutting, soft tissues, use of various microtomes.

11. Section cutting, hard substances, methods of cutting and grinding.

12. Section cutting, serial sections, S. H. Gage's methods.

13. Use of dissecting microscope, methods of dissecting, etc.

14. Practical demonstration of the relation of aperture to power in objectives.

15. Methods of measuring aperture, power, focal length, etc.

16. Methods of manipulation, decantation, desiccation, isolation, etc.

17. Methods of illumination for special purposes, special objects, etc.

18. Uses of the mechanical finger, applications to research, etc.

19. Electrical and thermal applications, uses of hot stage, etc.

20. Uses of live boxes, growing cells, troughs, compressors, etc.

21. Special methods of treatment or examination of special subjects, such as blood, pus, sputum, urine.

22. Staining and mounting bacteria, micrococci, etc., for examination.

23. Special methods of cell making, cementing, cover cutting, etc.

24. Special methods of mounting, labeling, finishing, packing, and storing slides, etc.

All microscopists who expect to attend the Cleveland meeting and are willing to take part in the working session, and assist in the above demonstrations, are cordially invited to communicate with me on the subject as soon as possible, and any suggestions regarding the Working Session and the subjects to be presented and demonstrated there will be very welcome.

Every indication so far points to a large and successful meeting at Cleveland, fully equal to any of the preceding meetings, and it is hoped to make the working session a valuable feature of the meeting. The active co-operation of microscopists who are interested will insure such a result.

C. M. Vorce.

Cleveland, Ohio.

—o—

Culture Media for Bacteria.

In the *Journal of the American Medical Association*, under the head of Foreign Correspondence, a writer in Berlin gives some information concerning the preparation of solid culture media. We print the greater part of two letters, as they seem to be written by a person of experience in the culture of micro-organisms.

The method of preparing the flesh-peptone-gelatin is given as follows:—

'Half a pound (0.25 kilo.) of fresh lean meat (beef or mutton) is finely chopped, and to it is added a pint (500 c.c.) of distilled water, the mixture remaining in a cool place for twelve to twenty-four hours. It is then strained through fine linen gauze, the mass being pressed to extract all the liquid, which appears as a reddish-bloody fluid. To this pint of "flesh-water" in a clean flask is added 75 grains (5 grammes) of peptone, 30 grains (2 grammes) of common salt, and from 1 to 2 ounces (30 to 60 grammes) of fine gelatin, and to the flask is fitted a cotton-wool stopper. The mixture should then stand for a half hour to allow the gelatin to swell up, and as gelatin has an acid reaction, enough sodic carbonate ($Na_2 CO_3$) should be added to make the solution neutral or very slightly alkaline; because most germs do not grow in an acid solution. The solution is then placed in a Koch's steam sterilizer and cooked for an hour. This is an apparatus made of tin and covered with thick felt, by which the

articles placed inside are exposed to the direct action of a large volume of steam.

'The solution is then filtered hot through filter-paper, and it comes through clear and yellow. This is best done by means of a hot-water filter, which keeps the gelatin thoroughly melted all the time. If this, however, is not at hand, the ordinary glass filter tunnel and its contents may be warmed by carefully and quickly throwing against it the flame of a Bunsen-burner or a spirit lamp. It should be emphasized that the filter and filter-paper, and the test-tubes, together with all the other apparatus used in the process, should be thoroughly sterilized in a sterilizing oven to a temperature of 300° F. (150° C.) for at least ten minutes.

'The next process is to fill the test-tubes, which have been fitted with a cotton-wool stopper and sterilized as above described. They are filled for about a quarter or a third of their length and are cooked for fifteen minutes in the steam sterilizer, when they are probably in a condition for use; but to make sure, it is better to cook them three days for fifteen minutes each day.'

* * * * * *

'There are two ways of using the gelatin which has been prepared according to the method I described last week, viz: plate cultures and tube cultures.

'(*a*) For plate cultures, which are especially useful to separate different forms of germs in a mixture, there is necessary an apparatus consisting of two bell-jars, a glass-plate, and glass-bridges. Of the bell-jars, which are about seven inches in diameter and two inches deep, one should be a trifle larger and a trifle less deep, to set over the other as a cover. The glass plate should be about six inches long and four inches wide, but this should be regulated by the size of the table to one's micrescope stand, for we must be able to examine every portion of it by the microscope. The glass bridges should be such as to elevate the plate about one-quarter of an inch above the bottom of the bell-jar. All of this, like everything, as I said before, should be sterilized in a sterilizing oven by exposure for ten or fifteen minutes to a temperature of about 300° F. (150° C), and then it is put together to cool, the plate resting on the bridges in the lower bell-jar, which is covered by the larger one.

'When cold it is so placed that the plate is exactly horizontal, and for this purpose especial levelers are sold, which, though convenient, are not absolutely necessary. The cover being removed, gelatin melted in a test tube is poured over the plate, so that when cold there is a layer about an eighth of an inch thick. The cover is replaced and all is set aside for the gelatin to harden, when it is ready for vaccination, which may be done in two ways. (a) Vaccination of the entire surface. This is accomplished by making a *very dilute* mixture containing the several germs it is desired to separate, and pouring this over the surface of the gelatin. (b) Vaccination in stripes. This is accomplished by dipping a platinum wire sterilized by heat into the *very* dilute mixture of germs and gently scratching the surface of the gelatin. This is repeated, making the rows from a quarter to a half inch apart. N. B. It is of great advantage to apply moistened filter-paper to the inner surface of the cover to make a moist chamber. Also, N. B. It is almost impossible to make too dilute a mixture, and beginners make a great mistake in this respect. Theoretically it should be so weak that any one germ of a kind drops in a place, and another at a little distance, and so on. This apparatus being kept at a temperature varying according to the cultivation, the plate shows, after twelve to forty-eight hours, little points which grow, and some of which may be distinguished from the rest. By using these as seed in successive fractional cultures the last becomes quite clean,

when it may be transferred to a test-tube culture.

'(*b*) The test-tube culture is made in test-tubes filled as above described, about one-third of their length, and stopped by cotton-wool.

'The vaccination is made by taking seed on a platinum wire sterilized by heat and thrusting it into the gelatin about an inch. In their growth many germs build characteristic forms.

'Although no books give the information, it is to be noted that in making the vaccination the test-tube should be held inclined and with the *mouth* downwards when open, so that no outside germs may fall in from the air.

'For certain culture gelatin has the disadvantage of melting at a comparatively low degree, and when a higher one is necesary aga-aga or blood serum is used.

'Aga-aga is prepared like gelatin.

'Blood serum is prepared by filling sterilized test-tubes one-third deep with clear serum from the blood of an ox or sheep, and cooking in the steam sterilizer at 135° F. (58° C.) for two or three hours. During this time the test-tube should be inclined at an angle of 45° to allow the serum to solidify in this position, which gives a much larger surface in the test-tube for vaccination. (N. B. Aga-aga may also be thus prepared.) The heating should be repeated for five days, when it is ready for vaccination with platinum wire.'

—o—

—Microscopists should always find delight in flower gardens. There is always a rich field for study where there is a variety of plants, some of them always blooming and ripening their fruit through the summer and autumn. Vick's 'Floral Guide' for 1885 is a useful book of 150 pages, and 1000 illustrations of flowers, plants and vegetables. It is a valuable catalogue, from which one may make choice selections of seeds, of most excellent quality. Persons who are mounting seeds for the microscope would do well to send for a copy. It is sold for ten cents, by Mr. James Vick, Rochester, New York.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

PROCEEDINGS AMERICAN SOCIETY OF MICROSCOPISTS.—The *Proceedings* of the seventh annual meeting, held at Rochester last year, were published several weeks since, but we have been unable to give them earlier notice in this place. The volume is an excellent one of 300 pages and five plates, with numerous illustrations in the text. A portrait of the late R. B. Tolles makes an appropriate frontispiece.

The articles published are not all of the highest degree of scientific value, but there is enough reading that is good and useful to make the volume worthy of a place in every library of microscopical works. We do not wish to be critical, but it is only proper to say that there are one or two articles published in the volume before us which have nothing more to recommend them than that they were read before the Society. We doubt very much if the publication of such papers does, in any way, encourage, or act as an incentive to, careful scientific work. It seems a pity that the Committee on Publication should not exercise discretion, and publish in full only articles of scientific value, letting the others go in by title or short abstracts.

The work of the committee has been done as quickly as could be reasonably expected, and as a whole it has been done very well indeed.

Copies of the *Proceedings* can be obtained from the treasurer of the Society, Dr. Geo. E. Fell, Buffalo, N. Y.

——o——

TEXT OF SYNOPSIS OF DIATOMS.—The text of this valuable work will be issued in a short time, probably next month. It makes a volume of more than 200 pages, printed on paper like the Atlas, and uniform with the latter in size. The price will be definitely announced hereafter, when a more full notice will appear.

At the same time will also be published one or two supplementary plates, including one showing the pearls or beading of the *Amphipleura*, for which an additional charge will be made.

Subscribers to the Synopsis will be promptly informed of the time of publication and the price.

NOTES.

— We have received two beautiful preparations of plant-hairs from Mr. James E. Whitney, of Rochester, N. Y., who has given considerable attention to them and has a large collection, embracing thirty different forms. The hairs on leaves are often very beautiful objects, and there is such great variety in their form and arrangement that they afford an endless source of delight to the microscopist who undertakes their study. The specimens sent by Mr. Whitney are from *Alyssum saxatile* and *Solanum stacagnifolium* (?).

— The supplementary volume of the *Tijdschrift der Nederlandsche Dierkundige Vereeniging* just received contains an extended account of experiments in oyster culture, principally conducted by Dr. P. P. C. Hoek and Dr. A. A. W. Hubrecht. It also contains contributions by other authors to the knowledge of the fauna of the Oosterschelde (a gulf of the North Sea), including the crustacea, bryozoa, cœlenterata and protozoa. The latter is by Dr. J. Van Rees, and is illustrated by a plate. The volume is of great value, the more important articles being printed in French as well as in the language of the country. It makes a large book of about 450 pages and 16 plates.

— Dr. L. Younghusband, of Detroit, informs us that he has received a letter from Dr. Koch, of Berlin, accompanied by a mounted preparation of the comma bacillus, which Dr. Koch regards as the cause of Asiatic cholera. It is of interest to know where an authentic preparation of this organism can be found.

— Mr. Van Ermengem has observed that certain bacteria, at the period of sporulation, if treated with staining agents such as are used in staining *Bacillus tuberculosis*, become double stained. In *Bacillus subtilis*, for example, treated by Ehrlich's method, the spores become stained red and the rest blue. Fine and very interesting preparations can thus be made. These facts of double coloration have been previously observed by Bienstock.

— The function of the green coloring matter in the pseudo-chlorophyll bodies of *Hydra viridis* is still unknown. Recent experiments by Von Graff lead to conclusions directly opposed to the supposition that these bodies assist nutrition. Hydras kept in filtered water died after a certain period, apparently from want of animal food. The chlorophyll bodies do not lose their color when kept in the dark, even for a hundred days or longer.

— The February number of *Science Gossip* contains the following announcement:—

'Mr. Wm. Taylor has brought out a simple and clean method of using balsam. It is inclosed in compressible metal tubes, like those containing moist colors, so that the smallest quantity can be expelled at will.'

This will be news to those who have used balsam in this way for a decade or more.

— Some very suggestive observations on the action of pathogenic microbes in the blood have been made by E. Metschnikoff. He found a daphnia affected by a fungus which eventually was fatal in its attacks. By inoculating healthy daphnia he was able to trace the progress of the disease by studying the action of the fungus on the blood-corpuscles. In the first place the spores were attacked by the corpuscles and destroyed. Soon the blood-cells showed signs of injury and some of them burst, setting free gonidia of the fungus. Thus the blood-cells were destroyed, in greater number as the disease progressed. It thus appears that the disease is a struggle between two living

organisms, one the cells of simplest plants, the other the lowest tissue-elements of the animal body. It is easy to draw an inference from these observations, concerning the possible parallelism between the phenomena observed in the case of the daphnia, and the course of certain diseases in higher organisms.

— Mr. W. H. Bulloch is making a portable stand which will fit in a case 9 inches by 4½ by 2½, inside measurements. The base is to be detachable. The stand will have centering substage, with mirror on the substage bar sliding up behind the substage. An Abbe condenser can be used on the stand.

— We have received a preparation of the cholera bacillus from Mr. Woolman, marked 'culture of Dr. Koch,' such as he is now offering for sale. This is a pure culture, very rich in the so-called comma-bacillus. The name comma-bacillus is an unfortunate one, for the slightly curved, and rather short robust rods do not resemble commas very closely, and they seem not to be bacilli at all.

— As is well known the souring of milk is attributed to the growth of a peculiar organism, the *Bacterium lactis*. There is good reason to suppose that the peculiar characters and flavors of the various kinds of cheese are due to the growth of specific organisms. Mr. Earnest Hart, speaking at the London Health Exhibition, said:— 'The milk industry opened up a great field for investigations of this class; it was found that every variety of cheese was due to the influence of a particular kind of minute vegetable organism, which, by its mode of maturation, gave to each cheese its particular flavor and quality; so much so, that one kind of cheese could be made only in one cellar, and another kind in a cellar perhaps 300 yards off, and in none of the intervening cellars could the same kind be made. The last time M. Pasteur was in England with him, he told him that his greatest desire would be, if he had some years to spare, to spend them in the laboratory of a dairy, working out the relation of germs to the milk and cheese industry.'

— We have received some printed notices of recent meetings of the Wellesley Microscopical Society, from which it appears that the Society is active, and that the meetings are as interesting as they were several years ago, when notices were published regularly in these pages. One specimen of considerable interest, dust collected on the barque Wm. H. Bessie from the eruption of Krakatoa, was shown. The vessel was in the Straits of Sunda twelve or fifteen miles in a direct line from Krakatoa when the eruption began; it soon became too dark to run from the shower of ashes. Being in twenty-five fathoms they lay with anchors down for over forty-eight hours, until it was light enough to see. During most of the time the darkness was so great that at noon the hand could not be seen within a few inches of the eye. The ashes fell in such enormous quantities that all hands were constantly engaged in shovelling it overboard as well as they could in the darkness. The sea was not rough, but a tremendous current was running. This vessel was probably as near the volcano as any that escaped unharmed.'

CORRESPONDENCE.

Various Subjects

TO THE EDITOR:—Enclosed please find $1 to renew subscription; wish it had to be $2 for a double dose. Last summer I bought an immersion $\frac{1}{10}$ of Spencer, and asked you for some advice in regard to handling it, and was told to 'go at it.' I have done so, and now go up to No. 19 very well, but am not willing to swear to a good resolution of *A. pellucida* yet. I for one need your long promised article on illumination very much, and pray devoutly that you may soon have leisure for it. I have Prof. E. Smith's celebrated 'How to see with the Microscope,' but have derived more benefit from your single sentence 'go at it,' than from all his highly mixed instructions, down to pulling out table drawer, and putting of napkins on the edge of it.

Last June you answered a question of mine in regard to cementing balsam mounts. I have cemented all my uncemented slides; but afterwards you take it all back, and decide not to cement, so we can tell balsam mounts from others. Would it not be better to cement, and make the label tell the story?

I had great trouble at first from cover breakage. Mr. Ward, in his very interesting paper on mounting, uses the expression 'often breaking cover after cover.' Let me tell you my plan. I think it is handier than your bullet pressure. It is some 25 years ago, when I sent my last bullet adrift, and missed at that. About that time deer took H. Greeley's advice and disappeared from this prairie. I suppose bullets can be found in city gun

stores, but the American clothes-pin, my favorite, blossoms in every country store. I believe it is more readily to be had. After adopting the following plan, I have not lost more than two per cent. of covers. I cut squares of glass a little smaller than the covers, to put on the cover before applying the clothes-pin. This distributes the pressure as evenly as a bullet can; besides the pin forms a convenient handle, quite an advantage in handling slow-drying mounts. I also make the handles do as temporary labels by writing the name of object on them. I enclose the best envelope I have, and shall be much obliged for a little material for mounting. Please command me if I can ever be of service to you, and accept my best wishes for yourself and the new volume. I for one never yet made the acquaintance of the man that pleased everybody and amounted to much himself.

F. DIENELT.

—o—

Microscopic Specimens about Mobile

TO THE EDITOR:—During the course of the past year the following novelties for the microscope have been found tributary to Mobile, Ala., by the writer. A limestone or chalk formation from which the microscopic foraminifera may be brushed out in water, or worked into semi-transparent sections; microscopic fossil, resinous pollen-grains; fossil carbonized woods; petrified woods, and wood changed into iron pyrites, found in a seam of Quaternary lignite; fossil sponge spicules and diatoms composing a seam of material of close texture resembling bituminous coal; a dense foraminiferous limestone containing very minute dark foraminifera in a transparent, white, crystalline matrix, very pretty and unique. Dredgings from lower channel, Mobile Bay, furnished spines of minute sea urchins, transparent foraminifera, and various specimens of marine diatoms as *Eupodiscus*, *Triceratium*, etc. A compact Tripoli stone, showing casts of hollow spicules, when examined in very thin sections.

K. M. CUNNINGHAM.

MOBILE, Ala.

NOTICES OF BOOKS.

Smith's Diagram of Parliamentary Rules. By Uriah Smith. Second edition—revised. Battle Creek, Mich.: Review and Herald Publishing Association. 1883. (Price 50 cents.)

This is an invaluable aid to any person who has occasion to preside over meetings. The diagram is of convenient size for use, and folds in a book containing the key to the diagram, which can be carried in the pocket. On the diagram the relations of various motions to each other are shown at a glance.

Outline of Vegetable Histology. By Mrs. William Streeter, President section of botany, R. A. S. Rochester, N. Y.: Davis & Leyden. (Pamphlet, pp. 11, with 5 plates; price 50 cents.)

This is a very concise outline of vegetable histology, which may be read with profit by those who have not time or inclination to take up larger works.

The Geological and Natural History Survey of Minnesota. The first annual report, for the year 1872. By N. H. Winchell, State Geologist. Second edition. Minneapolis. 1881. (Pamphlet, 8vo, pp. 130.)

The Geological and Natural History Survey of Minnesota. The eleventh annual report, for the year 1882. N. H. Winchell, State Geologist. Minneapolis. 1884. (Pamphlet, 8vo, pp. 220.)

The Geological and Natural History Survey of Minnesota. The twelfth annual report, for the year 1883. N. H. Winchell, State Geologist. Minneapolis. 1884. (Pamphlet, 8vo, pp. 196, with numerous plates.)

This volume is of special interest to naturalists since it includes an extended report on Minnesota crustacea, by C. L. Herrick, with a synopsis of the species described in North America and keys to the known species of the more important genera. It is fully illustrated.

There is also a catalogue of the flora of Minnesota by Warren Upham, which is rendered particularly useful by a good index.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Will exchange very fine unmounted material for single numbers or volumes of MICROSCOPICAL JOURNAL.

A. LAHR,
73 West 3d St., New York City.

Wanted—A clean copy of the January 1884 number of this JOURNAL; will give mounted slides in exchange, or pay cash

C. M. VORCE,
Cleveland, O.

Wanted good Diatomaceous material; will give in exchange unmounted *A Pellucida* very pure; or first-class mounts of diatoms.

EDWARD S. NOTT,
Hamburg, Erie Co., N. Y.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., APRIL, 1885. No. 4.

Abstract from an Article on Intracellular Digestion by Dr. Elias Metschnikoff.*

BY H. G. BEYER, SURG. U. S. N.

Metschnikoff has long been of the opinion that many questions connected with the genealogy of the Metazoa are not to be solved by the methods of purely morphological embryology, but that in the determination of the phylogenetic importance of any organ, a knowledge of the physiological history is often indispensable. The embryonic history of an animal or organ shows us a series of phenomena, often extremely complicated, among which mere embryology cannot, in many cases, choose out those which are of primitive from those of secondary importance. The difficulties, he says, are increased by the fact that the primitive Metazoa have all disappeared, so that the gap between the Metazoa of to-day and the Protozoa is wide indeed. Thus, in attempting to discuss the evolution of such an organ, as for instance the alimentary canal, one of the oldest and most widely distributed organs of all the Metazoa, one must collect not only embryological evidence as to the mode of formation of the endoderm, but also physiological evidence as to its function.

When it became known that all the lower Metazoa, such as sponges, cœlenterates and turbellarians, possessed an intracellular digestion, the conclusion, of course, was obvious, that this mode of nourishment was one of the few characters in the organization of the Metazoa which had been directly transmitted to them from the Protozoa, and so constituted a link, however small, between the two groups. Now, since the colonial monads—organisms which most closely resemble the lowest known Metazoa, their embryos and larvæ—show no kind of division of labor, no separation into nutritive and locomotive individuals, the question arose as to whether the lowest Metazoa had not retained the power of using any or all the cells of their body for the purpose of ingesting food. In order to answer this question, Metschnikoff undertook a series of investigations of the results of which we will here give a brief summary.

I. *Ectodermal Intracellular Digestion.*—The sponges being at present the lowest known Metazoa, it seems indeed surprising that Metschnikoff has not been able to discover any ectodermal digestion in them. Repeated researches on *Ascetta primordialis* and *Halisarca lobularis* gave negative results, and thus, although not absolutely denying the possibility of digestion taking place within the ectodermal cells of sponges, Metschnikoff does not think it proved as some would have it. More favorable objects for these researches were found to be the true cœlenterates, and a digestive ectoderm was indeed described in a single one of these before Metschnikoff undertook his researches. Merej-Kowsky, in describing a *Bougainvillea*, in which the alimentary canal was rudimentary, put forward the supposition that in this medusa the food was taken in entirely by the ectoderm, but, not

* Read before the Biological Society of Washington, March 7th, 1885.

having seen any solid particles within the ectoderm, supposed that it was nourished entirely by organic matter in solution in the sea-water. It has long been known that the ectoderm of hydroid polyps protrudes pseudopodia which frequently anastomose to form a kind of plasmodium, and it occurred to Metschnikoff that these pseudopodia might have the function of picking up food particles. This was really observed to be the case with the nematocalyces of *Plumularia* (*setacea.*) When powdered carmine was suspended in the water surrounding a *Plumularia*, it was, after some little time, seen in considerable quantities within the substance of the ectoderm of the nematocalyces. Furthermore, colonies of *Plumularia* polyps, observed in a watch-glass, will only live a short time after gathering; but only the polyp heads die, while the cœnosarc and the nematocalyces survive, which latter may be seen eating up the dying hydranths. Thus, after the polyp has retracted its tentacles and become a mere rounded mass, the free end of a nematocalyx creeps into the theca and gradually absorbs, by means of its ectoderm, the whole contents of the cup. These so-called nematocalyces are therefore classed among organs whose chief function is prophylactic; they eat up necrotic parts of the colony, and also continually explore the organs in this vicinity, in order to render harmless any injurious bodies by devouring them.

Ectodermal digestion has also been observed to take place in *Actinias*, especially *A. mesembryanthemum*. The solid particles contained within the ectoderm are usually seen surrounded by a vacuole, thus indicating the occurrence of some digestive process. If a larval *Actinia* is taken from its mother and placed in water containing carmine in suspension, the carmine granules are eaten by the ectoderm cells, being seized by means of short pseudopodia, extended from the free surface. After the development of the gastric pouches, however, the number of foreign particles within the ectoderm is much smaller. As a further example of ectodermal nourishment, Metschnikoff cites the ovarian ova of those animals whose generative cells are ectodermal; for example, those of *Tubularia*, and, according to Kovotneff, of *Hydra*. In the first named, Metschnikoff saw the young ovoum eat and digest the neighboring follicular cells, and Kovotneff says that during the winter the young ectoderm cells of Hydra devour the older ones.

II. *Intracellular Ingestion and Digestion by Wandering Mesoderm Cells.*—While the taking up of nutriment by ectoderm cells can only be observed in rare and exceptional cases, nothing seems to be easier than to find amœboid cells of the mesoderm which both ingest and absorb food particles. Haeckel was the first to observe that when a *Tethys* was injected with indigo, the granules were taken up by the blood corpuscles. Later on he proved this occurrence in the blood of various invertebrates, and it was this observation of Haeckel which formed the starting point of so many important researches in histology and pathology.

As objects for the study of this function in mesoderm cells, Metschnikoff chose the *Auricularia* of synapta, and the *Bipinnaria asterigera*. At the period of the metamorphosis of these larval Echinoderms, which is, as is well known, extremely complicated, and associated with the loss of many larval organs, these mesodermal cells ingest the cellular debris of the disappearing organs and finally absorb them. Resorption-phenomena can best be seen at two stages in the life history of *Auricularia*. They first occur at the assumption of the so-called pupa stage, when a large part of the longitudinal ring of cilia is lost; that is, is disintegrated and devoured by the mesoderm. At this time every amœboid cell of the mesoderm is generally loaded with enor-

mous numbers of debris-granules which are slowly absorbed during the pupa stage, so that the cells which contained them become filled with clear vacuoles. On the metamorphosis of the pupa into a young synapta, the cells begin again their devouring work, collecting as before beneath the ciliated ring and eating up the products of disintegration. In every case the disintegrating elements break up into albuminoid granules of various sizes which are gradually eaten up and absorbed by mesodermal cells. These appearances have been found to so constantly accompany metamorphosis that they are believed to be normal and necessary events in the life of an Echinoderm larva, and comparable to the appearances exhibited by the osteo-clasts in developing vertebrate bone. This function of the mesoderm is believed to be present in all animals which undergo any great degree of metamorphosis and especially in the complicated larval changes occurring in Ascidians, in which Metschnikoff frequently saw wandering cells loaded with debris. If this should prove to be the case we should have a simple explanation of such appearances as, for instance, the transformation of the degenerating nervous system into a heap of blood-corpuscles, which is at present believed to be due to a direct morphogenetic change in the ganglion cells. Many ovarian ova of *Aurelia aurita* have been observed to become surrounded by amœboid cells and completely devoured. In his early investigation on intracellular digestion in Ctenophores, Metschnikoff saw that carmine-granules suspended in water passed not only into the entoderm cells, but also into those of the mesoderm. In order to study this property of mesoderm cells more extensively, Metschnikoff chose *Bipinnaria asterigeria* and *Phyllirhoë bucephalum*, because these animals are not only transparent, but also large enough to admit of the performance upon them of simple operations which they are hardy enough to survive. If water holding indigo or carmine in suspension was injected beneath the epidermis of the animal under observation, the portions of coloring matter were after a short time taken up by the amœboid cells. Two different kinds of amœboid cells were found in *Phyllirhoë*—one large, the other small; the smaller ones only ingested coloring matter in this way; the larger ones, although bearing rosy patches, did not contain solid particles. The smaller granules of solid carmine were all eaten by the small cells in the usual manner; the larger masses, on the other hand, were surrounded by a kind of plasmodium of small cells, which approached each lump one by one and flattened themselves upon it, fusing with neighboring cells as these arrived. In this way plasmodia arose of very different sizes, some even large enough to be visible to the naked eye, which might be compared to the giant cells so often described in vertebrates. This certainly confirms the observation so often made by pathologists, that giant cells are often found in the neighborhood of foreign bodies, and long before the discovery of the tubercle-bacillus one of the characteristic microscopical signs of tuberculosis was known to be the giant cell. In all those cases in which Metschnikoff found giant cells in Invertebrates they had arisen around foreign bodies, being always formed by the fusion of separate cells, and not by a process of incomplete fission, as some pathologists hold. Glass-spicules, atoms of dust, or carmine are surrounded and devoured by aggregates of cells in exactly the same way. Metschnikoff thinks it undeniable that the results of the introduction of a glass-spicule or other irritant into the body of an Invertebrate bear no small resemblance to the phenomena of inflammatory exudation in Vertebrates; for certainly, in both cases, a number of mesoderm cells collect around the irritant body and act upon it as best

they may. Therefore, from a point of view of comparative pathology, Cohnheim's dictum, 'without blood vessels, no inflammation,' does not hold; for in *Bipinnaria*, which has no trace of vascular system, we see a gradual accumulation of the numerous amœboid cells scattered throughout the mesoderm. Inflammation is consequently a phenomenon much older, phylogenetically speaking, than blood vessel, while exudation is a comparatively late development. It was one of Cohnheim's leading ideas that inflammation was due primarily to a diseased condition of the vascular walls, and that the migration of leucocytes and the exudation of liquor sanguins was a direct consequence thereof. The results of Metschnikoff's observations on the resorption during metamorphosis among Echinoderms are moreover in complete harmony with the results of histological and pathological observations on Vertebrates; they have taught us that mesoderm cells are able to take up and to digest albuminoid granules. This conclusion is strengthened by other observations. After the ingestion by the mesoderm cells of *Bipinnaria* of a human blood corpuscle, we see that they are completely resorbed. Within the cell they swell up and become clearer; the hæmoglabin is then dissolved out and finally the whole corpuscle disappears. Milk injected beneath the skin of *Bipinnaria* and *Phyllirhoë* incurs the same fate. If fluids containing bacteria be injected or if they develop spontaneously in the wounds of these animals, they will soon be found within the substance of many amœboid mesoderm cells. Both still and motile forms were thus ingested and found either embedded in the protoplasm of the absorbent cell or surrounded by a vacuole. These phenomena of the ingestion of bacteria by mesoderm cells were most easily seen in *Botryllus*, colonies of which, when freshly gathered, contained almost invariably large quantities of bacteria. Within this last, Metschnikoff found especially a *Spirochæte* closely resembling the *S. Obermeyeri* of relapsing fever, and a small bacillus like the Lepra-bacillus which had a spore at each end. Both these forms were pursued by the wandering cells of the *Batryllus* and were found ingested and absorbed by them in various stages of development. The victory was not, however, all on one side; here and there were found mesoderm cells to all appearances dead, with long bacterial filaments projecting from them. Koch has observed *Bacillus anthracis* and the *Bacillus septisæmiæ* within the white blood corpuscles of mice and the *Bacillus tuberculosis* in the interior of giant-cells, so that throughout the whole animal kingdom the wandering mesoderm-cells make use of their ingestive power for the destruction of bacteria and similar organisms. These wandering mesoderm-cells have lately been termed by Metschnikoff phagocytes in connection with an article of his entitled 'The Mesodermic Phagocytes of Certain Vertebrates'; for he has shown that intracellular absorption is also found in the vertebrate mesoderm. Thus, for instance, during the early stages of its absorption, the tail of Batrachians was found to contain a large number of amœboid cells, within which were seen remnants of nerve-fibres and muscle cells. These phagocytes were seen in the living uninjured tail in the case of the *Bombinator* larva, where, at the beginning of the metamorphosis, they collected round the muscles of the tail, the fibres of which were gradually surrounded and devoured. When the atrophy of the gills was in progress it was easy to ascertain the presence of large fully-laden phagocytes. So that phagocytes seem to play a part in the metamorphosis of Batrachians as important as that which they have shown to take in the larval changes of *Bipinnaria* and *Auricularia*.

In order to ascertain whether, in

Vertebrates as well as Invertebrates, the phagocytes had the power of ingesting parasitic bacteria, putrescent blood was injected beneath the skin of the hog, so as to induce septicæmia. After a time the white blood corpuscles were found to contain both still and motile bacteria, each surrounded by a vacuole. The bacteria were found to be especially abundant in the phagocytes of the spleen, which confirms the statement of pathologists that the white blood corpuscles, when they have ingested an insoluble body, are carried into the spleen, indicating the prophylactic function of this organ. Further observations made on the larval triton's tail by touching it with nitrate of silver and noting the phenomena of the ensuing inflammation have led Metschnikoff to regard the cells of the connected tissue as phagocytes, since they act as such during inflammation.

The observations of Metschnikoff confirm those of several investigators who assume an active wandering on the part of the white corpuscles themselves, effected by the protrusion of numerous pseudopodia, similar to those extended by the resting corpuscles of many Invertebrates; this observation is not compatible with the current theory of inflammation, which regards imflammation as primarily due to a morbid condition of the walls of the blood-vessels. Metschnikoff believes that the essence of the whole process is a struggle between the phagocytes and the sceptic material whether the latter be a dead or dying cell, or a fungus or other foreign body, thus apparently reducing the whole theory of inflammation, whether caused by an injury to a certain part or due to its invasion by living organisms as is the case in infectious diseases, to a microscopic war between phagocytes on the one hand and foreign bodies on the other, and the result of this must be here as elsewhere in nature, the survival of the fittest.

Staining Tissues in Microscopy.*—I.

BY PROF. DR. HANS GIERKE.

In 1883 a quarter of a century had past, since the introduction of a method of investigation, that has, more than anything else, assisted to produce the most important results obtained by workers with the microscope in modern times. It is of the greatest use in zoological histology, in the medical sciences, and also, if not quite to the same degree, in botany.

I refer to the treatment of microscopical preparations with dyes which differentiate the elements of structure by the different degrees of affinity between the dye and the tissue, whereby portions thereof are stained in various shades or even in different colors. I would offer this essay on the history and processes of this method of study as a memorial of the twenty-fifth anniversary of its discovery. From imperfect and modest beginnings it has gradually grown into favor, and during the last decade with immense rapidity, so that it is perhaps well to arrest the epidemic ambition of those, especially the younger investigators, who search the copious list of dyes for some material that, either pure or modified, they can warmly recommend for staining, and thereby become an authority. To relate the history of all these methods would make my essay too long, and those which are but repetitions of earlier work will be omitted. With a historical review I shall combine some discussion of particular dyes, and the principles governing their application. Also a list of color-material employed in microscopy, the methods of their preparation and directions for use. I have endeavored in all cases to cite original articles, so that the reader may inform himself thereby. I know well how desirable it is to find the exact manner in which a stain was first applied. Very many hand-books omit to give particulars,

* From the *Zeitschrift für wissenschaftliche Mikroskopie.* Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.

and likewise omit to cite authorities, whereby the student might be enabled to search for himself. The metallic impregnation of tissues I have also included, because the object of this operation is the same as staining, to wit, the differentiation of structure, and also because a real coloration sometimes results.

A stranger entering a histological laboratory must be forcibly impressed by the prominence given to staining. Neither the microscope nor the microtome with its menacing knife is so striking to the observer. The clear light everywhere falls upon all the hues of the rainbow. Cabinets full of glowing colors, and tables covered with brilliant stainings, are unexpected revelations. It is true the earnest worker must often bewail and condemn the tedious methods of modern research, but he cannot do without staining for we owe to it extraordinary results in our investigation of animal tissues; in fact, without it our most important discoveries in pathology and histology would be impossible. It is true we are much in the dark as to the exact nature of staining. The chemical reactions involved are not yet so clear but that experience is our best teacher, and we must not confide too much in generalizations respecting our methods.

Nowhere is so much staining done in microscopy as in Germany. The methods in use elsewhere have mostly been carried hither by Germans, or by students educated in Germany. In foreign works on microscopy, for example, in Beale's 'How to work with the Microscope,' manipulation is treated with exhaustive particularity unknown in German books, but methods of staining occupy little space. All important discoveries in this direction have been made by Germans. Even the celebrated French histologist, Ranvier, a master in manipulation, is obliged to content himself with improving our methods.

Gerlach is to be regarded as the founder of this art. His discovery of the staining power of carmine, and his recommendation of this dye, excited histologists to use it and to experiment further. It is true, colored injections and hardening fluids that sometimes stained to some extent had been previously used; and if carmine-gelatin accidentally retained an excess of ammonia when used as an injecting fluid, the consequent tinging of the tissues adjacent to the vessels by the dissolved carmine could hardly fail to be noticed, and thus suggest staining in mass. Many independent attempts were made to use carmine. The botanists Goppert and Cohn appear to have been the first. (*Botan. Zeitung*, 1843, No. 37.) They added a carmine solution to the cell-contents of *Nitella flexilis* to better study rotation and determine if the chlorophyll masses had cilia, and they remarked that these masses were more deeply dyed than the surrounding fluid. Welcker, in 1858, used carmine for studying the cell-nucleus of muscle-fibres. In England, Lord S. G. Osborne grew plants in carmine solution. He likewise observed the nucleus grew darker than the other elements. More important were the efforts of Hartig for a new method of investigation by staining plant tissues with carmine and other dyes. His results were published at the time Gerlach first turned his attention to carmine as a stain. In connection with Hartig's work that of the apothecary Maschke should be mentioned, published in 1859. Hartig's researches went further than even Gerlach. He showed the tissue must be dead, in order to take the dye, and he observed the same results in plants that Gerlach found in animal tissues. Among the substances used by him were the juice of *Phytolacca decandra*, litmus, black ink, cuprous sulphate, gamboge, and cinnabar. For a time these experiments were fruitless, and so it has come about that Gerlach has received credit as the real discoverer of staining.

Notwithstanding the numerous staining preparations that have been strongly recommended, some of which are useful for special work, such as the net-work of fibrillæ in the gray matter, carmine is, in my opinion, the best material for showing white nerve substance, branching cells, and neuroglia. This dye is obtained from cochineal, which is the dried female of a scale insect first found in Central America. It is now cultivated wherever the cactus on which it feeds will grow. The insects are boiled in a solution of certain salts, as alum or saltpetre. Each maker has his own method, but only the very best brands are suitable for microscopy, that known as 'Nakarete' being the best. The cochineal solution is allowed to stand until the carmine precipitates, when it is dried in cakes. Chemically it is carminic acid with the formula $C^{17}H^{18}O^{10}$. It is not soluble in water, but combines with ammonia and acetic acid, the first compound being tha most often used in staining. To set cure the best results a strong solution should be kept in stock; that which is freshly made seldom works so well, and may contain free ammonia to its injury. I pulverize the commercial cubes, add water and sufficient ammonia to dissolve it. I then allow it to stand several days in an open vessel; then filter. This concentrated solution I keep for about two years in corked bottles before using if possible. All the ammonia will disappear—part by absorption of carbon dioxide, part by evaporation. The presence of ammonium carbonate is very advantageous; it acts as a mordant. One of the chief advantages of carmine is that it works well whatever the previous treatment of the preparation. Chromic acid has been said to be incompatible, but it is not so unless too strong, and for brain sections is better than alcohol, the use of which for them should be avoided even to moisten the knife. Ammoniacal carmine is the most permanent dye known; if properly used it never fades. I have seen some of Gerlach's preparations of the spinal marrow twenty-five years old, that appeared to be unchanged. None of the numerous colors that have been tried are entirely satisfactory in this respect. Gold preparations darken, vegetable dyes fade, though Hematoxylon with alum as a mordant is the most desirable after carmine. In 1856 a new class of dyes was introduced, the anilines, that worked a revolution in dyeing. The first was Mauvein; in 1858, Hofmann discovered anilin red, and many others soon followed. Waldeyer was the first to apply these in histology; he used rosanilin, anilin violet and anilin blue. But the anilin colors have not found favor yet as important stains. Thiersch, in 1865, recommended indigo-carmine and Chrzonszczewski found it especially suitable for injecting the tubuli of the liver and kidneys.

About this time a great step forwards was made, viz., double staining. Picric acid and carmine were used separately by Schwarz for this purpose, and the publication of his peculiar methods in 1867 undoubtedly led Ranvier to the idea of combining the two and making picrocarmine, which remains one of our choicest stains. A species of double staining was however known before Schwarz, made by impregnating tissues with metals, then dyeing in carmine. Also Schulze and Rudneff in 1866 used osmic acid to darken sections subsequently treated with carmine. This brings me to another branch of the subject, viz., impregnation with metallic salts, which is quite as useful as staining, and has been entirely worked out since 1860.

The following historical synopsis of literature on staining in Microscopy contains all the important original works, essays, and notices on our subject. Those which are simply repetitions or recommendations of earlier work are omitted.

Foreign methods find a place only so far as they have been published in works known in Germany, but I think but little has wholly escaped us, and corrections and additions will be gladly received.

[*To be continued.*]

—o—

Provisional Key to Classification of Algæ of Fresh Water.—I.

BY THE EDITOR.

The classification of the algæ of fresh water is still in a very unsatisfactory condition, when viewed from a scientific standpoint, for the reason that there still remains so much to be learned about the methods of reproduction and development. No doubt the only scientific classification possible must depend, to a greater or less extent, upon the methods of sexual reproduction. Not that these processes as observed will serve as a universal and only indication of the relationship or differentiation of families, genera and species, but that they must form a basis of classification which shall bring together forms that are genetically connected. It is not sufficient to know how reproduction in a given plant is effected, but it becomes also necessary to know the significance, in the genetic history of the plant, of the phenomena observed. For example, in the family zygnemaceæ there are various processes of conjugation between neighboring cells. It becomes necessary to trace this method of conjugation downward until we can discover its most primitive manifestation, and then to follow its various modifications until we can determine the course of its development. We shall then be able to understand the true relation between the different genera of the family, and also to assign the family itself to its proper position among the other families of algæ. At present this is not possible; and whoever attempts to improve upon the classification already sanctioned by continued usage, if by no greater authority, must be prepared to devote years of constant study to the work.

It is no new system, therefore, that will be brought forward in these articles. We cannot even promise that they will be in all respects fully up to the times, for much of the literature which we would wish to consult is not at present available. However, the work is offered in the belief that it will prove useful to many readers who are sometimes puzzled to make out the distinctions between the genera as usually described in books. Distinctions which those who are familiar with algæ recognize immediately—by what seems a kind of intuition, but is really the result of familiarity with the different genera which permits one to instantly recognize many of them at a glance—are not readily picked out from the descriptions usually given. It is to aid those who are not acquainted with the subject that this work is compiled from notes and observations made by the author in the course of reading as well as in the study of fresh specimens. It does not purport to be more than a provisional key—a sort of original draft to serve as an outline and guide for future work of a more thorough and comprehensive character.

It is only after long consideration that we have concluded to follow, in a general way, the arrangement of Rabenhorst's 'Flora Europæa Algarum.' This we have decided to do in view of the fact that it will doubtless be more readily used by the beginner in this study, having reference to either Rabenhorst's work, or to the beautifully illustrated work 'British Fresh-Water Algæ by M. C. Cooke,' than any more scientific system that might be proposed.

The system serves very well for the study of the fresh-water species by themselves, but when it is desired to study the algæ as a whole, including the marine forms, and to indicate the systematic position of algæ among the cryptogams, it is far from satisfactory.

The desmids and diatoms are not regarded in this classification, the former having been adequately treated by Mr. Wolle, and the diatoms by various authors.

The colored protoplasm of the cells of algæ is known as the endochrome. The color is due to chlorophyll, which may be either pure (green), or mixed with other coloring matters such as a blue (phycocyanin), a red phycoërythrin), a brown (phycophærin), which impart to it various shades of color. The colors afford a means of distinguishing several classes which have received corresponding names, thus we have—

1. Chlorospermeæ, Harvey; Chlorosporeæ, Thuret; Chloro phyllophyceæ, Rabenhorst. Green, chlorophyllous algæ.

2. Cyanophyceæ, Sachs; Phycochromaceæ, Cohn; Phycochromophyceæ, Rabenhorst. Bluish-green algæ.

3. Melanospermeæ, Harvey; Melanophyceæ, Rabenhorst; Phæosporeæ, Thuret. Olive-green, brown or blackish algæ.

4. Rhodospermeæ, Harvey; Rhodophyceæ, Rabenhorst. Red algæ.

By far the greater number of algæ found in fresh water belong to the first two classes, a few belong to the third. All the red algæ are marine.

The separation of the algæ into classes founded upon the coloring matter within their cells is too purely artificial to form basis of a scientific classification. We have only partially adhered to it in this place, and that merely as a matter of convenience; but it separates many species that are unquestionably closely related, and which should be placed in the same genera. Thus, there is not the slightest doubt that various forms of unicellular algæ such as *Glœocapsa* and *Glœocystis*, for example, are genetically connected, yet some are green and others are olive-green.

Many of the divisions of families and descriptions of genera are taken largely from Kirchner's work, although the arrangement is not entirely the same, and Rabenhorst's and other works have been carefully studied in the same connection.

The descriptions are limited to the genera, since it would enlarge this work too much to include descriptions of species.

The writer would be very glad to receive suggestions from persons using this key, which will enable him to improve upon it in future; and he would be especially grateful for corrections of errors that may be found in it.

I. ORDER PROTOCOCCOIDEÆ Kirch.

Unicellular algæ, of chlorophyll-green color, propagating by swarm-cells. Without terminal growth, not branching.

The thallus of these algæ consists during their entire life either of a single cell, or else the single cells remain united in a more or less close parenchymatous-like combination, still indicating in this case their unicellular character since in each of the cells all vegetative and reproductive processes take place.

Propagation either sexual, by oogonia and antheridia, or by copulation of swarm-spores.

Cell-contents chlorophyll-green (very rarely reddish yellow or brown), never bluish green.

FAMILIES.

Propagation by swarm-spores, and cell-division. The single cells either free or united by a gelatinous matrix, stems, etc. Copulation of swarm-spores not observed.

PALMELLACEÆ, I.

Vegetative cells not ciliated, either single or in cœnobia. Propagation by copulation of swarm-cells and by asexual zoospores. No vegetative cell division. PROTOCOCCACEÆ, II.

Vegetative cells during their entire life motile. Reproduction sexual, or asexual by copulation of swarm-cells. VOLVOCACEÆ, III.

Family I. PALMELLACEÆ Kirchner.

Cells single, free or united by a gelatinous envelope, connecting stems, etc., into large or small, mostly slimy or gelatinous, families.

Reproduction by vegetative cell-division and formation of zoogonidia. Copulation of zoogonidia has not been observed in this family.

a. Single cells, separate, or not forming definite families. (SEPARATÆ.

Synopsis of Genera.

Cells single, spherical, floating; envelope thick. *Eremosphera*, 1.
Cells separate in small, indefinite families; envelope thin. *Pleurococcus*, 2.
Cells oblong; floating, or attached by hyaline pedicel. *Dactylococcus*, 3.
Cells oblong, single or in rows. *Stichococcus*, 4.
Cells cylindric, straight or curved; in series end to end or bundles. *Raphidium*, 5.

b. Cells united in families by the envelope of the mother-cell enclosing the daughter-cells. (INCLUSÆ.)

Synopsis of Genera.

Cells distributed in large, gelatinous, spherical families. *Botrydina*, 6.
Cells oval; in botryoidal, lobed families. *Botryococcus*, 7.
Cells enclosed in globose, lamellose envelopes. *Glœocystis*, 8.
Cells red, on thick gelatinous stalks of concentric lamellose structure. *Urococcus*, 9.
Cells kidney-shape, lying separate in ample, gelatinous envelope. *Nephrocytium*, 10.
Cells oblong, in common gelatinous envelope. *Oocystis*, 11.
Cells oval, with large, colorless vacuole; in common, gelatinous envelope. *Glœococcus*, 12.

c. Cells united in families of characteristic form by the formation of slimy and confluent envelopes. (GELATINOSÆ.)

Synopsis of Genera.

Cells oval, in tubular, branched, gelatinous thallus. *Hydrurus*, 13.
Thallus globose, eight-celled, floating. *Chromophyton*, 14.
Cells in hyaline, cylindrical, single or radiately arranged envelopes. *Palmodactylon*, 15.
Cells longitudinally arranged in tubular hyaline thallus. *Hormospora*, 16.
Cells in hyaline envelopes, the latter joined into a long thallus. *Palmodictyon*, 17.
Cells distributed in a hyaline thallus attached by a pedicel-like base. *Apiocystis*, 18.
Cells in oval transparent envelopes in a globose, hyaline thallus. *Entophysalis*, 19.
Cells distributed, often in twos and fours, in a gelatinous layer. *Tetraspora*, 20.
Cells cubical, angular, in tubular families. *Staurogenia*, 21.
Cells oval, in longitudinal series in gelatinous thallus. *Inoderma*, 22.
Cells in gelatinous families, integuments splitting in halves and quarters remaining in the gelatin. *Schizochlamys*, 23.
Cells green, red, or orange, thick walls; indefinite gelatinous thallus. *Palmella*, 24.
Cells spherical or angular, red or purple, in layer of gelatin. *Porphrydium*, 25.

d. The single cells are united in families by the formation of pedicels or fine stems. (STIPITATÆ.)

Synopsis of Genera.

Cells elliptic, on ends and at axes of dichotomous, hyaline stems. *Cosmocladium*, 26.
Cells terminal, on stems. *Mischococcus*, 27.
Cells terminal, on very delicate stems, in spherical hyaline thallus. *Dictyosphærium*, 28.
Cells in fours, on very short branching stems. *Dimorphococcus*, 29.
Cells on radiating gelatinous stems

of a hard, crustaceous, greenish thallus. *Oocardium*, 30.

Genera of doubtful value, omitted in this classification :—

Tachygonium Nägeli.

Palmophyllum Kützing.

a. Separatæ.

1. Genus *Eremosphæra* De Bary.

Cells spherical, free-swimming; walls thick, firm, hyaline; contents green, granulose, sometimes radiating in laminæ or plates from the centre of the cell.

Propagation by division into 2–4 daughter-cells, each of which escapes by a special rupture in the cell-wall. Zoogonidia not known.

2. Genus *Pleurococcus* Kirchner.

Cells spherical, or polyhedric through mutual pressure, with thin, not confluent walls, single or in small spherical or cubical aggregations; contents green, red, or reddish-yellow. Division in every direction.

Propagation by gonidia, not observed in all species.

3. Genus *Dactylococcus* Nägeli.

Cells oblong or spindle-form, free swimming, with thin walls, forming families of 2–8 cells by oblique division, the cells finally separating and becoming single. Contents green, with one starch granule.

[The cells of *Dactylococcus* are enclosed in ample hyaline sheaths, which are stiptate, or attenuated into a pedicel which is attached to some object. *D. De Baryanus*, for example, is parasitic on small aquatic crustaceans, such as entomostraca.]

4. Genus *Stichococcus* Nägeli.

Cells oblong, or short-cylindric through mutual lateral pressure, with thin walls; single or joined serially into small, free-lying families; contents green; division only in one direction.

5. Genus *Raphidium* Kützing.

Cells fusiform, cylindric or needle-shape, ends usually cuspidate or acuminate, straight or curved; single, or two joined end to end, or in fascicles or bundles; walls thin; contents green, with a central or rarely lateral vacuole. Division perpendicular to the longer axis.

b. Inclusæ.

6. Genus *Botrydina* Brébisson.

Cells spherical or oblong, with thick, gelatinous, partially confluent integument, associated in families, sometimes very large, closely surrounded by the expanded membrane of the original mother-cell, which constitutes a sub-globose thallus. Contents green.

7. Genus *Botryococcus* Kutzing.

Cells oval or elliptical, with thin walls, united in a small solid, botryoidal family (like a bunch of grapes), which is very closely enveloped by the thin, different membrane of the original mother-cell. Contents green, reddish or brownish.

8. Genus *Glœocystis* Nägeli.

Cells globose, with gelatinous envelopes; single or 2, 4–8 associated in globose gelatinous families; special and general envelopes lamellose. Contents green, with a starch-granule and a vacuole, rarely red. Division in alternate directions.

Propagation by motile gonidia.

[The peculiar lamellose structure of the gelatinous matrix distinguishes this plant from *Pleurococcus*.

We are inclined to place the very closely allied *Glœocapsa* in this family, particularly since the observations of Paul Richter* tend to prove that *Glœocapsa* and *Glœocystis* are the same plant under different conditions of growth. Both these genera are found in moist situations, exposed to the air, but never under water, since in water their gelatinous investments disappear.

The beginner may be puzzled at times to distinguish between the two genera. In a general way it may be said that the lamellose structure is more distinct in *Glœocystis* than in *Glœocapsa*, and the former is usually green, while the latter is olive or bluish-green. Some species

* See this Journal, vol. ii, pp. 25 and 52.

of *Glœocystis*, however, are brownish or yellowish.

We have, however, followed Kirchner in this classification, placing *Glœocapsa* in the family Chroococcaceæ, in the order Schizosporeæ.]

9. Genus *Urococcus* Hassall.

Cells globular or oblong, large, reddish or blood-red, with a thick gelatinous, concentrically laminated envelope, which forms a thick, annularly streaked, apparently articulated, gelatinous stem, which may have a branching character, with the red cells embedded in the ends.

10. Genus *Nephrocytium* Nägeli.

Cells kidney-shaped, 2, 4, 8, or 16 lying separate in ample kidney-shaped or oval, free-swimming bladders (of the mother cell-wall); contents green, with a starch-grain and a vacuole.

Propagation unknown.

11. Genus *Oocystis* Nägeli.

Cells oblong, single, or 2, 4, 8, in the extended, oblong mother-cell; contents green.

[This genus differs from *Nephrocytium* only in the oval and not reniform shape of the cells.]

12. Genus *Glœococcus* A. Braun.

Cells oval, green, with colorless vacuole, enclosed in ample gelatinous envelopes, which are united into a common thallus.

Propagation by zoogonidia, with two cilia, produced in the last generation of cells.

c. Gelatinosæ.

13. Genus *Hydrurus* Agardh.

Cells spherical or elliptic, with thick, gelatinous, confluent envelopes, forming a large tubular or worm-like, often branched, attached, gelatinous thallus, sometimes 3 dm. long; contents green or brown, cells often colorless at the end. The zoogonidia form single in each mother-cell.

14. Genus *Chromophyton* Woronin.

Thallus globose, pulveraceous, eight-celled, floating at surface of water.

[The genera *Hydrurus* and *Chromophyton* are described by J. Rostafinskiego* under a new family, Syngeneticæ, sub-family Chromophytoneæ, which includes only these two genera. They closely resemble each other, the principal difference being in size and form of the thallus. This author regards the plant as belonging to the Phæoideæ, a new division established by himself, nearly identical with De Bary's Phæophyceæ.]

15. Genus *Palmodactylon* Nägeli.

Cells spherical, with thick, vesicular or confluent cell-walls, enclosed in floating, cylindrical vesicles usually radiately arranged. Cell-contents green.

Division at first in one direction, later in all directions.

16. Genus *Hormospora* Brébisson.

Cells oblong, arranged in longitudinal series, in tubular thallus, simple or branched; floating free Cell-contents green, with a starch-grain at one side. Division only in one direction.

[This genus is a doubtful one, since it is probably a condition of dissolution of certain filamentous algæ.]

17. Genus *Palmodictyon* Kützing.

Cells spherical or oval, with thick gelatinous envelopes, one or several cells within single envelope of mother-cell. Gelatinous envelopes connected into a subreticulate or filiform anastomosing thallus.

Propagation by motile gonidia.

18. Genus *Apiocystis* Nägeli.

Cells globose, scattered or 8 disposed in a circle, embedded in a small gelatinous thallus which is attached by a stem-like base. Cell-contents, homogeneous or firmly granulose, with a distinct chlorophyllous vesicle and colorless vacuole. Tegument thick, dissolving to a homogeneous jelly. Division in every direction.

Propagation by motile gonidia, globose, with two cilia.

19. Genus *Entophysalis* Kützing.

Cells rotund, associated in families surrounded by elliptical mother-cell. Thallus globose, cartilaginous, including the families of cells.

* Hydrurus i jego Pokrewienstwo. Kraków, 1882.

20. Genus *Tetraspora* Agardh.

Cells spherical, with thick diffluent walls, distributed without order, or in twos and fours, in a large, one-layered gelatinous thallus, originally sac-like, afterwards open. Walls of the mother-cells after division disappear. Cell-contents green, usually with distinct starch-grain. Division in different directions, in the same plane.

Zoospores with two cilia form singly in the cells.

21. Genus *Staurogenia* Kützing.

Cells of cubical or angular form, lying in a plane, united in table-like, free swimming families of 4–8–16 cells. Division in two directions, at right angles.

Propagation by still gonidia.

22. Genus *Inoderma* Kützing.

Cells oblong; arranged more or less in longitudinal series loosely connected with soft gelatin, tegument thick, diffluent; constituting a gelatino-membranaceous, irregularly expanded, or pseudo-filamentous thallus. Division in one direction only.

Propagation by motile gonidia.

23. Genus *Schizochlamys* A. Braun.

Cells globose or ovate, single or united in gelatinous families like *Tetraspora*. Tegument of mother-cell separating in 2–4 equal parts, by splitting into halves or quarters. The pieces remain embedded in the common jelly for a long time.

Propagation by micro- and macro-gonidia.

24. Genus *Palmella* Lyngbye.

Cells spherical, with green, red or orange colored contents, and thick confluent walls, which produce a structureless, gelatinous layer. Division in all directions. Thallus without definite form.

[The palmellæ are doubtless for the most part stages in the development of higher algæ.]

25. Genus *Poryhrydium* Nägeli.

Cells spherical or angular from mutual pressure, with rather thin diffluent integument, united in families of a single (rarely double) layer of cells. Cell-contents red or purple. Division in different directions of the layer.

[This genus is included among the Rhodophyceæ by Rabenhorst, but it is evidently very closely related to *Palmella*.]

d. Stipitatæ.

26. Genus *Cosmocladium* Brébisson.

Cells elliptic or kidney-shape, on the ends and axes of dichotomously branched, hyaline stems, the entire family having a tree-like appearance. Cell-contents green, with a starch-grain. Division only in the direction of the stem.

Propagation by zoospores, 4–8 of which form in a mother-cell.

[A new genus *Hauckia* Borzi, is very closely related to *Cosmocladium*; but we are not now able to give its distinctive characters. See *Brébissonia*, 1881, p. 97.]

27. Genus *Mischococcus* Nägeli.

Cells globose, terminal, two or four in rows on the ends of dichotomously branching, very delicate, hyaline thallus.

Propagation by zoogonidia.

28. Genus *Dictyosphærium* Nägeli.

Cells elliptic or kidney-shape, with thick, diffluent walls, united in free-swimming spherical, hollow families, single cells on the ends of slender filaments which radiate from the centre of the family and repeatedly branch toward the periphery. Cell-contents green, with a starch-granule and a peripheral vacuole. Division at first in all directions, later only radially.

29. Genus *Dimorphococcus* A. Braun.

Cells in fours on very short branches, dissimilar, the two intermediate ones contiguous, oblique, reniform or obtuse ovate, the two lateral ones opposite and separate, lunate. Families free-swimming, forming botryoidal clusters.

30. Genus *Oocardium* Nägeli.

Cells subovate, slightly emarginate at the ends, stipitate, with central chlorophyll vesicle, often with a

colorless vacuole. Thallus crustaceous, hard, verrucose, pale green, radiately striate within. Cells borne singly or in pairs on gelatinous stems, tubular, di- or tri-chotomously branched, fastigiate, densely compacted, calcareous. Division alternately in two directions.

[*To be continued.*]

—o—

Pollen-tubes.

The number of the *Journal* of the New-York Microscopical Society of January, 1885, contains an account of the proceedings at their meeting of November 21st, and also a paper read by Mr. N. L. Britton, to which he gives the title, 'Criticism on Mr. J. Kruttschnitt's Papers and Preparations relating to Pollen-tubes.'

Mr. Britton's remarks can scarcely be taken as a criticism; they seem to be rather intended as a hint that an amateur worker in a science should not annoy the professors thereof by persistently calling into question the infallibility of their dogmas and their teachings.

I am not inclined to take the hint, notwithstanding the formidable array of heavy artillery brought to bear against me. I will not haul down my colors; I will only do so on condition that Mr. Britton, or any one else, produce a preparation in which the pollen-tubes as they are emitted on the stigma of any angiospermous plant may be traced down the style to the ovarian cavity and to the micropyle of the ovules. This should not be a difficult task, considering what Mr. C. R. Barnes, professor of natural history at Purdue University, La Fayette, Ind., says on this subject. In a letter received from him on the 22d of May last occurs the following: 'There is a plant in which you can easily see the entrance of the pollen-tubes into the micropyle, that is, if you are as successful as my students usually are. That plant is *Capsella Bursa-pastoris*.' I sent him some of my preparations, requesting him to send me some of his; in answer he writes under date of June 4th: 'I am just now in the very busy time of commencement, but as soon as that is over I shall send you a slide showing the entrance of the pollen-tube into the micropyle of an ovule of *Capsella*. They are so easily gotten when wanted that I have never thought worth while to make a permanent preparation.' So far Prof. Barnes has not redeemed his promise; I, however, in the interval, have made a number of preparations, in fact, I have subjected *Capsella* to a most thorough examination in the various phases of development of its ovaries, but have failed to discover anything having the appearance of a pollen-tube, such as the pollen-grains of certain plants emit on the stigmas. I am therefore at a loss to imagine to what structure Prof. Barnes attaches the significance of a pollen-tube, unless he take as such the vascular fibre in the funiculus.

The difference of opinion concerning the fecundation of the ovules refers apparently to the functions which are attributed to the conducting tissue. All admit that the conducting tissue performs a part herein; some assign it only a subordinate one, making it the carrier of the pollen-tubes towards the micropyle, whilst I consider it the principal factor, in as much as it diffuses the fertilizing element of the pollen all over the whole ovary in its entirety to the extent of its ramifications. Mr. Britton, on the authority of Mr. Sachs, says: 'The pollen-grains which germinate on the stigma send out their tubes through the channel of the style, where there is one, or more frequently through the loose conducting tissue in its interior down to the cavity of the ovary.'

The examination of the style and of the ovary of *Cereus grandiflora* shows unmistakably the functions assigned in this plant to the conducting tissue. The pollen-tubes, after their emission on the stigma, insinuate themselves amongst the papillæ of the stigma where their contents, the

fovilla, are discharged and taken up by the conducting tissue of the style. If the style be torn open and the fibrillæ of the conducting tissue separated, the fovilla in it is easily traceable all along in streaks and blotches down to the ovary. Here the conducting tissue spreads itself out over the walls of the ovary and the placenta, accompanies the funiculi to their juncture with the ovules. The tuft of papillæ surrounding the micropyle of the ovule, which on bending round on its long funiculus is brought in easy contact with the minute papillæ which beset its ventral portion, the fertilizing element is absorbed; thus also communicated to the oosphere in the embryo sac and the process of fertilization is accomplished.

According to Mr. Britton the number of pollen-tubes depends on the number of ovules, and he says the former are generally in excess of the latter. The ovary of *Cereus grandiflora* contains at least 3,000 ovules; the style is a tube about 8 inches long and has a very small channel; the fibrillæ of the conducting tissue, which are also tubular, fill up the body of the style; more than 3,000 pollen-tubes must therefore seek their way down to the ovary. Such a mass of foreign material in the style should certainly leave a trace behind; but I have never discovered any. Transverse sections of the style before and after pollinization are similar in appearance, but the style on being laid open longitudinally after pollenization contains plenty of fovilla granules throughout the conducting tissue.

Mr. Detmer, in a paper also cited by Mr. Britton, has undertaken to trace the course of the pollen-tubes in angiosperms; I have corresponded with him and also with Mr. Strasburger on this subject, pointing out to them the impossibility of pollen-tubes reaching the micropyle of the ovules in certain plants in the way indicated. I submitted them also some of my preparations; but our correspondence remained without result, the gentleman named first having not the leisure to re-examine into the question.

In September, 1883, I exchanged also a few letters with Mr. Britton concerning pollen-tubes. On that occasion he mentioned also the fortuitous experience he met with in *Cypripedium acaule*, the same as he mentioned in his paper; by not alluding to any other observation of his own in support of his criticism, one might be induced to draw the inference that with this casual and superficial observation in the field, his researches after pollen-tubes have been exhausted.

I have also observed more than once bundles of fibres like a skein of silk filling the style, of which Mr. Britton speaks; but the idea never occurred to me that they were pollen-tubes. I took them for a bundle of fibrillæ of the conducting tissue, which, in the wall of the ovary, run down in the rear of the placenta and in close proximity of the ovules. I have prepared a slide showing this very plainly. The material is from an *Orchis*.

The slide of *Monotrapa uniflora*, which, at the same meeting of the New York Microscopical Society, became the subject of a magic-lantern exhibition, was kindly loaned to me by Mr. Joseph Schrenk also in 1883. On returning it I took occasion to mention that the fibre seen to approach the micropyle of one of the three or four ovules the slide contains, was not a pollen-tube, according to my conception, but a branched fibre of the conducting tissue, and my more recent investigation in *Monotrapa* would not allow me to change my opinion in this respect.

Angiospermous plants with orthotropous ovules would offer the greatest facility to fecundation by means of pollen-tubes, but these are only of limited occurrence; plants, on the contrary, having anotropous ovules comprise the largest number, and these would offer also the greatest

difficulties if not absolute impossibilities to fertilization by this process. If the pollen-tube theory be ignored the fecundation of every single ovule in whatever position it be attached to its funiculus or to the placenta would be easily accomplished in the most simple and natural manner by reason of such position or attachment. Nature chooses always the most simple means to accomplish its ends; it has never been found to have placed obstacles in its own path; where we think to have discovered them, they are only the children of our imagination or of a misinterpretation of appearances.

In conclusion I will say that as Mr. Britton considers it necessary in the interest of science to warn the amateur student not to allow himself to be led astray by my heretical notions, he would have rendered a much greater service to science by encouraging that class of workers to examine for themselves, instead of counselling them to imitate the example set by the professors of the science and to believe blindly in what is offered by others as Gospel truth.

J. KRUTTSCHNITT.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol. III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

MICROSCOPICAL SOCIETIES.—We desire to publish a complete list of the microscopical societies in the country, with the dates of their organization, number of members, and names of their present officers. We would also like to have information concerning their membership, condition, and prospects. It has been suggested that the list should be revised each year, so as to be a record of the societies in existence.

We therefore request the secretaries of microscopical societies to favor us immediately with the information desired that we may soon be able to publish the list for this year. We would be pleased to receive copies of constitutions or rules of the societies for reference. To ensure the proper entry in the list, it is earnestly requested that secretaries do not delay sending the desired information. We cannot possibly know all the societies in the country, and if any are left out of the printed list it will be due to the neglect of the officers who are able to give the information.

—o—

STAINING TISSUES.—The first of the series of articles which Prof. W. H. Seaman has undertaken to translate for this JOURNAL, published this month, does not give a very good idea of the practical value they possess. This part is introductory to the most exhaustive study of the staining agents used in microscopy that can be imagined, it is an invaluable work for reference, giving as it does a brief statement of the materials used, their method of preparation, and their special applications, with references to the original descriptions of processes.

The article is not confined to dyes used for animal tissues, but it treats of colors used in all branches of microscopical investigation. All who have occasion to do staining of tissues, of whatever kind, will find this article of the greatest use, and our readers are much indebted to the translator for devoting so much of his time to the subject.

The subject will be continued from month to month, as it necessarily occupies a considerable space on these pages.

Microscopical Exhibitions.–The ostensible purpose of public exhibitions given by microscopical societies is to promote interest in microscopical studies. As usually conducted they bring together a large collection of attractive objects, chosen mainly because they are of a striking character, well calculated to arrest attention and produce astonishment in the minds of the uninitiated. While we do not wish to write one word of opposition to such displays, which are undoubtedly very desirable and instructive, we were led to think, on the occasion of the recent exhibition in this city, whether there could not be devised some means to make them far more useful, from an educational point of view.

A plan very soon came to mind, which at the time seemed practicable, and has since commended itself more perfectly; we now offer it for consideration to our readers, some of whom may feel disposed to try it. It is this: Instead of asking all the members of a society to select their own objects for exhibition, which results in a promiscuous collection without any pretence of systematic arrangement, let some member, or several members acting together as a committee, take charge of the entire exhibition and select one or more series of objects to be shown in their proper order, to illustrate certain subjects. The list of objects once made out, it will be a very easy matter for any person familiar with the tastes and abilities of the members to assign the objects around to the satisfaction of all.

The purpose of such an arrangement is to make exhibitions instructive in the highest degree possible. To more fully explain our meaning let us take a special subject for present consideration, premising, however, that we have not given it sufficient consideration ourselves to offer a scheme in any sense complete or satisfactory concerning any subject. We will suppose, then, that there are fifty microscopes available for an exhibition, and it has been decided to devote a number of them to the illustration of the process of fertilization and early development of plants. The first object shown should be a drawing or painting of a flower, designating the filaments, anthers, ovaries, etc., so that subsequent explanations may be understood. Then, beginning with the microscopes, some varieties of pollen might be shown, followed by a preparation showing the growth of the pollen-tubes. Next there should be some sections of ovaries of different plants, showing the various positions in which the young seeds grow within them, and other features that will occur to an observer. Then there might come some ripe seeds of various kinds, showing the ornamentation upon many of the common flower and vegetable seeds, and finally sections of the ripe seeds showing the young plant in embryo. Each specimen should be clearly described, as concisely as possible, so that the observer can immediately understand it. The plan of describing every specimen in order on a printed program, adopted by the New-York Microscopical Society, would be excellent for an exhibition of this kind. Out of fifty microscopes, twenty might be devoted to one series of objects, twenty to another series of a different kind, and the remaining ten to the standard show-specimens, such as the circulation of blood, cyclosis in a plant, beetle's wings, and gorgeous objects of all kinds.

This hastily drawn outline will be suggestive to those who deem the plan worthy of trial. It appears to us it would add greatly to the interest of such exhibitions, and benefit not only the guests but also the members themselves. It would certainly make it necessary for members to prepare special objects for such an exhibition and to read up on the subjects assigned to them—a proceeding that could not fail to be beneficial.

At the present time society exhibitions are not in great favor among

men of science because there is not much to be learned from them. The average exhibitor has but a very superficial knowledge of the specimens he shows—a fact very easily discovered by an inquisitive guest. This should not be so, and hardly could be if the spirit of these suggestions were carried out. If persons attend exhibitions of the kind to pick up scraps of knowledge here and there, certainly the exhibitors should at least read up about their own objects, and be ready to tell something about them.

We would be glad to receive communications and suggestions from readers concerning the subject, as it is one of universal interest.

——o——

Postal Club Boxes.—Box I came into this circuit Feb. 9th an empty box, to be filled. The new headings of the letter packet are a great improvement over the old. The printed form calls for common and scientific name of the object, how prepared, mounting medium, cell and cements, objectives advised for examination, and history or description of the object.

We have put in a slide of *Chroolepus aureus*, one of the aerial algæ, collected in 1882 in Watkins Glen, New York.

Box B^2 reached this circuit on the fifth of March, with the following preparations:—

1. Sections of seeds of *Cucurbita melopepo*, squash. Rev. A. B. Hervey. The sections of the seed are quite interesting for study. Four layers are described, viz:—

1. Large reticulated cells.
2. Lignified cells, two layers.
3. Small reticulated cells.
4. A very much thicker layer of elongated cells or tubes, filled with starch in the natural state. 'This layer constitutes the white velvety coating of the side of the squash seed, and is very much more developed in this than in the *C. pepo*.'

The cement is running in and spoiling this preparation.

2. Hairs and scales of *Shepherdia Canadensis*. W. H. Pratt.

3. Sand from the shore of Provincetown, Cape Cod. J. M. Crocker. 'Said to contain upward of a dozen varieties of minerals.' This is interesting information, but it would be desirable to know what the minerals are. This preparation was spoiled, and is 'out for repairs' A fern leaf with fruit double stained has been substituted.

4. Diatomaceæ from Sandwich Islands. Elijah Brent. Very good diatoms, but the cover-glass might have been put on the middle of the slide instead of where it is, on one side.

5. Diatoms from marsh near Mount Auburn, Mass. L. M. Willis.

6. Diatoms from Island of Corsica. W. H. Curtis.

Box Cb came to hand February 18th with a fine preparation of pikrite from Mr. A. C. Cole's series. This was the only slide in the box.

Box Ca came to hand March 17th containing two preparations of Cole's series—one a transverse section of the stem of the copper beach, the other a section of the stem of the umbrella plant.

NOTES.

—We find a notice in one of our valued exchanges to the effect that Mr. Duclaux has sent a communication to the Académic des Sciences, Paris, stating that from experiments he has made with the Dutch pea and haricot bean, he concludes that seeds will not germinate in soil freed from micro-organisms. This rather surprising conclusion requires, to say the least, confirmation before it can be regarded as of the slightest importance. A still more astonishing announcement is made in the same place in these words: 'Mr. Pasteur also states that he has found, by experiment on animals, that food which is free from micro-organisms cannot be digested.' It is truly astonishing how rapidly such squibs as these are taken up by newspapers and spread broadcast. The readers of this journal will not be carried away by the brilliancy of either of these remarkable observations. We

do not hold Mr. Pasteur responsible for the latter—there are cranks in all professions.

— We are indebted to Mr. W. H. Pratt, of Taunton, Mass., for two of his neatly mounted preparations, one of stained pollen-grains of the sunflower, the other spores of the fern *Osmunda cinnamomea*. Both are stained green.

— We have also received, from Mr. George Freeston, of Oswego, N. Y., two excellent preparations of *Volvox* and other algæ, which are unusually well preserved. One of the preparations contains some *Spirogyra* showing the fruiting condition very perfectly, and some of the finest mounted specimens of *Nostoc* we have seen.

— The microscopical societies of Easton and Bethlehem, Pa., gave an exhibition at Bethlehem on the evening of February 18th, at which a short address was delivered by the Rev. Mr. Wolle, followed by a display of objects by both societies. The meeting was well attended, the hall being crowded with visitors, eager to see the many wonderful things revealed by the microscopes.

— We have also received notice of two meetings of the San Francisco society, one of which was the annual meeting, when an address was delivered by the President, Mr. G. M. Kinne. This society is in a prosperous condition, and some good papers are expected during the year.

— It is feared by many persons that there will be an outbreak of cholera during the present year in this country. The disease advances steadily when once started on its way, and if we escape it, it will be almost a miracle. That its introduction could probably be prevented by an efficient health board acting for the general government, we have no doubt. Congress has not realized the importance of a health department, and the National Board of Health has, from want of appropriations, only a nominal existence. It is doubtful if economy in this direction is economy at all. Another serious epidemic will, perhaps, demonstrate more clearly than the last, that prevention secured by the annual expenditure of a few thousand dollars every year, is far better than the loss of life and depression of business always caused by an epidemic, which costs the country hundreds of thousands.

— While other governments are aiding the investigation of contagious diseases, by furnishing laboratories and placing funds at the command of competent men to conduct important observations, what is our own government doing in this direction? Not only is its penurious policy shown in regard to appropriations for health officers, but it offers to its ablest and most unselfish investigators, who have already conducted many experiments of great importance, the privilege of doing as much work as they please at their own cost. This is the way the most advanced and enlightened and progressive country in the world encourages scientific researches!

— Referring to cholera above, it will be of interest in the same connection to quote from an article by Dr. Max von Pettenkofer, in *Popular Science Monthly*. He writes as follows:—

'The disease is best known in Europe under the names of cholera, cholera morbus, Asiatic cholera, since the epidemic of 1817 to 1819, in which the English army, under the command of the Marquis of Hastings during a war against the natives, was rendered unfit for fighting and almost annihilated. But cholera had never visited Europe till the present century, when in 1830 it appeared in Russia and spread to Poland, where war was prevailing. Since that time, sometimes at longer and sometimes at shorter intervals, cholera has appeared in Europe. The question why cholera remained a thousand years in India before it first began to migrate is one of great interest, but one which cannot be satisfactorily answered. The principal consideration appears to me to be that the event happened at the time when intercommunication in all directions, both by water and land, had become more rapid. The first steamship appeared in the Indian waters at the beginning of the second decade of the present century. By land also intercourse was greatly accelerated. The Russians possibly took cholera from India, Arabia, Afghanistan, or Persia, through couriers and stage-coaches. It soon became clear that cholera, the specific cholera-germ, was in some way or other propagated along the paths of human intercourse, and it also became evident that unless the germs found a suitable soil within a certain time they did not flourish. Observers soon discovered that cholera was more prone to appear in certain regions and to affect certain localities, while it shunned other districts; and, again, that other regions were only visited at intervals of many years. It is also a fact that Asiatic cholera never yet appeared at a place which had not previously been in communica-

tion with a region where cholera prevailed; and, further, that the disease from an infected locality never yet passed on to another place if the journey lasted a certain time without interruption. The large intercourse between India and Europe, more particularly England, by means of ships which sailed round the Cape of Good Hope, had never succeeded in carrying cholera from India to England.'

CORRESPONDENCE.

Concerning Angles.

TO THE EDITOR:—* * * In the November number of the JOURNAL, 1884, under the head 'Choosing Objectives,' you make the statement that a 'Hartnack water-immersion at $45 probably will not do what the Spencer homogeneous immersion at $55 will do.' I have been working with wide angle homogeneous objectives for the last three years, and I have Tolles $\frac{1}{10}$ and $\frac{1}{6}$ each 126° B. A., and my experience is simply this, that no water-immersion objective that I have examined is in any respect their equal for histological work or anything else. I use the microscope daily, and have had several hundred dollars worth of various grades of objectives to examine. Now, as a matter of fact, I ordered of Dr. Chase a Spencer $\frac{1}{15}$ of 100° B. A. which you so highly recommended in the JOURNAL, and I can say that it was one of the best high-powers I had examined; yet it did not do the work of the Tolles $\frac{1}{10}$ or $\frac{1}{6}$, so I exchanged for a Spencer $\frac{1}{15}$ of 115° B. A. I consider this $\frac{1}{15}$ of 115° B. A. worth about twice as much as the one of 100° B. A. For all ordinary work its resolution is greatly superior to the one of a 100° B. A., its working distance is ample, its definition and resolution are all that could be expected for the angle.

Another statement made in the article above mentioned is this:—'Even for those refined studies of bacteria and diseased germs, which have attained such great importance at the present day, these objectives [water-immersion] are to be most highly recommended.' One question may be asked here, is it possible for a low or medium angle water-immersion objective to give as sharp and clear definition of those minute organisms as a first-class homogeneous-immersion objective of high angle can? I have tested both kinds of objectives with bacteria, salivary corpuscles, and histological slides of various kinds, and I will have to see the water-immersion objective that is in any respect the equal of a well-constructed homogeneous-immersion objective of 126° B. A. They, water-immersion objectives, are useful on very thick histological sections, because their working distance is greater then high angle homogeneous objectives of high power. I have a Tolles $\frac{1}{6}$ of 126° B. A., which works easily through three and four thin cover-glasses, and I deem it one of the best histological lenses ever made. I can examine almost anything with it. It resolves *Amphipleura* in balsam beautifully, and can do the work of any ordinary dry $\frac{1}{4}$. Now, in conclusion, I will state that of all the objectives I have examined, I found none equal to Tolles' or Spencer's best work. The JOURNAL has been a welcome visitor to me for the last three years. I deem it a most useful publication. PIERCE TYRRELL.

ELGIN, Ill.

NOTICES OF BOOKS.

Second Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1880–'81. By J. W. Powell, Director. Washington: Government Printing Office. 1883. (4to, pp. 477.)

Among the many publications of a scientific character issued by the authority of the United States Government, few can compare in general interest, or in excellence of form, with the two reports of the Bureau of Ethnology, under the able direction of Major Powell. It is impossible to condense within the few lines that can be here accorded to notices of books, anything that will convey even a faint idea of the varied contents of this, the second large volume. Ethnology includes a vast range of subjects. We find here the results of long study of the languages and customs of the aborigines of America, of their folk-lore and strange myths, superstitions, and religion, their arts and industries. The volume includes an illustrated catalogue of the collections obtained by Mr. James Stevenson from the Indians of New Mexico and Arizona.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Palates of molusca in exchange for other objects, mounted or unmounted.

A. B. AUBERT,
Orono, Penobscot County, Maine.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., MAY, 1885. No. 5.

Koch's Method of Isolating and Cultivating Bacteria as used in the Laboratory of the Bureau of Animal Industry, Dept. Agriculture.*

BY DRS. D. E. SALMON AND THEOBALD SMITH.

In investigating the causes of infectious diseases that are supposed to be due to micro-organisms three lines of research are considered essential to a complete demonstration. We must, in the first place, prove by microscopical means the existence of the suspected microbe in the diseased organs or tissues of the body. This microbe must then be isolated and cultivated outside of the body in a state of purity, and finally it must produce the disease when the pure culture is introduced into the animal organism. In the study of infectious diseases affecting mankind only, the third requisite must necessarily be set aside, yet the other two may be so strengthened that their evidence alone will furnish a strong probability.

The communication this evening is to deal with some recent methods bearing on the cultivation of pathogenic bacteria in a state of purity. The nature of the problem before us may be most readily comprehended with the aid of a few simple illustrations. There are certain bacterial diseases in which the microbe is confined to the blood almost exclusively, as, for instance, in the various forms of septicæmia and anthrax. In certain others they may multiply on the serous surfaces of the thorax and abdomen, in the subcutaneous connective tissue, or in the lymphatics. In such cases, the specific microbe may be obtained free from other bacteria at the outset and a pure culture obtained directly if proper precautions be observed. Minute portions of blood or of the effusion into the serous cavities or subcutaneous tissue, transferred with a pipette, needle or platinum loop into tubes containing liquid or solid culture media, will in most cases give the desired result. There are a number of other infectious diseases in which the pathogenic microbe does not occupy the ground alone. The intestinal and the respiratory tract in health always contain numerous forms of microbes, most of which are harmless, saprophytic forms. Diseases in which the lesions, due to the presence of micro-organisms, involve these tracts are not uncommon. Asiatic cholera and swine plague are well-known illustrations. The disease-germs, as they are popularly called, are mingled with the numerous bacteria normally occurring there to such an extent that the minutest visible portion which may be transferred to culture-media will contain at least two or three species. Placed in liquid media each species will multiply, that one most rapidly which meets conditions most favorable to its growth. Within one or two days each drop of the culture-liquid will probably teem with each of the forms sown, and to transfer a small portion to another tube would simply reproduce former conditions; the second culture would be equally impure. The method of dilution has been used with more or less success in these

* Abstract of a communication to the Biological Society of Washington, D. C., April 18th, 1885.

cases, but it requires much labor and apparatus.

A method has been recently introduced by Dr. Koch which enables us to secure pure cultures from mixtures without much labor, and which furnishes, in addition, the means of distinguishing different species with a low power. The method, in brief, consists in distributing individual microbes through a liquid medium which rapidly gelatinizes. The microbes are thus forced to remain isolated and to multiply *in situ*. The steps of the process are as follows: A minute portion of tissue or liquid which contains, among others, the pathogenic microbe is thoroughly shaken up in about 10 c.c. of sterilized water. We prefer sterilized broth, and thus obtain a liquid culture of the various forms, the examination of which may serve as a check upon errors in the plate-cultures to be described later. We have at hand some nutritive gelatin which is prepared according to Löffler's formula: 10% gelatin, 1% peptone, ½% common salt dissolved in an infusion of meat. This gelatin remains solid at ordinary temperature, but liquefies above 80° F. The gelatin is stored for this purpose in test-tubes provided with a cotton plug, each containing about 10 c.c. The gelatin having been liquefied by gentle warming or by placing in the thermostat at 100° F. for a short time, the protruding portion of the cotton plug is singed away and the tube thoroughly heated in the flame around the plug itself until the latter turns slightly brown. This will insure the destruction of all bacteria that may have gathered on or around the plug. A drop of the fluid in which the bacteria have been distributed is transferred to the liquid gelatin, and this in turn is thoroughly shaken to secure uniform distribution. The gelatin is then poured upon sterilized glass plates which have been cooled in a refrigerator, and upon which it rapidly solidifies, so that the plates may be placed under a bell-jar in a moist atmosphere within fifteen minutes. In these manipulations the object sought is to secure such a distribution of the bacteria on the plates that they will not interfere with each other as they develop, and that they are far enough apart to allow each centre of growth to be touched with a needle without touching adjacent centres. Since the number of bacteria will vary with their source, the amount of dilution necessary in each case cannot be foretold. Judgment and experience must be our guides. We have found glass plates measuring about 8 by 10 cm. a convenient size. It is more expeditious in most cases to transfer fluid with a platinum loop than with a pipette. The loop carries smaller quantities, and is more easily sterilized.

After a period of from 24 to 48 hours minute opaque points are perceptible on the plates. Each of these represents the progeny of a single microbe, which has multiplied until the brood numbering thousands becomes visible to the naked eye. Under a low power these so-called colonies are observed to vary greatly according to the species of bacteria of which they are made up. Some are spherical, with sharply-defined outlines, others with circumference not very distinct; some bear protuberances of various forms; some have an area of liquid gelatin surrounding them, or are situated at the bottom of steep, funnel-shaped depressions; some have peculiar markings on their surface. They may be made up of granules or appear homogeneous. Finally, they may differ in refrangibility and in color. It is needless to say that such distinctions must be carefully noted. By removing, with a sterilized needle under a dissecting microscope, a colony, as each centre of growth is called, and mixing on a slide with a drop of sterilized water, the microscopic characters of the different forms of colonies are readily determined. The plate-culture has thus given us pure cultures of all the bacteria in the origi-

nal mixture which were capable of multiplying in the nutritive gelatin at the temperature of 70°–80° F. These pure cultures are represented by minute colonies, which will soon invade one another's territory. To study the differential characters of the various microbes thus isolated, their morphology and biology, larger cultures are prepared in the following manner: A sterilized needle melted into a piece of glass tubing, to serve as a handle, is made to pierce a given colony carefully singled out under a dissecting microscope, and then introduced into a culture-medium contained in these culture-tubes which have been devised by Dr. Salmon and described in the first annual report of the bureau, 1884. These tubes are used exclusively by us for these cultures. The test-tube plugged with cotton which Koch employs seems poorly adapted for the purpose. The media at present employed for the cultivation of pathogenic forms in tubes may be roughly classed as solid and liquid. Nutritive gelatin has been employed quite extensively of late, no doubt on account of its use in the culture and diagnosis of the 'comma-bacillus.' We have here a number of tubes which illustrate very well the microscopic appearances of different bacteria. The gelatin is liquefied by most of them, but the manner and the progress of liquefaction present interesting features. Micrococci which we could not distinguish satisfactorily under the microscope are here shown to grow very differently. Another valuable medium introduced by Koch when cultivating tubercle-bacilli is blood-serum. We have here a series of cultures, in this medium, of different forms of micrococci, and each growth presents peculiarities of its own. Several have the power of liquefying the serum, while the rest limit their growth to the surface, the growth in the track of the needle remaining nearly stationary. These growths on potato are interesting, inasmuch as they show that certain pathogenic bacteria may multiply on vegetable substrata, besides furnishing us with additional means of distinguishing different bacteria with the naked eye. Both cultures are micrococci, yet one forms a reddish growth, the other a whitish one. This color, moreover, is not appreciable in any of the previously-mentioned media.

Various liquid media have been employed in our work, consisting chiefly of decoctions and infusions of lean meat. Sterilized milk offers some points of interest. Certain bacteria will cause speedy coagulation; others will multiply without producing any perceptible change in the appearance of the milk. Still others may change the appearance and color entirely without inducing coagulation.

However much may have been said against the use of liquid cultures, we must admit that in general they cannot be dispensed with. They are essential in microscopic work; they offer a convenient medium for inoculation experiments on animals, for testing all important biological questions such as the influence of heat, disinfectants, etc., and for studying the attenuation of virus.

The method of plate-culture was first introduced by Koch in the biological analysis of drinking-water. His object was to determine the number and kind of bacteria contained in a given quantity of water. It is evident that in making this application of the method, the scrupulous care necessary in quantitative experiments must be observed, while in the isolation of bacteria from a mixture we need not dread the occasional lodgment of an aerial germ on our plates as our results are to be qualitative rather than quantitative. Accidental contaminations are usually spores of fungi and isolated colonies of bacteria readily distinguished from the rest. In the same way earth has been subjected to analysis with reference to the number and kind of bacteria which it contains.

The gelatin plate may be employed in still another way, which, however, preceded the one already mentioned in the order of time and no doubt paved the way for its invention. If we dip a needle into a liquid culture and draw it rapidly across the surface of a layer of gelatin, we have distributed in this line or track a number of bacteria, the fewer scattered along the way the better. In from one to two days this track, at first scarcely visible, becomes defined as an opaque line, and under a low power the colonies, descended from single bacteria, may be seen distributed irregularly along this line. These line cultures, as they might be called, present all the characters and variations which belong to the isolated colonies, and in fact quite frequently we are fortunate enough to observe single colonies in the track itself. By drawing 3 or 4 lines from different cultures on the same plate as has been done with these, we are enabled to compare their growth directly and also to determine whether the culture from which each line was inoculated was pure at the time. If all the colonies occurring in a given track are identical in appearance as they enlarge, no matter what may appear on the plate beyond the track, we may safely assume that the culture from which the colonies originated was pure, in that it contained but one distinct form or species. This method was used on substrata not so easily liquefied, such as agar-agar and blood-serum. Dr. Rosenbach in a recent work* used these line-cultures on agar-agar almost exclusively, the method of isolating germs not having been introduced. In spite of the care with which the work was done and accuracy with which the plates were drawn, we cannot but feel that it must be done over again with more recent methods to be of permanent value.

All of these methods must of necessity be employed in the future in the study of any micro-organism in order that the work may be received with confidence and form the basis of additional and more extensive investigations.

* Mikro-organismen bei den Wundinfections krankheiten des Menschen.

—o—

Abbe Condenser.

We present this month an engraving of the very simple and inexpensive mounting for the Abbe condenser made by Mr. Zentmayer. The lower

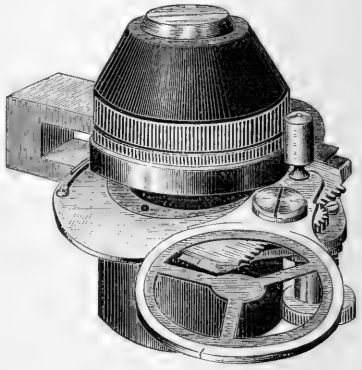


Fig. 13.—Zentmayer's Abbe Condenser.

ring fits into the substage-ring, and can be made to fit any microscope. The milled head, seen below on the right, moves the plate which carries the diaphragms, one of which is shown resting against the apparatus. The arrangement for this purpose is very neat and convenient. The cumbersome mounting of Mr. Zeiss is not suited to the stands made in this country, and the lighter forms now made by several of our opticians are quite as efficient in every way.

This condenser will fit the 'Histological' stand, thus making the latter equal to any demands that may be made upon it by the student of the most evanescent microbes of disease.

—o—

Lantern Transparencies.

BY C. M. VORCE, F. R. M. S.

Where a considerable number of lantern slides are desired, as for distribution among co-workers, they can

be made considerably cheaper by the use of the carbon process than by using dry plates. The process is very cheap and not difficult of application. Prepare a solution of gelatin in distilled water, which when warm shall be quite fluid, not much thicker than milk. In this, while warm, place a small piece of bichromate of potassium, and shake the mixture till it acquires a strong yellow color; then remove the undissolved bichromate and add enough thick indian ink well rubbed up in water to render the emulsion so black that when held between the eye and a gas-jet large print cannot quite be read but can be just dimly distinguished.

Now take plates of clear glass cut to proper size and thoroughly cleaned, warm them and flow them with the black gelatin emulsion so that a thin, even coating is left upon the glass. Any excess may be poured back, just as wet plates are coated with collodion. Dry these gelatin plates in the dark, keeping them level until the film has set, when they may be placed on edge and the drying finished. They are now sensitive to light and must be kept and handled like dry plates, which in fact they are, only less sensitive than the bromo-gelatin dry plates generally used.

To use these carbon plates they are placed in a printing frame under a negative and exposed to sunlight for about the same time required for silver prints, and when removed from the printing frame in the dark room are first immersed in cold water, then in warm, and after two or three minutes soaking are held under a gentle stream of quite warm or moderately hot water, which speedily dissolves and washes away the gelatin forming the lights of the image, while the shadows having been acted on by the sunlight, are insoluble and but slightly lose their color in washing. When the image is sufficiently clear the plate is rinsed in cold water and dried in the light.

The lantern slides when dry are mounted and used precisely as those made upon the ordinary dry plates.

Paper coated with the same emulsion will give prints in the same way, and such are the 'carbon prints' so much used in England and on the Continent, but paper is more difficult to manipulate than glass—at least I have found it to be so.

Lantern transparencies when prepared to show microscopic objects very highly magnified are best made from camera enlargements of a less highly magnified negative, as follows: Prepare a negative showing the desired points by means of an objective of as low power as will clearly show all the desired details. This negative will be smaller than is required but will be a better one than one made of the desired size by a higher power, because the penetration of the objective—however much abhorred penetration is of real value here—will give sharper projection than if a higher power were used. Place the negative in a copying camera and enlarge it to the desired size if possible, if not a second enlargement would be required, but is seldom if ever necessary. The second plate, that is the enlargement of the first negative, is a positive, and if well done may be mounted as a lantern slide, but first a negative is made from this by contact printing, and from this negative not only paper prints but other lantern positives may be made at will. It should be noted that if any retouching in the original negative is required it must be done with care and skill as any errors would be exaggerated by the enlargement, but the enlarged positive may be freely retouched before being used for contact printing, and thus letters, figures, names, etc., may be introduced into the lantern slides prepared from the last negative, which also may be retouched if necessary like any other negative. The superiority of such enlargements over negatives made originally of the same size is often very marked.

The Gum of Liquidambar Styraciflua or American Storax as a Mounting Medium.

BY PROF. A. B. AUBERT.

This gum is an exudation of the sweet gum tree of the Southern States, scientifically known as *Liquidambar styraciflua*. The more tropical the climate the greater the quantity of gum produced.

The gum is usually light-colored, being at times nearly white, while other specimens may be considerably darker, of a greyish yellow or light brown color. In consistency it varies somewhat, but is generally as thick as pine pitch of good quality. It is soluble in alcohol, ether, chloroform and benzole. Its odor is pleasant. Cinnamic acid and styracin are among its constituents.

Through the kindness of a friend I have been able to use the gum as a mounting medium, and have been very much pleased with it. I have had to work with rather small quantities, but I find a chloroform solution all that can be desired for diatom mounts. A benzole solution replaces most satisfactorily the benzole-balsam solution.

The method of preparing these solutions is simple enough, and anybody who can obtain a specimen of the gum will find it easy to prepare them for use. When the specimen is small it may be exposed in an open vessel in the water-oven to a temperature of 100° C. for from four to eight hours. This thoroughly dehydrates the gum, and when cool and hardened it may be dissolved in benzole or chloroform; this solution must be set aside for a few days to allow flocculent matter to form and settle, then filtered, and, if necessary, a part of the solvent evaporated.

There is a better way of preparing the solutions, but a larger quantity of the gum must be obtained in order to carry it out. The first step in this process is the filtration or straining of the gum. This is done by cutting the bottom out of a small wide-mouthed bottle, tying muslin of rather loose texture over the mouth, inverting the bottle over a vessel, and partly filling it with gum; now expose the whole apparatus to the heat of a water-oven for from six to ten hours. The gum melts and filters through the muslin. The filtered product is of a clear amber color, readily dissolves in the solvents, and gives much lighter solutions than can be obtained by the first-mentioned process.

The gum is so adhesive that it cannot be gathered without including some debris of bark, wood, etc.; these, when not separated by filtration, give up some coloring matter to the solvent, rendering the solution somewhat darker. The solution obtained from filtered gum is not much darker than Canada balsam.

In using these solutions as mounting media the method of procedure is very similar to that for balsam mounts. The chloroform solution I have used exclusively for diatoms, boiling a few seconds to expel all air. When mounting in the benzole solution objects are dehydrated in absolute alcohol, cleared in oil of cloves,* which must be carefully drained off and absorbed by blotting-paper before adding the drop of gum solution and applying glass cover. It is best to harden the mounts in a warm place. When slides are allowed to harden at ordinary temperatures the gum may show signs of cloudiness; this is readily made to disappear by the application of a little heat, and I have never observed the turbidity to reappear after this treatment.

My experience with the gum has proved that it can in about all cases be used instead of Canada balsam, indeed that it is superior to balsam, showing the finer parts of objects more clearly. I have entirely discarded balsam for diatoms. Cartilage when properly stained shows very well, better in my opinion than

* I am not entirely satisfied with oil of cloves to clear objects that are to be mounted in this medium. As time permits I hope to experiment on other essential oils.

in glycerin jelly. For histological objects generally it will be a welcome addition to the present stock of mounting media. Tooth, bone and other sections would undoubtedly show to better advantage in this medium than in balsam.

Mr. C. V. Smith, of Carmarthen, Wales, a well-known mounter of fine botanical objects, to whom I have sent specimens of this gum, speaks very highly of it for botanical mounts. He writes me that he has never tried any medium which showed aluerone grains in section of castor-oil plant as satisfactorily. It shows the mycelia of fungi more clearly than most other media.

Objects mounted a year ago show no signs of deterioration, and I have every reason to believe that it will prove an excellent medium for permanent mounts, preferable to balsam, not only on account of its higher refractive index but also because it seems somewhat less brittle.

When the solutions kept in capped bottles become thick by evaporation it is best to transfer them to a common bottle and add the proper amount of solvent. This will cause a flocculent precipitate. Let stand for several days, filter back into capped bottle, when a clear solution, ready for use, will be obtained. These solutions are liable to become turbid, but thus far I have had no trouble in using them, the hardened gum always proving perfectly clear and transparent, especially if hardened by the aid of slight heat.

Orono, Maine.

[We have received a specimen of the gum from Prof. Aubert and also a sample of the solution in chloroform described above. Our experience in the use of the medium leads to a full confirmation of all that Prof. Aubert says concerning it. Two mounted preparations of diatoms accompanied the specimens, one of which is six months old and perfectly clear. The gum can be purchased in any drug store, and those who are not provided with a chemist's drying oven can use the oven of a stove to dry the gum, or the gum may be placed in a wide-mouth bottle and stood in a vessel of hot water.—Ed.]

—o—

Microscopical Societies and Microscopy.*

The Washington Microscopical Society takes great pleasure in welcoming their friends to this first annual soirée, which is a happy and encouraging close of the first year of our existence as a society. It is especially fitting that scientific societies should exist in Washington, which contains more men engaged in scientific pursuits, in proportion to its population, than any other city in the Union. And the number of these societies that have recently been established is only one sign of civic progress towards a broader, richer and more cosmopolitan life than we have yet shown. The first microscopical society in this country appears to have been formed in New York city, about the year 1840, chiefly of medical men, who are naturally particularly interested in the microscope

At that time the Wilkes Exploring Expedition wanted a microscope, but none were on sale, and finally the loan of an instrument from Dr. Goddard was obtained. This early society had few immediate imitators. In 1870, at the time of forming a society in Troy, N. Y., there appears to have been only two or three in the United States. The establishment of the Postal Microscopical Club, in 1875, no doubt gave an impulse to microscopic work throughout the country, and in 1879 over thirty societies were reported to exist, which number has since much increased.

The microscope is an instrument for scientific research. In these days we hear much said of science, without always having a clear idea of its

* Abstract of an address by Prof. W. H. Seaman at the first annual soirée of the Washington Microscopical Society, March 24th.

meaning. As a concrete thing, it is the written record of the experience and opinions of men trained in observation and in logical methods of thought. . . . .

It is said that pieces of glass shaped like lenses have been found in the ruins of Assyrian towns, but if so their use was forgotten. The year 1590 is the first date that can be assigned with certainty to the first microscope, a huge thing like a dwarf telescope with dolphins for legs. In 1665 small globules of water were used, a device that may be imitated by a pill-box with a pinhole in the top and a drop of water in the pinhole. In 1672 Sir Isaac Newton made a reflecting microscope on the principle of the reflecting telescope. But so little hope did any one have of the successful application of the principle of achromatism, or the correction of lenses, then newly discovered by Euler, that so late as 1821 the construction of a good achromatic instrument was regarded as impossible.

The modern microscope dates from 1829, when Lister discovered the methods of aplanatic correction. Since his discovery there has been a steady improvement in the construction of lenses, which has not yet reached its limit. So short a time has elapsed since the construction of the first compound microscope, that its entire development has been accomplished in a single lifetime. One of the most agreeable personal reminiscences of my life was a meeting with Dr. Carpenter, of London, the well known author of 'Carpenter's Physiology,' and other valuable works, at Montreal, in 1882. Himself one of the leading microscopists of our time, he described the various steps in the improvement of the microscope and the more important discoveries made by it from personal observation and participation; being one of those of whom it might particularly be said that he was there and a part of it, having seen, and had a share in, the improvement of the microscope from the very earliest beginnings.

The limit of vision was placed by Ehrenberg at $\frac{1}{4000}$ of an inch, that being the smallest object we can see with our naked eye, but with the most powerful instrument it may now be placed at a little over 100,000 lines to the inch. What this means it may help you to discover if you consider that an inch enlarged in like proportion would measure one mile and a half, or reach from here to the Capitol.

Probably there are not a dozen persons in the world at any one time who are competent to make a first-class, high-power objective, and anything that is so rare must necessarily command a high price.

The most expensive tools are not at all necessary to do good and valuable work with the microscope, or to obtain from it an immense amount of enjoyment. This latter use of the instrument is one that people are only just beginning to find out, and we hope to give you this evening some of the pleasure that any intelligent mind receives from looking into a new world, where everything is not only new and strange but in many cases wonderfully beautiful. Among the things you will see are some of the diatoms whose surfaces are marked with a fine net-work of carving in patterns that rival the finest lace in geometrical accuracy and intricacy, the surfaces of crystals that glisten and glow like polished gems, and, most beautiful of all, the wonderful effects produced by polarized light, which furnishes us with a means of analysis whereby the most minute molecular structure of matter is made known. But the microscope is far from being only a pretty toy or a means of seeing pretty things. It is not an extravagant statement that our knowledge of the physiological action and minute anatomical structure of living beings is wholly built on the use of the microscope. In 1636 Dr. Harvey held many and long arguments to prove

the circulation of the blood in animals. One of our members will endeavor to illustrate this physical fact this evening in a way that could Harvey have done it, would have rendered any further argument unnecessary. It is not now a question of whether or no the blood circulates in animals, but the question is, what are the primary causes of a similar circulation in plants? And instead of considering motion or the power of motion as the peculiar property of animal life, we almost persuade ourselves, as we look on the Brownian movements of inorganic particles, that all matter has something of life in its nature. But it is not merely for beauty or for scientific research that the microscope can be applied. It may play its part in the most ordinary concerns of life. It will tell you of the chicory the grocer puts in your coffee, and the cotton that forms the warp of your silk dresses. You may see through it the menagerie you keep in the vinegar cruet, and you will have explained to you this evening by a member of the society the difference between butter and oleomargarine, a difference allow me to assure you that you can find out in no other way. And finally when stern justice puts on her cap, and, clothed in the majesty of law, seeks to hunt out, to punish the murderer, it is not unfrequently to the microscope that appeal is made for evidence in no other way to be obtained.

Hundreds of years ago when the Danes ravaged the east of England they pillaged a church. Tradition said that the Saxons captured some of them and for this sacrilege flayed them alive and nailed their skins to the church door. A few years ago, on taking down the old church door and removing the hinges, portions of something like dried leather fell out and revived the memory of the almost lost tradition. The material was collected and sent to a skilful microscopist, and when he examined these, after centuries of exposure he found hairs that could only grow on a human form, and the tradition of ages was confirmed by the testimony of an art and an instrument that has grown up as it were since yesterday.

——o——

Staining Tissues in Microscopy.*—II.

BY PROF. DR. HANS GIERKE.

CARMINE.

1. Goppert ŭnd Cohn. Ueber die rotation des Zellinhaltes von Nitella flexilis. Botan. Zeitung, No. 37, 1849.

The first attempt to differentiate tissues by staining in microscopy.

2. Hartig. Chlorogen. L. c. No. 32, 1854.

Hartig stains chlorogen† with ammoniacal carmine and tries other dyes. Attempts to explain staining.

3. Hartig. Ueber die Functionen des Zellenkerns. L. c. No. 33.

Investigates the facility with which carmine combines with various elements of plant structure. Nucleus only absorbs the dye, which unites with albumen and gelatin. Washed gluten and gelatin absorb dyes, but vegetable gums do not. In order to stain cell-nuclei the plant or tissue must be dead. The nuclei of living structures do not take color.

4. Hartig. Ueber das Verhalten des Zellkerns bei der Zellentheilung. L. c. No. 51.

Describes his method of investigation.

5. Lord S. G. Osborne. Vegetable cell structure and its formation, as seen in the early stages of the growth of the wheat plant. Trans. Micr. Soc., v, 1856.

Cultivated wheat in solution of carmine, and found the tissues colored, contrary to Hartig. Beale quotes Osborne to show the use of carmine before Gerlach's time.

* From the *Zeitschrift für wissenschaftliche Mikroskopie*. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.

† A name given by Hartig to portions of protoplasm that ultimately become chlorophyll-granules.

6. Hartig. Entwickelungsgeschichte des Pflanzen keims. Leipzig, 1858.

In this great work Hartig repeats many of the statements in his earlier articles. He grew algæ, chara, hyacinths and other plants for weeks in carmine without staining them. Only after death was the solution absorbed. He considers carmine indispensable for his work, and describes the method of preparation. He used other dyes, as iodine. This essay induced Dippel in 'Das Mikroskop' to consider Hartig the inventor of staining, and he does not seem to have known of the earlier work. Hartig has also been much praised by other botanists for his services in introducing staining, but he is not known in zoology or medicine.

7. Gerlach. Mikroskopische Studien aus dem Gebiet der menschlichen Morphologie. Erlangen, 1858.

Four years previously Gerlach perceived that in preparations injected with ammoniacal carmine, where the color diffused through the walls of vessels, that the nucleus was more deeply stained than the cells and intercellular substance. He then treated nerve sections with concentrated carmine solutions without good success; the elements were not well differentiated. Accidentally having left over night a portion of brain in a very dilute solution, a better result was obtained.

8. Gerlach. Ueber die Einwirkung von Farbstoffe auf lebende Gewebe. Wiss. Mitth. d. Phys.-med. Soc. Erlangen. 1858, p. 5.

Gerlach describes his efforts to dye living animal tissues, which did not succeed. Dead tissue gradually withdrew all the color from very dilute carmine, the nuclei and nucleoli absorbing the most, the cells less, and the intermediate substance least. It could not be washed out. A peculiar affinity seemed to exist between the dye and elementary parts, of the physical reasons for which we are yet ignorant. (Neither of the above articles contain anything more than Hartig had already shown with respect to plants.)

9. Maschke. Pigmentlosung als Reagenz bei mikroskopisch-physiologischen Untersuchungen. Botan. Zeit., No. 3. 1859: Journ. f. prakt. Chemie, lxxvi, 1859, p. 37.

Maschke knew of Gerlach's work, not of Hartig's. He criticised the theory of staining, and described numerous experiments. He used carmine especially, but also other substances, as indigo. He stated there are two groups of organic bodies, one whose members belong to the class of proteids, as horn, albumen, gelatin, which unite readily with dyes, while the members of the other group or the varieties of cellulose, amylums, sugar and gum do not take colors. At the close of his essay he strongly recommends staining. He says: 'In the future staining solutions will be as indispensable as the iodine test, and both in microscopic work will be held of equal value with the scalpel.' This interesting essay has never been properly esteemed.

10. Maschke. Ueber einige Metamorphosen in den Zellen der reifenden Frucht von Solanum nigrum. Botan. Zeit. 1859, No. 22 f.

Description of the investigation made in 1857 in which he employed carmine.

11. Thiersch. Injecting fluids of Thiersch and W. Muller. Schultze's Archiv f. Mikr. Anat. 1865, p. 149.

a. Carmine 1, liq. ammon. caust. 1, aq. dist. 3. Mix one volume of this solution with 8 of oxalic acid (1.22 of water.) To this mixture add 12 of absolute alcohol, and filter. The addition of more oxalic acid to the filtrate gives an orange red, while excess of ammonia turns it violet. This fluid tinges cells deeply in a few seconds. Diluted with 70 or 80% spirit of wine it colors more slowly. The

addition of absolute alcohol precipitates acid ammonium oxalate. If the stain is too deep or irregular, it may be cleared by an alcoholic solution of oxalic acid. This staining fluid is to be recommended for all purposes, without regard to previous treatment of the preparation.

b. Carmine 1, borax 4, aq. dist. 56. Mix 1 volume with 2 of absolute alcohol; filter. For bones decalcified by chromic acid. May be cleared by solution of oxalic acid or borax in spirit of wine. Gives lilac tint.

12. Beale. How to work with the Microscope. 5th ed. London, 1880, and in the earlier editions.

Carmine 10 grains, liq. ammon. caust. ½ drachm, glycerin 2 oz., aq. dist. 2 oz., alcohol ½ oz. Shake the carmine and ammonia in a test tube, boil a few minutes, cool for an hour, add the water, glycerin and alcohol, and filter. Keeps for months; if carmine precipitates, add a few drops of ammonia.

Beale recommends this form of ammoniacal carmine as better than any other. I have stained much with with it, and do not perceive it has any particular advantages over the simple ammoniacal carmine, certainly not for sections which require dilute solutions, and for which the glycerin and alcohol are of no use. For staining in mass, that is, of pieces to be afterwards cut into sections, it is to be recommended as more penetrating than simple watery ammoniacal carmine. Perhaps the glycerin and the alcohol give it this character.

13. Schweigger-Seidel. Cyon, Ueber die Nerven des Peritoneum. Ber. d. Sachs. Gesellsch. d. Wiss. 1868, p. 125.

Cyon worked in the histological laboratory at Leipzig, and used Schweigger-Seidel's acid carmine, which he warmly recommends.

Ordinary ammoniacal carmine is to be saturated to excess with acetic acid, and filtered, making a wine-red color. The preparations may be cleared by acid glycerin—hydrochloric acid and glycerin 1–200. The dye settles in the nuclei, and the protoplasm will be bleached. The preparations should be thoroughly washed, and are not so permanent as ammoniacal carmine.

14. Rollet. Bemerkungen zur Kenntniss der Labdrüsen und der Magenschleimhaut. Unters. a. d. Inst. f. Physiol. u. Histol. Graz. Heft 2. 1871, p. 143.

Rollet describes several processes to make carmine solutions more permanent, by adding definite quantities of free acids, avoiding precipitation of the color.

15. Graucher. Technique mikroskopique. Des usages de la solution ammoniacale de carmin en histologie. Arch. de Physiol. iv, p. 770.

Graucher examines the behavior of animal tissues toward ammoniacal carmine. He finds the greater the vitality of any part, the more readily it stains. Elements already colored by other dyes, as chromic acid, picric acid, potassium bichromate, chloride of gold, iodine, etc., take carmine slightly or not at all. The same is true of elements normally having special coloring matter, as the blood-corpuscles, which absorb carmine readily on the removal of the hæmoglobin. (Much may be said against the above statement).

16. Woodward. The best mode of carmine staining tissues. Monthly Micr. Journ. viii, p. 37.

Carmine 1, saturated solution borax 60. Add twice as much absolute alcohol, filter and use the precipitate of crystals of borax-carmine. The crystals should be dissolved.

17. Betz. Methode feine Schnitte a. d. Centralnerven-system anzufertigen. Mittheil, d. ärzl Ver. Wien. 1872, i, p. 9.

Betz sets carmine solution in the sun till a dark, flocky precipitate falls, then filters and uses the filtrate. This is the so-called 'precipitated

carmine,' supposed to be less liable to alteration.

18. Lieberkuhn. Ueber die Einwirkung des Alizarin auf die Gewebe des lebenden Korpers. Sitzungsb. d. Gesells. z. Beförderung d. ges. Naturwiss. Marburg. 1874, No. 3, p. 33.

Experiments to ascertain if living tissues would stain. Injections of ammoniacal carmine in the lymph sacks of the backs of frogs. (See previous articles.)

19. Richardson. Mode of staining animal tissues of a permanent purple-grey color. Quart. Journ. Micr. Sci. 1874, p. 281.

Carmine solution mixed with Draper's dichroic ink strongly recommended. The ingredients of the ink are unknown.

20. Pouchet et Legoff. Sur la fixation du carmin de cochenille dans les éléments anatomiques vivants. Gaz. med. de Paris. 1876. No. 52. See No. 17, above.

21. Hoyer. Beitrage zur anatomischen und histologischen Technik. Archiv. mikr. Anat. xiii, p. 649.

Hoyer thinks the power of ammoniacal carmine is increased by adding alcohol. Beale's solution is preferred on that account, the glycerin is rather an injury. The following troublesome process gives a powerful dye. Warm some carmine in a flask with alcohol to which a little sulphuric acid has been added, till it dissolves. Filter and dilute with much water. Add to the filtrate lead acetate so long as the rosy precipitate of lead sulphate forms. As soon as the precipitate becomes violet, filter and to the filtrate add lead acetate till the violet precipitate no longer forms. Collect this, wash, dry, dissolve in a little strong alcohol, and add alcohol acidulated with sulphuric acid drop by drop till the precipitate is colorless and the alcohol a deep red. This alcoholic solution is a powerful dye.

22. Obersteiner. Technische Notiz. Arch. mikr. Anat. xv, p. 136.

Obersteiner dyes sections of large nerves with ammoniacal carmine by exposing them 2 to 5 minutes in watch-glasses filled with the dye to hot steam. He finds the sections stain quickly and well, and he appears to use a rather concentrated solution. (I have tried his method, and can confirm his statements, but do not recommend it, except to save time.)

23. P. Mayer. Die Verwendbarkeit der Cochenille in der mikroskopischen Technik. Zool. Anz. 1878. No. 15, p. 345.

Mix powdered cochineal with 70% alcohol, digest several days, filter. The proportions are 1 gram. of cochineal to 8–10 c. c. alcohol. Alcoholic preparations free from acid are the best for staining.

(The following method of boiling cochineal with alum is much better.)

24. Grenacher. Einige Notizen zur Tinctionstechnik besonders zur Kernfarbung. Arch. mikr. Anat. xvi, p. 463.

A watery solution of alum or alumed ammonia (1 to 5%) is boiled 10 to 20 minutes with $\frac{1}{2}$ to 1% powdered carmine and filtered after cooling. The purple solution dyes nuclei only very quickly, and no excess of color results from long soaking.

25. Grenacher. l. c.

One or two per cent. of borax in water is boiled with $\frac{1}{2}$ to $\frac{3}{4}$% of carmine. The cooled solution is treated, drop by drop, with dilute acetic acid till it assumes the color of the ordinary ammoniacal carmine. After standing 24 hours, filter. It stains diffusely, but the color may be confined to the nuclei by washing with 50–70% alcohol containing a few drops of muriatic acid.

26. Grenacher. L. c.

In 50 c. c. of 60–80% alcohol, with 3–4 drops of hydrochloric acid, boil a pinch of carmine for 10 minutes. Cool and filter. Sections stained with this

fluid require treatment with hydrochloric acid to bring out the nuclei; otherwise they are diffusely stained.

(We do not regard the last two compounds as valuable additions to our list.)

27. Schneider. Ueber die Anflosung der Eier und Spermatozoen in den Geschlechtsorganen. Zool. Anz. 1880, Jan. 12th and May 24th.

Schneider boils 45% acetic acid and adds as much carmine as it will dissolve. Stains with this solution direct or dilutes it to one per cent.

28. P. Mayer. Ueber die in der Zoologischen Station zu Neapel gebräuchlichen Methoden zur mikroskopischen Untersuchung. Mitth. a. d. Zool. Stat. Neapel. ii, 1–27.

Coarsely powdered cochineal is left covered by 70% alcohol for several days. The tincture is not a strong dye, but selective.

29. Czokor. Die Cochenille-Carminlösung. Arch. Mikr. Anat., xviii, p. 712.

Cochineal 7 grms., roasted alum 7 grms., rubbed together in a mortar. Add 700 c. c. distilled water and boil till reduced to 400 c. c. Cool, add a trace of carbolic acid as preservative and filter till clear. The liquid is violet, will keep six months, when it may require additional carbolic acid and filtration. For tissues generally, however hardened. Excellent for the nuclei, which takes the color of hæmatoxylon, while the other constituents are stained various shades of cherry to dark red. (The best substitute for ammoniacal carmine, and to be preferred, for staining nuclei. It is better than the anilins, and may be used for ordinary purposes in the place of any other dye, especially hæmatoxylon. It is particularly adapted for beginners, and for laboratory courses for instruction. For large nerves it is to be recommended only for staining nuclei. Nerve cells and their prolongations are not well shown. In summer, unfortunately, a precipitate often appears. I filter just before using, usually.

30. Hoyer. Beiträge zur histologischen Technik. Biol. Centralbl. ii, p. 17.

Hoyer thinks it very necessary to have a dry preparation of ammoniacal carmine, that may be applied in definite proportions and kept on hand without deterioration. For such a material he takes 1 grm. carmine and 1–2 c. c. strong ammonia and 6–8 c. c. distilled water and warms till the excess of ammonia evaporates. It will be finished when large bubbles no longer appear on boiling, and the liquid becomes a clear red. Cool and filter, the result will be a neutral solution, which is treated with one or two per cent. of chloral hydrate and may be kept and applied like ordinary ammoniacal carmine. On adding 4 to 6 volumes of strong alcohol a copious, bright-red precipitate falls, which is to be filtered, washed and dried. By mixing it with alcohol and a little glycerin and chloral hydrate the alcohol will be changed to a paste that is also very permanent. Both preparations consist of perfectly neutral ammoniacal carmine. They are strong dyes and very convenient.

(The above compounds made by Hoyer himself work well, and some of his preparations of the spinal marrow sent to Privy Councillor Heidenhain leave hardly anything to desire. But such as are sold in the market, though made by Hoyer's directions, are far inferior to ordinary ammoniacal carmine).

31. Maschke. 1882.

Has experimented much with carmine, and has made dry sodium carminate. I have used this, and find that by a small addition of ammoniacal salt (as ammonium bicarbonate 2–5 drops in a watch-glass) it is of great service.

It is to be used exactly like ammo-

niacal carmine for similar purposes, but is more convenient and has the advantage that it may be applied in definite quantities. Like Hoyer's, it is well adapted for double staining and for picro carmine, and is much to be preferred to the commercial article called by Hoyer's name.

I add here a few carmine preparations whose authors I can give, but not date and place of publication. Some of them are among those best known:—

32. Frey. Das Mikroskop und die Mikroskopische Technik. 7 Aufl., Leipzig, 1881. (In the 3 Aufl., 1868, not given.)

Dissolves carmine in acetic acid, adds water, and filters.

33. Perls. Nach mündlicher Mittheilung an Frey. In dessen, das Mikroskop und die Mikroskopische Technik. 7 Aufl., 1881.

Perls finds that the carmine now in market is sufficiently soluble in water to make a stain. (This does not appear true of all kinds; my best is almost wholly insoluble.) He recommends the following method: Carmine is slowly boiled for an hour in water, then filtered. The filtrate is at first cloudy. It is to be repeatedly passed through the same filter till of a clear red. Perls thinks it stains chromic acid preparations better than ammoniacal carmine.

(I do not consider the above to compare favorably with ammoniacal carmine or sodium carminate, because it does not give clear stainings.)

34. Rollet.

Recommends carmine in water. Boils ordinary carmine with dilute sulphuric acid a precipitate of fermentible sugar, and a dark red mass $C_{11}H_{12}O_7$ is obtained, slightly soluble in water and alcohol. It possesses no advantages over carmine (carminic acid).

35. Ranvier.

Recommends clearing diffuse stainings in formic acid instead of acetic or muriatic. (Glycerin 100 to 1 of formic acid).

In this connection I must protest against the numerous objections to the use of ammoniacal carmine. I have kept concentrated solutions a year without mould, and have some that is eight years old. It is true it was made from the best carmine of the old make. The early directions succeed well, even with chromic acid preparations; want of success is usually due to bad manipulation or a bad quality of carmine. A slight addition of ammoniacal salts (possibly others also) improves its action very much, and may be necessary for some purposes. Old ammoniacal carmine always contains ammonium carbonate or bicarbonate through absorption of carbon dioxide from the air.

Although it may seem from this collection that a sufficient number of processes for staining with carmine already exist, and perhaps some we could well dispense with, yet I will add one I employed long ago for staining the great nerves. It is especially to be recommended when the material has lain too long in alcohol after hardening by chromic acid, or after too much chromic acid, the carmine does not stain deeply enough. I lay the sections for 24 hours in a 1% watery solution of uranium nitrate, sulphate, or chloride, wash them well, and treat them 10 to 24 hours with dilute ammoniacal carmine. The preparation, colored by the uranium salt slightly yellow or green, takes a dark purple; the nuclei are better shown than with carmine alone; the nerve cells and their prolongations are extremely clear. This method may be applied to other organs, but does not for them have especial advantages. A purple staining fluid may be made by adding some of the uranium salts to a dilute ammoniacal carmine solution, and filtering after some hours. This dyes nerves very clearly, but I prefer the first method. Carmine is often used for double staining, which see.

[*To be continued.*]

P. 106

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

TO SUBSCRIBERS.—There are a few of our old subscribers who are disposed to take offence because their JOURNAL is stopped when subscriptions expire. A very little consideration will convince them that such a rule is a perfectly just and proper one, and also that, having made the rule, it is not reasonable to expect us to go all through our subscription-list and select certain names to be excepted from the operation of the rule.

One subscriber writes that he 'shouldn't think it would pay?' Perhaps it does not. Nevertheless, we have not time to look after the small number of subscribers who fail to renew each year. No doubt if we had no other work it would pay to do so. As it is, we assume that every subscriber who wants the JOURNAL will take it.

—o—

MICROSCOPICAL SOCIETIES.—The officers and members of microscopical societies are requested to aid us in preparing a list of such societies in the country for publication, as explained last month. It is desired to make the list as complete as possible, but no society will be entered in the list until we have definite information concerning its active existence, which should properly come from the Secretary or President. We do not intend to copy from any old lists, as it is only desired to publish the names of societies in existence each year. As yet we have very few responses to our request last month. If the Secretaries are not sufficiently interested in this matter to enable us to make a reasonably complete list (which only demands a few moments of the time of each one), we will be obliged to postpone it indefinitely.

—o—

OBJECTIVES FOR SPECIAL USE.—The wide-spread interest in the study of bacteria with reference to their morphology and their association with diseases, has called forth many private letters to the editor inquiring what objectives are the most suitable for such investigations. In view of the importance of this subject to many readers, we propose to offer a few remarks in this place, but with much diffidence, since our personal experience in this particular kind of examinations has been extremely limited.

In the first place we would say that we cannot understand why an objective of extreme angular aperture should be required for this work. It would seem that what is wanted is not angular aperture but extreme sharpness of definition, which can be obtained quite as well with lenses of moderate angular aperture. Whether this is true or not we are not prepared to assert in positive terms, but so far as our experience goes it seems to be so. Yet the fact is, that those who are practically engaged as investigators prefer the high-power, homogeneous-immersion, wide-angle lenses. For this reason we hesitate to advise the purchase of any others for this kind of work, although we can scarcely resist the impression that the advantages of the homogeneous-immersion lenses are due in great part to their excellence as optical instruments, rather than to their large angle. As is well known, the use of oil as an immersion medium gives no little advantage to the maker, and there is no doubt its benefits are felt equally well in the making of lenses of moderate angular aperture.

As regards this matter it may also be said that it is not usual for investigators in this field—at least so far as we are aware—to use oblique light for illumination. The Abbe condenser is used very largely, but probably it finds its greatest application in the study of sections of tissue, in which the organisms are distributed and stained. A flood of light from the condenser thrown upon such a preparation makes the tissues almost invisible, and causes the deeply colored bacteria to stand out with wonderful clearness. But this is not due to the angle of the objective. The condenser is useful in this work more on account of the control it gives over the light than for the angular illumination it is capable of giving. If we are in error concerning this matter we would be glad to have some more practical observer correct us.

As regards our own experience, we have yet to see anything more of bacteria with a homogeneous-immersion lens than with a $\frac{1}{15}$ by Spencer, glycerin-immersion. What few observations we have made have mostly been conducted on mounted specimens, and the Spencer $\frac{1}{15}$ was carefully compared with a Zeiss $\frac{1}{12}$, without any noticeable difference. Yet on *Amphipleura* the Zeiss is far superior to the other.

So much for the ordinary study of the bacterial organisms. From this we may pass to a very brief notice of another kind of observation, requiring the greatest skill of the observer and objectives of the highest excellence. Dr. W. H. Dallinger stands almost alone in the thorough study of the life-history of certain monads. His opinions, therefore, are of great weight concerning the best objectives for such work. In his address as President of the R. M. S. of London, published in the April number of the *Journ. R. M. S.*, he states that for continuous observation of monads he uses only dry lenses, a $\frac{1}{16}$ a $\frac{1}{25}$ a $\frac{1}{35}$ and a $\frac{1}{50}$ being the favorite ones, the $\frac{1}{35}$ being chiefly used. He then says: 'But beyond the work of continuous watching, when the opportunity presents itself, there is the work of developmental morphology, of discovering all the details of the adult form, and of thoroughly demonstrating the changes that ensue in the completion of the life-cycle. It is here that first, water immersion, and now, above all, homogeneous lenses have been to me of untold value.' He has used in his investigations a $\frac{1}{12}$ N. A. 1.47, a $\frac{1}{25}$ N. A. 1.38, a $\frac{1}{50}$ N. A. 1.38 and a $\frac{1}{6}$ N. A. 1.50, all by Powell & Lealand. Of all these we should infer that the $\frac{1}{6}$ is regarded by Mr. Dallinger as superior to the others. This work of Dr. Dallinger is of the most refined and delicate character, involving the detection of the extremely delicate long flagella with which the organisms are provided, as well as the study of the structure of their bodies.

We have presented this matter for the consideration of those who may be interested, and in conclusion we can only say that the weight of evidence from practical observers indicates that there are advantages in the use of homogeneous-immersion objectives for the study of bacteria; but whether these are due to the wide angular aperture or to excellence of construction we are not prepared to say.

——o——

Electric Illumination.—There are continually coming into notice new devices in lamps and batteries for electric illumination for medical and microscopical purposes. Considerable advance has already been made in the matter of electric illumination applied to the microscope, as the pages of this Journal in the past have shown. But it must be confessed, much still remains to be done before one can sit down to a microscope in his home, and turn on the electric light like gas-light. Perhaps it is too much to expect quite so great convenience, yet if it is to be brought

into general use it must be reasonably convenient, and it must not be far removed from a kerosene lamp in this respect. It is true there are decided advantages in the excellence, purity and brilliancy of the electric light, which make it very desirable. Nevertheless, these advantages are not so great as will induce observers to put up with the nuisance of ordinary batteries.

Among those who have been quick to recognize the value of the electric light in microscopy is Mr. Edward Bausch, who, in the spring of 1882, became interested in the subject, and in that year made use of an electric attachment at a public exhibition of the Rochester Academy of Sciences constructed substantially like that now made by Messrs Bausch & Lomb. Later in the same year it was shown at the meeting of the American Society of Microscopists, at Elmira. Mr. Bausch believed that his application of the electric light to the microscope was new, and he therefore applied for letters-patent, which were granted May 22d, 1883. To Mr. Bausch belongs the credit of having quickly appreciated and practically applied a source of light which is sure to grow in popularity, when suitable batteries are devised.

A number of different kinds of batteries have been made already, and as we may expect some of them to be offered for microscopical use, it may be well at this time to mention some facts about batteries in general.

In the first place it does not seem to us advisable to recommend any battery that will not run a one candle power lamp at its full brightness at least three hours without intermission. This can easily be done with a large battery—one which exposes considerable surface of zinc and carbon, and holds considerable fluid. But a large battery of even one or two cells is only desirable when one can store it out of the way, and use it always in one place.

The problem is, how to make a durable small battery. This has not yet been accomplished, so far as we have heard; but there are several promising devices under way, which may lead to a solution of the problem.

Among the large batteries we were well pleased with a couple of cells which were recently at work in Mr. G. S. Woolman's establishment at New York. These gave a very good light, which would probably last many hours.

Passing to the other extreme, there are offered very small batteries, scarcely larger than an ordinary collar-box, which are said to give a good light. Such batteries are practically useless for microscopical work. The production of electricity involves the consumption of a certain amount of zinc and battery fluid, and a very small battery cannot furnish enough of either. The amount of electricity produced in a given time depends upon the rapidity of the chemical action in the battery, and this is largely dependent upon the extent of surface exposed. It seems likely that a satisfactory battery will be made which will go in a box of a cubic foot capacity, this space allowing for the removal of the zincs from the fluid when not in use. One can scarcely expect anything smaller than this that will be convenient for use, unless new combinations of fluids are employed, of which we may hear more anon.

We would advise all purchasers of batteries to be careful about choosing their lamps. There is a great difference in lamps of different makers, some requiring far more battery power to run them than others. The Edison lamps are good.

NOTES.

—Mr. R. D. Nevins, of Olympia, Washington Territory, has sent us some beautiful specimens of a marine plant covered with diatoms. One specimen is thickly spread with *Arachnoidiscus*, and the other has the same diatom and many others, including *Isthmia* and *Tricera-*

tium. Readers who desire some of this material for mounting would do well to send a good preparation of some kind to Mr. Nevins as an exchange.

— The first annual soirée of the Washington Microscopical Society was given at the Washington High School building on the evening of March 24th. It was attended by a large number of persons, who had never before seen such a display of microscopes and apparatus. There were forty-three microscopes on the list, and the Bausch & Lomb Optical Company sent several of their new stands for exhibition, which were greatly admired. There is not much to be said about the exhibition, it being no different from others of the kind—a collection of fine, showy objects, of all kinds, along with some others of a more special interest, among which we may mention the bacilli of tubercle, and of cholera, and some very fine sections of fish-eggs made and exhibited by Mr. John A. Ryder. The printed program was far from creditable to the society, being replete with egregious blunders, such, for example, as 'Bacilli' instead of Bacillus, and 'Lepido syren' instead of Lepidosiren. We trust more care will be exercised in this respect on future occasions of the kind. An abstract of the address of Prof. Seaman is printed on another page.

— The Rev. Mr. Wolle is engaged upon a comprehensive work treating of the fresh-water algæ of the United States. It will be illustrated with about one hundred plates, of the same character as those in his work on the desmids. About fifty plates are already drawn. Mr. Wolle has been spending a short time in Florida, where he has doubtless found a rich field for collecting algæ.

— Mr. Henry Mills recently favored us with a call on his way home from Florida. He has found sponges in the fresh-water streams abundant there, although it is the general impression that they are not common in that state. We hope to receive from him an account of his sojourn there, before long.

— We have received some sample glass slips from Messrs. Emmerich & Son, which they are offering at $2.00 per hundred, if we are not mistaken in the figures. They are made of very white and clear glass, quite thin, and polished on the edges. We should say they were very good slips indeed. They are probably made in Germany.

— We notice the Liverpool (Eng.) Microscopical Society has adopted the new time. The council now meets at eighteen o'clock, they have tea and coffee at eighteen thirty, and the chair is taken at nineteen o'clock precisely. A very little calculation doubtless enables the members to reduce these figures to ordinary watch-time. It is quite right that scientific societies should take the initiative in this matter, and if we are to have the new plan (which is old enough among astronomers and navigators) let us aid in its immediate introduction.

— At at recent meeting of the New York Pathological Society bayberry-tallow was recommended for embedding tissues for sections. A writer in the *Louisville Med. News* in a report of the meeting says:—

'It is obtained from the ordinary bayberry-bush, and is used by furniture manufacturers for oiling the sliding surfaces of bureau-drawers, etc. They claim for the bayberry-tallow that it is cheaper and better than celluloidine, and far superior to paraffine and other kinds of wax heretofore used. A special feature claimed for it is non-solubility in alcohol, except when warmed to about the temperature of the body or a little above it, and hence the specimen may be kept indefinitely in alcohol at ordinary temperatures. Another count to the credit of the new tallow is that tissues injected with it or embedded in it can be shaved in thinner sections than those allowed by other materials, and that on account of its firmness it allows of a more even cut. After making a section the tallow may be removed from the specimen by simply placing it for a few minutes in a bath of warm alcohol. The exhibitor took occasion to mention the usual precaution that in heating the alcohol it must not be held over a flame, etc. The specimen presented with the paper was a section of the smallest bronchi, which showed up beautifully under a low magnifying power.'

— The old and rather worn-out controversy of monoculars *vs.* binoculars bids fair to be gone over again in the columns of the *English Mechanic*. Perhaps it is well to have such discussions occasionally. It refreshes one's memory concerning many little points (microscopic in more than one sense), and reminds us that there are differences of opinion on every subject. If any reader is uncertain which kind of a stand is the better, we would advise him to try both.

— In addition to their objectives a new price-list of which was received a short time ago, Messrs. H. R. Spencer & Co. now offer two microscope stands, which they designate as 'Nonpareil' No. 2 and No. 4, respectively, with one-inch and quarter-inch objectives, for $42.00 and $49.00. They consider the stands to be 'the best low-priced stands made in the United States.'

— Mr. W. H. Curtis has favored us with two neatly mounted preparations of diatoms; one a slide of five selected and arranged frustules of *Arachnoidiscus*, the other a mount of some fresh-water gathering. The diatoms are well cleaned and the mounting is well done, but highly ornamental. Between two fine rings of bright red color surrounding the specimens a white ring is made in which the preparer's name is written with a needle-point. Outside of this, around the edge of the cover-glass are dots of red and blue. The ornamentation is of the same kind as that on slides prepared by Mr. W. C. Walker.

— Another microbe of diseases has been brought to notice by the researches of Boniet, who has cultivated, through six generations, the microbe of mumps. It is still possible (not to say probable) that inoculation experiments will not fully sustain the supposition that they are the cause of mumps. Thus far only rabbits have been subjected to such experiments, and the results have been negative.

— Reports of the meetings of the San Francisco Microscopical Society come to us regularly, with much interesting matter. The society seems to be in a flourishing condition. At the meeting of March 11th, Dr. S. M. Mouser exhibited his newly acquired microtome of the Thoma pattern. It consists essentially of a frame of cast-iron, on which slide two carriers. A large and finely-finished knife is clamped to one of these, which slides on a horizontal plane. The second carrier (which holds the specimen to be cut) moves on an inclined surface.

Professor Thoma has based the construction of this microtome upon the principle (first theoretically deduced, and then practically demonstrated) that a body sliding between two inclined planes and touching the latter at five points only will slide evenly and exactly over such planes even if they be not geometrically true. A knife attached to such a carrier will, therefore, always cut perfectly parallel sections of an object which is elevated after each cut. As a practical exemplification of the perfection with which the above principle has been worked out in the Thoma microtome, it may be stated that it permits the cutting of serial sections of well-hardened animal tissues of certain kinds as thin as .002 mm. (.00008 in.), and even such a comparatively coarse tissue as liver can, if well hardened, be cut to .01 mm. (.0004 in.) The ability to produce sections of such wonderful delicacy has given a great impetus to histological and pathological research of late.

Mr. Breckenfeld exhibited a Graduated Blue-Glass Modifier, which has just been brought out by the Bausch & Lomb Optical Company. It consists of a glass disk revolving upon an adapter under the stage of the microscope. It is flashed from clear glass to dark blue, and one-half of its surface being lightly ground, any desired tint of field may be obtained, from white to deep blue, either transparent or translucent, by merely revolving the disk.

— The semi-monthly meeting of the San Francisco Microscopical Society was held March 25th. Dr. C. P. Bates exhibited an ingenious and efficient warm stage, for use in the study of pure cultures of bacteria and similar minute organisms. A sterilized cell containing the material under observation is laid upon a wooden slide which rests upon the stage of the microscope. This slide has a central perforation for admitting the rays necessary for illumination, and is heated by two twisted copper wires, which form a loop directly under the culture cell, and then, passing out of the slide at either end, meet directly in front of it, and are there again joined and prolonged a distance of several inches. The free end is made to pass through the perforated chimney of a small lamp, and by adjusting the flame of this along the wire the temperature of the culture cell may be raised or lowered until the desired point is reached. A delicate thermometer, adjustable on the slide, registers the temperature with great exactness. By the peculiar arrangement of the wires, the entire slide is heated with absolute uniformity, and in this respect it is a modification of, and somewhat of an improvement upon, a warm stage recently described in the *Journal* of the Royal Microscopical Society.

CORRESPONDENCE.

Pollen-Tubes.

TO THE EDITOR:—Without entering the discussion, I am glad to see your article on 'Pollen Tubes' in the February issue of the AM. M. MICR. JOURN., extending that courtesy to the researches of Mr. J. Kruttschnitt which is due to every earnest searcher for the true in science. Knowing somewhat of Mr. Kruttschnitt's earnest work for facts, I certainly should think twice before speaking once on points wherein we might differ.

When discussing the subject on our stage we should be careful not to enlarge the object at the other end of the tube. The search for truth in science calls for a very strong abnegation of self, and the same may be said of scientific discussions.

G. C. TAYLOR.

NOTICES OF BOOKS.

The Microtomist's Vade-Mecum. A handbook of the methods of Microscopic Anatomy. By Arthur Bolles Lee. Philadelphia: P. Blakiston, Son & Co., 1012 Walnut street. 1885. (Pp. 424. Price $3.00.)

The word 'microtomy' was first introduced by Mr. John A. Ryder in an article published in this JOURNAL last year. It has rapidly grown in favor, and we now have the microtomist's vade-mecum, one of the most useful books for the working microtomist or microscopist in the English language. The aim of the book is to put into the hands of the worker 'a concise but complete account of all the methods that have been recommended as useful for the purposes of microscopic anatomy.'

Part I treats mainly of the methods of fixing, staining, hardening, imbedding, injecting, etc., being a compendium of formulas, systematically arranged, covering 300 pages.

Part II is a description of special methods. This part is invaluable to the student, giving as it does the methods used by various investigators for special purposes, in a convenient form for reference. Thus, the methods of studying cell-division, karyokinensis, and embryological methods are given in chapters xxxiii and xxxiv, at the beginning of this portion of the work.

To render the book valuable to the beninner as well as the advanced worker introductory paragraphs are added to different chapters, and examples to guide the learner in his experiments. We have not space for a more detailed notice of the work, but cannot refrain from calling attention to the author's unqualified condemnation of the freezing microtome for zoological work (p. 169). The book should be in the hands of every working microscopist.

Our Living World. An Artistic Edition of the Rev. J. G. Wood's Natural History of Animate Creation. Revised and adapted to American Zoology by Joseph B. Holder, M. D., F. N. Y. Acad. Sci.; Member Soc. Nat. E. U. S.; Member Amer. Ornithologists' Union; Curator of Vertebrate Zoology, American Museum of Natural History, Central Park, New York. Fully illustrated with scientific accuracy. New York: Selmar Hess. (4° Complete in 42 parts. Price 50 cents each part.)

Parts 1 to 8 of this elegant publication have been issued. They are beautifully illustrated, and the descriptions of animals and their habits are very interesting as well as instructive. The work is a popular natural history, and as such deserves, and will undoubtedly have, a large sale. The publisher states that 'the illustrations, with few exceptions, have never appeared in an English publication before—those of mammals being the results of the latest drawings by Frederick Specht.' The colored plates are from Brehm's Thierleben, reproduced by Prang & Co.

The work begins with an account of the quadrumana or monkey tribe, and has a fine colored plate of gorillas and another of the chimpanzee, with numerous woodcuts.

The body of the work has been studiously preserved in a simple and readable form, and the more strictly scientific portions have been removed to a 'Compendium of Generic Distinctions' at the end of each volume. In this Compendium the reader will find a brief notice of the various characteristics which are employed by our best systematic naturalists for the purpose of separating the different genera from each other; and by its aid he will be enabled to place every animal in that position which it is at present supposed to occupy.

The complete work will form three handsome volumes of royal quarto size, and contain forty-two oleographs, eighty-four full-page wood engravings, and very nearly a thousand more scattered through the text.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., JUNE, 1885. No. 6.

The Microscopical Examination of Tea.

Tea is the leaves of *Thea sinensis*, an evergreen, native in China, Japan and Eastern India. A few years ago teas were greatly adulterated in China, and more or less after importation, but at the present time it is not an easy matter to find teas adulterated with other leaves. The leaves that have been used, according to testimony more or less trustworthy, are the willow, elder, sloe, and many others, and exhausted tea-leaves.

Green and black teas are obtained from the same plant, the differences in appearance and flavor being due to the methods of preparation. To give the leaves an attractive appearance they are sometimes faced with coloring matters, such as plumbago, Prussian blue, soapstone, turmeric and other harmless compounds. Such additions cannot be regarded as adulterations; but occasionally sand or solid particles in excessive quantity are found, obviously added to increase the weight.

The microscopical characters of the tea-leaf are such as to enable the observer to distinguish even small fragments with certainty. The leaves should be treated with hot water and then spread out on a smooth surface, such as a plate of glass, and examined with a hand-lens to make out the venation. This is quite peculiar in the tea-leaf, the veins spreading from the midrib, forming closed, oblong loops within the margin of the leaf, and oblong meshes on either side of the midrib.

The margin is distinctly toothed, and more or less emarginate at the apex. Each serration ends in a short spine, more or less curved inwards.

For perfectly satisfactory examination of the microscopic structure the leaves require some preparation, since they are too thick, and too close in texture, to make good objects for study in their natural condition. However, one who is familiar with their structure can identify the leaves very well after they are softened in water and prepared in glycerin.

The under surface of the tea-leaf is shown in Fig. 14. It consists of numerous stomata among the curious,

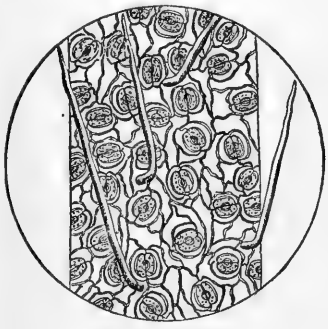


FIG. 14.—Under surface of Tea-leaf.

irregular, outlined cells, and simple hairs. The upper surface bears no stomata, and the cells are similar to those of the under surface, but smaller. The interior of the leaf is made up of fibro-vascular tissue, and cells filled with chlorophyll, the latter shown at A Fig. 15. There are also some peculiar branched cells like that shown at C in the same figure.

To study the epidermis to advantage it may be readily removed by boiling in water acidified with nitric acid. The epidermis is thus made to peel off

in large pieces, which may be stained and mounted in balsam, or else

Fig. 15.—Ground Tea.

mounted in dilute glycerin without staining, as we prefer.

Another method of making the structure of leaves visible under the microscope may also be employed in these examinations. Place a portion of the leaf on a slip of glass, spread out flat, cover it with thin glass, and place a coin on top for a weight. Moisten it with a few drops of an alkaline solution of potassic permanganate and heat carefully to boiling. Wash with water and then let a few drops of hydrochloric acid flow under the cover-glass, to dissolve the oxide of manganese which was formed in the tissues by the previous boiling. Then wash again with water. The protoplasm is thus destroyed, and only the more firm cellulose membranes remain, showing perfectly the structure of the leaf.

Still another method is to carbonize the leaf by heating it, covered with thin glass, weighted as before, on a strip of platinum. The ash thus remaining retains the form of the leaf.

To detect the facing on the leaves it is only necessary to examine them dry by reflected light, when the minute particles will be readily seen under a low-power. By boiling the leaves in water the particles of mineral matter are detached, and on standing will sink to the bottom as a fine sediment, which may be examined.

Microscopical Exhibits at the New Orleans Exposition.

BY L. W. CHANEY, JR.

The display of microscopical apparatus which the exposition called forth was not a little disappointing—not in the quality of the exhibit, but in its extent. But two firms made exhibits of microscopes and apparatus of sufficient importance to challenge attention. There may have been others, but four weeks of diligent search failed to reveal them. The firms referred to were the Bausch and Lomb Optical Company and the McIntosh Galvanic Company. The first-mentioned doubtless manufacture the fullest line of optical goods of any firm in this country. Their exhibit, although unfortunately placed and too crowded to show to the best advantage, was of great interest and excellence. Their stands are as a whole good representatives of what has been called the American model. They have neither the clumsy complication of some of the large English models nor the severe plainness characteristic of the Continental forms. There is doubtless an evolutionary process going on in this matter by which we are attaining the form best suited to our needs. Their 'universal' stand particularly attracted attention. It seems in many respects to deserve its name. It may be reduced to a simplicity which would almost command the approval of the admirer of German style, and at the same time is capable of development in various ways which add much to the ease and rapidity of manipulation. The glass stage and slide-carrier, which may be applied to this and other stands, is an admirable contrivance. It has one marked advantage over the forms held down by ivory points, in that it maintains its position much better when the instrument is placed horizontal.

At the time of my visit they did not have a full display of objectives, the homogeneous-immersion series not being represented. As they claim

much for their objectives of this class, I was disappointed at not being able to test the performance of some of them. The best test of an optician's skill is the making of thoroughly good lenses which can be sold at moderate prices. Judged by this test, the Bausch and Lomb Company have achieved a gratifying success. Having used their 'student series' side by side with similar objectives of foreign make, I am convinced that it is scarcely possible to secure more satisfactory work for the same price, and that it is very possible to get poorer.

Much more might be said of their general exhibit, but there was one feature worthy of special attention. I refer to their newly-produced microtome. This is almost a new departure in this country, but one other maker having attempted the production of such a machine. The model shown at New Orleans was a tentative one, and has since been much modified and improved. It differs from the foreign model most familiar in this country in that the object-holder has a vertical motion, imparted by a micrometer screw working in the bed of the machine, instead of moving upon an inclined plane. The object-holder is firm, and has universal motion on three axes. The micrometer screw is actuated by a large head or wheel, upon whose edge are notches into which a catch falls. These notches are so spaced as to represent an upward movement of the screw of $\frac{1}{2000}$ of an inch. It is thus easy by the clicks of the catch to determine the thickness of the cut section. The triangular, prismatic block carrying the knife moves along the side of an upright rising from the centre of the bed. It is held steadily in place by a weight fastened to the end of a bent arm extending over the side of the way. This throws the centre of gravity below the way and gives great steadiness. For some reason this feature has been abandoned in the later forms.

Whether the extreme delicacy of work possible with the Thoma microtome can be secured with this can only be settled by trial. So far as can be judged by observation without experiment good services may be expected from the Bausch and Lomb machine. It would seem desirable that metric units should be used in their micrometer screw, since not a few American students already find metric expressions more readily intelligible than fractions of the inch.

The McIntosh Galvanic Company, of Chicago, have a large exhibit of their manufactures, including Dr. McIntosh's projection microscope. The accompanying cuts give an idea

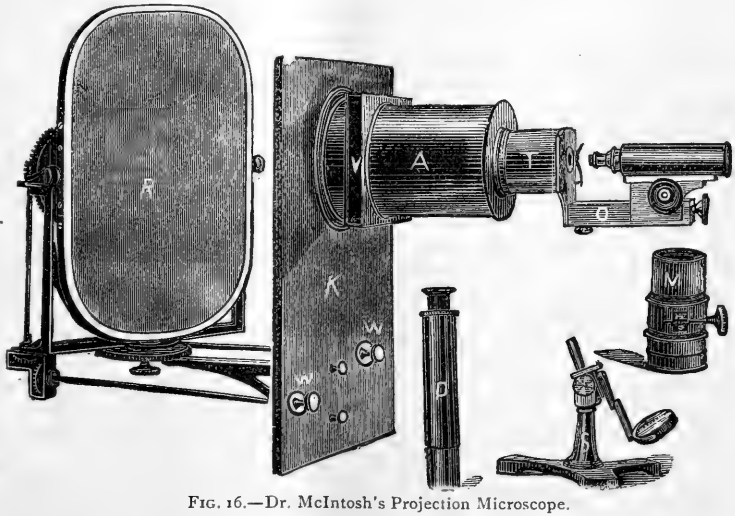


FIG. 16.—Dr. McIntosh's Projection Microscope.

of the arrangement of parts, and of the appearance of the instrument when arranged as an ordinary stand. Dr. McIntosh has spent most of the winter in New Orleans and has had a place fitted up in the space occupied by his exhibit in which to show his instrument. I spent a pleasant hour with him, and came away with an impression that the resources and adaptability of projection were not fully comprehended as yet by microscopists. For the making of drawings it is greatly to be preferred to the camera lucida in any form, while for continuous study of a preparation it has a double advantage in giving a larger field than can be viewed with the eye-piece, and being much less wearisome to the eyes.

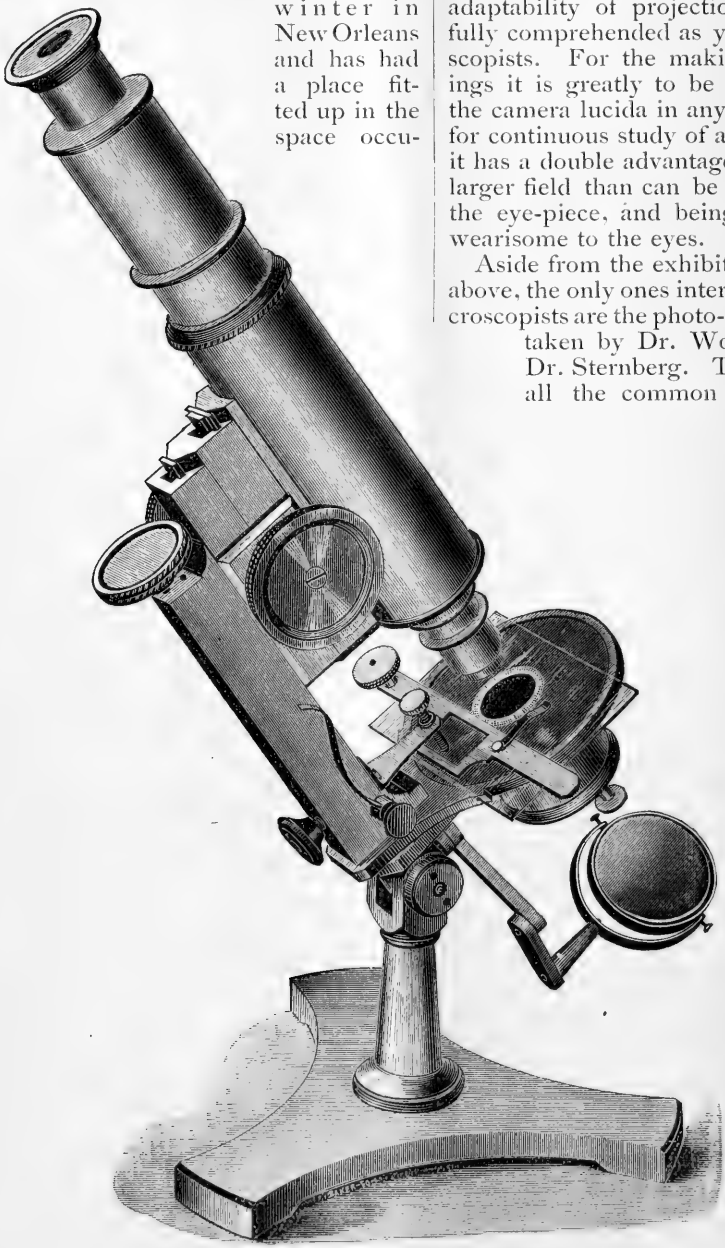


FIG. 17.—McIntosh Galvanic Company's Microscope.

Aside from the exhibits mentioned above, the only ones interesting to microscopists are the photo-micrographs taken by Dr. Woodward and Dr. Sternberg. These include all the common test objects and many histological and pathological specimens. The clear definition and general excellence of these productions are worthy of all praise, show what can be done in this line, and justify what seemed presumption before the attempt was made. To secure pictures as good as some of these with an amplification of 6,000 diameters is no small achievement of skilful and delicate manipulation.

A Collecting Bottle.

We illustrate this month a device for collecting, which was described more than a year ago in the *Journal* of the Royal Microscopical Society, but which was crowded out from our columns at the time. The apparatus scarcely requires any description. It

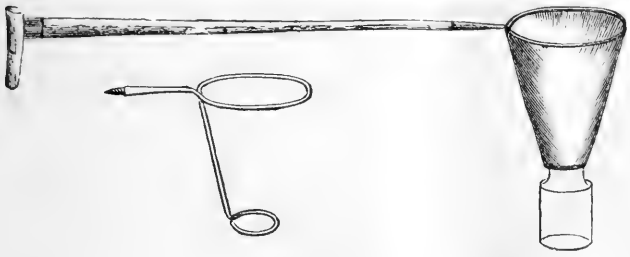


Fig. 18.—A Collecting Bottle.

consists of a light wire frame covered with muslin, made to grasp the neck of the bottle. It is attached to a rod or walking-stick. The wire keeps the muslin stretched, which is a great advantage, as those who have had experience in collecting will readily understand.

For the benefit of those who have not had experience in collecting it may be said that the organisms in pools of water are usually found in greatest abundance living among the vegetation along the borders and at the bottom, or in the masses of algæ which float on the surface. They should be secured by scraping along the plants and washing the finds down into the bottle, from which they are easily transferred to smaller vials for convenience.

—o—

Orthocarpus Purpurescens.

The seeds of *Orthocarpus purpurescens* possess marked characteristics of interest to the microscopical observer. The plant which furnishes them is a native of California, where it appears in early spring, usually in large patches. The genus *Orthocarpus* belongs to the family Scrophulariaceæ and is represented by nine or more species in California. Of these *O. purpurescens* is one of the largest and most showy. It is a low plant about six inches high, usually strict but sometimes branching and bearing a spike of small crimson flowers and colored bracts. The blossoms are much visited by insects for the sake of the contained nectar.

The ripened seeds are shaped like a truncated cone about 0.75 mm. broad and 1.25 mm. long. It is at once observed that they present a punctated appearance and in certain positions reflect light strongly.

Placing some of the seeds in a shallow cell on an object slide, and transferring the same to the stage of the microscope, we examine them by reflected light, with a three-inch or two-inch objective. Behold, a revelation! That which we saw glitter is a latticed capsule, reminding us of the Radiolaria, and the seed itself is a plummet-shaped brown body safely lying within. If some of the seeds are comparatively green we may see that some of the interstices are yet closed by a thin membrane.

Examining by various methods of illumination we discover that a charming effect is brought out by the dark ground illumination. The latticed network inclosing the seed now shines like crystal. This resemblance is enhanced when on trying the polariscope we find that the capsule acts on polarized light. The use of a suitable selenite is desirable. This reaction to polarized light appears to prove that the trabeculæ of the capsule are largely composed of silica. What purpose the capsule may subserve remains as yet unknown.

Few, if any, seeds can equal these in varied microscopic interest, and they are heartily commended to all observers. Edward Gray.

[We have received a beautiful pre-

paration of these seeds from Dr. Gray, such as he is offering in the Exchange column. The lattice-work capsule is beautifully shown under a 2-inch objective, and, makes a most attractive object for exhibition.—Ed.]

—o—

Staining Tissues in Microscopy.*—III.

BY PROF. HANS GIERKE.

[*Continued from p. 94.*]

HEMATOXYLIN, EXTRACT OF LOGWOOD.

36. Waldeyer. Untersuchungen über den Ursprung und den Verlauf des Achsencylinders bei Wirbelthieren und Wirbellosen. Henle und Pfeufer's Zeitschr. f. rationelle Med. 3 Reihe. Bd. xx, p. 200.

Waldeyer tried to stain the central axis of nerves with carmine and anilin and also with logwood, alkanet and Brazil wood. He obtained good results only with alkanet. The watery extract of both dye-woods stained too deeply, and did not differentiate the axis.

37. Böhmer. Aerztl. Intelligenzb. f. Baiern, 1865. No. 38.

1. Hematoxylin in crystals, 0.35 gm.; absolute alcohol, 10.0 gm. Dark brown fluid; does not spoil.

2. Alum, 10 gm.; distilled water, 30.0 gm.

Add a few drops of No. 1 to No. 2, according to the strength desired. The result is a deep bluish violet fluid. The first solution improves with age. The mixture should be made three or four days before using, and exposed to the light, or it will stain too darkly. The fluid keeps well, but requires filtering in summer. It dyes specimens hardened in chromic acid as well as in alcohol, but requires care to prevent overstaining. If this happens, acids—especially acetic acid—may be used to wash out the excess of color, but preparations thus treated are less permanent, and in the course of years some bleaching takes place, especially when chromic acid has been used.

38. Frey. Die Hematoxylin farbung. Archiv. mikrosk. Anat., Bd. iv, p. 345.

Frey recommends Böhmer's fluid. For preparations hardened in chromic acid, potassium bichromate, or copper sulphate the alum may be omitted; the alcoholic solution of hematoxylin is merely diluted with water. Frey thinks the action on chrome preparations is similar to that of Leykauf's ink. (See Wagner's Chem. Technol., 3 Aufl., p. 532.)

39. Merkel. Der quergestreifte Muskel. Arch. mikrosk. Anat., Bd. ix, p. 293.

The double refracting portions of muscular tissue stain readily with extract of logwood; other parts remain uncolored.

40. Arnold. Logwood as a staining material for animal tissues. Quart. Journ. Micr., 1873. p. 86.

Rubs up logwood with three times as much alum, digests in water, and adds one-fourth as much 25% alcohol. (Can only take the place of Böhmer's fluid when no crystals are to be obtained.)

41. Lawson Tait. Journ. of Anat. and Physiol., vol. ix, p. 250.

Recommends that preparations stained with hematoxylin should be treated with 4% nitric acid. The nuclei will then show brown on a cherry red ground. (Preparations thus treated soon bleach out.)

42. Kleinenberg. In 'Grundzuge der Entwickelungsgeschichte der Thiere,' by Foster and Balfour. Leipzig, 1876.

Three solutions are to be made:—

1. Saturated solution crystallized calcium chloride in 70% alcohol, to which add as much alum as it will dissolve.

2. Saturated solution of alum in 70% alcohol. Mix 2 with 1 in the pro-

* From the *Zeitschrift für wissenschaftliche Mikroskopie*. Translated for this Journal by Prof. Wm. H. Seaman, M. D.

portion of 8 to 1. 3. Concentrated solution crystals of hematoxylin in alcohol or in No. 1, and add a few drops as required to the mixture of 1 and 2. (Especially recommended for embryos, and very satisfactory.)

43. Alleyre Cook. Note on logwood staining solution. Journ. of Anat. and Physiol., vol. xiv, p. 140.

Extract logwood, 6 pts.; alum, 6; copper sulphate, 1 pt.; water, 40 pts.; thymol, a small crystal. Rub the first three well in a mortar, add water to a thin paste, stir occasionally for two days, filter, and add the thymol to preserve it.

The solution acts on material fresh and hardened in alcohol. For chromic acid preparations use eight drops of the above tincture to 120 of water and one of a 1% solution of potassium bichromate. For mounting in balsam wash well in absolute alcohol to prevent bleaching.

(Bleaching will occur more or less. The solution of bichromate is too weak to be effective. The dilution is 1 to 130,000.)

44. P. Mayer. Ueber die in der Zoologischen Station zu Neapel gebrauchlichen Methoden zur mikroskopischen Untersuchung. Mitth. d. Zool. Stat. Neapel, Bd. iv, p. 1.

Kleinenberg's method is highly recommended and is modified slightly by adding one volume of strongly-concentrated solution calcium chloride and alum in 70% alcohol to 6–8 of spirit of the same strength. To this is added as many drops as required of a solution of hematoxylin crystals in absolute alcohol.

45. Renaut. Sur le mode de préparation, et l'emploi de l'éosine, et de la glycérine hematoxylique en histologie. Arch. de Physiol., 1881, p. 640.

A thick neutral glycerin is saturated with alum, and about one-fourth as much of an alcoholic solution of hematoxylin added drop by drop. Too much causes a precipitate, and the alumed glycerin must be added to clear up; filter and set in the light for some weeks, till no smell of alcohol is perceptible; filter again, and it is fit for use, and will keep well. It dyes in five to ten minutes. Renaut uses a few drops as a mounting fluid.

(We find the color leaves the fluid and goes into the preparation, which is therefore very good. At first, however, the uniform color renders the objects less distinct and transparent.)

46. Dippel. Das Mikroskop, 2 Aufl., 1882. Bd. i, p. 719.

Kleinenberg's method is herein simplified. A saturated solution of chloraluminium is diluted by 6–8 volumes of 70% alcohol. Alcoholic solutions are recommended. A mixture of alcohol, alum, and hematoxylin solution diluted with 50–70% alcohol or water is also described.

47. Friedländer. Mikroskopische Technik. Berlin, 1882, p. 43.

A process similar to Renaut's is here described, which only differs by the use of determined volumes, as follows: Hematoxylin, 2.00; alcohol, 100.00; distilled water, 100.00; glycerin, 100.0; alum, 2.0 gm.

(Hematoxylin is very much used in double staining, which see.)

48. Rindfleisch.

Uses concentrated watery solutions of hematoxylin and alum. Pour the first into the second.

—o—

The Sizes of Blood-Corpuscles.

Professor Theodore G. Wormley, in the new edition of his work, gives the following sizes of blood-corpuscles, as measured by himself and Professor Gulliver. We have only copied the sizes for mammals and birds. It will be seen that, with three or four exceptions, the sizes obtained by the two observers are practically the same:

Mammals.	*Wormley.*	*Gulliver.*
Man, ...	1–3250	1–3260
Monkey, ...	1–3382	1–3412

Mammals.	*Wormley.*	*Gulliver.*
Opossum,	1-3145	1-3557
Guinea-pig,	1-3223	1-3538
Kangaroo,	1-3410	1-3440
Muskrat,	1-3282	1-3550
Dog,	1-3561	1-3532
Rabbit,	1-3653	1-3607
Rat,	1-3652	1-3754
Mouse,	1-3743	1-3814
Pig,	1-4268	1-4230
Ox,	1-4219	1-4267
Horse,	1-4243	1-4600
Cat,	1-4372	1-4404
Elk,	1-4384	1-3938
Buffalo,	1-4351	1-4586
Wolf, (prairie),	1-3422	1-3600
Bear, (black),	1-3656	1-3693
Hyena,	1-3644	1-3735
Squirrel, (red),	1-4140	1-4000
Raccoon,	1-4084	1-3950
Elephant,	1-2738	1-2745
Leopard,	1-4390	1-4319
Hippopotamus,	1-3560	1-3429
Rhinoceros,	1-3649	1-3765
Tapir,	1-4175	1-4000
Lion,	1-4143	1-4322
Ocelot,	1-3885	1-4220
Mule,	1-3760	
Ass,	1-3620	1-4000
Ground-squirrel,	1-4200	
Bat,	1-3966	1-4173
Sheep,	1-4912	1-5300
Ibex,	1-6445	
Goat,	1-6189	1-6366
Sloth,		1-2865
Platypus, (duck-billed),		1-3000
Whale,		1-3099
Capybara,	1-3164	1-3190
Seal,		1-3281
Woodchuck,		1-3484
Muskdeer,		1-12325
Beaver,		1-3325
Porcupine,		1-3369
Llama, Long diam.	1-3201	1-3361
Llama, Short "	1-6408	1-6229
Camel, Long diam.	1-3331	1-3123
Camel, Short "	1-5280	1-5876

	WORMLEY.		GULLIVER	
Birds.	*Length.*	*Breadth.*	*Length.*	*Breadth.*
Chicken,	1-2080	1-3483	1-2102	1-3466
Turkey,	1-1894	1-3444	1-2045	1-3599
Duck,	1-1955	1-3504	1-1937	1-3424
Pigeon,	1-1892	1-3804	1-1973	1-3643
Goose,			1836	1-3839
Quail,			2347	1-3470

	GULLIVER.	
Birds.	*Length.*	*Breadth.*
Dove,	2005	1-3369
Sparrow,	2140	1-3500
Owl,	1736	1-4076

The subject of minute measurements was discussed in an interesting manner in an address before the Microscopical Section of the A. A. A. S. last year, an abstract of which was published in this JOURNAL, vol. v, p. 181.

The slight differences in size accurately given in this table are not always appreciable under modern amplification, but under a power of 1,150 diameters 'corpuscles differing by the 1-100000 of an inch are readily discriminated.' For the conclusions of Prof. Wormley as regards the possibility of identifying blood of different animals, the reader is referred to the brief review of Micro-Chemistry of Poisons, which will be found in another column.

—o—

Provisional Key to the Classification of Algæ of Fresh Water.—II.

[*Continued from page 74.*]

Family II. PROTOCOCCACEÆ Kirchner.

Vegetative cells without cilia, single or united in cœnobia. Propagation by copulation of swarm-spores, or by unsexual zoospores. No vegetative division.

a. The individual cells do not remain united, but live separately, or at the most, in families of irregular form. (EREMOBIÆ.)

Synopsis of Genera.

Cells single, angular, angles sometimes produced, slender, radiate. *Polyedrium*, 31.

Cells single or in masses, starch-grain and vacuole. *Protococcus*, 32.

Cells green, irregular in shape, within water-plants—endophytic. *Chlorochytrium*, 33.

Cells oval or elongate, attached by a pedicel. *Characium*, 34.

Cells like *Characeum*, contents contracted into a ball.
Hydrianum, 35.
Cells stiptate, in tufts. *Codiolum*, 36.
Cells cylindrical, curved, free.
Ophiocytium, 37.

b. Individual cells united in a cœnobium-like family, which, however, differs from a true cœnobium, in that their cells are not all of one and the same generation. Zoospores by simultaneous division. (PSEUDOCŒNOBIÆ.)

Synopsis of Genera.

Elongate cells, spreading from end of mother-cell, forming tree-like families. *Sciadium*, 38.

c. Individual cells united in cœnobia, or families of definite form, produced by the growth of daughter-cells of one and the same mother-cell. These plants differ from the multicellular algæ in that the single cells show no vegetative division. (CŒNOBIÆ.)

Synopsis of Genera.

Elongate cells in series of 2–8 side by side. *Scenedesmus*, 39.
Cœnobium globose, solid; cells angular, two spines at angles.
Sorastrum, 40.
Cells half-moon shaped, convex margins joined in cœnobia of 4–8.
Selenastrum, 41.
Cœnobium spherical, hollow, cells in a single reticulate layer near the surface. *Cœlastrum*, 42.
Cœnobium flat, round or oval.
Pediastrum, 43.
Cœnobium a net, formed of cylindrical cells placed end to end forming the meshes. *Hydrodictyon*, 44.
Genus of doubtful value omitted (combined with *Characeum*, 34):—
Hydrocytium.

a. EREMOBIÆ.

31. Genus *Polyedrium* Nägeli.

Cells single, angular, free swimming, three or more angled, the corners lying in one plane, or tetrahedral; contents chlorophyll-green, often with red spots.

Propagation by gonidia, 3–4 forming of the contents of one mother-cell, which pass out through an opening in the wall, covered with a delicate envelope and grow separately.

Apparently some of the species here placed belong in the development-cycle of cœnobian protococcaceæ, and correspond to the so-named *polyedern* of *Hydrodictyon* observed by Pringsheim, from which, by free cell formation, new hydrodictyon-nets develop.

[Some of the forms bear close resemblance to certain desmids, especially to members of the large genus *Staurastrum*. Their mode of propagation is quite different.]

32. Genus *Protococcus* Agardh.

Cells spherical, not attached, single or in irregular masses, with green or red contents, a starch granule and vacuole. Zoospores formed by successive binary division.

[The appearance of *Protococcus* is so very much dependent upon conditions, that it is not possible here to describe its many transformations. When in the water the cells may be actively swimming about, but most frequently it will be recognized as a thin, powdery layer of cells, or, in the presence of abundant moisture, the cells may be surrounded by gelatinous envelopes. It occurs on bark of trees, damp walls, etc., and seems to be not unfrequently confounded with *Pleurococcus*, which is found in similar places. It is, indeed, doubtful if the two genera are distinct, although *Pleurococcus* is seldom observed except in the vegetative condition, while *Protococcus* is more ready to pass into the motile condition in the presence of water.

It is more than probable that many of the plants included in this genus belong to the life-cycles of higher algæ.]

33. Genus *Chlorochytrium* Cohn.

Endophytic plant. Cells spherical, oval, kidney-shape, or 2– 3– multilobed, single or in groups in the intercellular space of the parenchyma of water-plants. Numerous zoospores

are produced from the chlorophyllous contents, which escape through tubular projections, either into intercellular space or the surrounding water. Resting cells with thick walls have been observed.

[These plants have been found in *Lemna* and *Ceratophyllum*. They have not been observed in this country.]

34. Genus *Characium* A. Braun.

Cells always with one end attached, usually with a pedicel, of various forms. Propagation by zoospores formed by successive binary division within the mother-cells, escaping singly through a lateral opening in the cell-wall.

[The cell-contents are homogeneous or granular, finally breaking up into numerous oblong zoospores with two cilia, which fill the cell. When they escape they make their way to some plant in the water to which they become attached and grow into new plants like the parent.

The Genus *Hydrocytium* A. Braun seems not to differ in any way from *Characeum*, and we have, therefore, omitted it. Rabenhorst describes a peculiar stellate arrangement of the zoogonidia, in which a number of the motile cells are united together by their ends in a radiate manner.]

35. Genus *Hydrianum* Rabenhorst

Cells as in *Characium*, but contents at first homogeneous, afterwards contracted into an ovoid green body, from which, by oblique division, 2–4–8 short zoogonidia are produced, each with two cilia, which escape by a terminal aperture.

[This genus may well be included under *Characium*.]

36. Genus *Codiolum* A. Braun.

Young cells obovate, later cylindrico-subclavate, stiptate, aggregated in tufts; contents green, finely granular, with numerous starch-granules.

Propagation by zoospores and resting spores (hypno spores.)

[This genus is found in both fresh and salt water.]

37. Genus *Ophiocytium* Nägeli.

Cells cylindrical, straight or variously curved, usually one end attenuated to a short stem, contents green, usually with red or reddish-yellow spots.

Propagation by zoospores formed by the simultaneous subdivision of the contents, which pass out and become distributed.

[The curved forms of the older cells enable this genus to be readily recognized. The young cells are short, and often attached. Later they become much curved in half-circles, or s shaped.]

b. Pseudocœnobia.

38. Genus *Sciadium* A. Braun.

Family of cylindrical or somewhat curved cells, united by short stems; on the ends of the older cells the daughter-cells stand fan-like, and this arrangement is repeated with the daughter-cells, making a tree-like growth.

Propagation by elongated zoospores, formed by division of the contents, usually into six parts, which escape through the end of the cell, the top being thrown off like a lid. They become attached at the summit of the cell, and there grow, producing the characteristic form of the plant.

[The intimate connection between this genus and *Ophiocytium* will be readily seen. In one case the zoospores separate, in the other they grow together about the end of the mother-cell.]

c. Cœnobiæ.

39. Genus *Scenedesmus* Meyen.

Cells elongate, polymorphous, often with spine-like projections at the ends, joined by their sides in series of 2–8.

Propagation by gonidia formed by division of the contents of a mother-cell. These arrange themselves within the latter in the form of a new cœnobium.

[A very common genus, of considerable interest from its close relation to *Hydrodictyon* in regard to

the process of forming new families within the mother-cells.]

40. Genus *Sorastrum* Kutzing.

Cœnobium globose, solid within, formed of 4–8–16 or more radially arranged, wedge-shaped, or compressed-cuneate cells, with sinuate or concave margins and bifid at the corners. Propagation unknown.

[This genus resembles *Staurogenia*, and is usually placed near to it in systematic works. Kirchner, however, places this genus here, probably because of the definite character of the cœnobium.]

41. Genus *Selenastrum* Reinsch.

Cells semilunate or almost sickel-shaped, joined together at the middle of the convex surfaces, in spherical families of 4–8 cells. Propagation unknown.

[It is by no means certain that this genus is not more closely associated with *Raphidium*, (5,) but the arrangement of the cells in families, although somewhat variable in different species, is rather more definite than in *Raphidium*.]

42. Genus *Cœlastrum* Nägeli.

Cœnobium spherical, hollow, formed of a single layer of cells, with clear spaces interspersed between them. Cells angular by mutual pressure or spherical.

Macrozoospores form a new cœnobium within the mother-cell, which is set free by rupture of the latter.

43. Genus *Pediastrum* Meyen.

Cœnobium flat, disk-like, formed of 8–16–32 cells. Cells angular, those in the periphery truncate at the base and dilated outwards, notched in the middle of outer margin.

Propagation by micro- and macrozoospores. Macrozoospores formed by repeated division of one cell of the family. They come out from the mother-cell enclosed in an envelope, within which they arrange themselves, after they have come to rest, into a new cœnobium. The microzoospores form in the same way, but in greater number, escape from the mother-cell, and swarm about in the water; nothing further is known of them, but they probably conduct themselves like those of *Hydrodictyon*.

[*Pediastrum* resembles a round or oval desmid, but it differs in being made up of several distinct cells forming a cœnobium.]

44. Genus *Hydrodictyon* Roth.

Cœnobium consisting of many large, cylindrical cells, so united by their ends as to form a closed net of numerous polygonal, usually pentoganal meshes.

Propagation by macro- and microzoospores. Macrozoospores pear-shaped, with two cilia in great number within the mother-cell, where they remain for some time in active motion, then join together and form a net like the parent, which escapes by the solution of the cell-walls, and grows to a large size.

Microzoospores form in like manner in great numbers within a mother-cell (as many as 30,000), each with 4 cilia. They escape through a lateral opening, swarm about, and may copulate. After copulation they come to rest, and form spherical cells, resembling *Protococcus*. After a long time, and dessication, their contents produce 2-5 large swarm-cells with 2 cilia, which escape, and after swimming about come to rest. They then grow to large, angular, irregular cells, with points or horns at the angles (*polyedern* Pringsheim), which produce new nets by division of their contents, in the same manner as in the propagation by microzoospores.

[The nets of *Hydrodictyon* may grow to a length of 12 inches or more. They are common in ponds almost everywhere, most abundant in June and July.]

Family III. Volvocaceæ Kirchner.

Vegetative cells during their entire life in motion, by means of cilia. Propagation sexual, or by copulation of swarm-cells, or asexual.

In accordance with present knowledge the family is divided into—

a. Genera with only asexual propagation.

b. Genera with sexual propagation. In making this convenient division, it should be understood that the distinction is not regarded by the present writer as having the slighest permanent value. It will be observed that as here used the term sexual propagation applies only to propagation by means of male and female cells, the former (antheridia) giving rise to spermatozoids; the latter to oogonia, which are fertilized by the spermatozoids.

It by no means follows that this is the only process of sexual propagation among these algæ. It may be said, and with considerable reason, that the conjugation and fusing together of microgonidia, as in the genus *Chlamydomonas*, for example, is a true sexual process; indeed, we have so designated it in several instances, for want of a better term. Nevertheless, we are rather inclined to regard this process as a sort of parthenogenesis, although there are observations which tend strongly toward a different view.

A.—Propagation Asexual.

Families of spherical or tabular form; in some cases the cells of the family separate from each other and each one swims free, like swarm-spores of the confervas.

Propagation by pairing of the swarm-cells, or asexual by parthenogonidia or unsexual swarm-cells. The copulation of the swarm-spores has been certainly observed in two genera, but in some other genera swarm-spores of two kinds, macro- and microgonidia have been seen, which indicate a not yet observed copulation of the micro-gonidia.

Synopsis of Genera.

Cells single, motile.

Green, centre red, envelope widely extended from plasma. *Chlamydococcus*, 45.

Green, envelope close. *Chlamydomonas*, 46.

Cells in motile families.

Family spherical, 8 spindle-shape cells in hyaline sphere. *Stephanosphæra*, 47.

Family flat or tabular, 4–16 cells in hyaline envelope. *Gonium*, 48.

Family spherical, cells brownish, wedge-shape, 2–32 in berry-like mass, within hyaline envelope. *Synura*, 49.

Family spherical, cells angular, in berry-like mass, within hyaline envelope. *Pandorina*, 50.

Genus of doubtful value omitted. *Spondylomorum*.

45. Genus *Chlamydococcus* A. Braun.

Families do not remain united after their growth from one mother-cell, but the individual cells (macrogonidia) separate. These are spherical, covered with a cellulose membrane, which is commonly somewhat widely separated from the plasma (mantel-like), with green, in the middle red, contents, the anterior end colorless, pointed, with 2 flagella; the plasma-body usually attached to the membrane by gelatinous extensions.

Sexual propagation unknown.

Asexual multiplication of two kinds:—1. By macrogonidia 2–4–8 from a mother-cell, which come to rest and after a period of dryness divide into 2–8 swarm-cells, with 2 flagella. 2. By repeated division of one mother-cell a large number of microgonidia are formed, with 2 cilia, of red or dull green color and with a red spot. These (perhaps after copulation) come to rest.

[The so-called red snow, commonly known as *Protococcus nivalis* or *Hæmatococcus nivalis*, is now placed in this genus as *Chlamydococcus nivalis*.]

46. Genus *Chlamydomonas* Ehrenberg.

Families do not remain united, but the individual cells separate. These (macrogonidia) are similiar to those

of *Chlamydococcus*, oval or round, with a closer envelope, entirely green contents, a starch-granule, 2 vacuoles and 2 cilia.

Sexual propagation by copulation of microgonidia, which form in indefinite number in one mother-cell, egg-shape, of greenish or yellow color, with a hyaline end, a red spot, and 2 cilia. These may be distinguished as male and female. The former 8 the latter 2–4 in a mother-cell. In copulation the male cell is wholly absorbed in the female. The zygospore is thus produced and by repeated division, the daughter-cells not being motile, into a *Pleurococcus*-like resting condition.

Asexual multiplication by division of vegetative cells in 2–8 microgonidia with 2–4 cilia, which go into a resting condition.

[*Chlamydomonas* resembles *Chlamydococcus*, but the mature motile cells differ as follows:—In *Chlamydococcus* the envelope stands away from the green contents; in *Chlamydomonas* it is close. *Chlamydococcus* has a red central portion; *Chlamydomonas* has not, but sometimes has a parietal red pigment spot. The former also has well-defined starch-vesicles.]

47. Genus *Stephanosphæra* Cohn.

Family spherical, consisting of 8 spindle-shape cells, regularly arranged in a circle, with green contents and 2 cilia each, enclosed within a hyaline sphere.

Sexual propagation unknown.

Asexual multiplication by division of each vegetative cell into 8 daughter-cells which grow into new families, as in *Eudorina* and *Pandorina* (50.51). Also microgonidia with 4 cilia are produced, which, probably after copulation, become red resting-cells whose contents, after dessication are transformed into 4–8 swarm-cells (macrogonidia) each with two cilia. These in turn give rise to new families.

48. Genus *Gonium* Müller.

Families of 4-16 cells in a single, tabular quadrangular layer, enclosed by a common gelatinous envelope. Cells somewhat polygonal by mutual pressure, enclosed by a delicate envelope, with green contents, a starch-granule, 2 contractile vacuoles, 2 long flagella and a red spot.

Sexual propagation unknown.

Asexual by repeated division of all vegetative cells forming new families.

49. Genus *Synura* Ehrenberg.

Families spherical, 2–32 wedge-shape cells in grape-like families, of brownish color, without pigment-spot, without firm envelope, with 2 long flagella.

Sexual propagation unknown.

Asexual by breaking up of the families into single cells; these cells continue motile and produce new families by division, or they become resting cells, surround themselves with a gelatinous envelope and multiply by binary division. The growth of new families from these resting cells has not been observed.

50. Genus *Pandorina* Bory.

Families spherical or nearly so, composed of cells aggregated together in grape-like masses, the whole enclosed in ample hyaline envelope. Families of 16, 32 or 64 cells, somewhat angular by mutual pressure, each with 2 flagella, green contents, and usually with a red spot.

Sexual propagation by pairing of similarly shaped swarm-cells of different families. These form by the division of all the cells of one family in (usually) 8 swarm-cells, spherical, green with a red spot and colorless end, with 2 cilia. When set free they copulate with other swarm-cells, joining by their anterior ends, finally fusing together, and form a red zygospore. After a period of rest this gives rise to 1–3 large macrogonidia, each of these becomes quiet and produces a new family by division.

Asexual propagation as in *Eudorina* (51).

B.—Copulation Sexual.

Families spherical, moving about

by means of the cilia of the individual cells.

Sexual propagation by oogonia and antheridia. The latter form by the enlargement of single vegetative cells, the contents giving rise to spermatozoids. The oogonia are produced by the enlargement of other vegetative cells. When ripe the oosphere is surrounded only with a gelatinous covering. The spermatozoids penetrate the latter and the fertilized sphere becomes covered with a thick membrane. After a period of rest it germinates.

Asexual multiplication by division of vegetative cells of considerable size (parthenogonidia), giving rise to new families, which separate from the mother-family as soon as the cilia are developed.

Synopsis of Genera.

Families spherical, cells in berry-like mass, within thin hyaline envelope. *Eudorina*, 51.

Family a hollow sphere, with green cells regularly disposed within the surface. *Volvox*, 52.

51. Genus *Eudorina* Ehrenberg.

Families ovate, usually of 16 or 32 cells, within a hyaline, gelatinous envelope; cells spherical, with thin membrane, each with 2 cilia, green, colorless in front, with a starch grain, pigment spot, and 2 pulsating vacuoles in the colorless end. Cells evenly spaced around the outside of the sphere, the cilia projecting as in *Volvox* (52).

Antheridia form in the four anterior cells of the family, the remaining 28 cells producing oogonia. Oospores red, smooth or somewhat stellate.

Asexual propagation by division of vegetative cells into 16–32 daughter-cells, which at first are united into a *gonium*-like, tabular family (48), afterwards becoming spherical.

[*Eudorina* and *Pandorina* are scarcely different enough to make two genera. In the latter the common envelope and the membranes of the individual cells are rather thicker than in *Eudorina*. The shape of the *Eudorina* family is described as oval, that of *Pandorina* globose or sub-globose, but this character is not of much value, or even constancy. The process of sexual reproduction may serve as a distinction for the time, but it is probable that *Pandorina* also propagates in the same manner. It has been stated that *Eudorina* is diœcious.]

52. Genus *Volvox* Ehrenberg.

Family consisting of many cells, spherical, continually rotating, resembling a hollow globe with green cells regularly disposed just within the surface, each with 2 long cilia projecting through the common, hyaline envelope, a red spot, and two pulsating vacuoles.

Sexual propagation by biciliated spermatozoids formed within special cells, and oogonia, forming red oospores.

Asexual propagation forming new families within the parent sphere, by division of certain cells. These are set free by the rupture of the parent sphere.

[*Volvox* may well be regarded as the highest type of this interesting family. There are two species generally recognized which are distinguished by their difference in size, *V. globator* and *V. minor*. The former is diœcious, the latter monoœcious.]

[*To be continued.*]

—o—

Germicides and Antiseptics.

In a lecture before the Biological Society of Washington some time ago Dr. Geo. M. Sternberg, U. S. A., gave the following lists of germicides and antiseptics. A germicide is an agent which destroys the life of an organism. It may be able to kill only the actively growing organism, or it may also kill the spores. Antiseptics may not be germicides. They may only prevent the growth of organisms without killing them.

Germicides which kill micrococci and bacilli.

Heat—five minutes boiling at 212° F	
Mercuric chloride	1–10,000
Sulphuric acid	1– 100
Sulphuric dioxide	1– 100
Carbolic acid	1– 50

Antiseptics which are not germicides. (Prevent growth but do not kill the organisms).

Sulphate of copper	15%	solution	failed.
Sulphate of iron	saturated	"	"
Sulphite of soda	"	"	"
Sulphite of zinc	"	"	"
Sulphate of zinc	"	"	"
Sulphite of lime	50%	"	"
Alcohol	95%	"	failed

to kill in 48 hours.

Germicides which destroy spores.

Dry heat, 130° C.	
Moist heat, 105° C. (221° F.) five minutes.	
Mercuric chloride	1–1,000
Liquor sodæ chlorinatæ	10%
Liquor zinci chloridi	10%
Sulphuric acid	8%
Nitric acid	8%
Muriatic acid	15%

It is a remarkable fact that sulphurous acid, upon which so much reliance is placed for disinfecting, does not destroy spores. Even the pure liquid sulphurous acid does not kill the spores of anthrax. Pieces of cotton dipped in culture-fluids were placed in bales of rags to be disinfected by sulphurous acid, which was forced into them. The experiment failed to kill the spores.

——o——

Discrimination of Butter and its Substitutes.

Dr. Thomas Taylor, Microscopist of the Department of Agriculture, at a meeting of the Washington Microscopical Society, held on the evening of May 26th, read a paper on some discoveries he has recently made while experimenting with butters and the various forms of butterine and oleomargarine. He first boiled a number of samples of pure butter obtained from Maryland, New York, Ohio, and other States, for the purpose of crystallizing their fatty acids. After a lapse of twenty-four hours, during which time they were laid away in a cool place to crystallize, on placing small portions of each under the microscope, using cotton-seed oil as a mounting medium, he discovered that the crystals of pure butter were sometimes globular and sometimes elipsoidal in shape, and on turning the polarizer so as to cross the analizer there appeared on each a well-defined cross, having equal arms, like that known as the St. Andrew's cross, and that on rotation of the polarizer the cross rotated in like manner. He found also that the crystals of butterine and of oleomargarine, beef and swine fats, are of stellar form, and differ from each other. These do not exhibit the cross spoken of in the case of true butter, and do not follow the rotation of the polarizer. In this way butters may be distinguished from oleomargarine made of beef or swine fats.

Dr. Taylor stated that only in fresh butter has he been able to detect the cross in perfect form, and that in butter which has been kept for some time, or butter of inferior quality, when boiled and viewed under the polarizer, the crystals present a rosette form, generally four-lobed, and these rotate on the turning of the polarizer as do those in fresh butter—conditions not observed in any other fatty bodies, animal or vegetable.

——o——

Eye-Piece Micrometers.

For some months past, my friend, Dr. M. D. Ewell, and myself have been working at micrometry, and the relative advantages of the eye-piece and cobweb micrometers. A short time ago we decided to make a series of independent measurements to see which method was superior. Two slides of fresh blood were prepared under the same circumstances, as nearly as possible, the blood was

dried about half an hour in the air of a well-warmed room, and then sealed in a cell, so that the degree of dessication would be the same, and the measurements were made the same evening, independently. The doctor used a $\frac{1}{10}$ Spencer (homogeneous immersion, N. A. 1.35) with an amplifier and 1-inch eye-piece, giving a power of about 2000, and I a $\frac{1}{10}$ Spencer (homogeneous immersion, N. A. 1.25) with a $\frac{3}{4}$-inch eye-piece, power 1562. He measured twenty-five corpuscles, the average being $\frac{1}{3138}$-inch and I measured fifty with an average of $\frac{1}{3139}$-inch, the difference between our measurements being only $\frac{1}{985000}$, an amount far too little to measure, this being only the finale of a considerable amount of similar experiment in the same direction. I feel pretty well convinced that the cobweb micrometer does not offer sufficient advantage in point of accuracy to compensate for its additional cumbersomeness and expensiveness.

HENRY L. TOLMAN.

CHICAGO, Ill.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1.50.
Vol. III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

SOME CITY SANITATION.—We do not know that the majority of our readers are especially interested in sanitary matters which do not immediately concern them, but they will, at least, be surprised, and perhaps amused, at the vast influence the microbes of disease have come to exert in the legislation of the city of New York. The following quotation from the *New York Herald* will explain itself. It seems that the public welfare demands that the numerous telephone and telegraph wires in the city should be placed under ground. As this is a matter of considerable expense, the companies prefer not to comply with the regulation. The Board of Health and certain eminent physicians who should (and probably do) know better, have thus conspired to defeat the plan of underground wires:—

'The Board yesterday received from Drs. Fordyce Barker, Alfred L. Loomis and H. B. Sands the following letter:—

'Our attention has been called to the proposed action of the various telegraph, telephone, messenger and electric companies for placing wires under ground during the ensuing season, in compliance with the provisions of a law passed at the last session of the Legislature, which made it compulsory that all electric wires in the city of New York should be placed under ground by the 1st of November next.

'In this connection we are very much impressed with the bearing which this proposed action may have upon the public health of this city, as a simultaneous tearing up of the various streets and avenues for the purpose of complying with the provisions of the above law will, in our opinion, be very detrimental to the health of the city, inasmuch as the underlying structure of our streets is composed of material more or less saturated with coal gas and other noxious gases, which, when let loose, will contribute to the unhealthfulness of the city.

'We are more apprehensive on this subject just at the present season than possibly at any other time, for the reason that we may not unreasonably expect to have a visitation of cholera here during the summer months, and the above result would certainly tend to make the sanitary condition of the city more difficult to perfect.' . . . .

'The Health Commissioners, after the reading of the letter, adopted the following preamble and resolutions:—

'Whereas the attention of this Board has been called by several eminent physicians to the danger to the health of the city likely to result from the general open-

ing of the streets and avenues during the coming season for the purpose of putting under ground the numerous telegraph wires, as required by a recent act of the Legislature. . . . .

'*Resolved*, That in the opinion of this department, while the occasional opening of a street or avenue in ordinary times for the laying of a water or gas pipe or for other similar purposes might not seriously threaten the health of the city, the execution of so extensive a piece of work as the laying of all telegraph wires under ground in one season, as contemplated by the act referred to, or to make extensive excavations in the streets for any purpose, would prove highly detrimental to the health of the city, especially in that portion densely populated, through the exposure to the atmosphere of so much subsoil saturated, as most of it is, with noxious gases, and that it would be wise for all parties, officials and others, to avoid as far as possible during the approaching summer making any street excavations not imperatively needed by the exigencies of the public service.'

Probably nobody dreams that all that cut-and-dried preamble and resolutions of the Board of Health were purely in the interest of public health. But can it be possible that Dr. Fordyce Barker, for example, really believes that the tearing up of the New York streets would be followed by, or in any wise contribute to, such dire consequences? If not, why did he or his associates concoct such a communication? Either it must have been through ignorance, or else self-interest. In either case it was reprehensible in such men.

It is not, perhaps, within our province to make notice in these columns of such matters, yet from one point of view it seems to be so, for it is the duty of every editor of a scientific publication to condemn without fear or favor whatever, in the guise of science, may seem calculated to deceive, and especially when it emanates from those whose high position gives great, or undue, weight to their utterances. It is thus that the scientific press can exert an influence, which will counteract the tendency now and then manifested among able men of science to sacrifice their integrity for the sake of gain. Thus it would come to pass that a man's reputation would depend not, as it too often does, upon public favor, but upon the more critical estimate of his associates and co-laborers.

——o——

Postal Club Boxes.—Box B^2 came to hand April 14th, containing some excellent preparations from Troy, N. Y., all well described.

1. Leaf of sundew, *Drosera rotundifolia*. R. H. Ward. The glandular trichomes of the leaf which secrete a viscid fluid to capture insects and digest them to supply food for the plant are well shown.

2. Cancer, Scirrhous carcinoma. J. D. Lomax.

3. Transverse section of tongue of cat. C. E. Hanaman. An exceedingly good and interesting section, well described in the letter.

4. Internal parasite of black bass. Frank Ritchie. The name is not given by the preparer, but A. S. Packard writes that it is probably an *Echinorhynchus*. Mr. Ritchie suggests that it was probably introduced into the lakes about Troy from Rochester, from whence the lakes were stocked, as the parasites had not been observed previous to time of stocking.

5. Urns or spore-capsules of a moss, *Funaria hygrometrica*. Joseph McKay. Mounted dry in a brass cell with a lid. A fine preparation for study. The preparer offers duplicates, mounted with glass covers, for exchange. His address is Troy, N. Y.

6. Ossifying cartilage. A. M. Wright. An excellent preparation for study.

Box Y^2 came to hand April 18th with the following preparations:—

1. Section of stomach of hound. H. B. Chamberlin.

2. Crystallized native silver. Prof. L. D. Short. Somebody asks,' Where from?'

3. Transverse section of a human tooth, with ossified pulp. Dr. A. B. Robbins. A good section.

4. Section of kidney of jack rabbit. Geo. C. Faville.

5. Section of petrified cedar wood. H. F. Wegener.

6. Section of kidney of kitten. A. W. Chamberlin.

Some of these preparations are very poor, and we trust the preparers will send in more creditable work next time. A little more care and neatness in mounting as well as in preparing the specimens is desirable.

Box Cz, containing two of Cole's preparations, came to hand April 24th. The subjects are sections of human cerebrum and cerebellum.

Box G came to hand May 24th with six excellent preparations.

1. Ureter of hog. Dr. W. H. Currier, showing fibrous outer coat and inner mucous coat with epithelium.

2. *Utricularia.* Henry M. Brown. A fine preparation by Mr. L. R. Peet, of Baltimore, who was one of the most expert preparers of stained vegetable specimens. The colors in this preparation are still excellent. This plant is said to catch and kill young fishes.*

3. Section of small intestine of cat. Rev. E. C. Bolles.

4. *Caprella geometrica.* Rev. J. D. King. A fine preparation. 'The slide was mounted some years ago, before anything was said about mounting without pressure.' It is a balsam mount of first-class character.

5. Transverse section of petiole of *Brasenia peltata.* N. N. Mason. Two very excellent, well-stained sections. The starch in the cells shows beautifully with the polariscope.

6. Spores and elaters. Miss M. A. Booth. An interesting preparation, showing well the structure of the elaters.

——o——

Silvering Glass Reflectors.—We promised long ago to give a process for silvering mirrors in these columns, but hitherto we have not been able to refer to some notes of experiments, which we desired to use in writing up the subject.

There being no immediate prospect of finding them, we now give a formula, which is practically the same as we have successfully used. It is the same as Mr. John Browning recommends for silvering glass specula for telescopes.

The glass must first be thoroughly cleaned. Plunge it into nitric acid, and in a few moments wash thoroughly in clean water. Then polish it with putty-powder. It is then ready to receive the coating of silver.

Make three solutions composed as follows:—

A. Silver nitrate.....45 grains.
Water.....2 ounces.

B. Caustic potassa (by alcohol).....½ ounce.
Water.....12 ounces.

C. Milk sugar.....½ ounce.
Water.....5 ounces.

Take one ounce of solution A and add solution of ammonia to it drop by drop, with constant stirring, until the dark-brown precipitate at first thrown down is dissolved in a slight excess of ammonia. Add now to this 2 ounces of solution B. This will produce a precipitate, which must be redissolved as before by the careful addition of ammonia. Now make up the bulk of the solution to 8 ounces by the addition of water, and in order to neutralize any excess of ammonia that may be present add a few drops of solution A, until a slight precipitate thus formed does not redissolve. Then add 7 ounces of water. Set the solution aside to settle, and then pour off the clear fluid.

When ready to silver the cleaned glass, mix a sufficient quantity of the solution as prepared above with one-fifteenth its volume of solution C, (15 oz. to 1 oz.), and pour the mixture into a shallow dish in which the glass to be silvered is supported, face down. The silver will then be slowly deposited upon it, the rapidity varying with the temperature. It may

* Vol. v, p. 130.

require an hour or more to complete the operation, but in warm weather an hour will usually suffice.

When the deposit is thick enough it may be protected by a coat of photographers' varnish. The silvered surface may also be polished if desired, using fine wash-leather and rouge—but for glass mirrors this is not necessary as the deposit seen through the glass is bright.

The solution of silver will keep, but after mixing with solution C it rapidly decomposes, the silver being thrown down in the metallic state.

NOTES.

— A women's anthropological society, the first of the kind in this country, has just been organized in Washington. The first meeting was held June 8th, Mrs. Col. James Stevenson presiding and Miss S. A. Scull acting as secretary. Officers for the year were elected as follows: President, Mrs. Col. James Stevenson; recording secretary, Mrs. Romyn Hitchcock; corresponding secretary, Miss S. A. Scull; treasurer, Mrs. John W. Foster. Miss Cleveland, who was mentioned as the first mistress of the White House who had manifested an active interest in scientific pursuits, was requested to name the society, and did so. There is good talent among the cultured ladies in Washington to conduct such a society in a creditable manner, and we shall hope to see an instructive and valuable volume of Proceedings emanating from it at an early day.

— The announcement of the next meeting of the American Society of Microscopists has just been issued.

The eighth annual meeting of the society will be held at Cleveland, Ohio, beginning on Tuesday, August 18th, 1885, lasting four days. Members of the society will need little urging to attend, for the steadily growing interest in the meetings for seven years is a sufficient guaranty that they will look forward to this one with eager anticipation.

Titles and abstracts of papers should be sent as soon as practicable to the secretary, Prof. D. S. Kellicott, Ph. D., 119 14th street, Buffalo, N. Y.; and all who intend to be present or to join the society are requested to notify him or the local committee at Cleveland, Ohio.

The session for illustration of practical work in preparing and mounting objects will be still more varied and instructive than heretofore. Mr. C. M. Vorce, of Cleveland, has charge of the preparations for the working session.

— Dr. R. H. Ward has written a systematic treatise on the microscope of the present day as compared with the past, which covers twenty-four large octavo pages in Appleton's Cyclopedia. The article is already printed and will soon be issued in the forthcoming volume. It is fortunate that the publishers entrusted the work to Dr. Ward, who is undoubtedly more competent than any other person in the country to treat the subject.

— The great Bartholdi statue, the largest in the world, which is to stand in the harbor of New York, will doubtless be landed by the time these lines are printed. An illustration of the statue is given this month in our advertising columns, and the committee having the matter in charge are offering statuettes to all subscribers toward the completion of the pedestal. The London *Daily News*, in speaking of it says: 'It is out and away the largest statue of modern times. The Colossus of Rhodes was nothing to it. It could carry the "Bravaria" or the "Hermann" in its arms. It towers to the skies from the yard of the Rue de Chazelles, where it has been eight years in construction, and the view from its coronet sweeps clear of the six-story houses and beyond the walls of Paris.'

— Absolute alcohol, or what for all practical purposes may be regarded as absolute alcohol, is prepared in Ranvier's laboratory by removing the water from 95% alcohol by means of anhydrous cupric sulphate. Ordinary blue vitriol is pulverized and heated to redness in a crucible. The white powder thus obtained is added to 95% alcohol, and allowed to stand a day or two with occasional shaking. The powder takes up the water that is in the alcohol, turning blue as it does so. The alcohol is then poured off, and the operation repeated if necessary, which will only be the case when the copper salt is almost entirely changed to blue.

CORRESPONDENCE.

TO THE EDITOR:—I see in an editorial note which follows my article on the gum of liquidambar styraciflua you state that it can be obtained at any drug-store. Is

not this an oversight? I have been unable to procure it in drug-stores. Messrs. Eimer & Amend, after much trouble, sent me a small sample, perhaps half an ounce, which had been taken from a private collection of drugs. Druggists down South even rarely have it. That used by European mounters usually comes from Central or South America, and can only be obtained from one or two firms. The styrax or storax of the shops is the gum of *L. orientale* (more or less pure). It is much darker, more sticky, and has a far stronger odor, at times nearly sickening. I much prefer the American gum, and have entirely discarded the ordinary styrax of the drug stores. I think upon examination you will find that I am correct.

I am glad to see that you are publishing a translation of the article on staining from the *Zeitschrift f. Wissen s. Mikroskopie;* the original is certainly excellent. Your readers generally should be pleased.

A. B. AUBERT.

NOTICES OF BOOKS.

Micro-Chemistry of Poisons, including their Physiological, Pathological, and Legal Relations; with an Appendix on the Detection and Microscopic Discrimination of Blood: Adapted to the use of the Medical Jurist, Physician, and General Chemist. By Theodore G. Wormley, M. D., Ph. D., LL.D., Professor of Chemistry and Toxicology in the Medical Department of the University of Pennsylvania. With ninety-six illustrations upon steel. Second edition. Philadelphia: J. B. Lippincott Company. 1885. (Large 8vo, pp. 741 and 17 plates. Price: Cloth, $7.50; sheep, $8.50.)

This work is not merely a treatise on the detection of poisons with the microscope, but a complete manual of toxicology for the physician and chemist. The microscopical characters of the crystals of such compounds as are in any wise characteristic are described, and beautifully delineated by Mrs. Wormley, who has made all the engravings on steel. The quantities of poisons that can be recognized are in some cases truly microscopic. For instance, 1-10000 of a grain of arsenic, mercury, strychnine, or hydrocyanic acid can be recognized with absolute certainty—indeed, 1-100000 of a grain of hydrocyanic acid will give a characteristic crystalline compound.

Perhaps we can do no better than to quote a few paragraphs from the book to show the concise and clear style of the writer, who, it need scarcely be said, has no superior in toxicology. For this purpose we will choose the reaction of mercuric chloride with nicotine, as this is a test which can readily be repeated by the reader. The reactions are carried out in watch-glasses.

'1. $\frac{1}{10,0}$ grain of nicotine in one grain of water yields a copious white precipitate, which in a little time becomes yellow, and yields a mass of large groups of crystals. These crystals are especially beautiful under polarized light.

'2. $\frac{1}{500}$ grain: yields a rather copious, dirty-white precipitate, which soon deposits colorless crystals.

'3. $\frac{1}{1000}$ grain: in a few seconds the mixture becomes turbid, and soon there is a quite good, white, flocculent precipitate, which afterwards yields crystals having the same forms as illustrated above. If, upon the addition of the reagent, the mixture be stirred with a glass rod, it immediately yields streaks on the bottom of the watch-glass over the path of the rod.'

The Appendix treats of blood, its composition, detection, and discrimination. Some of the measurements of the corpuscles are quoted on another page. The conclusion as regards the possibility of microscopical discrimination is given in these words:—'The microscope may enable us to determine with great certainty that a blood is not that of a certain animal and is consistent with the blood of man; but in no instance does it, in itself, enable us to say that the blood is really human, or indicate from what particular species of animal it was derived.'

The book is invaluable to all who are interested in the applications of the microscope in chemistry and toxicology.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Seeds of *Orthocarpus purpurescens*, in exchange for other objects, mounted or unmounted.

EDWARD GRAY, M. D.,
Benicia, California.

Diatomaceous earth from Denver, Colorado, in exchange for mounting material.

H. B. CHAMBERLIN,
280 Fifteenth St., Denver, Colorado.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., JULY, 1885. No. 7.

Opercularia Constricta, n. sp.

BY D. S. KELLICOTT.

In November last, I found, among some *Utricularia vulgaris* and *Chara coronata* collected from a ditch filled with rather pure water, an aquatic, lepidopterous larva. It inhabited a free case similar to that of a phryganeid larva, and constructed, likewise, of silk holding together fragments of *Lemna*, etc.; probably it is the preparatory stage of a species of *Cataclysta*. On nearly all the caterpillars examined there occurred an interesting, commensal vorticellid abounding on the sides of the thoracic rings. I have said that it is an interesting form, a remark which it is safe to make concerning any infusorian, but this one, an opercularian, is especially interesting, both from the fact of its commensalism on a case-bearing larva, and from certain striking individual characteristics, which indicate that it is specifically distinct, and which render it easy of recognition. In allusion to one of its distinctive features it may appropriately be called *Opercularia constricta*.

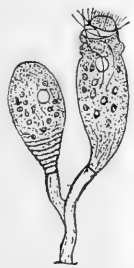


FIG. 19.—Opercularia Constricta.

The body is elongate, somewhat fusiform, and twice constricted below the peristome, plastic, the cuticular surface smooth, except the attenuate posterior fourth, which is longitudinally striate. On contraction the zooid becomes pyriform, when the striated portion is transversely wrinkled. The endoplasm contains many coarse granules.

The ciliary disc is comparatively wide and dome-like; its margin is cord-like, with a double row of cilia, one above and one below the marginal ring. The membraneous collar is elevated considerably above the border of the peristome. The capacious vestibulum extends first backward and is then bent downwards. The contractile vacuole is situated at the angle of the œsophagus, opposite or just below the second or lower constriction of the body.

The pedicel is short, more or less bent, and bears few zooids—two or four are usual numbers.

Length of zooid $\frac{1}{190}$ of an inch; width about one-third the length. On aquatic, case-bearing, lepidopterous larva, Squaw Island, Niagara river.

—o—

Notices of New Fresh-Water Infusoria.—III.

BY DR. ALFRED C. STOKES.

Actinómonas vernális, sp. nov. (Fig. 1.)

Body subspherical, the frontal border slightly emarginate, somewhat changeable in shape, free-swimming or temporarily attached by a short pedicel; flagellum entirely vibratile, equalling or somewhat exceeding the diameter of the body in length; endoplasm transparent, slightly granular; pseudopodia few in number, radiating from any part of the periphery, simple or variously branched, often capitate, sometimes curved, their length exceeding the diameter of the body; contractile vesicles sev-

eral, small, distributed near the periphery; nucleus spherical, subcentral. Diameter of body $\frac{1}{1200}$ to $\frac{1}{1500}$ inch. Habitat.—Shallow ponds in early spring.

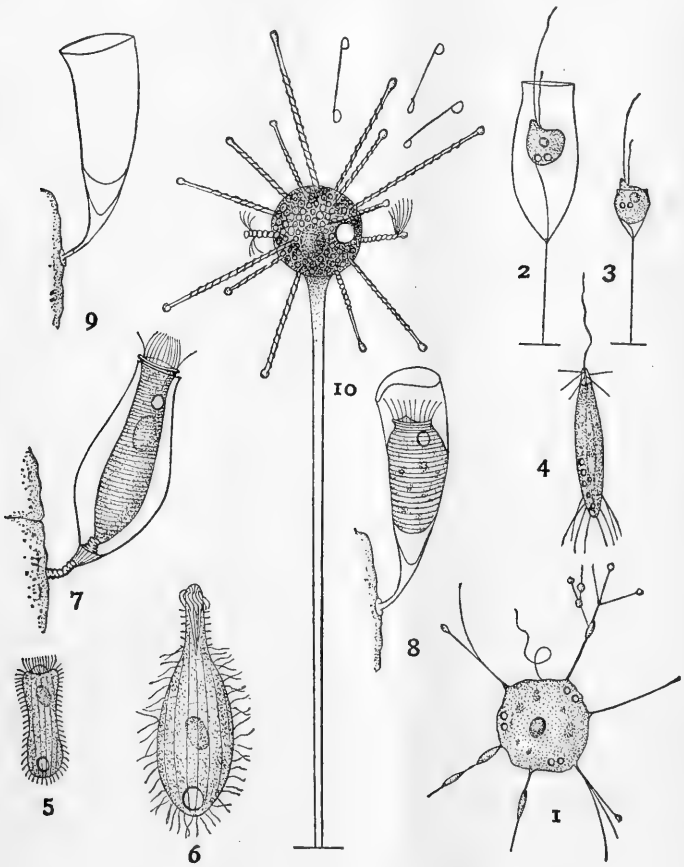


Fig. 20.—New Fresh-Water Infusoria.

This remarkable combination of rhizopod and infusorian was abundant in the first gathering made in early spring from a shallow little pool near a country wayside. Green algæ were already a conspicuous feature of the surface, and their flagellate spores quite as conspicuous constituents of the water when in the field of the microscope. On these active germs the actinómonas was so greedily feeding that its endoplasm was usually crowded and colored by them. In this matter of taking food it has decidedly the advantage of its relatives higher in the scale of life, since the act can be performed in either the sedentary or the freely motile conditions. In the former the pseudopodia are entirely withdrawn, and food is then engulfed at any point on the surface, being taken with a large drop of water, as is commonly done by so many of the mouthless forms.

The movements in the rayless state are comparatively slow and irregular, consisting of a revolution on the longitudinal axis, with sudden changes of position, and with a frequent, rapid, but not long continued trembling or shivering of the entire body, very little space being traversed by its efforts, the motions not being those of the gigantic monas which the infusorian then closely resembles. When in this monadiform condition it is

Explanation of Figures.

Fig. 1. *Actinómonas vernális* × 750.
Fig. 2. *Bicosœca dissímilis* × 720.
Fig. 3. *B. acuminàta* × 720.
Fig. 4. *Mallómonas litómesum* × 750.
Fig. 5. *Lacrymária vértens* × 180.
Fig. 6. *Lágynus lásius* × 312.
Fig. 7. *Cothúrnia plectóstyla* × 275.
Fig. 8. *Cothúrnia bipártita* × 225.
Fig. 9. *Cothúrnia bipártita*. Variety with elliptical aperture.
Fig. 10. *Podóphrya macróstyla* × 250.

easily recognized as a member of the genus actinómonas by this peculiar and characteristic shivering. When quietly seated at the extremity of the short temporarily developed pedicel, the flagellum dashes the food-particles into contact with the pseudopodia, which then draw it into the body, a performance characteristic of the genus.

The pseudopodia themselves are usually simple and often tipped by a minute spherule of protoplasm, with one or more protoplasmic enlargements in the course of the ray, and a frequent thickening at any point by a flow of sarcode, after the manner of the rhizopoda. The branching, in the individuals observed, was at times a simple bifurcation, occasionally becoming compound as shown in the figure.

The small contractile vesicles are scattered near the periphery, their exact number being difficult to determine on account of their irregular distribution and apparently different distances from the surface under examination. At least six can be detected, two placed near the frontal border, two on the opposite side near the equator, and two in the posterior part of the body. This large number would be sufficient to distinguish the creature from the previously observed species, all of which are marine, did not the branching pseudopodia serve the purpose better, as this habit has not been noticed in the salt-water forms.

The thread-like pedicel seems to be but seldom protruded unless, in the instances in which I have failed to observe it, the infusorian has been in such a position that the body has obscured it. Two or more of the pseudopodia appear to serve as anchoring attachments, the capitate tips being applied to an algal or other filament. This habit has also been noticed in *A. pusilla*, S. K.

As the infusorian was first obtained in early spring, or what by courtesy toward our abominable winter climate is so styled, the fact suggested the specific name.

Bicosœca dissimilis, sp. nov. (Fig. 2.)

Lorica elongate-ovate, two and one-half times as long as broad, slightly narrowed anteriorly and there forming an inconspicuous, neck-like prolongation, the border truncate, not everted; supported posteriorly on a pedicel nearly equalling it in height; enclosed body subspherical, situated near the centre of the lorica, not in contact with the walls when extended, nor projecting beyond the frontal border; contractile ligament about one-half as long as the lorica; nucleus spherical, subcentral; contractile vesicle double, postero-terminal. Length of lorica, $\frac{1}{900}$ inch; diameter of enclosed animalcule, $\frac{1}{3400}$ inch. Habitat.—On *Utricularia* from the pine barrens of New Jersey. Solitary.

There is a remarkable disparity between the size of the infusorian's body and that of the sheath formed for its protection. It is a pigmy in a giant's castle, and it seems a timid creature. Safely surrounded by its transparent walls, it remains near the centre of the single apartment even when the retractile ligament has extended to its greatest length, never passing the anterior opening, never exposing itself to any current except that made by the lashing of its own flagella, the body freely floating at the extremity of the restraining thread. The lip is short and inconspicuous, and the frontal excavation shallow. The long flagellum is very long, and seems to vibrate throughout its entire length. It at least does not present the aspect of a lash curved and vibrating at the distal extremity only, as in most of the forms hitherto discovered. The lorica also is the largest yet noted in any member of the genus, while the enclosed zooid is among the smallest.

Bicosœca acuminàta, sp. nov. (Fig. 3.)

Lorica irregularly ovate, less than twice as long as broad, slightly nar-

rowed anteriorly, the border truncate, the posterior two-thirds rapidly tapering to a pedicel, two to three times its height; enclosed animalcule subspherical, filling the anterior part of the lorica and projecting beyond the anterior border; contractile vesicle double, the two placed side by side near the centre of one lateral border; nucleus subcentral. Length of lorica, $\frac{1}{3000}$ inch; of enclosed zooid, $\frac{1}{4500}$ inch. Habitat.—On *Utricularia* from the New Jersey pine barrens. Solitary or scattered. Reproduction by transverse fission.

This minute form seems as bold as the preceding is timid, sitting at the aperture of the lorica and exposing a considerable part of the body almost continuously, the contractile ligament rarely drawing it to the rear of the sheath. It is also noteworthy in respect to the position of the contractile vesicles, these being usually posteriorly located, often postero-terminal. Reproduction is accomplished quite rapidly, the body elongating and dividing transversely, having previously extended one, probably two, additional flagella. The newly-formed long flagellum is very apparent, the smaller being so excessively minute that its existence could not be positively determined.

The lorica is very delicate. It will not even for a short time resist the action of a solution of caustic potassa, which was applied for the destruction of the enclosed zooid so that the exact form of the sheath could be seen, but which dissolved the lorica almost as soon as the softer body within. This is somewhat unusual, the loricæ commonly withstanding even prolonged exposure to the caustic solution.

Mallómonas litómesum, sp. nov. (Fig. 4.)

Body elongate-ovate, three times as long as broad, widest centrally, the anterior extremity narrowest, the cuticular surface finely crenulate; the non-vibratile setose hairs confined to the two extremities, the central part of the cuticular surface entirely naked, those of the posterior extremity longest and most numerous, those about the anterior apex radiating in an almost horizontal direction; flagellum long, slender; endoplasm yellow; contractile vesicles mutliple, confined to the posterior body-half; nucleus not observed. Length of body $\frac{1}{1000}$ inch. Habitat.—Marsh water, with *Sphagnum*.

This pretty creature is remarkable for the naked condition of the central portion of the body surface, a characteristic readily differentiating it from the other members of its genus hitherto described. This species recalls, in this respect the Holotrichous *Cyclidium litomesum* described by the writer in the *American Monthly Microscopical Journal*, December 1884, in which a similar arrangement of setose cilia obtains, the central cuticular surface there also being quite naked. This condition will necessitate a slight change in the diagnosis of the family and generic groups as now formulated.

The endoplasm is lemon yellow in color, the pigmentary matter appearing to be collected in two somewhat indistinct lateral bands, the intervening pale, almost colorless, strip of sarcode filled with fine granular matter, near the centre of which is located what seems to be the nucleus, the latter, however, being very obscure. The oral aperture and the continuation as a narrow pharyngeal passage are usually distinct, the former quite conspicuously so.

Lacrymária vértens, sp. nov. (Fig. 5.)

Body subcylindrical, soft, flexible, and somewhat extensile, about three times as long as broad, longitudinally striate; constricted near the middle, the lateral borders consequently concave; cilia fine and numerous; apical extremity rounded, oral cilia numerous; contractile vesicle single, spherical, postero-terminal; nucleus ovate, conspicuous, located in the anterior body-half; endoplasm usually coarsely granular. Length of

body, $\frac{1}{300}$ inch. Habitat.—Stagnant pond water.

This readily recognized form is only the second fresh-water species hitherto observed, the first being *L. truncáta*, which was obtained by the writer in a habitat similar to that of *L. vértens*. The body is very flexible, insinuating itself with ease among and between tangled threads of fungi and heaps of debris. The anterior extremity seems to be the most extensile portion, the region also retracting itself until the smooth apical hemisphere, which is pierced centrally by the oral aperture, is apparently sunken and surrounded by a deep circumvallation, the characteristic constriction of the body then being lost by the dilation of the part. The movements are by rapid revolutions on the longitudinal axis.

Lágynus lásius, sp. nov. (Fig. 6.)

Body normally flask-shaped, about three times as long as wide, longitudinally furrowed, the ventral surface flattened; contractile to an ovate form and extensile until elongate-clavate or subcylindrical; anterior extremity rounded, oral aperture terminal; oral cilia conspicuous, those of the general surface long, numerous, vibrating somewhat irregularly and independently, and confined chiefly to the body back of the anterior neck-like prolongation, the latter being rather sparingly ciliate and bearing numerous, immotile, hispid setæ, a series also continued down the dorsal surface to near the posterior extremity; pharynx conspicuous, longitudinally plicate; nucleus subcentral; contractile vesicle single, postero-terminal. Length of body $\frac{1}{260}$ inch. Habitat.—Fresh water.

A noteworthy feature of this little bottle-shaped creature is that the neck is abundantly clothed with short, stiff bristles with a great decrease in the number of the vibratile cilia, which in equal abundance are borne on the remaining body surface. At first glance the appearance of this roughened neck is such as to lead the observer to at once imagine that the infusorian has recently taken part in a fierce battle, and has had the anterior cilia broken or in some way incompletely removed; but the perfect condition of the oral circle, and the continuation of a row of the setæ down the median line of the dorsum show that the condition is normal and the infusorian uninjured.

The movements vary with its form. When flask-shaped progression is evenly forward on the flattened ventral surface; when contracted to the broad egg-shape, or extended to the subcylindrical form, it rotates on its long diameter.

Cothúrnia plectóstyla, sp. nov. (Fig. 7.)

Lorica elongate-urceolate, two and one-half times as long as broad, hyaline, slightly compressed, inflated, and somewhat gibbous subcentrally, thence tapering posteriorly to the pedicel and anteriorly to a short, subcylindrical neck, the margin truncate, not everted; pedicel conspicuous, transversely plicate, often sinuose, continued through and filling the tapering posterior extremity of the lorica, and prolonged as a short internal footstalk which is entirely invaginated by the posterior extremity of the contracted animalcule; enclosed zooid transversely striate, when extended projecting very slightly beyond the orifice of the lorica; nucleus broadly ovate, conspicuous, subcentral. Length of lorica $\frac{1}{250}$ inch. Habitat.—Fresh water, on *Canthocamptus minutus*.

This was very abundant on the entomostracan mentioned, as were what were supposed to be the immature pedicellate zooids which were still without a trace of a lorica. The pedicel of these was long, tortuous, and conspicuously plicate, the ovoid bodies also exhibiting transverse striations. The mature forms are readily distinguished from allied species not only by the shape of the lorica and the very short distance to which the body extends beyond the sheath, but

chiefly by the peculiar wrinkling of the pedicel and its internal continuation, both the zooid and the lorica appearing to be pedicellate.

Cothúrnia bipártita, sp. nov. (Figs. 8 and 9.)

Lorica elongate-subcylindrical or elongate-campanulate, gibbous, somewhat curved, one side being longer than the other; two and one-half times as long as broad, widest anteriorly or at the frontal border, tapering posteriorly, finely striate longitudinally, and with irregular transverse markings resembling lines of growth; transparent, colorless when young; margin not everted; aperture variable in form, either elliptical and the borders even, or narrowly ovate and prolonged for some distance down the shorter side of the lorica, the borders then somewhat unevenly curved; lorica divided posteriorly into two unequal parts by a curved, transverse chitinous partition to which the enclosed animalcule is sessilely attached; pedicel stout, usually curved, widest at its attachment to the sheath, about one-fifth as long as the lorica; animalcule taking the form of the sheath posteriorly, transversely striate, when extended not reaching to the anterior aperture; peristome narrow, everted, not revolute; ciliary disc small, obliquely elevated; nucleus short, band-like, curved. Length of lorica $\frac{1}{225}$ inch. Habitat.—On *Canthocamptus minutus* from marsh water, with *Sphagnum*.

The longitudinal striations of the lorica are very fine, the irregular transverse lines being much more conspicuous. The former are peculiar to this species, not having been observed in any other member of the genus. They are purposely omitted from the figures. The internal partition, as well as the entire lorica, changes in color with age.

Podóphrya macróstyla, sp. nov. (Fig. 10.)

Body subspherical; tentacles irregularly distributed over the entire surface, distinctly capitate; pedicel seven to eight times as long as the diameter of the zooid, large, hollow, widest at the point of attachment to the body; contractile vesicle single, laterally located; nucleus ovate, subcentrally placed; endoplasm usually coarsely granular. Diameter of the body $\frac{1}{450}$ to $\frac{1}{500}$ inch. Habitat.—Pond water.

The tentacles extend until once and one-half to twice as long as the diameter of the body. They are usually surrounded externally by a spiral, thread-like film, or by irregular transverse or circular folds of sarcode distinctly visible with even a comparatively low amplification. These spirals, when the tentacle is retracted, are apparently forced close together and seem often to coalesce and form an irregular protoplasmic mass at the point of attachment to the body, as if the tentacle had for its basis a rigid, internal, hollow filament which, when drawn into the body, was partially stripped of the external investment in its passage through the cuticular surface of the zooid. That this internal support or rigid lining exists is scarcely possible, yet the outer wall of the tubular tentacle seems unusually firm. When first placed on the glass slide for examination and subjected to slight pressure of the cover, the creature has the habit of voluntarily throwing off the tentacles apparently in contact with the cover, which then float away as delicate, rod-like filaments with a loop or bulb at each end, as shown in fig. 10. The separation is quickly accomplished, and the tentacle at once assumes the aspect of a fine thread, an anterior bulb or loop being formed from the capitate extremity, and a posterior one apparently from the protoplasmic contents. Other tentacles are almost immediately substituted, a fact militating against the apparent possession of a rigid tubular foundation. A similar separation takes place after submission to prolonged observation and the consequent deoxygenation of the water. What useful purpose this

voluntary mutilation can subserve it is not easy to conjecture, and why the suctorial organs are not withdrawn and this waste of substance prevented it is equally difficult to imagine. Can the infusorian be without the ability to entirely withdraw the tentacles when once extruded? The suggestion seems plausible, and, indeed, I have not yet observed an individual without some trace of these organs protruding from the surface. In several instances tentacles have been partially withdrawn, and the extremity of the crowded external spirals of sarcode below the capitate bulb have become divided into numerous long, fine, vibratile filaments, as shown on two tentacles in fig. 10. This formation has been observed only after the infusorian has been in confinement for a considerable period. It is therefore probably an evidence of discomfort or a symptom of pathological change. Two tentacles on the same individual have been seen in this condition, but the infusorian did not appear to be weakened or ill at ease, as the remaining ones were fully extended, or actively withdrawn and protruded. The appearance has not been previously observed, and it needs an explanation which is indeed difficult to make.

TRENTON, N. J.

—o—

The Microscopical Discrimination of Blood.*

BY C. M. VORCE, F.R.M.S.

After what has already been written on this subject (vol. iv, p. 223, vol. v, p. 17) it is now desirable to detail some practical applications of the facts recited. By many persons the subject is treated as if it were a matter of great and natural difficulty, while the fact is there is no other inherent difficulty than the necessity of care and the choice of proper methods. As the result of considerable experience, I consider that the practical requisites for accurate measurements of blood corpuscles and the examination of blood stains are :—

1. Homogeneous immersion objectives of powers $\frac{1}{8}$ to $\frac{1}{12}$ or upwards with good working distance. The objectives should be non-adjustable, or else the adjustment should be fastened so as to be incapable of movement after being once correctly adjusted.

2. Eye-piece and tube-length to give 1,000 to 1,500 diameters or upwards.

3. Eye-piece micrometer to give measurements to $\frac{1}{50000}$ inch or finer.

4. Fine adjustment to move body and not nose-piece.

5. Mechanical stage and good substage achromatic condenser.

6. A quiet work-room, free from noise or tremor.

The methods of treatment may be various, but all comparisons should be by absolutely the same method.

It may prove of interest to describe some methods chosen from actual experience, and the results obtained thereby. For this purpose the processes followed and results obtained in an investigation undertaken at the request of the authorities in one of the interior counties of Ohio, in a murder case lately tried there, will be briefly given.

In the case in question certain blood stains on wood, steel, felt, cotton cloth and woollen cloth were submitted for examination, with a view of determining whether stains of human blood could be distinguished from stains of the blood of other animals, especially the dog. The stains were upon the hat and clothing of the accused person, and upon the bit and helve of an axe found on his premises. As to the stains on the prisoner's clothing, he accounted for them by claiming that he had suffered with bleeding at the nose on the night in question; as to the axe he professed entire ignorance.

The examination was conducted in

*This article was originally written in the fall of 1884 as a conclusion of the author's previous articles on the subject, but, being withheld for revision, was mislaid, and for a time lost.

the laboratory of the writer by Dr. Tuckerman, of this city, jointly with the writer, and occupied several weeks' time. We worked at it nightly for some three weeks, usually devoting from five to seven hours to the work each evening. Afterwards less time was given to it, but the work was steadily pursued. Of the numerous objectives tried, we finally settled upon a homogeneous immersion $\frac{1}{10}$ by Gundlach, which proved admirably suited for the work on account of its relatively great working distance. This quality in an objective is essential in working on stains, though not important for work on fresh or spread blood. After trying many processes and media we finally adopted the following method:—The blood stain was scraped with a knife blade and the dust received on a clean glass slip; to this was added a drop of distilled water and a cover glass was laid on. After three minutes a blotting strip was applied at one edge of the cover and a watery solution of eosin at the other; after acting one minute this was in like manner drained away and a solution of chloral hydrate 40 grains to 1 ounce applied. As soon as the eosin solution was wholly replaced, the slide was wiped around the cover with a dry blotter, and the cover cemented down with gold size or Folsom's finish, and the mount at once examined.

Our tests seem to show conclusively that after the chloral is applied no further change takes place in the corpuscles enclosed. Having settled on this method, all the tests considered in reaching a conclusion were made strictly according to it, although it should be noted that all the tests by other methods, and they were many, were entirely corroborative of those by this method. Casting the image of the corpuscles enlarged about 4,500 diameters upon a screen was tried, but abandoned as it required too much time and seemed no more certain than other methods. The difference between the corpuscles of human and dog's blood is, however, shown with striking effect by this method. The average human corpuscle will measure about $1\frac{3}{8}$ inches, while the largest dog's corpuscle will hardly exceed $1\frac{1}{4}$ inches, and the average will be about $1\frac{1}{8}$ inches (1.357, 1.278, 1.164).

Although measurements made by the camera lucida, or with the cobweb micrometer, are doubtless sufficiently accurate for the purpose, there are theoretical and practical sources of error which, though minute, are not found in the use of the eye-piece micrometer, and the latter was used by us exclusively in the tests relied on, it being removed from its mount and cemented in the eye-piece used, so that the same spaces were always used in making the measurements, having previously determined that the spaces used were exactly equal within the limits of any test we could apply with over a dozen stage micrometers.

The reagents used were from the same bottles throughout, which were kept corked with scrupulous care; pipettes were drawn to capillary points, and any change in strength of solutions due to evaporation thus guarded against; in short, we taxed our combined ingenuity to secure absolute identity of conditions in all the comparative tests. The blood of ten different kinds of animals was measured, a varying number of each kind, but the greatest attention was paid to that of the dog and man. Usually 100 corpuscles on each slide were measured, an equal number by each of us, 25 at a time, thus distributing as equally as possible any effects of personal equation, or variation of the specimen. The average of the 100 measurements was then tabulated for comparison. In addition to the measurements of known bloods, slides were prepared, in several series, by Dr. Tuckerman, and submitted to me with labels marked with symbols of significance unknown to me, which specimens I would measure and record, and then substitute labels of significance unknown to him and let him measure

them and record, and we would then compare our respective results.

For present purposes we may confine our attention to the comparison of the measurements of human and dog's blood, although I am far from confident that dog's blood is that most likely to be mistaken for human. Not to weary the reader with voluminous tables, the result is summarized as follows by giving the maximum, minimum, and average measurements in each specimen, taking in every case the specimens giving the largest and the smallest average, also the average of these two, and the average of all of that kind. The measurements are given in terms of the eye-piece micrometer used.

Specimen.	*Minimum.*	*Average.*	*Maximum.*	*Gen. average.*	*Average of all.*
Human dry, -	2.00	2.402	2.60	2.3885	2.40
Ditto, - - -	2.00	2.375	2.60		
Dog dry, - -	1.80	2.157	2.60	2.1315	2.153
Ditto, - - -	1.80	2.106	2.40		
Human on steel,	1.80	2.270	2 60	2.1210	2.23
Ditto, - - -	1.80	1 972	2.30		
Dog on steel, -	1.60	1.840	2.40	1.80	1.7:9
Ditto, - - -	1.40	1.760	2.20		
On axe-bit, -	1.90	2.300	2 60	2.148	2.094
Ditto, - - -	1.60	1 996	2.30		

Who could reasonably doubt that the blood on that axe-bit was human blood instead of dog's blood, if it was either?

This difference between the measurements of human and dog's blood may seem to some supercautious persons to be a very small basis on which to rest a conclusion from which such important results as the decision of a capital case may ensue. But such a difference, if found to be constant, is more certain and reliable than the identification of a person by the features or clothing simply; and is it ever objected that because persons are constantly being misidentified because of chance resemblance of their faces, persons, or clothing to those of other persons, therefore such evidence of identity, when offered, shall not be received and given its due weight?

Probably the cases of doubtful identity are few where a conscientious witness would testify that he could identify the party in question by his features alone with absolute certainty or beyond the possibility of a doubt; but he might very properly claim to do so beyond a reasonable doubt, and this is all the honest microscopist will ever claim for his identification of blood.

I am, however, while aware of the difficulties which encompass the matter, and with a full sense of the momentous results to be affected, convinced, after the investigations detailed and the examination of the subject, that the careful and skillful microscopist may, after some experience, justly claim so much of certainty for his determination that it is beyond a reasonable doubt of correctness.

—o—

Provisional Key to the Classification of Algæ of Fresh Water.—III.

[*Continued from page 114.*]

II. ORDER SIPHONEÆ Kirchner.

Vegetative thallus composed of a single, anastomosing, tubular or bladder-like, comparatively large cell; the upper part, growing in air or water, produces chlorophyll, the lower part a colorless, often much branched, hair-root.

[A large order, with only two genera represented in fresh water. The strictly unicellular nature of the fronds is not in all cases constant throughout the life of every species, but it appears to continue in every case until the reproductive process is about to begin.]

FAMILIES.

Plant terrestrial, spherical, green, with branching, subterranean rhizoid. BOTRYDIACEÆ, IV.

Thallus filamentous, green, branching. VAUCHERIACEÆ, V.

Family IV. BOTRYDIACEÆ.

Thallus terrestrial; composed of an aerial green part, and a subterranean, colorless, branching, root-like part.

Propagation by copulation of swarm-spores giving rise to a zygospore, from which a new vegetative plant grows.

The contents of this are transformed into an indefinite number of resting-spores, the contents of which become converted into a number of sexual, copulating swarmspores (microzoospores).

Propagation also by cell-division and formation of asexual swarm-cells (macrozoospores).

53. Genus *Botrydium* Wallroth.

Vegetative plant, a large, green, single cell, spherical or balloon-shape above the ground, tapering downward to a colorless, branching subterranean root (rhizoid).

Propagation by cell-division, formation of uniciliate zoospores, and copulating biciliate zoospores.

By division of the aerial portion an outgrowth is divided off which grows to the size of the mother-cell, develops a rhizoid, and finally becomes a separate plant.

The contents of the cell (zoosporangium) may divide into numerous macrozoospores, each with one cilium, which escape, lose their cilia, acquire a membraneous covering and germinate (*Protococcus botryoides*) on moist earth.

The contents of the green cell may also give rise to a number of spores, at first green, changing to red (*Protococcus coccoma*, *palustris*, *botryoides*), which in water produce biciliate zoospores (microzoospores). These copulate and form spherical zygospores (also named isospores). These may germinate immediately, or pass into a resting condition.

[The processes of propagation are variously modified by the conditions of growth, especially by the amount of water present. The phenomena that have been observed are confusing and difficult to understand, but they afford an excellent example of adaptation to changing conditions.]

Family V. VAUCHERIACEÆ.

Thallus filamentous, rather robust, unicellular, aerial and aquatic, large. The entire plant is a single, long tube, usually branched. The protoplasm forms a thin layer on the walls, in which are chlorophyll-grains, and oil-drops. Usually there are hair-roots at the lower end.

Sexual propagation by oogonia and antheridia. Oogonia spherical, lateral on the frond, stalked or sessile. Antheridia colorless, polymorphic, lateral on the frond, within which form numerous spermatozoids, which escape through an opening, enter the oogonia, and fertilize the oosphore. The resulting oospore is inclosed by several coats. After a period of rest it germinates and grows to a new plant.

Asexual propagation by gonidia, which in many species are motile, in others not, and germinate in a short time.

54. Genus, *Vaucheria* De Candolle.

Oogonia and antheridia produced in indefinite number near together on the same individual, sessile or on pedicels. Antheridia either sac-shape or elongate and curved cells; spermatozoids elongate, with two cilia usually of unequal length.

Zoospores formed in terminal cells, which are divided off from the filaments by a septum after an accumulation of dark protoplasm occurs at the ends. A single spherical or oval zoospore is formed in each cell, which escapes by an opening. The motile zoospores are covered with cilia, and after a short time they come to rest and germinate. The motionless ones likewise germinate soon after their escape.

[The life-history of *Vaucheria* has been presented in an interesting manner on pages 2 to 6 of the current volume. The species are numerous.]

[*To be continued.*]

—o—

Improved Microscope Objectives.

The following notice of the recent work of Mr. Gundlach has been sent to us by a correspondent, which we publish for the information of our readers. The new lenses are worthy of a trial:—

The Gundlach Optical Company of Rochester N. Y., are now making their microscope objectives after the new principle discovered by Mr. Gundlach, and described by him in a paper read before the American Society of Microscopists, at the meeting at Rochester last August. Their water-immersion, glycerin-immersion, and dry objectives made upon this plan are especially well spoken of. With a $\frac{1}{10}$ glycerin objective a well-known microscopist of Ohio has succeeded in clearly resolving *Amphipleura pellucida*, in balsam, with simple mirror illumination, without any accessory apparatus. The same gentleman with a $\frac{1}{5}$ dry objective has resolved *A. pellucida* in a medium of 2.42 refractive index.

The water-immersion objectives have a very long working distance, and the observations of higher order are corrected to a much higher degree than was heretofore possible in a water-immersion objective; hence these objectives have a definition and resolving power found in oil-immersion objectives only. This series of objectives may therefore be regarded as a new improvement in the field of microscopic apparatus, a water-immerson objective of highest optical quality having also a long working distance. The objectives are provided with collar adjustment.

—o—

Staining Tissues in Microscopy.* III.

BY PROF. HANS GIERKE.

[*Continued from p. 107.*]

AMMONIUM MOLYBDATE.

49. Merkel. Von Henle in seinem Handbuch der Nervenlehre des Menschen. Braunschweig, 1871. Band III d. Handbuch d. Anat. d. Menschen mitgetheilt.

Dilute 1 part saturated solution of ammonium molybdate with 1–2 parts water, add a pinch of limatura ferri. Add drop by drop, with constant stirring, sufficient hydrochloric acid to produce a dark blue, nearly black. The cloudy white precipitate formed at first soon dissolves by stirring, but if the solution turns brown it is worthless. After ten minutes filter. It will be found particularly adapted for nerves, sections of which stain in from 6 to 15 hours.

50. Krause.

In various hand-books, as Frey 7th ed., Thanhoffer, and Dippel, Krause is named as discoverer of a method of staining with ammonium molybdate. He stains dark blue in about 24 hours with a 5% solution in water. Stainings may be made brown by subsequent treatment with 1% sol. tannic acid or 20% pyrogallic acid. The stain is recommended for nerves, glands, and ciliated cells.

MADDER DYES.

51. Lieberkuhn. Müller's Archiv. 1854 u. Ueb. d. Wachsthum des Unterkiefers u. der Wirbel. Sitzber. d. Ges. z. Beförderung der ges. Naturwiss. Marbg., 1867, No. 10.

Living animals were fed with madder to study the formation of bone, the dye uniting with the forming bony matter.

52. Kölliker. Die normale Resorption des Knochengewebes. Leipzig, 1873.

Same process as 51 *ante*.

53. Lieberkuhn. (1) Ueber die Einwirkung von Alizarin auf die Gewebe des lebenden Körpers. Marburger Sitzungsber, 1874, p. 33, u. (2) Ueber das Verhalten des Alizarin (l. c. p. 77).

After feeding pigeons on madder the dye unites with the lime salts of the bones, but not with the organic matter. The latter may be removed by boiling in soda solution without injury to the dye. By injecting a 5% solution of sodium-alizarin into dogs, stainings were obtained—in young dogs the entire bones, in old ones the inner surface only, became red.

* From the Zeitschrift für wissensschaftliche Mikroskopie. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.

A chemical union between the calcium phosphate and the dye occurs, while the calcium carbonate is unaffected. In three days the alizarin disappears from the blood and other organs. It may be found temporarily in any part of the system, as in lymph, gall, urine, fæces and saliva, but is not permanent.

54. Strelzoff. Genetisch-topographische Untersuchungen des Knochenwachsthums. Unters. a. d. Pathol. Inst. zu. Zürich, herausg. von Eberth. 1874. H. 2, p. 83.

Confirms Lieberkuhn's statements that the madder unites with inorganic portions of the bones.

55. Benczur. Augegeben in v. Thanhoffer, Das Mikroskop und seine Anwendung.

Von Thanhoffer describes an alcoholic solution of alizarin as recommended by Benczur for staining large nerves. The sections should remain twenty-four hours in the dye. The cells and axis of the preparations will be light brownish red. The contents of the cells and the axis will be sharply differentiated.

56. Ranvier. Des applications de la purpurine à l'histologie. Arch. d. Phys. 1874. p. 761.

Dissolve purpurin in a boiling solution of alum 1–200 of water. Add ¼ part alcohol. The solution is an orange-red. It dyes strongly the periosteum, cornea, and nucleus of cartilage cells, bones, etc. Bioplasm remains uncolored. This stain is much to be recommended for the spinal marrow hardened in ammonium bichromate, but specimens treated with chromic acid and Müller's fluid are not good. In the spinal marrow the nuclei of connective tissue and of capillaries become red, but the nuclei of nerve cells remain colorless. It becomes thus a means of differentiating nerves from connective tissue.

57. Grenacher. In hand-books of microscopy.

Dissolve a pinch of purpurin in a 1–3% solution of alum in glycerin, pure or slightly diluted. After standing 2–3 days, filter. Keeps longer without a precipitate than Ranvier's solution of purpurin, and stains in from 10–30 minutes.

VARIOUS DYES.

58. Waldeyer. Ueber den Ursprung und Verlauf des Axencylinders bei Wirbelthieren und Wirbellosen. Zeitschr. f. rat. Med. 3. Reihe, Bd. xx. 1863.

To stain the axis of nerve fibres without staining the sheath, a watery solution of the coloring matter of alkanet root is recommended. An extract made with turpentine has also done good service, producing similar effects.

59. Dippel. Das Mikroskop, 2 Aufl. p. 721. 1882.

Uses an alcoholic tincture of alkanet in vegetable histology. It serves particularly to distinguish resins and fats, which color a deep red while protoplasm only takes a rosy tinge. Dippel thinks it would be useful for animal tissues.

Hartig. See No. 2. Alkanet, like carmine, tends to concentrate in cell nuclei. 1854.

60. Lawson Tait. On the freezing process for section-cutting and on various methods of staining and mounting sections. Jour. Anat. and Phys., vol. ix, p. 250. 1875.

Tait rejects anilin dyes and carmine and strongly recommends litmus. Boil powdered litmus in water, filter, add a little alcohol. The sections color uniformly deep blue. By adding a very little nitric acid a brownish red is obtained. Wash quickly and thoroughly, and the nuclei will be blue, the rest of the tissue a rose pink.

The leaves of the red cabbage extracted with water or alcohol may be used with good results. The addition of ammonia gives a green, of acid a purple. But these are temporary stains and not permanent. For quinolein and cyanin see the anilins.

INDIGO-CARMINE.

61. Thiersch. Injectionsmassen von Thiersch u. W. Müller. Arch. Mikr. Anat. Bd. 1. 1865.

Make a saturated solution of indigo-carmine in oxalic acid (1 : 22–30 of water). Dilute with alcohol. When strong gives intense blue in a few hours. Cells and nuclei are colored, and any excess may be removed by oxalic acid. Introduced into the bodies of living animals indigo-carmine is taken up by the tissues and again separated. Without attempting to analyze the relations of this process with staining proper, an abstract of its literature is given here on account of its importance.

62. Chrzonszczewski. (1) Centelbl. f. d. Med. Wiss. 1864. No. 38. (2) Arch. pathol. Anat. Bd. xxxv, p. 135. 1866.

Chrzonszczewski discovered this method, by introducing colors into the blood of living animals, and studying their excretion by the urinary capillaries.

63. Diaconow. Medicinisch-chemische Untersuchungen. Berlin, 1867. p. 245.

Indigo-carmine introduced into the stomach or the blood is taken up and then separated by both liver and kidneys. Other tissues do not absorb it, it is not found in the lymph or serum of the blood.

64. Heidenhain. (1) Arch. Mikr. Anat. Bd. x. p. 30. (2) Arch. f. d. ges. Phys. Bd. ix. p. 1. (3) Hermann. Handbuch d. Physiologie. Bd. v, p. 345.

Applies the above processes to show that the urinary tubuliferi separate soluble material and the Malpighian glomerules of the kidneys separate the water.

65. Arnold. Arch. f. path. Anat. u. Phys. Bd. lxiv, p. 203; Bd. lxv, p. 77; Bd. lxvi, p. 77; Bd. lxviii, p. 465; Bd. lxxiii, p. 125; Centralbl. f. d. med. Wiss. 1875, No. 41 u. 51. 1875 bis 1878.

66. Thoma. Centralbl. f. d. med. Wiss. 1875 No. 2. Arch. path. Anat. u. phys. Bd. lxiv, p. 294.

67 Küttner. Arch. f. path. Anat. u. Phys. Bd. lxv, p. 12; Bd. lxvi, p. 12, Centralbl. f. d. Med. Wiss. 1875, No. 41.

68. Gerlach. Centralbl. f. d. Med. Wiss. 1875, No. 48. Ueber das verhalten des indigschwefelsauren Natrons in dem Knorpelgewebe lebender Thiere. Habitations-schrift. Erlangen, 1876.

69. Nykamp. Arch. Mikr. Anat. Bd. xiv, p. 492.

70. Zeller. Arch. path. Anat. u. Phys. Bd. lxxiii, p. 257.

Nos. 65 to 69 treat of the separation of sodium sulphindigotate in the gelatinous matter between the epithelium cells and the walls of the vessel. Nos. 65, 68, 69 especially of cartilaginous tissues. Küttner examined the separation of the color by the basal portions of pulmonary epithelium, and Zeller the same in certain glands of frogs.

Arnold (in Arch. f. path. Anat. u. Phys. Bd. lxvi) gives a description of apparatus for the slow injection of colors into the abdominal vein of frogs.

Sodium sulphindigotate has been employed in double staining, which see.

[*To be continued.*]

—o—

The Chromatoscope.

Some time ago Mr. J. D. Hardy devised an instrument, which he has named a chromatoscope, so easily made by any one who has a spot-lens that we take the following description from the *Journal* of the Royal Microscopical Society:—'Its chief purpose is that of illuminating and defining objects which are non-polarizable, in a similar manner to that in which the polariscope defines polarizable objects. It can also be applied to many polarizable objects. This quality, combined with the

transmission of a greater amount of light than is obtainable by the polariscope, renders objects thus seen much more effective. It is constructed as follows:—Into the tube of the spot-lens a short tube is made to move freely and easily. This inner tube has a double flange, the outer one (which is milled) for rotating, and the inner one for carrying a glass plate. This plate is made of flat, clear glass, and upon it are cemented by a very small quantity of balsam three pieces of colored (stained) glass, blue, red, and green, in the proportion of about 8, 5, and 3. The light from the lamp is allowed to pass to some extent through the interspaces, and is by comparison a strong yellow, thus giving four principal colors. Secondary colors are formed by a combination of the rays in passing through the spot-lens.

'The stained glass should be as rich in color and as good in quality as possible, and a better effect is obtained by three pieces of stained glass than by a number of small pieces. The application of the chromatoscope is almost unlimited, as it can be used with all objectives up to the $\frac{1}{5}$. Transparent objects, particularly crystals which will not polarize, diatoms, infusoria, palates of molluscs, etc., can not only be seen to greater advantage, but their parts can be more easily studied. As its cost is merely nominal, it can be applied to every instrument, large or small, and when its merits and its utility by practice are known, I am confident that it will be considered a valuable accessory to the microscope.'

——o——

— Prof. W. O. Atwater, as the results of a series of experiments, finds, contrary to the general opinion of chemists, that plants assimilate nitrogen from the atmosphere. They take up the greatest quantity when supplied with abundant nourishment from the soil. Well-fed plants acquired fully one-half their total nitrogen from the air. It seems probable that the free nitrogen of the air is in some way assimilated by the plants.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

SCIENTIFIC MEETINGS.—The A. A. A. S. meets this year at Ann Arbor, Mich., on the 26th of August. A large attendance is anticipated and plans for the meeting are well advanced, calculated to make an interesting one.

The American Society of Microscopists meets at Cleveland, where great preparations are under way for the occasion. A circular concerning this meeting will be found inserted in this number of the JOURNAL. Press of matter this month forbids further notice of either of these meetings.

——o——

THE POSTAL CLUB.—A few weeks ago Dr. Ward gave us a short but thoroughly satisfactory account of the condition of the Postal Microscopical Club. He said the affairs of the club were being closed up for the year, 'with every vow fulfilled,' 'all the circuits being now upon the last box of the number assigned when we started last fall.' No other boxes will be sent out until September.

We can understand the satisfaction the officers of the Club must feel at such a result. It has only been secured by having a careful system whereby the course of every box can be followed throughout its migrations, and wherever there is delay the cause can be promptly discovered and removed. Efficient management in ad-

dition to such a system has resulted in a successful year, satisfactory to the members as well as to the officers.

Our monthly notices of the boxes as they come to this circuit may or may not be of value. They serve as a record of what passes through the circuits each year, and for this, if for no other reason, we purpose to continue them. Merely as a record they will be of interest to some of the members, and if the few words of commendation or criticism that occasionally appear result in improving the character of the preparations, or lead contributors to add more information concerning their preparations in the letter package, we shall be much pleased at the result.

The preparations as a whole are not yet what they should be. During the year just passed there has been a noticeable improvement over previous years, but there is still room for much better work. Each member is only called upon for a single preparation during a whole year, and it seems as though that one should be one of the best, and, even if the preparer merely uses the microscope for pastime, a few hours' study will enable him to write a description of it that will add greatly to its value to others like himself.

The annual report of the Club for the year 1884 has recently come to hand. The Club has now been in existence ten years. There are twenty-two circuits of six members each. During nine months of 1884 one hundred and ten preparations passed through every circuit. The Managers say:

'Of the slides contributed last year, many were of great interest, and the average was probably as high as could be reasonably expected. Some members have desired that a censorship of slides be provided, in order to secure objects of a high grade; but no plan has been suggested which would not occasion increased labor and impracticable delays. The selection is therefore left to members themselves, trusting to their offering things worthy of study, and avoiding so far as possible the duplication of objects frequently circulated. Valuable special boxes representing original work have been contributed during the year by Messrs. J. Kruttschnitt, J. M. Adams, and Geo. Timmins. In judging of the circuit boxes, those few persons who have extraordinary facilities for securing material and making superb slides should remember that there are learners as well as teachers, and that those fellow-workers whose opportunities for intercourse at the centres of learning are most limited are often those who need the privileges of the Club most definitely and prize them most highly; that a club composed of a few experts of equal advantages would be of a selfish character, and greatly limited in size and usefulness; and that unpretending slides have often contained points of interest to the most experienced members.'

Empty boxes for new preparations will be sent out soon, and members should have their contributions ready so as not to delay the boxes.

——o——

Studies of Amœbæ.—Dr. August Gruber, of the University of Freiburg, has published a valuable contribution of 38 pages* and three large colored plates, describing his observations on amœbæ. The special object of these investigations was to establish, if possible, some characters by which the different species can be identified. In this the author believes he has succeeded. To accomplish the result, it was necessary to study the different species for long periods of time, in order to discover any modifications of form they might undergo. During nine months no indication of transformation was observed in the species studied, but all were sharply defined, and showed at the end of the year the same peculiarities of structure. These observations were conducted upon specimens collected from a small pond, and the same species in

* Studien über Amoeben. Leipzig.

an aquarium. The attempt to cultivate them separately in small glasses failed, as they would not multiply. In this respect our own experience has been more fortunate, for several years ago we succeeded in watching the multiplication of a species that was very abundant in a one-ounce vial, in which was a spray of *Anacharis*. The bottle was covered with a watch-glass, and the amœbæ multiplied rapidly and were abundant for months.

The species principally observed was *Pelomyxa villosa* Leidy. A number of species are carefully described, but we can only give the names of the new species in this place, which are named *Amœba prima*, *secunda*, *tertia*, *quarta*, *quinta*, all of which are related to *Pelomyxa*, and are thrown together by Prof. Leidy, and *Amœba lucida*. A general account of various other amœbæ follows:

The diagnosis of an amœba must be based upon several features the average size, consistence of the protoplasm, and through this the character of the movements, the kind of inclusions in the protoplasm, such as vacuoles, granules, crystals, the parasitic living filaments of fungi, and the constituents of food; but especially the number, size, and structure of the nuclei.

The contribution is one of great interest for the value of the observations on the peculiarities described as well as for the systematic treatment.

——o——

Synopsis of Diatoms.—To subscribers to the Synopsis of Diatoms we have to announce that the volume of text, containing three supplementary plates, was issued some time ago, and a consignment of a sufficient number to complete all the sets has been received for us at the custom-house in New York, where it has been for a fortnight. Eventually it will reach us, and subscribers will be promptly informed of it. In case we should receive it before the Journal goes to press this month, announcement of the price will be made in our advertising columns.

The price of the complete work has been placed at $58.30. This is much more than our subscribers have paid; but the edition is nearly exhausted and the price has been raised.

We would say for the benefit of those persons who are interested in diatoms that, on the occasion of a fire in our New York office two years ago, a considerable number of plates of the Synopsis were injured by water, so as to be unfit for sale in the complete sets. These injured plates belong to fascicle VI. We have several sets, almost complete, of the injured plates of this fascicle, which we will send to subscribers to the Journal for fifty cents, and ten cents additional for postage. They will be sent on approval on receipt of the amount.

——o——

Recent Progress in the Improvement of the Microscope.—The article on 'Microscopy' in Appleton's 'Annual Cyclopedia' for 1884, written by Dr. R. H. Ward, has already been mentioned in these columns. We have since received a proof copy from the author, which has been carefully read, with great interest. The author begins with the simple microscope, describing some of its forms, and the different kinds of supports useful for dissecting and other purposes. He then describes the modern form of stand, and says that there is now a distinctive American form of stand, differing from the English model formerly extensively copied in this country, and from the continental model. The American stands 'combine nearly all the simplicity and portability of the continental stands with nearly all the efficiency and scope of adaptations of the more ambitious English instruments.' As types he mentions the 'histological' stand of Mr. Bulloch as a 'very simple and inexpensive form yet efficient for a great variety

of scientific work,' and the Bausch & Lomb 'universal' as one of the more elaborate ones.

Among the improvements during the past six years are mentioned a broad body to receive oculars of wide field, the broad-gauge screw for objectives, short body with draw-tube, the Jackson model universally adopted, the pinion of the coarse adjustment high up on the limb, and the various improvements in the fine adjustment by various makers; the stage is round and revolves around the optic axis, and has various adjustments; the swinging substage and mirror-bar, moving independently or together; the various forms of concentric stands in which the body is supported on a sectoral limb, instead of swinging on trunnions.

We cannot mention all the improvements that should be included under this head. The new method of mounting the Wenham prism used by Messrs. Bausch & Lomb, and the Abbe binocular eye-piece, are notable improvements in the binocular. Improvements in objectives have been very great, and we cannot enter upon a notice of this part of the subject. We must not fail, however, to give the ideal series of objectives recommended by the author, which is as follows:—

Focus. Inches.	*Amateur.*	*Professional.*	*Expert.*
4	–	9°	12°
2	12°	–	–
1	–	25	30
$\frac{3}{4}$–$\frac{2}{3}$	35	–	–
$\frac{1}{2}$	–	–	–
$\frac{4}{10}$	–	110	75
$\frac{1}{4}$	–	–	–
$\frac{1}{5}$–$\frac{1}{6}$	140	–	140
$\frac{1}{8}$	–	n. a. 1.20	–
$\frac{1}{10}$	–	–	n. a. 1.40+

From this it will be seen that Dr. Ward favors moderation in regard to angular aperture.

Without extending this notice to undue length, we can only say that the author has covered the field well, and has given a very instructive as well as interesting account of improvement in microscopical appliances and methods. The result seems highly creditable to American ingenuity and skill. It shows that there is a constant demand for microscopes of the most perfect form, which has been an inducement to our makers to improve them until the American model has become the best.

——o——

James C. Lathrop.—Mr. James C. Lathrop, of Bridgeport, Conn., died on the thirty-first day of May, at the age of 33 years. Mr. Lathrop was well known to scientific men in the East, and was one of the most active members of the Bridgeport Scientific Society. As a mineralogist he was particularly well-informed; his collection of minerals is said to be the most complete in the State, all his specimens have been carefully selected, and many of them are among the finest of their kind. In other branches of science he was an enthusiastic student and teacher, whose influence was felt in the community. He was a good observer with the microscope, of which he made much use. For nearly twelve years he has been an accountant and cashier for the Housatonic Railroad Company.

It is seldom that a man in active business acquires such accurate and extended knowledge in science as Mr. Lathrop possessed. Naturally active and quick in thought and apprehension, by close application during the hours that could be spared from business and home duties he became a leader among his associates, and an example worthy of imitation. The few hours it was once our good fortune to spend at his home gave us an insight into his character and attainments, and we can best express our recognition of his worth by saying that the world can ill afford to lose the influence and example of such a man.

He has left a wife and four bright children, who, with many friends, will deeply feel their loss.

NOTES.

— Mr. Walmsley has become a liberal contributor of ingenious devices for photographers within the past year or two, and seems to be as much interested in amateur photography now as he has been in microscopy for many years. Walmsley's excelsior lantern is a new device for the dark room, which is much cheaper than some lanterns that are certainly not better. We also read of Walmsley's folding pocket lantern, phantom instantaneous shutter, instantograph shutter, adjustable view finder, alkaline developer, ready sensitized paper, and photo-micrographic camera.

— A most valuable article for the photographer, especially for those who have only occasionally to develop pictures, and therefore are likely to be annoyed by the deterioration of their solutions of pyrogallic acid by long keeping, is the preparation of pyrogallic acid in tablets, just called to mind by one of Mr. Walmsley's circulars. Each tablet contains two grains of the acid, which can be dissolved at the moment of use, and thus a fresh solution is always at hand, and there is no trouble about weighing.

— Some measurements of blood corpuscles have been made by Henry L. Tolman and Marshall D. Ewell, M. D., the results of which are recorded in *The Western Druggist*. Mr. Tolman worked with a Spencer homogeneous immersion $\frac{1}{10}$, n. a. 1.27, with an eye-piece micrometer in a ¾ inch ocular, the value of each division being $\frac{1}{2000}$ of an inch. Dr. Ewell used a Spencer $\frac{1}{10}$, n. a. 1.35, a Bausch & Lomb amplifier, a Bulloch cobweb micrometer, each division of which represented $\frac{1}{1000000}$ of an inch. The results are thus tabulated:

	Corpuscles.	*Largest.*	*Smallest.*	*Average.*
Tolman ...	50	$\frac{1}{2709}$	$\frac{1}{3522}$	$\frac{1}{3139}$
Ewell	25	$\frac{1}{2817}$	$\frac{1}{3521}$	$\frac{1}{3138}$

— It was stated by Mr. J. J. Coleman, in an address before the Philosophical Society of Glasgow, that microbes in animal flesh are not killed by the intense cold of — 86° c. According to experiments of his own and Prof. McKendrick, microbes alive before the freezing are again brought into activity by heat and moisture.

— *Hedwigia, Organ für Specielle Kryptogamen kunde nebst Repertoriuu für Kryptogamische Literatur*, begins its twenty-fourth volume, enlarged, and in a new dress. We are pleased to note this change, and trust that it will be met with substantial appreciation by students of the cryptogams. The first number of this year contains an important article on new species of the genus *Riccia*, by F. Stephani, illustrated by a plate. *Hedwigia* is edited by Dr. G. Winter, and is published in Dresden.

— A valuable report on the Purification of Drinking Water by Alum, by Professor P. T. Austin and F. A. Wilbur, has been issued from the chemical laboratory of Rutger's College. It has been found that the addition of about 1.5 grains of alum to a gallon of water will cause suspended matters to subside in the course of two days or more, leaving the supernatent water clear. For domestic use the water may then be filtered clear through a filter of cotton batting pressed into the neck of an inverted, bottomless bottle, a few minutes after the addition of alum. It is presumed, with good reason, that in this way not only are suspended matters removed from the water, but albuminoid and perhaps other organic matters are also precipitated, or at least rendered incapable of supporting the life of microbes. The quantity of alum required is not sufficient to be detected by taste, and, indeed, only the slightest trace of alumina could be detected by chemical tests in the water thus treated, after the sediment was removed. The method seems to be eminently practical.

— The annual reception of the San Francisco Microscopical Society was given on the evening of May 19th. Thirty-eight objects are named on the programme, one for each microscope. According to the report that has reached us the display of objects was very fine, Mr. Hyde being especially commended for the beautiful way he showed some diatoms *in situ* on a dark ground, Mr. Breckenfeld for crystals of kinate of quinia, Mr. Bates for his colony of vorticellas, and Mr. Banks for the display of the electric spark.

— We receive regularly reports of the meetings of the San Francisco Microscopical Society, which is now one of the most active of our societies. At a recent meeting Dr. J. H. Stallard demonstrated the method of cutting sections by freezing the tissues with ether spray. At a subsequent meeting Mr. Banks showed the electric spark under the microscope in its passage between the terminals of a quarter-inch spark induction coil attached to a Grenet bichromate solution battery. Two vulcanite slides had been prepared, on which were fastened adjustable platinum

strips connected with the battery wires and terminating in brushes of platinum wire of extreme tenuity. The electric fluid, in its passage from one terminal to the other, formed a very attractive object under the microscope. One of the slides was used to show the effect on the electric spark of interposing films of soot of different thicknesses. In its passage through these the current was deflected into meandering lines, around which scintillated showers of sparks. The particles of soot could be seen arranging themselves in symmetrical groupings around the terminals. In conclusion, Mr. Banks announced that he had sent for, and would soon be able to exhibit, the Stokes-Watson apparatus for showing under the microscope the combustion of various metals in the electric arc.

— There is a law of adaptation in nature which the naturalist, in whatever field he may be occupied, finds exemplified in many ways. Dr. W. Breitenbach, describing the small crustaceans which have their home on the floating islands of sea-weed of the Sargasso Sea, gives the following interesting account of them in *Popular Science Monthly* :—

'The adaptation of the innumerable tints to every grade of change in the color of the sea-weed is really marvellous. The younger, lighter green crustaceans are always to be found on the young, verdant fronds of the plant, while the older parts of the weed are inhabited by older, brown animals. The older stems are often incrusted with the white shells of bryozoa, and corresponding with these we are sure to find white spots on the brown armor of the crabs. The legs of the animals are frequently of an olive green ground with brownish spots, deceptively like the slender sea-weed leaves that are just beginning to turn brown. If one will, as I did, pull one of the large plants upon the deck, leave it in a cask of sea-water for an hour or two, and then look through it for crabs without disturbing it, he will find it very hard to discover three or four of the animals, although he may be sure there are a quarter of a hundred of them there; and, if he gives the mass a lively shake, he will find a curious assemblage of the most varied sorts tumbling off the bush, whose behavior will go far to verify Wagner's view; for, if they are allowed the opportunity, they will all swim back to the sea-weed, and each will seek a part of the plant most like it in color. I tried the experiment forty or fifty times, and never saw a little green crab settle on a dark-brown stem. The crustaceans keep to their color, and the brown ones will, with amazing speed, dart through the thick net-work of stems and leaves, to the darkest spot they can find, where they quickly escape observation.'

— The Portland (Me.) Society of Natural History gave a microscopical exhibition on the evening of April 27th, a programme of which we are pleased to acknowledge. There are twenty-six microscopes on the list, and two objects for each. The society was incorporated in 1850, and is therefore among the older scientific organizations of the country.

CORRESPONDENCE.

Volvox Globator.

To the Editor :—After searching nearly every pond and pool in the vicinity of Washington for *Volvox*, I found plenty and fine specimens in the heart of the city. During a drenching rain today, I made a gathering from the pond spanned by the bridge running from Center Market to Pennsylvania Avenue, and among other strange specimens was the long-sought *Volvox*. I believe I am the first to find *Volvox* in the District.

H. A. Dobson, M. D.

May 29th, 1885.

NOTICES OF BOOKS.

First Annual Report of the Bureau of Animal Industry for the year 1884. Washington: Government Printing Office. (8vo, pp. 512.)

This valuable report is a detailed account of the investigations and general work under the direction of D. E. Salmon, D.V.M., chief of the Bureau. It contains so much that is of importance and interest that we shall not attempt a review in this place. The outbreak of pleuro-pneumonia in the West has afforded an opportunity to study some features of this disease, and especially to establish beyond question the fact of its contagious nature. A brief review of the evidence concerning the cause of the disease known as swine-plague, which Dr. Salmon's investigations have shown to be a micrococcus, is given, illustrated by two photo-micrographs. An article on the Gape Disease of Fowls, by M. P. Meguin, is translated by Dr. Theobald Smith, accompanied by a plate

showing the parasite causing the disease, *Syngamus trachealis* v. Siebold. Finally, there is a comprehensive report on Trichinaisis, by Dr. Salmon. We have been obliged to pass over other important subjects without notice, but this much will be a slight indication of the activity, efficiency, and importance of the newly-established Bureau of Animal Industry.

Report of the Commissioner of Agriculture for the year 1884. Washington: Government Printing Office. 1884. (8vo, pp. 580.)

The investigations constantly in progress in the Department of Agriculture make the annual reports of no little scientific as well as economic interest. In this volume the report of the chemist, H. W. Wiley, treats of sugar manufacture, milk and butter, their analysis and adulterations, the manufacture of flour, and other matters. The report of the botanist, Dr. Geo. Vasey, is illustrated by twenty-one plates, showing various plants. Dr. C. V. Riley's report as entomologist covers 134 pages and ten plates. It includes an account of the rust-mite of oranges, the cabbage cut-worm, and other insects.

Science and the Supernatural. A lecture by Prof. A. J. Du Bois, of the Sheffield Scientific School of Yale College, before the Bridgeport Scientific Society. 1885.

A lecture full of sound reasoning, clear and thoughtful, which should be read by those who have an interest in this subject. One may not be quite satisfied with the method of treatment, yet there is much food for thought in it.

The Oleates. An Investigation into their Nature and Action. By John V. Shoemaker, A.M., M.D., Lecturer on Dermatology at the Jefferson Medical College; Physician to the Philadelphia Hospital for Skin Diseases; Member of the Pennsylvania State Medical Society; the Minnesota State Medical Society; the American Medical Association; the American Academy of Medicine; the British Medical Association; Fellow of the Medical Society of London, etc. Philadelphia: F. A. Davis, Att'y, 1217 Filbert St. 1885. (12mo, pp. 122.)

A very useful book for the medical practitioner. Oleates, according to the author's experiments, are superior to other ointments, in that their active constituents enter the minute openings of the glands and follicles on account of being dissolved in the fatty base and vehicle. The oleates are not absorbed and taken up by the lymphatics and conveyed to the blood, as ordinarily supposed. They do not penetrate deeper than the glands of the epidermis. The work treats of their manufacture, and their physiological and therapeutical effects.

Manipulation of the Microscope. By Edward Bausch. Illustrated. Published by Bausch & Lomb Optical Co. Rochester, N. Y.: Post-Express Book and Job Printing-House. 1885. (12mo, pp. 96).

This is a thoroughly practical and instructive book, very neatly printed, and for the beginner in microscopy there is nothing better. Those who have become familiar with microscopic work will find it not unprofitable reading. We are greatly pleased with the plan and systematic arrangement, as well as the concise and plain manner of treating the subject. There is nothing to criticise in these respects. The information given is just what a beginner needs. We are not quite sure, however, that the statement on page 20, 'Other things being equal, it is the angular aperture of an objective which determines the quality,' will convey the right impression. There are just grounds for the impression that an excessive angular aperture does not improve an objective; and we would say, for instance, that the half inch of 98° mentioned on page 30 would not be the best kind of a half inch. The fact is very easily demonstrated by taking a photograph of such an object as a half inch would ordinarily be used upon—some minute polycystina, for example—with such an objective, and another photograph of the same object, using the same objective with the angular aperture cut down to 30° or 40° by a paper diaphragm.

The book is one which we shall be glad to recommend to all beginners in microscopy, and to intending purchasers.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted: Well cleaned and selected Foraminifera, for which cash will be paid or slides given.
EDWARD G. DAY,
Riverside, Conn.

Hundreds of varieties of fresh-water Algæ, including Volvox, Desmids, Rivularia, Draparnaldia, Tetraspora, &c., &c., for selected exchanges by list.
J. M. ADAMS,
Watertown, Md.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., AUGUST, 1885. No. 8.

A Practical Method of Finding the Optical Centre of an Objective, and its Focal Length.

BY PROF. W. F. DURAND, ASSISTANT ENGINEER U. S. NAVY.

The term optical centre, as usually defined in the text-books on optics, is that point in a lens through which if a ray pass, it enters and emerges in parallel lines. This definition will not exactly suit the point referred to in the following article, and it may be well to show exactly what is meant by the term.

In the diagram (Fig. 21) let $a\ b$ be an object. Then it is simply a matter of experiment to show that in some way the rays radiating from a, for example, are brought to a focus at some point a' on the opposite side of the centre line, and at a distance from it depending on the distances of a from the centre line, and from the objective. Likewise the rays radiating from b are brought to a focus at b', and thus is formed the inverted real image $a'\ b'$. Suppose that a and a' be joined with a straight line, and likewise b and b'. Without attending at all to the actual course of the rays, which, in an objective of two, three, or four systems is very complex, it is evident that $a\ o\ b$ and $a'\ o\ b'$ are similar triangles, and that we have

$$\frac{a'\ b'}{a\ b} = \frac{a'\ o}{o\ a} = \frac{c'\ o}{o\ c}.$$

Now, $\frac{a'\ b'}{a\ b}$ is evidently magnification, and by the equation this equals $\frac{c'\ o}{o\ c}$. That is, the magnification equals the ratio of the distance of the image from a certain point, o, to that of the object from the same point. If the position of o be known, it is evidently an easy matter to find the magnification when the positions of c and c' are known. Furthermore, if we wish to adopt the 10-inch standard for the vague quantity called tube length, o is evidently the point from which to start, and in this case we have $c'\ o = 10$ inches, and the magnification equals $\frac{10}{c\ o}$.

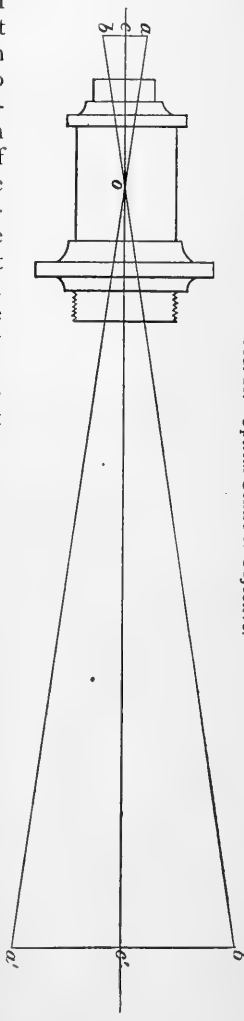


FIG. 21.—Optical Centre of Objective.

Now, this point o possessing the foregoing properties is the point which, for want of a better name, is here designated the optical centre of the objective. It is near, but does not coincide with the point answering the definition in the text-books.

If $c\ o$ can be determined, and from that the distance from c to the front of the objective (the working distance) be taken, o will be determined with reference to the front of the objective and its position definitely fixed. Now to find $c\ o$ we recur to the equation above.

$$\frac{a'\ b'}{a\ b} = \frac{c'\ o}{o\ c},$$

and by adding one to each side we have—

$$\frac{a'\ b'}{a\ b} + 1 = \frac{c'\ o}{c\ o} + 1;$$

$$\text{or, } \frac{a'\ b' + a\ b}{a\ b} = \frac{c'\ o + c\ o}{c\ o} = \frac{c\ c'}{c\ o};$$

$$\text{or, } c\ o = \frac{c\ c' \times a\ b}{a'\ b' + a\ b}.$$

Now, $c\ c'$, $a\ b$, and $a'\ b'$ are quantities which may practically be measured, and thus a definite value of $c\ o$ is obtained, and from that o is fixed.

Now, theory leads us to expect what experiment bears out, viz., that as the position of $a\ b$ varies, and with it that of $a'\ b'$, the point o does not remain quite stationary. In some objectives it moves slowly back as the object is approached to the objective, and in others slightly nearer the front. But since we wish to have o determined when $c'\ o = 10$ inches, that calls for one definite, fixed position of $a\ b$, and for a fixed value of the distance $c\ o$. But $c\ o$ cannot be fixed unless both c and o be known; that is, unless o be already known. It would, then, appear that the problem is impossible since it calls for the result as a necessary condition to the solution. This is true, strictly speaking, but, practically, as close an approximation as may be desired is readily attainable.

The change in o for a change of an inch or two in $a'\ b'$ will be probably less than the one hundredth of an inch, so that if the lengths be so adjusted that $c\ c'$ equals about 10 inches plus the focal length of the objective, the distance $c'\ o$ will come out differing from 10 inches by less than an inch, and, probably, by less than a tenth of an inch, and o will be as accurately determined as ordinary measurements are made. If, however, greater accuracy is desired, the lengths may be readjusted so that from the determined position of o to c' shall be 10 inches. Then, making the measurements again, a new value is found for $c\ o$, which will differ slightly from the first one, and be a still closer approximation. The position of o found from this value of $c\ o$ will differ from its true position when $c'\ o$ is 10 inches, by less than one thousandth of an inch, probably, which is far within the limit of error in such measurements.

So much for the theory. In the practical application, a stage micrometer is placed in position, and one of its divisions serves for $a\ b$. The eye-piece is removed, the tube placed vertical, and a screen of ground glass or thin oiled paper is placed over the end of the tube on which to receive the image $a'\ b'$.

Let us suppose that the objective to be measured is one rated as a $\frac{3}{4}$-inch; then bring roughly to a focus, and next adjust the draw-tube until the distance from micrometer to screen is $10\frac{3}{4}$ inches within, say, an eighth or a tenth of an inch. Then focus carefully until the lines are distinctly defined on the screen. Then measure the distance from the micrometer to the screen or $c\ c'$. This is found, we will suppose, to be 10.84 inches. Next, measure the value of a division on the screen. To do this as accurately as possible, measure the length of as many divisions as can be seen, and divide by the number. This will divide, by the same number, the error in making the single measurement. This gives $a'\ b'$, which in the case we have supposed equals .1125 inch. The value of $a\ b$, that is, of a division on the micrometer, is .01 inch.

Hence we have, making the proper substitutions,

$$c\ o = \frac{10.84 \times .01}{.1225} = .885-.$$

Taking this from 10.84 we find $c'\ o = 9.925+$. Next, measuring the work-

ing distance, it is found to be .295. Taking this from .885 gives .59 as the distance of o back of the front of the objective. This position corresponds to a value of $c' o = 9.925$ inches, which differs from 10 by .075 inch. Now, if greater accuracy is desired, readjust the draw-tube so that the screen shall be at 10.59 inches from the front of the objective; that is, at 10 inches from the determined position of o. Now, repeating the measurements, we find $c c' = 10.883$ and $a' b' = .113$;

$$\text{hence, } c\ o = \frac{10.883 \times .01}{.123} = .8848,$$

and $c' o = 10.883 - .8848 = 9.9982$.

This differs from 10 inches by .0018—a quantity unappreciable in such measurements. Taking again the working distance, we find it to be .293 inch, which, taken from $c\ o$, gives .5918 inch as the corrected distance of o from the front of the objective. This may safely be taken as the desired position, correct within the usual observational error in such work. As may readily be seen, an attempt at a recorrection of this might be made in the same way that this was corrected from the first; but the errors of observation would probably be greater than the proper correction, so that such observations would possess no additional weight.

The magnification, as above stated, equals $\frac{10}{c\ o}$, equals, in this case, $\frac{10}{.8848} = 11.3$, though this has been found previously by the actual measurement of $a' b'$ compared with $a\ b$.

It may be of interest to compare this result with those derived from some of the other formulæ in use as approximations. First, there is the common rule, 'Divide 10 inches by the focal length of the objective' or $\frac{10}{\frac{3}{4}} = 13\frac{1}{3}$. This rule assumes that the objective is exactly a $\frac{3}{4}$, and that the object is placed at the principal focal distance from the centre, in order to form an image at 10 inches distance. The first assumption may or may not be true, as objectives often differ considerably from their rated values. The second is inaccurate, as the distance is always greater than the principal focal distance.

Next, there is the formula $m = \frac{10 - f}{f}$, or, in this case, $m = \frac{10 - \frac{3}{4}}{\frac{3}{4}} = 12\frac{1}{3}$.

This assumes the rating of the objective to be correct, and makes use of the formula $\frac{1}{f} + \frac{1}{f'} = \frac{1}{r}$, which is only approximately correct.

Another method proposed is to measure the distance 10 inches from the front of the objective, and then to measure by a screen the magnified divisions of the micrometer. Performing these operations, we find in this case $m = 10.55$. This method will always give a result too small, and varying with objectives of the same focal length coming from different makers.

Next, as to the rating of the objective. This is usually defined as the principal focal length of a simple lens, which, under the same circumstances, would produce the same magnification. That is, it is the principal focal length of a double convex lens of equal curvature on each face, such that if substituted for the objective, and so placed that the distance from the image to the centre of the lens is the same as that between the image and optical centre of the objective, the magnification will be the same as that produced by the objective. The principal focal length of such a simple lens depends, however, on four elements: 1st, the radius of curvature of the faces; 2d, the refractive index of the material of which it is made; 3d, the thickness of glass traversed by the ray; 4th, the distance from the principal optical axis to the parallel ray. Within the limits for ordinary glass lenses, however these elements may vary, the principal focal length is not far from

the radius of curvature, but only equal to it under special circumstances. If, then, a comparison with such a lens were necessary in order to find the rating of an objective, there would need to be established a standard to which the last three elements above should conform; the variation in such standard lenses being only in radius of curvature. Of course such a system of lenses is out of the question, and some other method is necessary. The principal focal length might be measured practically but for the trouble in carrying out some of the details. It would be the distance from the optical centre for parallel rays to the point where they are brought to a focus. The first we do not know exactly, and cannot find in the same way as its position for diverging rays. The second calls for personal judgment on just when parallel rays are at a focus, which will admit of a slight variation on either side of the true position. Furthermore, the short working distances of higher powers would prevent the spot of light from being readily observed.

The function of focal length in general is to determine magnifying power, and, for all purposes of comparison, it seems but natural and just to base the rating on magnifying power, and on that alone. Such being the case, opticians seem to have generally come to use for such purposes what is virtually a kind of hypothetical lens possessing such properties that the common formula $\frac{1}{f} + \frac{1}{f'} = \frac{1}{r}$ holds exactly for it. It may be said, in passing, that in such a lens the thickness of the material would be entirely unappreciable in comparison with its radius of curvature, and the index of refraction of the material would be 1.5.

Such being the hypothetical standard, the formula above holds exactly, and solving for f we have $f = \frac{f' r}{f' - r}$. If, now, f represents $c\,o$ in the figure above, f' will represent $c'\,o = 10$ inches. Therefore, we have

$$f = c\,o = \frac{10\,r}{10 - r}.$$

But magnification equals $\frac{10}{c\,o}$; and substituting for $c\,o$ its value we have $\frac{10}{c\,o} = m = \frac{10 - r}{r}$, or $m = \frac{10}{r} - 1$, or $m + 1 = \frac{10}{r}$, or $r = \frac{10}{m + 1}$. That is, the principal focal length of such a hypothetical lens as would produce the same magnification as the objective under the same circumstances equals 10 divided by one plus the magnification of the objective: and this is taken as the rating. As seen, it depends entirely on magnification under a standard set of conditions, and cannot but be fair as a means of comparison between objectives of various powers from the same or different makers.

Applying this rule to the example above, we have

$$r = \frac{10}{11.3 + 1} = \frac{10}{12.3} = .812.$$

This objective, on this method of rating, then, would rather be called an eight-tenths than a three-quarters, and a variation from the true value as large or larger than this will often be found.

If the objective has collar adjustment the optical centre and equivalent focal length vary with the position of the collar, so that if an exact knowledge of them is desired for any given position of the collar the operations must be performed with it in such position.

An idea of the range of power is, of course, obtained by taking it at the uncovered and extreme covered points; and these, with one or two intermediate positions, would probably give a sufficiently extensive knowledge of the powers of the objective.

In closing, it may be well to notice that the above method of measurement provides a practical way of using the 10-inch tube length. This term

tube length is, perhaps, in itself open to objection, for it seems to indicate that the 10 inches must be measured from some point in the objective to some other point in or about the eye-piece or tube. A correct understanding of the matter would seem to indicate that the tube is of such a length that when the eye-piece is in position it brings to a proper focus for the eye the rays coming from the objective, which alone would form an image at 10 inches distance from its optical centre. In other words, standard conditions should mean that the objective is at such a distance from the object that, alone, it would form an image at the 10-inch distance from the optical centre; and the draw-tube so arranged that the eye-piece brings such rays to a proper focus for the eye.

To practically arrange the length to conform to these principles, take the tube in the position in which it was left after finishing the final measurements for the optical centre, and focus again carefully so that the image is clear on the screen. Then remove it and put in the eye-piece. If the object is clearly seen, no further adjustment is necessary. If not, hold firmly the coarse adjustment and adjust the draw-tube until the object is properly focussed. A mark on the tube or a note of the length drawn out fixes the position for this eye-piece. For another it will probably be somewhat different. Now, under such conditions, when the tube, carrying objective, eye-piece, and all, is focussed up and down in the usual way, the objects brought into view are at the same constant distance from the objective, so that their images by the objective alone would be formed at the constant standard distance of 10 inches from its optical centre.

These remarks of course apply principally to the higher powers not furnished with correction collar, where a constant set of conditions is very desirable. Light, thickness of cover, mounting medium, etc., of course constitute part of the conditions under which an objective is used, but, supposing these constant, we are here only concerned with the relative positions of object, objective, and eye-piece. These may be more or less widely departed from by the expert microscopist in order to balance some other unusual conditions, such as an extra thick or extra thin cover glass, some peculiarity in eye-piece or mounting medium, &c. But, aside from these, it would seem desirable to have some general method of using an objective under constant conditions, so that the interpretation of its appearances being once understood, the same principles may be always applied in future cases.

——o——

Diatoms of the Gulf.

BY J. D. COX, LL. D., F. R. M. S.

Scientific students, and especially those who are interested in the investigation of the diatoms, will, we are sure, take pleasure in the narrative of the work done by a trio of enthusiastic students in Mobile. These gentlemen are Messrs. K. M. Cunningham, W. S. McNeill, and G. H. Taylor. Neither of them is a professional botanist, all have other employments to which their ordinary working hours must be given, yet they have laid the students of the diatoms under such obligation to them that a recognition of the value of labors such as theirs is no more than their just due. The last named of these gentlemen is a surgeon dentist; Captain McNeill, formerly of the Confederate army, is the recent commissioner of Alabama to the New Orleans Exposition, and Mr. Cunningham is engaged in railway business.

In the summer of 1878 Mr. Cunningham accidentally became acquainted with Prof. Bailey's papers upon the Atlantic and Gulf diatoms in the Smithsonian 'Contributions,' and a zeal for research was thus awakened. He began a somewhat systematic examination of the region about Mobile for crude diatomaceous material, both

fossil and recent, and by exchanges collected a largely extended variety of material for work. He also made some investigation of the mud of Mobile harbor, but his first gatherings were not promising.

After a time, however, his patience was rewarded by the arrival of a vessel from Tampa bay, and upon its chain cables a considerable quantity of the Tampa bay mud was found. Joined at this time by Captain McNeill, both supplied themselves with the material, and Captain McNeill especially applied himself to the task of cleaning it and of studying the best methods of treating it. To this he devoted great patience and labor, with ultimate complete success. Mr. Cunningham continued to devote himself more particularly to the search for crude material in different directions.

Dr. Taylor early joined the two others, and devoted himself to the search for diatomaceous material in Mobile harbor, afterwards extending his researches to other harbors of the Gulf. His methods are presented in a paper published in this number of the JOURNAL, and will be found to contain many points of interest and some of decided novelty. His reliance upon thoroughly 'water-washing' his material, and 'sanding,' *i. e.*, taking the sand out of it, are lessons of experience of a very valuable kind. Even the most valuable muds were found very unpromising at first, and no German laboratory worker could excel in patience the persistent and careful manipulations to which Dr. Taylor resorted. To eliminate from the material everything which water alone would dissolve or hold in prolonged suspension was the first principle. It was followed out in almost innumerable washings, one following the other in indefatigable succession. The washing water was in large quantities, and the process pushed till his experience taught him that nothing more could be accomplished in that way.

Then came the 'sanding,' a process not new in itself, but applied with new and peculiar persistence. The material, in a shallow dish, being agitated gently and with a circular motion, the sand accumulates in a little heap, and the diatoms, in a watery cloud, can be tilted away from the coarser material, and drawn off with bulb pipettes or similar instruments.

The secret is to do this again and again until the separation is really complete. The result is not simply to prepare the material for the final acid cleaning. It is worth the trouble for this purpose, but it has the further and greater advantage of furnishing material so 'water-washed' and concentrated that it is prepared for easy and satisfactory study before acids have touched it. No real student of the Diatomaceæ will fail to see that in this condition it is material of the greatest use and most profitable examination. Frustules are whole, filaments are complete, the tissues soluble in or destroyed by acids are left intact.

These Mobile investigators have pushed their examinations east and west along the Gulf coast. Their Pensacola material was communicated to Mr. Peticolas, of Richmond, and is put by him within the reach of students generally. They early shared their treasures with numerous naturalists of the country, among others with Mr. Mallory, of Utica, and Mr. Van Brunt, of New York. They cannot, of course, answer all the calls that may be made upon them, but we hope they may be induced to take steps which will put their prepared material within the reach of those who will see that an ample supply of slides may he easily attainable. As to the special steps found useful in the acid cleaning, Dr. Taylor's paper speaks for itself, and will be found worthy of a careful reading. He found the need of modifying so many of the steps commonly prescribed in our treatises on the subject, and so patiently and carefully worked out every experiment of his own to successful results that the

record of his work is valuable not only for its perfected methods, but as an example of indomitable will and patience in investigation.

During the present season he has cleaned a considerable quantity of new material, and has generously arranged to put it in the hands of Mr. Vorce to add to the interest of the 'working session' of the American Society of Microscopists at the Cleveland meeting, and to supply members with samples.

—o—

Cleaning Marine Muds.

BY DR. GEO. H. TAYLOR.

Let us suppose the material comes to us from anchors of vessels in hard, dry lumps. The first step is to disintegrate these lumps in water. My method is to place a lump in a bucket or large basin of water, and let it remain for several days, until it is soft enough to break up with the fingers. I then place the material in a dish, fill with water, and thoroughly stir the whole, then allow it to settle for fifteen minutes, and pour off the top. I repeat this until the top water becomes clear. If this is thoroughly done it will consume the best part of a week. The next step is to place the whole mass in a shallow dish or pan, fill it with water, stir the mass up thoroughly, and pour off the top into another vessel, repeating this process until nothing remains but the sand and mollusc shells. This is thrown away and the material poured back again into the shallow dish and 'sanded' as before. This process is repeated until there is no longer a deposit of sand, then place the material in an evaporating dish, cover with water, and with a movement of the arm in a circle revolve the dish gently, when the sand will ball up in the centre of the dish. Pour off the top, and throw away the sand. Repeat this operation until satisfied all the heavy sand has been removed. The material is now ready for the acid, but before applying acid it must be dried. To obtain the best results, the best method is to let the water evaporate in the sun.

When the evaporation has taken place, transfer the material to a porcelain dish, pour nitric acid in with a free hand, and boil thoroughly, until all fuming has ceased; allow to cool, and wash thoroughly; again dry, and cover thoroughly with sulphuric acid, and boil until the fumes cease, then throw in pulverized bichromate of potash, little at a time, until the color changes; boil in sulphuric acid about ten minutes. Allow the material to cool thoroughly and pour into a large vessel of pure water, allowing it to settle thoroughly before drawing off the top water—about ten or fifteen minutes; repeat this washing until all traces of the acid are removed; when this is accomplished, the former process of sanding must be repeated. Keep this up until satisfied nothing more can be done in this way. The next step is to place the material in the porcelain boiling dish, add water until the dish is about two-thirds full, place over the fire, and, just before the boiling point is reached, throw in a stick of caustic potash about half an inch long, and let it boil thoroughly for four or five minutes, stirring from time to time. Pour this while hot into a large glass vessel, and let it settle for about one or two minutes—the appearance will determine the length of time necessary; draw off the top portion carefully and throw it away; the remainder must now be placed in a small bottle filled two-thirds with water, cork the bottle tightly, and shake vigorously, allow to settle ten minutes, then draw off the water; continue this process two days; then sand again by the rotary movement in the evaporating dish.

There must now be procured from a photographer two of the glasses used by them for embossed pictures, one large and one small, also from any drug-store one or two drop-tubes, with rubber bulbs. Now pour a little of the material upon the large

glass, and gently move it from side to side, which will cause the sand to settle; slant the glass toward one corner, and draw off with the pipette and place in the bottle; add more water to the glass and draw off as before, until nothing but sand and spicules remain; repeat this process five or six times with the small glass. The material is now placed in the shaking bottle, and a few drops of ammonia added. Shake vigorously two or three minutes, allow to settle, draw off carefully, and repeat this process ten times. Sand again by means of the embossing glasses, and the work is finished.

In this work everything depends on the thoroughness of the sanding and the faithful manner in which the shaking is performed. The shaking is, next to sanding, the most important part.

In regard to the acid treatment, I may say that good results can be produced by either nitric, sulphuric, or muriatic acid, but muriatic acid should never be poured into sulphuric without great caution, for it will boil over. Muriatic acid by itself produces good results. So also does nitric acid, but I have found the best results are obtained by the use of the nitric acid, followed by the sulphuric. It does no harm to boil again in nitric; this must be done if the sulphuric acid is not thoroughly washed out, otherwise crystals would form on the glass.

The best stand I have ever seen for holding the boiling dish is a tin-can procured from any drug-store, with a tin top; it is about ten inches high by about six inches broad. Cut a hole through the top to fit the dish, then cut a door large enough for the lamp to be placed through, one or two air holes near the top, and it is ready for work.

I use a dentist's chip-blower to draw the water out of my shaking bottle, and would advise others to do the same, as it saves many valuable forms from being poured off when decanting. My shaking bottles are about four-ounce vials, or vials that the tube of the chip-blower will easily reach the bottom.

In regard to my experience with Mobile Bay mud, I will only say that I took soundings every half mile for twelve miles in one way, and for thirty miles in another, and obtained samples of mud from any and every point I possibly could. I worked for more than a year before I found any forms except those that were worthless. My first find was from a dredge boat, seventeen and a half miles from the city. I had only a small hand full of this material. So I eagerly sought for more, but, alas! the dredge sank during a gale, and I was unable to procure any more for months. I next found good forms in mud from the bay one half mile from Fort Morgan. Again I obtained fine results from Lower Dog River Bar; I obtained this material by means of a tug-boat. I found a few good forms in Heron Bay, a small bay which makes into an island situated in Mobile Bay. The Pensacola material was procured for me by means of a row-boat, about one mile from Pensacola.

I do not like to speak of my trials and failures in working Mobile Bay muds, because when I look back upon them I am almost tempted to disbelieve myself. Suffice it to say I spent eighteen months on this one deposit without reward. Many a night have I sat up watching my bottles, which were placed between two lamps on the chimney-piece. I can remember my delight when, after a week's work, I would discover a single form, perhaps two, surrounded by a mass of sand; and such sand! I dreamt about that sand, fought with it, but for eighteen months it was my master. This long work, without success, taught me the lesson of patience, and finally resulted in my success. I declared war against the sand and tried to master it by watching the settlings, but in vain, until I adopted the plan

of fighting it from the moment the raw material came into my hands; then; and not till then, did I receive my reward. To give an idea of how poor the material is in its original condition, I will state that the amount contained in a homeopathic vial a quarter of an inch deep cannot be procured from less than one quart of the raw material.

—o—

Fasoldt's Detaching Nose-Piece.

The device of Mr. Charles Fasoldt for rapidly changing objectives, which is illustrated in Fig. 22, has already become very popular. It is an ingenious device, and it is said to be quite accurate in centring the lens. The method of operating it is easily understood from the figure. As will be seen, the device screws into the nose-piece of the microscope, and is adjusted in any desired position by means of a collar provided for the purpose. The objective is held securely by a spring working against the lever. The society-screw in the nose-piece is in three segments—one on the movable piece connected with the lever, the other two on the opposite side of the nose-piece. The objective should be marked so that it can always be put in with the screw-thread in the right position. The maker gives the following instructions for using the device:—'Take the objective in the right hand, between the first and second fingers, as represented in the cut, place it in the nose-piece, then let go the lever with left-hand finger, and turn the objective to its resting place. The objective should be turned back one-eighth of a turn, and a black mark made on it, which should stand between the fingers as a guide, when the objective is put into nose-piece. Then it will invariably require only one-eighth of a turn to bring it home.' If the objective is put in just right it will not require to be turned. This nose-piece has been very highly spoken of by those who have used it. We have given it a trial and

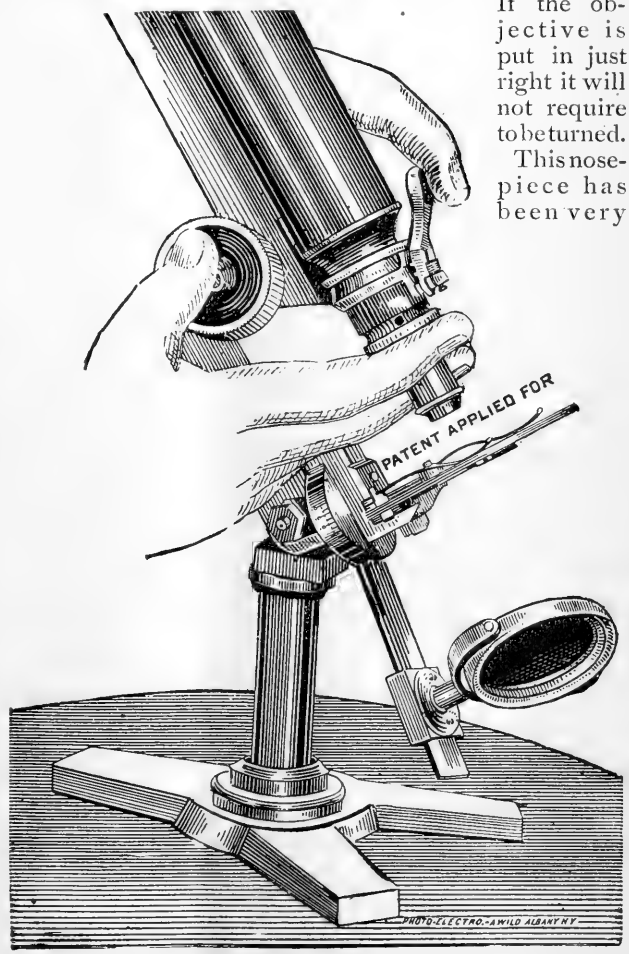


FIG. 22.—Fasoldt's Detaching Nose-piece.

can commend it, for convenience and rapidity of action, in the highest terms.

——o——

Measurement of Blood Corpuscles.*

For some time past I have been endeavoring, for my own satisfaction, to determine whether there is a constant average size of the human red blood corpuscles, with the view ultimately to determine whether it is possible, by means of micrometric measurements, to distinguish human blood from the blood of domestic animals.

In order that the results arrived at may be compared with those of other observers, I think it proper to state at the outset the methods and instruments employed.

The first requisite is obviously a correct standard of length, and the accurate determination of the value of the eye-piece micrometer used. This preliminary work has engaged much of my time and attention for several months past, and I have finally succeeded in obtaining two very accurate standards. The one of these which has been used as the standard of the measurements hereinafter given consists of lines ruled by Prof. W. A. Rogers, of Cambridge, Massachusetts (who is recognized as the highest authority upon questions of this sort), upon speculum metal at intervals of 1-2000 inch. The relative and absolute corrections of this standard have been determined by Prof. Rogers with very great accuracy, and the value of a division of the eye-piece micrometer described below was determined by taking an arithmetical mean of a long series of measurements of different intervals of 1-2000 inch, so as to eliminate as nearly as possible all errors of graduation and of measurement, and the value of one division of the micrometer was thus found to be .0000009925 or, approximately, 1-1000000 inch. The stand used, with mechanical stage and Abbe condenser, was made by Mr. Walter H. Bulloch, of this city, and is of the pattern styled by him the 'biological stand.'

The actual tube length was 8.91 inches from end of nose-piece to upper end of draw-tube.

The cob-web eye-piece micrometer used was also made by Mr. Bulloch, the pitch of the screw being $\frac{1}{2}$ millimeter, and the micrometer head being divided into 200 parts, which were read to 1-10 of a division.

The objective used was a homogeneous immersion 1-10, made by H. R. Spencer, of Geneva, N. Y., having a numerical aperture of 1.35, and it was used with a Bausch & Lomb achromatic amplifier, giving an amplification of about 1,500 diameters. The immersion fluid used was Prof. Smith's new homogeneous immersion fluid, the composition of which he has not yet made public.

The blood was drawn from my finger, and a thin film spread with a needle upon the side of a cover-glass from .150 to .165 of a millimeter in thickness, and examined at once, a fresh sample being used upon each occasion. It was examined with central illumination, and always under as nearly the same conditions as possible. During the first four days of the examination, I took, night and morning, about one drachm of the elixir of calisaya, iron, and strychnia; during the rest of the time no drug was taken, and the conditions were nearly identical each evening. From 25 to 100 corpuscles were examined each evening, and I have tabulated the results, giving the smallest, largest, and average size, in millionths of an inch, of each 25 corpuscles; also the average of each 50, 75, 100, and 200 corpuscles. The corpuscles were measured, large and small, as they presented themselves in the field of the microscope, the only condition being that they should be approximately circular.

[The tabular statement of results is omitted, as the summary given below is quite sufficient.—Ed.]

* From advance proofs of the *Chicago Legal News*.

An examination of the above figures shows that the difference between the greatest and smallest averages of 25 corpuscles is .000028 or 1-35714 inch, a magnitude that may be easily measured by any person having the requisite skill and apparatus.

The difference between the highest and lowest averages of 50 corpuscles is .000015 or 1-66666 inch, which approaches more nearly the limit of micrometric measurement, though probably not beyond it.

The difference between the highest and lowest averages of 75 corpuscles is .000012 or 1-83333 inch, which approximates the limit of micrometric measurement.

The difference between the highest and lowest averages of 100 corpuscles is .000009 or 1-111111 inch, which is within the limits of personal and instrumental error, according to the highest living authority upon this subject, who writes, in substance, that it is easy to measure 1-50000 inch, but to be sure of 1-100000 inch is not possible.

The conclusion to be deduced from the above figures is obviously that, when a sufficient number of corpuscles are measured, there appears to be an average size which varies within very narrow limits, which may possibly be accounted for or at least is consistent with personal and instrumental errors; for though I have carried out the figures to the sixth decimal place, I have not the presumption to declare that the results can be relied upon farther than the fifth place, and have carried out the figures to the sixth only to insure accuracy in the fifth so far as possible. Another conclusion is, that granting for the moment that it is possible to identify blood by measurements of the red corpuscles, of which I am by no means satisfied, it is reckless in the last degree, if not criminal, to express an opinion upon the measurement of less than 100 corpuscles. To express an opinion upon the measurement of only 10 corpuscles, as I am informed has been done in this section within the last year or two, to take the most charitable view of the subject, betrays such culpable ignorance of a subject involving such momentous consequences as ought forever to invalidate the testimony of one who should swear so recklessly. In a case involving the issue of life and death it would be better to measure several hundred corpuscles.

An examination of the unabridged table of measurements, from which the above summary is tabulated, discloses the further fact, that by selecting the corpuscles it would be possible for a dishonest observer to make the average much larger or smaller than that above given, without the possibility of detection; a fact, the bearing of which upon the value of expert testimony upon this subject is so obvious as to need no comment.

It will be seen that I have not attempted to draw any inference as to the cause of the larger average size of the corpuscles first measured. Whether it was or not due to the drugs exhibited during the beginning of this work, is an interesting subject of inquiry, which must be reserved for future examination. I expect to continue these investigations, and at some future day will publish the results.

MARSHALL D. EWELL, M. D.
CHICAGO, July 22, 1885.

—o—

Conjugation of Rhabdonema.

In a late number of the *Journal* of the Quekett Microscopical Club Mr. T. H. Buffam has described some newly-observed phenomena in the conjugation of the diatom *Rhabdonema arcuatum*, that are of great interest. It is not possible to do full justice to the subject without the plate, but an account of the phenomena observed may prove of interest to the reader.

The diatom grows in ribbon-like filaments on marine algæ, the breadth varying from three to nine times the

thickness. The author distinguishes the male and female frustules by their size and manner of growth, the former being small (.00156 inch in length), delicate, with a relatively small amount of endochrome, which is arranged about the nucleus in a roughly stellate manner. These frustules, attached by their corners, grow in a zigzag chain.

The female frustules are but slightly larger (.00188 inch), but are distinguished by numerous annuli and a large hoop in the middle.

In conjugation the male frustules attach themselves to the female, at or near the free end of a filament; usually four males are found on one female, but as many as eight have been observed. It would appear that the male filament breaks up and the individual frustules make their way to the female, and there attach themselves by their corners.

It now appears that the terminal half of the female frustule falls away, leaving the cell open. A gelatinous secretion closes it again. In some way, not very clearly explained in the article, the contents of the male frustule pass into the female cell. Being thus fertilized, the contents become surrounded with a thick, gelatinous secretion and form a large sporangium outside of the frustule. Either one or two sporangia may be formed from a single frustule. It is suggested that if the nucleus has divided just before fertilization there will be two sporangia, otherwise only one.

Within the clear sporangium a new frustule is produced, about three times the length of the original female cell.

The conjugation of diatoms is a process deserving of very careful study, and there is no field of observation open to the general student of microscopic life that promises better opportunities for new discoveries of importance. The subject is still very imperfectly understood. If the many who spend their time in detecting slight differences in form and markings of the frustules, thereby discriminating ephemeral species, and adding to the already almost inextricable confusion in the classification of the diatoms, would devote their spare moments to the study of the phenomena of the life, growth, and reproduction of these organisms, the results would be of great value to science. Will not some of our readers who are looking for a field of original work take up this subject in earnest? The specimens can be collected, preserved, and mounted, and then studied at leisure.

—o—

Staining Tissues in Microscopy.* IV.

BY PROF. HANS GIERKE.

[*Continued from p. 133.*]

ANILIN DYES.

71. Beneke. Correspbl. d. Vereins f. gemeinschaftl. Arbeiten, 1862. No. 59, p. 980.

Recommends dissolving commercial lilac anilin in acetic acid, which gives a clear solution.

72. Waldeyer. (See No. 36.) Untersuchungen u. s. w. in Henle u. Pfeufer's Zeitschr. 3 Reihe, Bd. xx, p. 200. 1863.

Describes a course of experiments with anilin dyes, especially red, violet, and Paris blue. The red is particularly commended. A strong solution contains, in 50 c. c. of water, 15 drops commercial anilin red, a weaker has 250–300 c. c. more water. This dye stains more quickly than ammoniacal carmine. It will even color in an instant under the cover-glass. But the preparations darken and are not permanent. Nuclei take the color more readily than protoplasm, and the axis cylinder more readily than the medullary substance of nerves.

73. Onimus. De l'emploi de la fuchsin dans l'étude des éléments anatomiques. Jour. de l'Anat., 1865. No. v, p. 569.

Recommends fuchsin as a stain.

*From the *Zeitschrift für wissenschaftliche Mikroskopie.* Translated for this JOURNAL by Prof. Wm. H. Seaman, M D.

74. Frey. (See No. 38.) Die Hematoxylinfarbung. Arch. Mikr. Anat. Bd. iv, p. 345. 1868.
Recommends 'Parma,' $\frac{1}{10}$%.

75. v. Ebener. Ueber den Bau der Aortenwandung, besonders der Muskelhaut derselben. Rollet's Unters. a. d. Inst. f. Phys. u. Hist. in Graz. Leipzig, 1870, p. 32.
Stains the walls of the blood vessels with anilin red, and finds elastic tissue colors well.

76. Merkel. Zur Kenntniss der Stäbchenschicht der Retina. Arch. f. Anat. u. Phys. 1870, p. 642.
The structureless skin of the retina is finely brought out by anilin red, even after treatment by perosmic acid.

77. Zuppinger. Eine Methode Axencylinderfortsätze der Ganglionzellen des Ruckenmarks zu demonstriren. Arch. f. path. Anat. Bd. x, p. 255, ff. 1873.
Cross-sections of spinal marrow are stained by anilin blue rendered soluble in water by a little acetic or hydrochloric acid.

78. W. Hatchelt Jackson. On staining sections with Magenta. Quart. Journ. Micr. Science. 1874, p. 139.
For permanent preparations the following dye is recommended:—To a dilute watery solution of rosanilin add by drops tannic acid till all the color is precipitated (a slight residue will always remain). Wash and dry the precipitate, and dissolve in alcohol with a few drops of acetic acid. The preparations should not be mounted in glycerin or balsam, but in sugar syrup, to which 3 to 4% of sodium or calcium chloride has been added.

79. Huguenin. In Correspbl. f. Schweizer Aerzte. 1874. No. 10.
Dahlia is warmly recommended to bring out the axis cylinders of nerves, but no details are given.

80. Fischer. Eosin als Tinctionsmittel f. Mikroskopische Präparate. Arch. f. Mikr. Anat. Bd. xii, p. 349.
Eosin, the potassium salt of tetrabromfluorescin, is red with green fluorescence, and dyes sections in water in 10–12 hours. It is better to precipitate it by acids, filter, and dissolve in alcohol, 1–20 or 30. May be used on objects treated by Müller's fluid, and on fresh specimens, which are by it hardened and stained at the same time. Epithelium, muscular fibre, axis cylinders and blood vessels stain of a beautiful red, connective tissue and nerve cells less readily, and the medullary matter not at all. The amyloid substance of degraded organs stains deeply.

81. Lawson Tait. On the freezing process for section cutting, and on various methods of staining and mounting sections. Journ. of Anat. and Phys., vol. ix, p. 250–258.
Mr. Tait condemns all the anilins as well as carmine. (See No. 60.)

82. Heschl. Eine hübsche à vista Reaction auf amyloid-degenerirte Gewebe. Wiener med. Wochenschr. No. 32, p. 714.
Leonhardt's violet ink, which is only a mixture of blue and red anilins, stains amyloid portions of tissue a beautiful rose red, while the rest is made blue.

83. R. Jürgens. Eine Neue Reaction auf Amyloidkörper. Virchow's Arch. Bd. lxv, p. 189–195.
Jürgens recommends iodine violet in water for the same purpose as in 82. Those parts showing amyloid degeneration stain a clear red, while the remainder appear violet blue. A little time is necessary to produce the best results, during which the colors deepen somewhat.

84. Ranvier. Des Préparations du tissu osseux avec le bleu d'aniline insoluble dans l'eau et soluble dans l'alcool. Arch. des Physiol, 1875, pp. 16-21.

Sections of bone are stained by an anilin blue that is soluble in alcohol, not in water. The sections are slightly scraped with the scalpel, then put in a warm concentrated alcoholic solution of anilin blue on the water bath, where they remain till nearly dry. They are then rubbed on a fine stone, moistened with a 2% solution of salt, in which they are at length well washed, and finally sealed in a mixture of equal parts of the salt solution and glycerin.

85. Cornil. Sur la dissociation du violet de méthyl-aniline et sa séparation en deux couleurs sous l'influence de certaines tissus normaux et pathologiques, en particulier par les tissus en degénéréscence amyloïde. Comptes Rendus, 27 Mai 1875.

An aqueous solution of violet methylanilin is recommended. A special advantage is, that many tissues are finely differentiated by the separation into blue violet and red shades which takes place. In hyaline cartilage, for example, the fundamental tissue becomes red, the cells and their capsules violet, likewise the fibrillæ of connective and elastic tissue and the fibres of elastic cartilage. The stain is unfortunately not permanent. In ordinary mediums, as glycerin, balsam, turpentine, oil of cloves, and alcohol, it is soon extracted from the preparation. Amyloid degenerations hold the methyl violet much better. They appear of a reddish violet, while the healthy elements dye blue; they may be kept in glycerin. On treatment by acetic acid the red color of the degenerate tissues is more permanent than the blue of the healthy parts.

86. Hermann. Ueber eine neue Tinctionsmethode. Tagebl. d. 48 Naturfvers. Graz, 1875. p. 105.

Sections stained with fuchsin are soaked in alcohol till no more color is extracted. The nuclei only retain the dye; the surrounding pale color is much altered. Anilin colors soluble in alcohol, and obtained from rosanilin only, are used, especially fuchsin, which is known in commerce as ruby red. The material should be hardened in alcohol and may be first treated with chromic acid. A good dye is made by adding 0.25 gm. ruby fuchsin to 20 c. c. alcohol of 96% and about 20 c. c. water. The mounts may be of the ordinary kind.

87. Wissowzky. Ueber das Eosin als Reagenz auf Hämoglobin, und die Bildung von Blutgefässern und Blutkörperchen bei Saugethier- und Hühnerembryonen. Arch. f. Mikrosk. Anat. Bd. xii, pp. 479–496. 1876.

Eosin and alum, each one part, are dissolved in 200 parts of alcohol as a reagent for hœmoglobin, with which it unites in the red blood discs and colors them orange red. The nuclei and stroma of the blood discs deprived of their hœmoglobin are no more affected by the dye than the white blood corpuscles.

88. Lavdowsky. Zur feineren Anatomie und Physiologie der Speicheldrüsen insbesondere der Orbitaldrüsen. Arch. Mikr. Anat. Bd. xiii, pp. 359–362.

An ammoniacal solution of eosin is preferred to one made with water or alcohol. It should be very slightly alkaline or neutral and so dilute as to barely show color. In this the sections lay for 24 hours, and are then exposed to the vapor of acetic acid. This solution stains the lining cells of the stomach red, leaving the basal tissue colorless, but in the peptic glands there is little differentiation. Lavdowsky also made a mixture of picric acid and eosin by adding to an ammoniacal solution of the latter some time made, picric acid till neutralized; this mixture he called picroeosin.

89. Dreschfeld. Ueber eine neue Tinctionsflussigkeit fur histologische Zwecke. Med. Centralbl. 1876. No. 40. On a new staining fluid. Jour.

Anat. and Phys., vol. xi, p. 181–182.

Sections of hardened material are stained by a watery solution of eosin, 1–1000 or 1500 distilled water. Treatment by absolute alcohol extracts the dye from fresh sections. When laid in the above stain for a minute or a minute and a half, they are put in very dilute acetic acid for a few seconds. Eosin is particularly useful for investigations of nervous tissue, for the nuclei and nucleoli of ganglia, and the axis cylinder of nerves which dye red, while the medullary substance remains uncolored, and the connective tissue stains more deeply.

90. Treitel. Eine neue Reaction der Markhaltigen Nervenfasern. Med. Centralbl. 1876. No. 9, p. 147.

Treitel used several anilin dyes, including iodine-violet, fuchsin and anilin blue. He found normal medullary nerve matter stains deeply, while degenerate nerves stain feebly, and connective tissue not at all. Preparations treated by Müller's fluid stain well. One drop of a 1% solution to 1 c.c. of water stains sections in one minute. In this method the nucleus remains colorless, also the membrane of Schwann, the axis cylinder is slightly tinged. The continued action of concentrated solutions stains all parts.

91. Baumgarten. Knorpel, Knochen und Anilin farbstoffe. Med. Centralbl. 1876. No. 37, p. 657.

Examines the nature of ossification and cartilage by means of Leonhardt's ink, which is a solution of anilin violet. This is applied to portions of the epiphyses of immature bones treated with wood spirit. The sections lay in the dye 2–10 minutes, then in slightly acidulated water till a decided change from a blue to a violet shade occurs, and are then well washed. The cartilage will now be slightly blue or violet, that which is slightly calcified violet to rose and the formed bone slightly reddish or colorless, while the marrow is blue. Similar results may be obtained by treating with fuchsin and washing in hydrogen chloride. In this case they must be washed in glycerin or absolute alcohol, not in water. The cartilage will then be reddish blue, that which is partly calcified clear blue, and formed bone red or colorless, and all nuclei carmine.

92. Ehrlich. P. Beiträge zur Kenntniss der anilin färbungen, und ihrer verwendŭng in der Mikroskopischen Technik. Arch. Mikr. Anat. Bd. xiii, pp. 263–277.

Dahlia is monophenylrosanilin, and is closely allied to parma blue, which is diphenylrosanilin, and anilin blue which is triphenylrosanilin. Most of it is only soluble in alcohol, but a variety soluble in water occurs. A reddish shade is usually preferred. In a neutral aqueous solution animal tissues take an intense color, amyloid substances red, and protoplasm bluish violet. Nuclei stain but little or not at all. Treated with very dilute acetic acid the protoplasm and connective tissue bleaches, the nucleus becomes a bluish violet. The 'plasma cells' of Waldeyer stain and do not bleach, not even after long treatment by absolute alcohol. To stain these cells only, harden in absolute alcohol, and treat with absolute alcohol 50, distilled water 100, glacial acetic acid, 12½ dahlia till saturated. Leave sections in dye for 12 hours, dehydrate, mount in balsam. Sometimes mucin cells will stain, also rarely the fat of fat cells.

Some other anilin colors dye plasma cells. They are all soluble in water, and are used with 7½ pts. glacial acetic acid and 150 parts 40% alcohol and as much dyestuff as will dissolve. The following have been used: primula, iodine violet, methyl violet, purpurin, safranin and fuchsin dahlia; and the first four stain plasma cells, only the rest remaining colorless, while the last two merely color the plasma cells more darkly. Ranvier's

chinolin blue and weak alcoholic solution of cyanin, when used with alkaline glycerin, make them a fine red, while protoplasm stains blue and fat bluish. The intensity of the dye depends on the granules scattered through the protoplasm. The nuclei of the plasma cells remain colorless. The granules are certainly not molecularly fat. They consist of a material having the following characters, viz., it is insoluble in water, alcohol and ether, and not attacked by alkalies, and does not readily decay. Further than this is unknown.

93. Sankey. On a new solution for staining sections of hardened animal tissues. Quart. Jour. Micr. Sci., 1876, p. 35.

Sankey uses an English dye commercially known as anilin blue black, easily soluble in water, not very soluble in alcohol. To 1–2 cc. water add 0.5 gm. of the dye, and 99 cc. alcohol. This will stain in a few moments, and shows the nuclei better than carmine. Excellent for the large nerves.

94. Bevan, Lewis. Preparation of sections of cerebral and cerebellar cortex for microscopic examination. Quart. Journ. of Micr. Sci., 1876, p. 69. Med. Times and Gaz. 1876, Mar. 4.

Warmly recommends Sankey's 'blue black' for nervous tissues and prefers it decidedly before carmine in aqueous solution of $\frac{1}{2}$ to 1%. Especially does it bring out clearly the prolongations of the cells, which may be more clearly made out by washing after staining and exposure for 20–30 minutes to a solution of chloral hydrate.

(It will be found that success with anilin dyes depends very much on the quality of the article used. I have not succeeded in obtaining good results in nerve preparations with such dyes as are found in the German market. Treatment with chloral hydrate renders the sections unfit for preservation.)

95. Luys. Emploi d'une nouvelle matière noire dérivée de l'anilin (noir Colin), pour les préparations histologiques et les reproductions photographiques. Gaz. Med. de Paris, 1876. No. 29, p. 346.

Material hardened in chromic acid or chrome salts must be very carefully washed before treatment with this new microscopical dye called 'Colin's black.' The sections may lay 3–4 minutes in a $\frac{1}{10}$% solution, and may then be mounted in the ordinary manner. They are especially adapted for photographic reproduction.

——o——

Improved Microtome.

The use of paraffin for imbedding is attended with difficulties on account of its becoming loose in the microtome. I have made a microtome in which the difficulties are overcome. A hole was turned about half-way through the table of a microtome, and into this a tube was screwed, forming the well. The hole through the remainder of the table, forming the mouth of the well, was turned with sufficient 'gather,' or taper, to take up the shrinkage of the paraffin. On the upper side of the piston a dovetailed groove was turned. The column of paraffin receives no support from the tube, but is securely held by the piston at one end and by the contracted mouth of the well-hole at the other. The following dimensions may be of use if any one wishes to make a similar instrument: Diameter at the top, .9 inch, tapering from diameter of .92 inch. Length of taper, .15 inch.

F. H. Gowen.

——o——

— Dr. R. V. Ledenfeld has recently described in *Zoologischer Anzeiger* some peculiar cells in certain Australian calcareous sponges which he regards as nerve-cells. The nervous system of sponges, when it consists of specially differentiated cells, is mesodermal. It is concluded that the calcareous sponges cannot longer be regarded as protozoic organisms.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1.50.
Vol. III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

MR. ZENTMAYER'S REMOVAL.—Mr. Zentmayer has recently changed his place of business from the building on South Fourth street to No. 201 South Eleventh street, Philadelphia, where he has opened a store, with a factory for optical apparatus in connection with it. Hereafter he will carry a full line of spectacles and eyeglasses, in addition to microscopes and accessories. The change will no doubt be beneficial, and we wish Mr. Zentmayer the best of success in his new quarters. His business was established in 1853.

—o—

MEETINGS THIS MONTH.—There will doubtless be a large attendance at the meetings of the American Association at Ann Arbor, and of the American Society of Microscopists at Cleveland this year. Especial efforts have been made to make the Cleveland meeting a brilliant one, and Mr. Vorce has exerted himself, as Chairman of the Soiree Committee, to get together the greatest display of objects ever yet seen. It is to be hoped he will be rewarded by perfect success.

At Ann Arbor a good attendance is anticipated. In addition to the regular meetings of the Association, the Botanical Club of the A. A. A. S. holds its meetings during the week of the Association, from August 26th to September 2d, at such times as announced on the daily programme. A good attendance of botanists is assured, and subjects of general interest will be considered. The Club offers an excellent opportunity for the presentation of short notes and observations, while the weightier matters can be brought before the general Association. Some excursions will be made especially for the botanists, and a thoroughly enjoyable time may be expected.

—o—

PROF. SMITH'S NEW MOUNTING MEDIUM.—Some misunderstanding has been created by the fact that Prof. Hamilton Smith has not yet seen fit to make known the composition of his mounting medium of high refractive index. We are not at present authorized by Prof. Smith to make any statement concerning this matter, but from what we know, and have learned from conversation with Prof. Smith some time ago, we are assured that there are excellent reasons why the composition is still withheld from the public. It is probable that Prof. Smith is as yet not fully satisfied that he has discovered the best method of preparing the medium. He has experimented with various combinations for a long time, and many of them have seemed to be at first very satisfactory, but they have not stood the test of time. We have no doubt that the principal reason for withholding the composition of the fluids is that Prof. Smith is unwilling to make it public until he is fully satisfied that he has obtained a perfectly reliable medium, and can give full directions for using it. Being ourselves acquainted with some of the compounds experimented with, and the results obtained, we are free to say that Prof. Smith is not keeping the matter from the public for any insufficient or selfish reason—in fact, it is not a secret.

—o—

SYNOPSIS OF DIATOMS.—The text of this valuable work is now to be obtained, and is offered in our advertising columns. Although published

in French, it will be found, we believe, quite practicable for those who do not understand the language to use the work for the identification of species, since the words used in description are so nearly like the corresponding words in English.

The first part of the volume is taken up with a general account of the diatoms—their structure, processes of growth and multiplication, and the methods of studying, preparing, and mounting them in different media.

The arrangement of the systematic part is, so far as our limited knowledge of the subject enables us to judge, far superior to any other classification we have seen. The family is divided into three sub-families, Raphides, Pseudo-raphides, and Crypto-raphides. The sub-families are then divided into tribes, genera, and species. In each case there is an analysis or synopsis of the tribes, genera, and species, arranged like the key of a botanical text-book, or like the synopses of genera of algæ in the 'Provisional Key to Algæ of Fresh Water,' now being published in this journal. The genera and species are clearly described, and references are given to original descriptions and figures.

We shall doubtless have occasion to refer to some parts of this work more at length in future. Hitherto we have regarded the study of diatoms, at least the determination of species if not also of genera, as something only possible after long study and familiarity with the various forms; principally because the subject has seemed involved in such hopeless confusion, with the valuable literature so extensive and scattered, and the synonymes confusing and almost endless. A careful examination of the text now published leads us to believe that Dr. Van Heurck has, by his masterly treatment of this very difficult subject, opened the way for the quick determination of any species described in his book.

We believe that the publication of this work marks an era in the study of the diatoms, from which great advances in our knowledge of these interesting plants will begin. No student need longer be deterred by want of sufficient literature from undertaking their study, for in this work alone will be found all that is essential for the determination of nearly all the established species. Not all, to be sure, since it is devoted especially to the diatoms of Belgium; but it is still sufficiently comprehensive for use in any part of the world.

A naturalist not specially familiar with the diatoms can now study his own collections and compare the species with those found in other localities, as it has never before been possible.

Subscribers to the plates have all received notice by mail that the volume of text can be furnished on receipt of their orders. As only a limited number of copies has been received orders should be sent promptly, otherwise we may be obliged to hold them until a second importation is received.

—o—

Microscopical Exhibitions.—The letter of a correspondent upon this subject, published in another column, brings forward probably the only valid arguments that can be urged against the suggestions that have led to his criticisms. Assuming that the proposed plan is practicable—which is a matter of uncertainty to us, except in exceptional cases—the subject seems worthy of further consideration, and we would invite a free interchange of opinions in our correspondence column from readers who are interested in it. Meanwhile, we avail ourselves of this opportunity to reply to our correspondent's objections, in order that the reader may have a clearer idea of the subject as it presents itself to us.

Our suggestions were made rather hastily, and, as was stated at the time, without sufficient consideration to enable us to present the details in a satisfactory manner. The subject,

however, has long been in mind, although not well thought out.

Our correspondent, whose name is withheld because his letter was not written for publication, asserts that the public does not want to be instructed, but amused. Perhaps so; but is it the proper function of a scientific society to amuse the public? It may be said, Yes, if thereby instruction can be imparted. However, we are not sure but something more than mere amusement is wanted by the public at microscopical exhibitions. Indeed we are inclined to believe the great attraction of a microscopical exhibition to most persons is the expectation of seeing beautiful and wonderful structures and organisms in the world of minute things. But it can hardly be true that the mere beauty of the specimens is the whole attraction, for the minute size of the objects, and the revelations of the perfection of Nature's smallest works, gives an additional interest to such exhibitions. There is, therefore, another element to be considered, which we have thus merely indicated, and it is only putting the matter in another form to say that the people who attend are really desirous of learning something. If the more brilliant and striking objects do attract most attention, it may be because they are more readily understood or appreciated. It would seem that before we reach a conclusion so uncomplimentary to the intelligence of the public, as that of our correspondent, we should at least try the experiment of making interesting to the mind objects not specially attractive to the eye. The experiment has yet to be systematically tried.

The criticism to be made upon our exhibitions generally is that they are mere displays of fine objects, and those who look at them are not able to learn what they are. Even the wing-case of the diamond beetle gains in interest by a few words of explanation, especially if the scales of a butterfly's wing are shown beside it and their relation to it briefly stated. The New York Microscopical Society was the first to attempt to materially improve this condition, and its annual programmes are excellent in this respect.

Whether the plan suggested possesses any merit whatever in large gatherings or not, it is unquestionably the one that is most satisfactory at home, when entertaining a friend with glimpses of microscopical life. In this connection the plan is not a new one, and probably every reader has made frequent applications of it.

At an annual exhibition in which the descriptive programmes are carefully arranged, like those of the New York Society, for example, the plan might readily be carried out. The whole scheme consists in selecting several objects—it may be only three or four in each group—that will, so to speak, explain each other, placing these in proper sequence, with suitable descriptions on the programme.

The indisposition of the public to acquire knowledge is proverbial, but the prevailing opinion on this subject may also be unjust—at least the extent to which it is true may be very much exaggerated in our minds. There are 300,000 visitors to the National Museum in this city in the course of a year. They do not all come for amusement, but a very large proportion of them examine the collections with deep interest, and endeavor to add to their store of knowledge.

NOTES.

—If any reader should know of an old form of microscope of American manufacture that would be of interest in a collection to illustrate the progress in improvement of stands in this country, the editor would be pleased to receive information concerning it. A collection of old microscopes will, probably at no very distant day, be on exhibition in this city, such as will be of great interest to every microscopist. A nucleus for a complete collection of this kind, embracing not only American but foreign instruments, has already been secured by Dr. Billings for

the Army Medical Museum. We would esteem it a favor if readers who know of such instruments, that might be obtained now or at some future time, would kindly give us the desired information for future use.

—One of our correspondents has a full set of the *Monthly Microscopical Journal* and the continuation of it, the *Journal of the Royal Microscopical Society*, to the end of 1884, all bound, which he is willing to sell very cheap. If any reader desires to obtain the set we will be pleased to afford any assistance possible.

— Dr. Lardowsky has highly recommended a new staining fluid for the cellulose walls of plant cells and to reveal karyokinetic figures. It is obtained from ripe huckleberries. The juice is pressed out and diluted with twice its volume of water, and a few drops of alcohol added. It is then boiled and filtered hot. In use it is diluted with water. It stains objects that have been hardened with chromic acid. By staining a section and then plunging it into a one per cent. solution of acetate of lead a lilac color may be obtained.

— Mr. Carl Zeiss is about to publish a new catalogue of his microscopical apparatus, which will include, among other new things, an apparatus for photomicrography, which has been very favorably spoken of by those who have seen it. Messrs. Emmerich & Son, the agents for Mr. Zeiss in this country, will soon have a supply of the catalogues, and doubtless will also have an invoice of the latest productions at an early day.

— The trip made by Mr. Wolle to Florida, which was mentioned in these columns some time ago, has led to the discovery of at least twenty species or varieties new to our flora, although no specially good localities for collecting algæ were found.

CORRESPONDENCE.

Microscopical Exhibitions

TO THE EDITOR:—I enclose a programme of our last exhibition. You must not be too severe upon these affairs. Your ideas upon microscopical subjects are usually very correct, but I cannot help thinking that you are a little in error on that point. Your plan for soirées would be excellent if an audience of microscopists could be secured. But the general public does not want to be instructed as much as it wants to be amused, and a programme on your plan would hardly be as attractive to an average audience as the kaleidoscopic affairs now in vogue. By making such a display as attractive as possible, the result will be, I think, that more persons will become interested in microscopy—at first superficially, but finally deeply—than by any other method. From what I have seen and heard I firmly believe that some of the best workers in the line of microscopical research have originally had their latent aptitude in that direction awakened by the sight of some pretty object at the house of a friend or at a microscopical soirée.

Hope your JOURNAL is doing as well financially as it is in every other way.

NOTICES OF BOOKS.

Annual Report of the Operations of the United States Life-saving Service for the Fiscal Year ending June 30, 1884. Washington: Government Printing Office. 1885. (8vo, pp. 476.)

The Influence of Cocaine, Atropine, and Caffeine on the Heart and Blood-vessels. By H. G. Beyer, M. D., M. R. C. S., Passed Assistant Surgeon U. S. N., Honorary Curator, Section Mat. Medica, U. S. National Museum. (Pamphlet, pp. 31.)

An account of experiments conducted at the Museum of Hygiene, at Washington, by the author. They were made on the heart of the terrapin. The method of experimenting is fully described and the results given in detail. Cocaine and atropine act similarly upon the heart. Morphine in considerable doses antagonizes the effect of cocaine. Caffeine increases the rate of pulsation, and strengthens the contractions, and appears to be cumulative in its action. The article was originally published in the *Amer. Journ. Med. Sciences*.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted: Well cleaned and selected Foraminifera, for which cash will be paid or slides given

EDWARD G. DAY,
Riverside, Conn.

Hundreds of varieties of fresh-water Algæ, including Volvox, Desmids, Rivularia, Draparnaldia, Tetraspora, &c., &c., for selected exchanges by list.

J. M. ADAMS,
Watertown, Md.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., SEPTEMBER, 1885. No. 9.

Mounting Media of High Refractive Index.*

At the meeting of the American Society of Microscopists at Cleveland, Prof. H. L. Smith described his process of mounting in media of high refractive power, and gave the formulas for preparing the same, and we are enabled to present the following abstract, which embraces the principal points of interest. The white medium, which has a refractive index of about 1.7, is very easily prepared, and is pronounced by Prof. Smith, and those who have used it, as unchangeable, provided moisture is kept out. The following is the formula as given for this:—

A stiff glycerin-jelly is first made, about the consistency of honey, by dissolving clear gelatin (Cox's) in pure glycerin, by aid of heat, and, in two fluid drams of this, forty grammes of pure stannous chloride are dissolved. The solution is easily effected by a little heat. When this solution is made it will probably be somewhat milky, but by boiling it in a test tube it will become beautifully clear, and about the color of balsam. This boiling must be done in a test tube not over one-fourth full, as the bubbles are, towards the last, very large, and thrown violently up and liable to eject the fluid from the tube; but with care the whole may, in a short time, be made not only clear, but, when cold, about as stiff as thick balsam; and, if in a small vial, it is not readily poured out. This medium should be used in making mounts precisely as balsam is when the mounts are to be finished by heating. The bubbles escape very rapidly and easily, but towards the end of the boiling, as the medium becomes viscid, they are inclined to persist, but by carefully heating, using a small flame, they will disappear, and, indeed, as they are mostly steam, they will frequently disappear wholly in cooling, when a balsam mount under the same circumstances would be full of bubbles.

If the boiling has been sufficiently prolonged, on cooling the cover will be found to be pretty firmly attached, and will allow the excess of material to be cleaned off without danger to the mount—indeed, this excess should be hard, requiring a knife or a sharp edge to remove it. It is advisable to put on only so much as is necessary to fill in under the cover, and have no cleaning to do afterwards, or put on a minute drop, and if that should not be enough feed in a little more from the end of the small glass rod used for dipping. The best thing to clean off the excess is hydrochline acid—a bit of tissue paper rolled up and moistened with this, not too wet, serves the purpose admirably, but water may also be used, and is nearly as good.

As the medium is deliquescent it is necessary to use a protecting ring. For this purpose, after the slide is well cleaned around the cover-glass, and warmed to dry it, apply a good coat of zinc-white cement, or shellac, colored to suit the fancy. If the sealing is perfect there will be no change by time. It is recommended, how-

* Revised by the author.

ever, to use a wax ring. These rings, punched out of sheet wax, of such size as to cover the edge of the thin glass, are put on the mount when it is finished, and, by cautious application of a small flame, just melted, but not so as to run. If any bubbles form under the ring they may be removed by touching with a hot needle or pin-point before the wax cools. A mount made this way will stand indefinitely, and can, at any time, receive a supplemental colored ring of shellac or other varnish for a finish. *Amphipleura pellucida* is very beautifully shown in this medium, and the various pleurosigmas—indeed, all diatoms except the very coarse ones, which appear almost black in the medium. A very little experimenting will enable one to use the medium successfully.

The use of the gelatine is only to give such a hold upon the cover as will permit the necessary pressure in cleaning. Many mounts have been made, both by myself and others, in the earlier experiments with this medium, without the gelatine, but in all these cases the cover was less firmly attached to the slide. If the protecting ring keeps out moisture from immersion media, or the atmosphere, the mounts will remain unchanged. As the medium dissolves gelatine, albumen, etc., arranged diatoms must be fastened to the cover by heating the latter, supported on a bit of thin sheet-iron or platinum, nearly to melting or softening point. A larger proportion of the stannous chloride can be dissolved than that mentioned above, even as much as sixty grammes, but then, on heating to harden the mass, crystals will appear; the crystals never give any trouble when forty grammes are used.

The second medium is realgar, the transparent sulphide of arsenic, dissolved in bromide of arsenic by aid of heat. Both of these substances should be pure, and the mount should be boiled as long as bubbles are readily given off, with considerable heat, and when cold the cover should be more firmly attached than with balsam. These mounts are of a deep lemon-yellow color, and the compound has a refractive index of 2.4. Excellent, and even better, mounts, as to permanence, may be made by using realgar only by sublimation. A bit of the realgar is put on a plate of mica about one inch square, and thick as a penny. This is melted by strong heat of a spirit-lamp. On this mica plate is placed another, with a hole $\frac{5}{8}$ of an inch in diameter, and above this a thin glass plate with a hole slightly less than the glass cover on which the diatoms are mounted. In Fig. 25, *a* and *b* are the two mica plates, *c* the glass plate, and *d* the cover, with the diatoms facing the realgar. The whole is now supported on a metal ring. A strong heat will volatilize the realgar without change, and often a clear deposit is made all over the diatoms and underside of the cover, and the latter can now be mounted in balsam; but, if bubbles are formed in the operation, as probably will be the case, the heat must be continued till these disappear, and, as the deposit will now be thickest at the centre just over the realgar, the mount may be finished by putting the cover, realgar side down, on a clean slide, and on top of it, to prevent breaking, a piece of thick glass, and then, grasping tightly with forceps to give pressure, heating strongly over a spirit-lamp. The realgar will soften (it must not be melted, else bubbles will form which cannot be removed) and spread out, more or less, between the cover and slide, making a nice clear mount. The color of the heated realgar is very much deeper than when cold. Instead of the solid realgar a drop of the solution

FIG. 25.—Method of mounting with Realgar.

in bromide of arsenic may be used, but in this case it must be boiled to expel the most of the bromide, before the cover is placed above it; the solid compound now melts at a much lower temperature than the realgar alone. These mounts will not change, but those made from the solution directly will, if the ingredients are not entirely pure, containing no excess of either sulphur or arsenic.

Prof. Smith stated that Dr. Allen Y. Moore was an independent discoverer of the value of realgar as a medium for test-diatoms, though, owing to its high melting point, he had not been able to make satisfactory mounts with it. He also stated that Dr. Van Heurck, to whom he gave the formula some time ago, had written to him that, with materials prepared for him by Rosseau, of Paris, he had no trouble in making excellent and permanent mounts. As bromide of arsenic will dissolve both sulphur and arsenic, there is always danger, if the realgar is not pure, that there will be an excess of one of these, and if so, the mount will either crystallize or granulate.

——o——

Butter and Fats.*

BY DR. THOMAS TAYLOR,
Microscopist U. S. Department of Agriculture.

Since 1876, when my first paper was published on Butter and Fats, in the *American Quarterly Microscopical Journal*, I have devoted a good deal of time to the investigation of this subject, principally with the view of finding a method by which I could, by the aid of the microscope, detect butter from butter substitutes. As a result of many experiments, I find that a person experienced in the use of the microscope may distinguish the fats of various animals and of vegetables by following the methods herein described.

The experimenter should first procure a specimen of common lard. This is composed mostly of crystalline starry forms which represent the solid fat of the lard. Real lard is composed of these and the oil common to lard. In very hot weather, when the thermometer is up in the nineties, the crystals dissolve in the oil, and perfect crystals cannot then be obtained unless cooled slowly to about 70° Fahr.

Place a drop of sweet oil on a glass slide with the point of a needle. Place a small portion of the lard in the oil, and mix them together. Place a microscopic glass disc over the lard and oil mixture and press gently. If held up to the light white granules will be seen if the temperature is not over 80° Fahr.; these are fatty crystals. Under a low power of the microscope it will be observed that these crystals have stellar forms with dark centres, and spines radiating from them (fig. 7).

To procure normal crystals of beef kidney fat, render a piece of this fat in an iron pan, without water. Strain, and add sufficient sweet oil to bring the fat to the consistency of butter. Cool slowly for a period of from twelve to twenty-four hours. Mount in oil as directed in the case of lard. The crystals in this case present quite a different appearance from those seen in lard (fig. 8). View them by polarized light, with and without selenite plate. The beef crystals, to be seen to advantage, require a power of at least 500 diameters, being very small, although they appear very interesting objects with a power as low as 80.

When it is desired to examine the crystals of butter, boil about an ounce of pure, newly-made butter in a test tube or iron spoon for a period of several seconds; allow it to cool as directed in the case of beef and lard; place a few grains of it on a slip of glass; pour over it a few drops of alcohol (or better, alcohol nine parts, carbolic acid one part), separate the crystals with a pin, and view them with a pocket lens; they will appear

* Abstract of paper read before the American Society of Microscopists, August, 1885.

like the eggs of insects (fig. 1). Place a second portion of the same butter on a glass slide 3 × 1 inches; combine it with a drop of sweet oil by means of a pin, reducing the butter to granules; cover with a thick disc of glass, and view first with plain transmitted light, when crystals like fig. 2 will be seen. Second, by

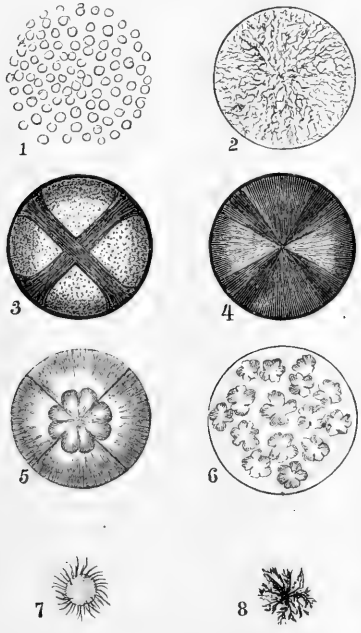


FIG. 25.—Butter and Fat.

polarized light. In this case place the polarizer low down and turn this prism round until its face angle crosses the face angle of the analyzing prism above. Under these conditions a dark ground is produced, and the butter crystals, which are globular in form, are seen in bold relief. The butter globular crystals will now exhibit a well-defined black cross representing that known as St. Andrew's (fig. 3). Figure 4 represents a crystal of butter showing divisions produced in prismatic colors when the selenite plate is used with polarized light. If old butter or a poor oily butter is used in this experiment, the secondary crystals of butter are generally shown. These crystals are of rosette form, much smaller than that of the globular, and exhibit no cross (fig. 6).

The globular crystals of butter, when kept for a month or more, seem to bud like a vegetable spore, and frequently every round crystal will show projecting from each a smaller crystal (fig. 5). The globular forms generally vary from fifteen ten-thousandths of an inch to the one-hundredth of an inch in diameter. These forms are never seen in pure beef or lard fats. Care should be observed not to press the crystals flat, especially the globular crystals, as the cross is not seen when severely pressed.

Butter crystals vary slightly from each other in size and in some other slight particulars, such as color. A butter received from Tennessee, made from milk of Holstein and native breed, shows on its crystals indentations, a condition represented in no other butter yet observed. The butter crystals seen in the butter made at Mr. Frank Ward's dairy of Washington, from milk of Alderney cows, also differ in some particulars from all others examined, being darker in color, spines longer, and of larger size. Specimens intended for permanent use should be mounted with a varnish ring, to prevent the cover from pressing on the crystals, and to prevent the movement of the cover used to protect them.

EXPLANATION OF FIGURES.

1. Represents crystals of boiled butter as seen by a pocket lens.
2. A single crystal of butter, highly magnified, viewed by transmitted light only.
3. A crystal of butter viewed by polarized light only. It exhibits the cross of St. Andrew.
4. A crystal of butter as seen under polarized light and selenite plate. In this case beautiful colors are displayed, while the cross is but faintly seen.
5. Represents what seems to be a budding butter crystal.
6. Represents the rosette crystals of butter.
7. The crystalline form of lard.
8. The crystalline form of beef.

American Society of Microscopists.

The eighth annual meeting of this society was held at Cleveland, Ohio, beginning the eighteenth of August. About one hundred and forty members were present. The following account of the proceedings is taken mainly from the columns of the *Cleveland Plain Dealer;* some of the details are from a correspondent who was present.

The proceedings were opened by an address of welcome by Mr. C. M. Vorce, President of the Cleveland Microscopical Society, who said:—

Gentlemen of the American Society and Visitors: It is literally true that words are inadequate to express the gratification that the members of the Cleveland society experience in being here to welcome your coming to this city. It is an event that we have looked forward to for years. The pleasure of making the acquaintance of many gentlemen not only in our own pursuit but in other branches of science and attracting them to our city has long been the subject of our anticipation. To realize the consummation of such an event, we have waited in patience for a favorable opportunity to invite you to our city. We at last concluded to invite you without further delay, although the facilities we offer might not be all that you could wish. While the Forest City offers innumerable attractions and inducements for visitors to sojourn with us, it is singularly wanting in buildings containing halls suitable for a convention of this kind. From the responses we have received from members and others interested in microscopy, we have every reason to anticipate a large attendance, a gathering of more than usual interest and the accomplishment of valuable results, which will add luster to our society. I take pleasure in introducing to you Mayor George W. Gardner.

Mayor Gardner said that he took pride in extending to the society, in behalf of the city, a hearty welcome: that he took pride in the fact that such a large body of men of high intelligence had chosen Cleveland as their meeting place. He declared that he had no doubt the meeting would be productive of great results, not only to the society but to science.

Prof. H. L. Smith, LL. D., President of the American Society, said in response, that he thanked the mayor for his words of welcome. 'We come from all sections of the country to your beautiful city, than which no more appropriate place of meeting could be chosen. Fifty years have passed since my first visit to Cleveland. There existed then for those days a palatial hotel kept by Mr. Scoville. At that time Ohio City on the west bank of the river was the ambitious rival of Cleveland, and bade fair to overshadow her glories. I look in vain for some of the old landmarks that then existed. They have been swept away with the flight of time, and others have taken their places. At that time there existed here a building called the ark, not because it resembled Noah's ship, nor because there were gathered there all sorts and kinds of creatures, but because there were assembled there the scientific and literary men of Cleveland, young men full of ambition. Well do I remember their first microscope. They thought it a wonderful instrument. Then they got a more wonderful one, but even that was far inferior to what we now have.'

Following the President's address Rev. Jabez Hall, a member of the Cleveland society, offered prayer.

The first paper read was by Prof. D. S. Kellicott on 'A New Floscule,' to which he has given the name *Floscularia Millsii*. Dr. F. L. James spoke on the 'Shrinkage of Cement Cells; the Cause of Leakage in Glycerin Mounts.' He stated that the fault in preparing specimens is not due to the zinc but to the persons using it. The cement should be properly made, and when used for making cells the latter should be al-

lowed to harden until they will shrink no more from loss of the volatile solvent. The hardness may be known by testing with the thumb nail. No time for drying can be stated, as it varies with the weather. The leakage is due to shrinkage of cells not sufficiently hardened.

Hon. J. D. Cox then read an article on 'The Actinic and Visual in Microphotography with High Powers.'

The President, Prof. H. L. Smith, delivered his address in the evening. His subject was 'The Influence of Science Studies.' After a few well-chosen words by way of introduction from Mr. Cox, he said:—

As I was writing this address far from home came the news of the death of Thaddeus C. Up de Graff, one of nature's gentlemen, and an eminent biologist, who did much for the success of this society. As a microscopist and physician he must long have known the inevitable result of the disease that was preying upon him, but he was always of good cheer. I wish that some one else might have been selected to give you the history of what has been done in microscopy the past year. While in a general way I may touch upon that subject, I shall take as my theme the unconscious influence of natural science study on the development of society. We are apt to lose sight of those quiet influences which are affecting our social life. The speaker then, in the course of his address, likened the progress of this influence to the steady movement of the world. Cyclones and tempests may claim all our attention for a time, but the world keeps on in its course undisturbed by those influences.

Happily, we in the study of microscopy are untrammelled by metaphysical thoughts. We microscopists do not trouble ourselves with cause and effect, but leave the leaven in the lump, feeling assured that it will in time leaven the whole. The old world has passed away. The age of the hero has passed away. The people have arrived. Science has arrived, and theology, law and all are on trial. Those who devote their lives to scientific research develop a love for truth. Do not think that I claim that the study of nature is all, however. There are men who look upon the scientific man as one who must snap, snarl, and sneer, and that where science appears religion must retire. It is a real relief to turn aside from this distrust to men who have made ears dull with pain hear the sweet music of nature. In discussing the depreciation of labor and the tyranny of office, men have often, in offering remedies, put in motion forces which, if uncontrolled, would have done more harm than good. The plans for the absorption of railroads and telegraphs by the government are miserable failures. We must solve the difficulties that confront us with some other power. We must have a unification of nations in the good work, and this is already shadowed in a universal system of time and of weights and measures.

A civilization based on science cannot so revert. Our trustworthy hopes for a glorious future are based on scientific research. No one is more to be pitied than the pessimist and agnostic. We, as students of nature, are not dependent on metaphysics, but find at our doors constantly the evidence of the truth.

Professor Smith hinted at the great work already accomplished by the study of science which has resulted in the ocean cable and other inventions having a bearing on our comfort and progress. He said that he presumed that all the members of his society are believers in the Darwinian theory, and spoke of the evidences of development as shown in a pure tone from the pulpit and bitter things from the forum and the exchange. It was far from his purpose, he said, to urge a further study of science in the schools and more science from the pulpit. All this will come in time.

Such a student as he who discovered the influence of the electric current on the magnetic needle has done more for the world than the demagogue who struts his brief time on the stage of human existence and then disappears.

The speaker referred satirically to those good old days when men grew old before their time; when geologists were considered akin to infidels; when the divine right of kings was believed in, and the luxuries which we now enjoy were unknown. It is quite the fashion to rave about those good old times, but we would not want them back again. We would scarcely give up our railroads and telegraphs and our table luxuries, now necessities, for the good old times. As we look upon the luxury of the present as compared with the past we may ask, 'How did our grandmothers live?' They did not live, growing old as they did before their time, but they were comparatively far advanced beyond what their ancestors were. Every gathering like the present has its benefit in human progress. We sometimes hear of conflict between science and religion, but it is only apparent. It was but a few years ago when good men looked upon geology as akin to infidelity, forgetting that astronomy had at one time been considered equally dangerous, but had come to be recognized as attesting the glory of God. So in time geology has become recognized as not in conflict with true religion. Professor Smith said that he could remember when physicians were shy of the microscope. To-day, while there are a few old practitioners who shrug their shoulders distrustfully when the younger physicians use the microscope, even the old ones are unconsciously affected in their practice by advancement in microscopical investigations. The president spoke of biology, which owed its existence to microscopy, and which has worked a revolution in medicine. Anything that can claim to aid us in coping with contagious diseases, with blights upon our crops and diseases in our flocks, is of intense interest to the public, and it is with these that biology deals. It is in its infancy yet, but it is destined to become more and more important. The speaker said that it had been shown that the two hundredth millionth part of a drop contains enough bacteria to be deadly infectious. He said that when it is shown that ventilation and sewage have been greatly benefited by microscopic investigations, it may be considered fortunate that some men have microbes on the brain, as has been said in jest. He said that biology may yet prove that the infinitesimal organisms with which it deals are not alone concerned with disease, but with health as well, and that they, acting in the pores of the human system as workers, carry off the sewage of the system, and thus overcome the effects of violations of nature's laws, and thus work to the end of aiding man in working out in himself the theory of the survival of the fittest. He said that microscopy has a great work to do in geology, and thus inaffecting the commerce of the world. It has been said, 'Make it unfashionable for men to drink and gamble, and our sons will stay away from the saloon and the gambling hell.' Fashion cannot be compared in its force with the influence of science studies on man. The hadcarrier, who climbs the ladder with his burden, is better and happier for that which has been accomplished by scientific research, which, with its electric lights and telephones, have done so much to lift him out of the ditch in which hisfathers were.

The professor did not claim everything for scientific research, but likened it to the carefully made balance-wheel in the chronometer, which, although but a part of the delicate machinery, is an essential part.

[*To be continued.*]

Optical Arrangements for Photomicrography, and Remarks on Magnification.*

BY ROMYN HITCHCOCK.

There are two methods of obtaining amplification in photographing microscopic objects; one is by regulating the distance of the sensitive plate, the other is by the interposition of an eye-piece, or a supplementary lens, usually an acromatic concave, between the objective and the sensitive plate. It is the relative merits of these two methods that we propose to briefly discuss.

The fact that both methods are used by different persons with perfectly satisfactory results might lead to the inference that it is purely a matter of convenience. This, however, is not the case; for the ordinary eye-pieces are not very perfect optical instruments, and it can scarcely be supposed that they will preserve the perfection of an image formed by an objective, in all its details. The conditions in photography are somewhat different from those of ordinary observation, wherein the defects of the ocular are not noticeable. The eye fails to discover a curvature of the image which is very evident when the latter is spread over a flat focussing screen six or eight inches square. In photography much depends upon whether the operator uses large or small plates, for with a small plate giving a field of three or four inches very high magnification can be satisfactorily attained by the aid of an ocular. For ordinary purposes such plates are quite large enough, but when we come to large sizes, such as eight by ten-inch plates, the eye-piece will not give sharp definition all over the field.

The eye-piece enables one to obtain increased magnification with short camera-bellows, and we have seen small photographs of difficult subjects taken with the eye-piece which leave nothing to be desired. Nevertheless, for the more difficult objects, and whenever finest details are to be photographed, we would not advise its use. By far the better plan is to use a long camera-box, and get amplification by increase of distance. In this way very good results can be obtained, but it must be observed that the objective requires to be specially corrected for the distance of the plate, and this is not only inconvenient, but in many cases quite impracticable. Thus, in using an objective of the oil-immersion form without any collar adjustment, one can only focus the image on the plate by causing the objective to approach nearer to the object than where it is used in ordinary observation.

Another plan which has been highly recommended by Dr. Woodward, Dr. Van Heurck, and others, is to make use of an amplifier. Dr. Van Heurck's very ingenious device has been described on page 45 of the current volume. Dr. Woodward was the first to point out the advantages of the amplifier in photomicrography, and also to give instructions for its proper application.

In working with objectives corrected with the utmost care for a definite length of tube, it is obvious that any change in the course of the rays passing through the objective will introduce aberrations which will impair the definition. If we focus upon an object with the ocular, then remove the ocular and receive the image upon a focussing screen several feet away, the objective must be moved nearer to the object in order to give a sharp image on the screen. Shortening the working focal length in this way obviously interferes with the normal course of the rays through the lens, and it is therefore not possible to obtain such a perfect image in this way as may be seen with the ocular. It will readily be seen that the only way to secure the best definition is to focus the objective with the ocular, for then we know the corrections are properly adjusted, and

* Read before Section G, at the meeting of the A. A. A. S., Ann Arbor, 1885, by Dr. H. G. Beyer, U. S. N.

then make the image sharp on the distant screen without the eye-piece by means of a supplementary lens. Mr. Zeiss attempted to do this by providing suitable correcting lenses to be screwed into the back of the objective, which were calculated to correct the aberrations when the screen is at stated distances away. A better plan, however, was employed by Dr. Woodward, who fully understood the problem and solved it in a satisfactory manner. He made use of an amplifier by Tolles, which he found to be most satisfactory of all at the time.* The amplifier was placed in a draw-tube, so that it could be moved out or in as required. He found that for any given position of the screen there was a corresponding position for the amplifier at which the image was as sharp and perfect as when observed with an occular, the objective meanwhile remaining unmoved. Herein is the secret of Dr. Woodward's unexcelled work in photographing the most difficult test-objects. He used no small plates, but the images of *A. pellucida* were ten inches in length, clear and sharp throughout. It is safe to assert that such pictures cannot be taken with an ocular, or even without the correcting lens properly applied. These facts are either not generally known, or they are sadly neglected by those who have most need to apply them; for in these days of photographing the most difficult of all objects, thev arious forms of bacteria, the utmost sharpness of definition is required if the results are to possess permanent value.

We now come to another question of importance in connection with this subject, viz., how much shall we magnify with each objective? We already know that there is a limit, clearly determined by calculation for each objective, dependent upon its numerical aperture, beyond which no further amplification will bring out additional details. Beyond that limit increase of magnification only enlarges the details then visible. Experience clearly shows, also, that as we increase amplification beyond a certain point, with every objective, we lose in sharpness of definition. This should be borne in mind in photographing with the microscope. The negative should be taken with only such magnification as gives perfectly sharp definition. By far the greater part of the general photographic work of microscopists is done with powers not greater than 250 diameters, and rarely indeed is 400–500 diameters required.

This, however, will depend upon the work to be done. In photographing diatoms, Mr. J. D. Cox has used powers of a thousand and twelve hundred diameters very successfully, and Dr. Woodward's celebrated photographs of *Amphipleura pellucida* were taken with magnifications of more than two thousand diameters. The magnification of certain photographs in our possession is 2,700 to 2,900 diameters with a $\frac{1}{8}$-inch objective, and 3,400 with a $\frac{1}{12}$-inch. The frustules measure about ten inches in length. Considering this fact and the size of the pictures, embracing as they do the entire length of the frustules in perfect focus throughout, we regard these photographs as the most perfect that have yet been produced. They conclusively demonstrate that it is practicable to make photographs with the highest powers which shall equal the best definition the lens is capable of giving with such magnifications; but as there is a limit to the sharpest definition of every lens as ordinarily used in observing with an ocular, there must also be such a limit in photography. The rational method would seem to be to get a sharp negative with as much magnification as possible, and make enlargements from that if required. In working with an amplifier enlargements will seldom be desired; but without the amplifier, either with or without an ocular, the limit of successful direct magnification is much reduced.

*See this journal, vol. i, p. 5.

A perfectly sharp negative will bear considerable enlarging without noticeable loss of detail. In an article published several months since* reference was made to some negatives about the size of an English six-pence, of bacteria, which competent judges pronounced excellent. These bore enlarging to the size of ordinary lantern positives. These were taken without the eye-piece, in a very small camera attached to the tube of the microscope. The opinion was expressed that 'better negatives of bacteria and very minute objects can be produced without the eye-piece, by obtaining more perfect small negatives, than by original large negatives.' Dr. Van Heurck also, as recorded in these columns, holds to the same opinion. Nevertheless, one may carry a very reasonable opinion to such an extreme as to lose the value of it. There is no reason for making negatives so small that a lens is required to examine them. There is, in fact, a decided disadvantage, in that greater enlargement is required by a photographic copying lens, and however excellent such a lens may be, it will not hold its sharp definition when required to magnify. Therefore, it is advisable to make the negative from the microscope at least as large as a $3\frac{1}{4}$ by $4\frac{1}{4}$ plate will take.

Summing up this matter, we are personally inclined to favor the use of large plates, 8 by 10 inches for example, in photomicrography, using the lens with an amplifier instead of an eye-piece, for the reason that large pictures, highly magnified, can thus be obtained of exquisite definition. These will bear further enlarging with the solar camera. There remains, however, the consideration of expense, and the inconvenience of using such a large apparatus under ordinary circumstances. It is unquestionably more convenient, in most cases, to use smaller plates, and to work with an eye-piece. Still better, to use an amplifier in place of the ocular, for then it is possible to attach the amplifier to the camera in such a position that when the object is focussed with the eye-piece, it is also in focus on the ground glass of the camera when the latter is attached. With such an arrangement a quarter-plate camera can be used with perfect satisfaction, giving negatives equal to any that can be made.

The same cannot be said when the ocular is used, although there is no doubt thoroughly satisfactory results can be obtained with the ocular on small plates, as already explained.

* This journal, vol. vi, p. 28.

—o—

Provisional Key to Classification of Algæ of Fresh Water.—IV.

BY THE EDITOR.

III. ORDER CONFERVOIDEÆ Kirchner.

Multicellular, filamentous algæ, simple or branched, rarely spreading flat; cell contents green [except in *Chroolepus*], only rarely showing a definite arrangement, but usually an outer layer of colored plasma, or the entire plasma uniformly colored; cell-wall never siliceous.

It is probable that sexual propagation will be found universal in this order, but at present it has not been observed in all genera. Sexual propagation takes place by female cells (oogonia) which contain usually a single oosphere, rarely several, and male cells (antheridia) in which spermatozoids are produced.

Asexual propagation by swarm spores.

[The unbranched Confervoideæ are readily distinguished from the filamentous Zygosporeæ by the uniform coloring of the cell contents in the former and the characteristic distribution of the color in the latter.

From what has been said above, it need scarcely be added that the division into sexual and asexual forms is merely tentave, for convenience.]

a. SYNZOOSPOREÆ and ASEXUAL FORMS.

Sexual fructification by spermato-

zoids not observed, but in a few cases copulation of two similar swarm spores has been seen. The product of such copulation is a zygospore (isospore) which passes through a resting stage, then grows and produces unsexual zoospores, which produce new plants.

Usually propagation takes place by the formation of one or numerous asexual zoospores within each cell. These are colorless at the front end, with a red pigment spot, and 2 cilia (microzoospores) or 4 cilia (macrozoospores). Both kinds are common in some genera, but only the microzoospores can copulate.

Resting cells of various kinds are found in most genera.

FAMILIES.

Filaments branched or unbranched, with or without gelatinous envelopes, cells sometimes ending in long bristles. CONFERVACEÆ, VI.

Filaments branched, upper part of cells swollen, all endochrome passing from the lower part into the swollen portion. PITHOPHORACEÆ, VII.

Family VI. CONFERVACEÆ.

Branched or unbranched filaments, cell-walls either delicate or thick, sometimes distinctly lamellose, with or without gelatinous envelopes or sheaths; terminal cells sometimes ending in long bristles or hyaline points.

Propagation by macro- and microzoospores, in some genera by resting-spores.

A. Filaments unbranched, or at most with short, lateral rhizoids; terminal cell without hair-like termination.

Zoospores of two kinds, macrozoospores with 4 cilia, microzoospores with 2 cilia, 8 many in a single cell, which may copulate, or vegetate without copulating. Copulation produces a zygospore, which grows slowly to an unicellular plant, that produces a number of macrozoospores. Other resting-spores not observed. (ULOTRICHINÆ).

B. Filaments branched; lower cells converted into colorless rhizoids, terminal cells often provided with long hairs or bristles. (CLADOPHORINÆ).

a. Cell-walls delicate, 2–16 zoospores formed in one mother-cell, with 4 cilia, set free by rupture or swelling up of the mother-cell. (CHÆTOPHOREÆ).

b. Cell-walls thick; zoospores very numerous (at least 32) in one cell, set free through an opening in the cell-wall, with 2 or 4 cilia. (CLADOPHOREÆ).

C. Spreading, flat, in a single layer of cells, either leaf-like, smooth, or crisped, or in the form of a hollow tube. (ULVINÆ).

A. ULOTRICHINÆ. Group 1.

Synopis of Genera.

Filaments tortuous, with short lateral proliferations. *Rhizoclonium*, 55.

Cells rarely exceeding diameter in length; walls delicate. *Ulothrix*, 56.

Cells longer, usually turgid, contents granular. *Conferva*, 57.

Filaments like *Ulothrix*, parallel, in gelatinous envelope. *Schizogonium*, 58.

Filaments large, not branched; walls distinctly lamellose and thick. *Chætomorpha*, 59.

55. Genus *Rhizoclonium* Kützing.

Filaments like *Conferva*, but distinctly tortuous (bending back and forth), with short, lateral, pointed proliferations or rhizoids.

56. Genus *Ulothrix* Kützing (extended).

Simple filaments, basal cell extended to a rhizoid. Macro- and microzoospores, the latter copulating (as observed in *U. zonata*); both set free while the cell-walls swell and break up.

[The genus as thus constituted includes *Hormiscia*, Areschoug, a genus usually recognized, characterized mainly by thick and robust cell-walls, often distinctly lamellose.

In the sterile condition it is difficult to distinguish between *Conferva* and

Ulothrix. In the former the cells are usually longer in proportion to diameter, more robust, and the contents more granular. In *Ulothrix* the cells are rarely longer than their diameter, the cell-walls thin, contents effused.

The formation of macrozoospores is very readily observed in this genus: it is only necessary to place the filaments in a saucer with water over night and examine them the next morning, when the zoospores will probably be set free.]

57. Genus *Conferva* Kirchner.

Simple series of cells, like *Ulothrix;* only microzoospores observed, but no copulation of them. They are formed in great number in a mother-cell, and escape through a circular opening in the wall.

[The genus as thus formed includes *Conferva* Link and *Microspora* Thuret. This union of the two genera is to be commended for the present at least; for it is practically impossible to distinguish between them except by the generic character of *Conferva* 'propagation unknown,' while *Microspora* produces zoospores in all its cells. It is stated by Wille that resting-spores are produced in the genus *Conferva*, which probably produce zoospores when they germinate. Until these observations receive further confirmation it seems proper to retain the genus as it is. *Conferva* Link includes usually slender filaments, with rather diffused and granular pale cell-contents. In *Microspora*, on the other hand, the cells are usually more turgid, the color more pronounced, and the contents have a tendency to contract toward the centre, finally producing numerous zoospores.

This genus also includes a peculiar form, *Psichohormium* Kützing, which is especially characterized by incrustations of calcareous or ferruginous matter.]

58. Genus *Schizogonium* Kützing.

Filaments like *Ulothrix*, with rather thick cell-walls, growing side by side in a common gelatinous envelope, forming more or less broad bands. In moist places, aerial.

[It is doubtful if this genus is a good one. It is supposed that *Schizogonium* is a condition of *Ulothrix*.]

59. Genus *Chætomorpha* Kützing.

Filaments thick walled, distinctly lamellose, cartilaginous, with rhizoid attachment; cells before division equal in length or longer than the diameter, after division shorter than the diameter; basal cell longer than the others; cell-contents green, finely granulate with a few starch grains, parietal in old cells.

[Most of the species are marine. This genus closely resembles *Cladophora*, and only differs from it in being unbranched.]

B. Cladophorinæ. Group 2.

a. Chætophoreæ. Sub-group 1.

a. Filaments in gelatinous sheaths, with rhizoids.

Synopsis of Genera.

Endophytic. Filaments irregularly branched, with bristles.
Chætonema, 60.

Main filament large, with lateral fascicles of smaller branches.
Draparnaldia, 61.

Branches like the main stem; chlorophyll in transverse bands.
Stigeoclonium, 62.

Filaments branched, radiating, in gelatinous or hard hyaline envelope spherical, or in a flat layer.
Chætophora, 63.

60. Genus *Chætonema* Nowakowski.

Endophytic. Filaments thread-like, irregularly branched, with spreading branches, usually at right-angles, most cells bearing one or several terminal or median bristles, somewhat swollen at the base.

Multiplication by breaking up of the branches: propagation by zoospores formed from the entire contents of the swollen cells at the ends or the middle of the branches, or after previous division into two or four

parts. Zoospores egg-shape, with four cilia and a red pigment spot.

[This genus is endophytic in the gelatinous envelopes of such algæ as *Tetraspora*, *Chætophora*, *Batrachospermum*, etc., growing along and winding about the filaments of the latter.]

61. Genus *Draparnaldia* Agardh.

Main filament larger than the branches, colorless, or with less color than the latter, bearing bright green clusters of smaller branches differing also in form from the main stem; terminal cells of branches end in colorless hairs. All the cells of the branches may form resting-spores. The entire plants, enveloped in slimy mucilage, forming soft, shapeless masses.

[The very pronounced difference between the main stem and the branches of this plant enable the genus to be recognized at a glance. Usually the coloring matter of the cells of the main stem is arranged in a more or less broad band across the cells. In at least one species it has been observed that the fascicles of branches (the main stem of the branches being likewise larger than the others) may grow into new plants, sometimes sending out rhizoids from the basal cell. This is a very beautiful alga, not uncommon.]

62. Genus *Stigeoclonium* Kützing.

Principal stem not distinct in size or form from the branches, with green contents, or colorless; the ultimate branches not aggregated into distinct fascicles. Otherwise like *Draparnaldia*. Resting-spores produced in the last branches.

[The terminal cells of some of the species end in long, colorless hairs. The green contents are usually arranged in transverse bands across the cells. The formation of zoospores and their escape from the ruptured cells can frequently be observed in this genus.]

63. Genus *Chætophora* Schrank.

Stem and branches alike, radiately arranged, or forming layers of definite form. The entire plant surrounded with a firm gelatinous envelope, sometimes very hard. The cells of the ultimate branches form chains of resting-spores.

[These plants are often found attached to submerged leaves, twigs or other plants, in the form of minute, solid particles of transparent jelly of a dense green color. The chlorophyll is usually arranged in transverse bands, as in *Draparnaldia* and *Stigeoclonium*. The terminal cells are often attenuated, and may appear quite empty. Zoospores may frequently be seen forming in the cells.

The more or less hard, or coriaceous, hyaline envelope which surrounds the filaments is not characteristic of this genus, as it is found also among the Nostocaceæ. The green color of the filaments and the manner of branching prevents any liability to error in distinguishing between them.]

β. Filaments without gelatinous sheaths; no rhizoids.

Synopsis of Genera.

Articulated, branching filaments, spreading irregularly over surfaces, cells with long bristles.

Aphanochæte, 64.

Filaments upright, branched, terminal cell obtuse.

Microthamnion, 65.

64. Genus *Aphanochæte* A. Braun.

Filaments prostrate, creeping, growing closely attached to a surface, often on larger filamentous algæ, branching and spreading irregularly. Some of the cells bear long bristles either at their apex or on the back.

65. Genus *Microthamnion* Nägeli.

Filaments articulate, upright, straight, dichotomously or trichotomously branched, sometimes very much branched; terminal cell obtuse, without bristle, afterward swollen, forming a sporangium. Distinguished by the peculiar method of branching—the lower of two cells sends out a lateral growth in which the dividing wall is formed, not at the point where the branch originates but a short distance above it.

Contents effused, with starch granules.

[The plants of this genus are quite small, and appear to have at times a gelatinous investment. The cells are sometimes distinctly swollen or turgid.]

b. Cladophoreæ. Sub-group 2.

Synopsis of Genera.

Aerial branching filaments; contents reddish or bright red.

Chroolepus, 66.

Filaments branching; cells robust, much longer than the diameter; branches becoming smaller than the main stem. *Cladophora*, 67.

Filaments branching once or twice; cells short. often torulose.

Gongrosira, 68.

66. Genus *Chroolepus* Agardh.

Filaments irregularly branched, often so felted together that it is difficult to recognize the branching. Cells with red or reddish brown contents, sometimes turning green after death. Zoospores usually as many as 32, reddish brown, with two cilia. No rhizoids; resting-spores unknown. Aerial algæ, often with a strong odor of violets.

[The color of the filaments is often distinctly yellow or orange. The cell-walls are thick and firm. The algæ are found on rocks where water trickles down, as a somewhat thick, leathery growth.]

67. Genus *Cladophora* Kützing.

Filaments many times branched; the last branches much thinner than the primary. Cells robust, usually several times longer than thick, with green contents and usually numerous starch granules; the first cell with a rhizoid.

Zoospores, with 2–4 cilia, formed in great number in a mother-cell. Resting-spores not known.

[The cell-walls are very thick, often lamellose. The cells are frequently very long in proportion to their diameter. The green contents seem to be quite uniformly distributed over the inner wall of the cells.

This genus has numerous representatives among the marine algæ.

Chætomorpha (59) resembles this genus so closely that it is only to be distinguished by the absence of branches.]

68. Genus *Gongrosira* Kützing.

Filaments usually dichotomously or simply branched, branches as thick as the principal stem; cells with thick walls, with green contents. The lower cell with a filamentous rhizoid. Resting-spores. Living in water or aerial.

[The filaments are not repeatedly branched as in *Cladophora*, and the cells are quite short, either equal in length to their diameter, or twice as long, often constricted at each end so as to form torulose filaments.

Rabenhorst describes two genera under his family Gongrosireæ which we have not regarded as sufficiently distinct from *Gongrosira* to be maintained as independent genera. Their characters are briefly given as follows:—

Genus *Pilinia* Kützing. Erect, articulate filaments, simply or sparsely branched, attached, in a crustaceous, spongy stratum, of an olive color. Propagation unknown.

Genus *Chlorotylium* Kützing. Filaments dichotomously branched, erect, parallel, in thin, pulverulent stratum, not laterally connected, not vaginate. Elongated hyaline cells interspersed in the filaments between short, tumid cells with colored contents. Zoospores 4–16 in a single cell.]

[*To be continued.*]

—o—

—The microscopical exhibit of the U. S. Department of Agriculture at the New Orleans exposition, prepared by Dr. Thomas Taylor, was made up in great part of water-color illustrations of fungi. Of these there were 800 plates, representing nearly 700 species. The remaining exhibits showed the results of experiments on butter, fats, and fibres of various kinds treated with reagents. A catalogue of the exhibit is published and can be obtained by application.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1.50.
Vol. III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

AMERICAN ASSOCIATION. — Our columns are so fully occupied this month that only brief mention can be made of the proceedings at Ann Arbor, and this must be confined to the microsopical section, although in the section of biology many important articles were read.

Prof. S. H. Gage was presiding officer of the section of Histology and Microscopy; Mr. W. H. Walmsley, secretary. Mr. Walmsley read an article on 'Photo-micrographs on gelatin plates for lantern projection,' and gave a practical demonstration of photo-micrography by lamp light.

Prof. Burrill presented a communication on 'Photo-micrography with high powers.' Mr. Chas. Porter Hart described 'A new, cheap, useful, and quickly constructed microtome,' and Dr. H. G. Beyer read an article by the editor of this journal, which is published on another page.

The address of Prof. J. P. Leslie, the retiring President of the Association, deserves careful reading. It is published in *Science* of August 28th.

—o—

AMERICAN SOCIETY OF MICROSCOPISTS.—The success of the meeting at Cleveland must be judged from the condensed account of the proceedings, which will be completed next month. These, although mainly taken from the newspaper reports, bear the stamp of careful preparation, and we must express our appreciation of the excellent character of the reports in the *Plain Dealer*, which are much better than the accounts of scientific meetings in the daily papers usually are.

There is no doubt all who attended the meeting were well pleased. Personally we are, and have been since the beginning, especially interested in the 'working session.' In spite of some trifling misunderstanding between a few members last year, which it was thought might injuriously affect the operations at Cleveland, Mr. Vorce has had a thoroughly successful working session, which is largely due to the energy and hard work he has given to it. We are pleased to notice that next year Mr. Griffith, who has done so much to establish the working session, will again have charge of it.

Prof. Kellicott is already at work on the Proceedings, which will probably be published at an early day.

We publish this month some of the important papers read at the meeting and others will be printed next month.

The meeting next year will be held at Chautauqua.

—o—

CHEESE POISON.—It will be remembered that some time ago considerable was said in the newspapers about some cheese which was said to be poisonous, in Michigan. At the time a number of chemists and microscopists examined specimens of the cheese, among others Dr. Sternberg, who was looking for the bacteria. Dr. V. C. Vaughn recently read a paper giving an account of his researches on this subject before a meeting of the Michigan Board of Health, an abstract of which we have received.

Dr. Vaughn finds that a poison, which he names tyrotoxicon, is produced in cheese under certain conditions, and he has succeeded in isolating it in the form of crystals. It is supposed that the poison is produced by putrefactive changes, and it may therefore prove to be a product of bac-

terial growth, although this is not so stated in the abstract before us. It is said, however, that 'old, foul-smelling cheese, such as Limburger and Schweitzer, have not been known to be poisonous.' Usually it is home-made cheese and cottage cheese that becomes poisonous, although sometimes it is cheese made in large factories. Such cheese instantly turns litmus paper red.

As regards the poison Dr. Vaughn says:—

'It is a product of slight putrefaction in the cheese, which probably occurs in the vat, as the curd has been known to poison a person. By this slight putrefaction, or excessive fermentation, as it may be called, a large amount of butyric acid is formed, and this, in the presence of the casein of the cheese, is capable of developing a poison. The poison was obtained in long needle-shaped crystals, which are freely soluble in water, chloroform, alcohol, and ether. The smallest visible fragment of a crystal placed upon the end of the tongue causes a sharp, stinging pain at the point of application, and, in a few minutes, dryness and constriction of the throat. A slightly larger amount produced nausea, vomiting, and diarrhœa. The poison is volatile at the temperature of boiling water, and for this reason even poisonous cheese may be eaten with impunity after being cooked.'

——o——

Poisonous Dried Beef.—It appears from the following highly intelligible paragraphs from the *Evening Post* of New York that somebody out West has been poisoned by eating dried beef. It also appears that two physicians, one of them a member of the State Board of Health of Illinois (which, by the way, we have hitherto supposed to be composed of gentlemen of somewhat different qualifications than are indicated in this instance), have submitted the dried beef to a microscopical examination. Making all possible allowances for the proverbial inaccuracies of newspaper reports, there is doubtless a trace of accuracy in this one, enough to justify the present notice.

'Kankakee, Ill., July 15.—Dr. Utley, of the State Board of Health, has completed an investigation at Momence of the dried beef poisoning, and says the poisoning was surely caused by the meat. He says further: "After a careful examination it seems impossible that the person putting up the meat did not know it was poisonous. The exact nature of the poison, because of the inferior microscopic facilities here, I am yet unable to determine. The investigation is necessarily incomplete, because no *post-mortem* examination was held. Were the powers of the State Board of Health enlarged, the guilty parties in such cases could be more quickly found and punished."

'Dr. Ellis, of Kankakee, a consulting physician in the poisoning cases, says: "From a partial examination under the microscope of the impure beef, I find a marked characteristic to be a very unpleasant odor, made more apparent on being macerated for a short time in pure water at an ordinary temperature. I find a total breaking down of the muscular fibres. This destruction of muscular tissue also means entire obliteration of the fibrous covering of the muscle with the blood corpuscles and fatty tissues, which leads me to believe that this beef was taken from an animal diseased, or more probably one partly decomposed, before being submitted to the so-called process of curing." No more deaths from this sickness have occurred, though several are yet in a critical condition.'

The evidence offered by Dr. Utley, in spite of the 'inferior microscopic facilities,' is scientifically complete—in fact, the meat was poisonous, because Dr. Utley says so.

Dr. Ellis, however, doubtless having adequate microscopic facilities, discovers an odor by a partial microscopical examination! He also finds that if the meat is macerated for a short time in pure water at ordinary temperatures, the 'marked characteristic odor' becomes more apparent! We should think it might—the probabilities are that the learned doctor is quite right in this conclusion, if in no other.

It is unfortunate that 'no more deaths from this sickness have occurred.' A portion of the meat should have been fed to the doctors before they had an opportunity to report on it.

The *Journal* of the American Medical Association contains another account of the poisonous beef, wherein it is stated that a severe form of cholera morbus occurred in Momence, Illinois, on July 17th, due to the eating of decomposed dried beef. About forty persons were affected. The *Journal* reprints the reports of Drs. Utley and Ellis, and adds that 'Dr. Keyser, on microscopical examination with 600 diameters, found numerous animalculæ,' which is likewise a highly instructive statement for a professional gentleman to make!

Prof. G. A. Mariner found numerous micrococci, bacilli, and other bacteria, so it appears that in spite of the reports of the other gentlemen there really was something the matter with the meat.

——o——

Testing Objectives.—Not unfrequently we are asked by persons wishing to purchase objectives, to advise them what kind they should get, and if we will test the lenses before they are selected. It is not a difficult matter for one familiar with microscopic work to select a good objective for every-day use. There is a vast amount of humbug talked about this matter by persons who ought to know better. Perhaps, after all, it is mostly for effect upon the novice, who, no doubt, is inspired with envy for the person whose long experience enables him to subject an objective to various 'tests' to determine what it will do. But the fact is, as every practical observer well knows, the best test for a working objective is to use it in regular work for a short time. It is well to have also a good *Podura* scale, which is an excellent object to show the character of the definition.

When we come to a different class of lenses, of very large angular aperture, such as are now much in demand by amateurs who can afford them, and by others who must have them, the difficulties are somewhat greater. It is customary to try such lenses upon a test-plate, and report how many of the diatoms it resolves. Unfortunately, this is a very misleading test. It will do very well for those who desire a lens for such work alone; but for most other purposes it is not a test in any sense.

In this case also the most satisfactory test for the lens is practical use in the work to be done with it. Many an observer of unquestionable skill in microscopical examination would be utterly 'at sea' if asked to resolve the *Amphipleura*. Yet we are inclined to believe such an observer is quite as well qualified to pass judgment upon an objective as any other.

There is, however, one way of testing an objective thoroughly, in every particular, and that is by means of the test-plate of Professor Abbe, made by Mr. Zeiss. This test-plate deserves to come into general use by those who make a study of objectives.

This subject was treated at length some time ago by Dr. H. E. Fripp, and we can do no better than to use his words in conclusion. He says:*

'In ordinary practice, microscope objectives, if tested at all by their possessors, are simply subjected to a comparison of performance with other lenses tried upon the same "test objects." The relative excellence of the image seen through each lens may, however, depend in a great part upon fortunate illumination, and not a little upon the experience and manipulative skill of the observer; besides which any trustworthy estimate of the performance of the lens under examination involves the consideration of a suitable test-object, as well as the magnifying power and aperture of the objective. The structure of the test-object should be well known, and the value of its "markings," if intended

Journ. R. Micr. Soc., ser. 2, vol. iii, p. 120.

to indicate microscopical dimensions, should be accurately ascertained, care being taken that the minuteness of dimensions and general delicacy and perfection of the test-object should be adapted to the power of the lens. A fairly correct estimate of the relative performance of lenses of moderate magnifying power may, doubtless, be thus made by a competent observer, but it is not possible from any comparisons of this kind to determine what may or ought to be the ultimate limit of optical performance, or whether any particular lens under examination has actually reached this limit.

'Assuming the manipulation of the object to be as perfect as possible, and, further, that the test-object has been selected with due appreciation of the requirements of perfect optical delineation, a fair comparison can only be drawn between objectives of the same magnifying power and aperture. Which of two or more objectives gives the better image may be readily enough ascertained by such comparison, but the values thus ascertained hold good only for the particular class of objects examined.'

NOTES.

— After an experience of three years with balsam of tolu as a mounting medium, M. G. Amann recommends it for the mounting of diatoms in preference to Canada balsam. In the *Bulletin* of the Belgium Microscopical Society he says:— 'It has given me excellent results, and comparative trials have shown that its optical properties are at least equal to those of storax. Moreover, its preparation is simpler; it suffices to discolor one part of balsam in two or three parts of chloroform, and filter the solution.' It is more deeply colored at first than storax, but becomes decolorized with time, especially if exposed to light.

— According to experiments by Prof. J. Richard, published in *Zoologischer Anzeiger*, the chlorhydrate of cocaine promises to be a valuable reagent for killing certain organisms, such as bryozoa, worms, and hydras. A small colony of bryozoa is placed in a watch-glass with 5 c. c. of water. When fully extended, about half a cubic centimetre of solution of cocaine to each cubic centimetre of water is added, little by little. After five minutes these animals, which, under ordinary conditions, retract their tentacles on the least agitation of the water, remain extended in spite of violent shocks. Another ½ c. c. of cocaine solution is now added, and after ten minutes the animals are dead and fully expanded. This reagent should be tried on other animals, and the results recorded, as the author believes its application may be greatly extended.

— A very interesting experiment, showing the influence of light upon the formation of starch in leaves, can be readily performed according to a method recently described by Sachs. To show the starch grains a leaf must be bleached and made transparent in this way: The fresh leaf is placed in boiling water for ten minutes, after which the chlorophyll is extracted by placing it in alcohol. The color is thus removed without rupturing the cells, which retain the starch. The latter is then made visible by treatment with iodine. The cellular tissue becomes stained dark blue or lighter, according to the quantity of starch present.

Comparative experiments may be made by exposing half of a leaf to sunshine while the other half is protected. A leaf collected in the evening contains much more starch than in the morning.

— The Association of the Alumni of the Albany Medical College have published the proceedings of their twelfth annual meeting in a pamphlet of 68 pages. It contains an address by Horace T. Hanks, M. D., president of the association, and two lectures by William H. Thomson, M. D., on the germ theory of disease.

—To color brass diaphragms or other articles black or steel-grey, the *Brit. Journ. Phot.* says, take a quarter of an ounce of sulphate of copper and half its weight of hyposulphite of soda, and dissolve them in a little more than a pint of water. Thoroughly clean the article, place it in the solution and heat it. More hyposulphite will give a darker tint, more sulphate of copper a lighter steel-grey color.

—Several years ago an English gentleman, Mr. Charles Blackley, attempted to determine the number of grains of pollen floating in the air, and also their distribution. He collected them upon squares of glass coated with a sticky medium and counted the number of grains found. In some experiments the squares were sent

up in the air attached to kites, and exposed at definite heights. He found a far greater abundance of pollen grains in the upper air than below.

—At the Inventions Exhibition in London, Messrs. R. & J. Beck received a gold medal award for their microscopical and other optical apparatus. The Messrs. Beck have been constantly improving their designs for microscopes, and now offer some excellent models at very reasonable prices.

—Mr. Hinrichs, of Baltimore, has sent us, for examination, some new preparations of bacteria, recently received from Germany, which he is offering for sale. Among them we find as especially good *Bacillas ovina*, and a preparation marked *Enclocarditis ulcersa*, Koch. These are from Marpmann's Institute at Esens, Germany.

— It appears from experiments of M. Miquel that bacteria do not rise to great heights in the air. Ten cubic metres of air at heights of 2,000–4,000 metres on the Alps failed to yield any bacteria. Hence it is concluded that Koch's cholera microbes cannot pass from Italy to Switzerland unless they find their way through the tunnels.

— M. P. Francotte has written an excellent article explaining the formation of images in the microscope according to the theory of Prof. Abbe. It is published in the *Bulletin de la Société Belge de Microscopie*, No. iv. It is an elementary exposition of the subject, illustrated with cuts, and affords a good insight into the theory.

— At a recent meeting of the San Francisco Microscopical Society, Mr. William Norris presented to the society a set of nineteen slides, mounted by him, being the first instalment of a series which, when completed, is intended to be a complete collection of all known California diatoms, with a list giving the generic and specific names of the diatoms found on eight of the slides, from as many different localities in the State, and comprising both recent and fossil forms. It is the first important step ever taken towards the systematic collection and classification of the California diatomaceæ.

The consideration of the subject appointed for discussion, 'Pathogenic Bacilli,' was then taken up. Dr. J. H. Stallard, of San Francisco, read a carefully prepared paper, giving a succinct account of the present state of our knowledge on the subject. He briefly reviewed the gradual progress of discovery in this field from the time when Leeuwenhoek, the father of microscopic biology, first discerned that minute organisms were associated with putrefaction and decay, up to the present day, when the magnificent researches of Koch, Pasteur, Lister, and others are exciting the admiration of the entire scientific world. It is to M. Pasteur that we owe the first observations which connected an epidemic disease with the presence of a parasite. He taught the silk-raisers of France how to check the ravages of pebrine, a disease infecting the silkworm. By following his advice the silk crop, which had fallen from 26,000,000 kilogrammes to 4,000,000, again increased to its former quantity. At a still more recent date, Lister made the discovery that the exclusion of germs and the use of applications which prevent their growth and propagation would render the practice of surgery far more successful. By the almost universal adoption of his methods many operations are now safely performed which formerly resulted fatally in nearly every instance.

In April, 1882, Koch announced his discovery of the bacillus of tubercle. These bacilla are minute rod-like fungi, and are readily found in the sputum of consumptives, generally free, but sometimes in colonies, in the large or 'giant' cells. They form spores at the temperature of the body, and human sputum retains its virulence after drying for considerable periods. Dr. Stallard then proceeded to detail the various methods of staining the material containing the bacilli, and thereby differentiating the latter.

In 1883 Koch was sent to Egypt by the German Government to study the etiology of cholera. After a series of prolonged observations he saw that a peculiar comma-like form of these minute fungi was invariably associated with the disease. In the appearance, growth, and vital properties of this bacillus, many characteristics were found which at once distinguished it from all its congeners. No formation of spores has yet been discovered. In uncomplicated cases of cholera, these bacilli appear as pure cultivations in the intestine of the patient, and their number is stated by Koch to always bear a direct proportion to the gravity of the attack.

Although the correctness of Koch's conclusions has been denied by the members of the British Cholera Commission, yet, taking everything into consideration, and bearing in mind the wonderfully careful and exhaustive nature of Koch's researches, it seems almost certain that the

soundness of his views will soon be established beyond all reasonable doubt.

In conclusion, Dr. Stallard gave a brief account of what is known regarding the bacillus of leprosy, showing it to be highly probable, although not yet demonstrated, that this organism is the cause, as well as the invariable accompaniment, of the disease.

The subject of the paper was further elucidated by means of engravings representing the appearance of the various bacilli, their modes of growth, the methods used in their artificial cultivation, etc. A number of slides had been carefully prepared, showing the bacilli of consumption and of leprosy, and these were exhibited under two microscopes, using a Powell & Lealand oil immersion $\frac{1}{12}$ inch objective, and a glycerin immersion $\frac{1}{6}$ by Tolles. An authentic specimen of Koch's common bacillus was also shown.

— We have received from Mr. W. H. Bulloch a photograph of a new microscope stand, which he has recently designed especially for lithological purposes. There are some peculiar features about it, and Mr. Bulloch has promised to write a description of it for publication. Probably it is not too much to say this is the most complete lithological stand made. The price is $300. Mr. Bulloch has recently furnished one of his largest stands to the Army Medical Museum.

NOTICES OF BOOKS.

The Technology of Bacteria Investigation. Explicit Directions for the Study of Bacteria, their culture, staining, mounting, etc., according to the methods employed by the most eminent investigators. By Charles S. Dolley, M. D. Boston: S. E. Cassino & Co. 1885. (Small 8vo, pp. 12 and 263.)

This book is composed of such notes and memoranda as would naturally be brought together by a person long engaged in collecting the current literature of a subject. In this respect the record is an excellent one. The author seems to have consulted everything of value that has been published on the subject, and given a brief outline of the many different processes described. For a person engaged in investigations of this kind, not possessing the scattered literature of the subject, the work will prove to be of value, as showing what has been done. The processes, however, are given in such a condensed form that it is doubtful if they could generally be applied successfully by a novice. However, some of the more important methods are given at length, and the others can easily be found from the references. It is unquestionably a valuable book for the investigator, and is evidently the result of much labor on the part of the author very carefully done. There are more typographical errors than should be found in a book of its size.

First Lessons in Amateur Photography. A series of lectures delivered before the senior class of the Montclair High School by the principal, Randall Spaulding. New York: Scovill Manufacturing Company, W. Irving Adams, agent. 1885. (8vo, pp. 28.)

Seven lectures covering the ground well, by an author who is evidently well acquainted with his subject. The information given is precisely what the amateur wants to know. We would recommend this book in preference to some much larger and more pretentious.

Fourth Annual Report from the E. M. Museum of Geology and Archæology. June, 1885. The Princeton Press. 1885. (Pamphlet. 8vo, pp. 24.)

Economy in type is perhaps laudable, but one might reasonably protest that the full name of a museum should be given on the title-page of an annual report. We are unable to say what the 'E. M. Museum' may be. However, it belongs to the College of New Jersey, and Prof. William Libbey, Jr., is the Director. In addition to the usual records of specimens received, etc., the report contains an account of the methods employed for hardening, embedding, etc. It is a useful report for reference by persons engaged in biological work.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Diatomaceous clay from this place, and fine slides of Foraminifera, for fine slides, material or back numbers of A. M. M. Journal.

E. H. RICHARDS,
Woburn, Mass.

Wanted: Well cleaned and selected Foraminifera, for which cash will be paid or slides given.

EDWARD G. DAY,
Riverside, Conn.

Hundreds of varieties of fresh-water Algæ, including Volvox, Desmids, Rivularia, Draparnaldia, Tetraspora, &c., &c., for selected exchanges by list.

J. M. ADAMS,
Watertown, Md.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., OCTOBER, 1885. No. 10.

Device for Testing Refractive Index.*

A new device for testing the refractive index of immersion media, and indicating how near an approach to homogeneity with crown-glass can be made, was described, at the recent meeting of the American Society of Microscopists, by Prof. H. L. Smith, who claims for this simple device superiority, both as to ease of manipulation and accuracy of indication, over the well-known wedge and bottle furnished by Mr. Zeiss.

In testing any medium for immersion purposes, but little more than a drop of the liquid is required, and the slightest variations of refractive index are indicated by a considerable latitude of motion, when, in the ordinary use of the wedge, these variations would be inappreciable. The instrument is used upon the microscope, and a reference to fig. 27 will

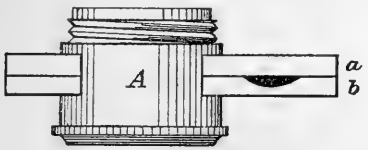


FIG. 27.—Device for Testing Rrfractive Index.

make the application plain. *A* is an adapter about three-fourths of an inch in length, with the society screw outside and inside. This is attached to the microscope, and carries a one-inch objective. *a* and *b* are two slips of crown-glass, as near the refractive index of the cover-glass as possible, two inches long and half an inch wide, each about a tenth of an inch in thickness. In one of these, *b*, near the end, a concave is ground to a depth of about one-third or more of the thickness of the glass, and polished. To test whether a medium has the same refractive index as the glass, and also the dispersion, a drop of it is put into the concave, and the two slips of glass are placed together and inserted into an opening cut in the adapter-tube, as shown in the figure. A thin stratum of the medium will flow between the two slips. The whole being now in the position shown in the figure, the one-inch objective is screwed on below, and the microscope is focussed on some well-defined object on the stage. Looking through the two slips in this way, the focus will be found not to differ appreciably from what it would be if the glass plates were removed. When the object is clearly defined the plates are pushed in, bringing the concave, filled with the liquid, directly over the back of the objective; if the medium be optically homogeneous with the glass slips, there will be neither spherical nor chromatic aberrations produced, and the definition and focus remain unchanged. As none of the immersion media now known are strictly homogeneous in this sense, but may, nevertheless, have the same mean refractive index as the crown-glass, clear vision with these will be obtained with the general focus unchanged, but an excess of color will fringe the outlines of the object. If the focus has been obtained by means of the rack and pinion, the fine adjustment always remaining the same, one can readily ascertain the refrac-

*Revised by the author.

tive indices of various media proposed for use with immersion objectives in this way. Let a mark be made on the rack-bar or sliding tube, as the case may be, when the focus is obtained with the plates in the position shown in the figure; this mark will indicate, for example, a refractive index of 1.52. Filling the concave now with cinnamon oil, and focussing again (using the same object, objective, and eye-piece), we get another position for a mark indicating refractive index of 1.6. Using water, we get still another, 1.33, and with glycerin 1.41, the extremes will be about half an inch apart, as measured on the bar or tube, and, by interpolating, we can thus get pretty nearly the refractive index of any fluid medium. I have found the so-called homogeneous media sold in the shops to differ very greatly, fully one-fourth of an inch out of the way in many cases. A specimen of cedar oil from Zeiss caused a change of focus only about one-twentieth of an inch, which was less than was required by any other samples I have tried.

When one has a fine objective, and with a given immersion medium has obtained certain positions of the screw-collar for the best work on certain tests, the exact refractive index of the medium can be ascertained, and afterwards always secured. A non-adjustable immersion objective, a $\frac{1}{8}$ by Spencer, which performed most admirably, both with oblique and direct light with the medium furnished by the maker, showed but indifferently well with another medium, which, on being tested with the little apparatus above described, required an alteration of focus necessary to obtain distinct vision, or rather the most distinct vision, of fully one-fourth of an inch. On diluting the second medium to bring it to the same index as that sent out by the maker, the performance was entirely satisfactory. It will be understood that there should be a diaphragm in the adapter of such size as will prevent any light passing through when the concave is put over the objective with the immersion fluid to be tested in it, except what actually passes through the fluid.

—o—

New Cement and New Mounting Medium.

Prof. Hamilton Smith has communicated to the Editor the results of some later experiments he has made with a new cement, especially adapted to protecting mounts in his new stannous chloride mounting medium, described in the September Journal. It is made by diluting a somewhat thick shellac cement, with benzole, and adding sufficient litharge to give a consistency about the same as that of white zinc cement. It dries very quickly, forms a much harder ring than does the white zinc cement, and is not unpleasant in appearance, as it becomes quite brown, or dark on exposure. A thin coat should first be applied, and when this is well dried it should be followed by another. So far as tried this cement seems to promise better than any other for preservation of the stannous chloride mounts. The white zinc often fails, and while the wax rings appear to answer admirably, the cement is more readily applied, and if the future use of it confirms the present promise, it will be more acceptable.

In regard to the medium itself, the refractive index may be raised considerably by making a saturated solution in the glycerin jelly—about 60 grammes to the fluid dram—and mixing this with the normal solution of 40 grammes. By a saturated solution is meant one which, when thoroughly cooled, will show signs of crystallization. The refractive index in this case becomes nearly 2.

Prof. Smith writes that he is now testing still another medium, of somewhat higher index than the stannous chloride, a full account of which will appear in due time.

Mr. Grunow's Illuminator.

The Abbe illuminator, as constructed by Mr. J. Grunow, has already been referred to in these columns, and the method of using it, as explained by Mr. Grunow, given in full.*

This month we present an illustration of the apparatus, from a woodcut recently received (fig. 28). It will not be necessary to enter into a description of the instrument,

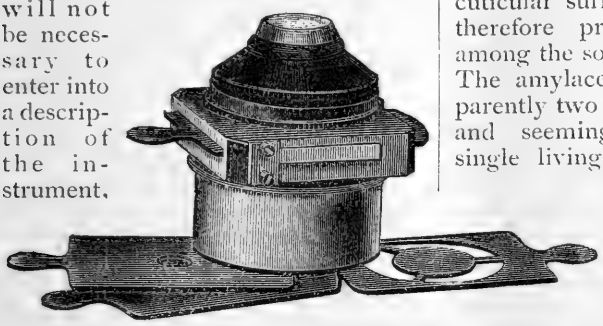


FIG. 28.—Grunow's Abbe Illuminator.

or to enlarge upon its value. The Abbe condenser, in its various forms, is not only the most extensively used, but it is also the cheapest and most generally useful, condenser now offered to microscopists.

——o——

Notices of New Fresh-Water Infusoria.—IV.

BY DR. ALFRED C. STOKES.

Phacus acuminatus, sp. nov. (Fig. 1).

Body depressed, broadly ovate or sub-orbicular, about as long as wide, the ventral surface slightly concave, the dorsal made convex by a subcentral, longitudinal keel-like elevation; cuticular surface longitudinally striate; posterior extremity rapidly tapering and produced centrally as a very short, straight, or slightly curved, acuminate tail-like prolongation; endoplasm colored green by chlorophyll corpuscles; pigment spot usually present; flagellum somewhat longer than the body. Length and greatest breadth $\frac{1}{1000}$ inch. Habitat.—Sluggish streams, and ponds with *Myriophyllum*.

This approaches nearest *Ph. triqueter* (Ehr.), S. K., differing from it in the concave lower surface, and the short, usually straight caudal prolongation. The presence of the distinct ovate chlorophyll corpuscles gives the endoplasm its green color, but the discs are apparently confined to the part immediately beneath the cuticular surface, and the *Phacus* is therefore probably to be classed among the so-called symbiotic forms. The amylaceous corpuscles are apparently two only. They are small and seemingly subspherical. A single living active individual has been met with having the endoplasm perfectly transparent and entirely colorless. The cuticular striations are usually distinctly visible only in the dead and colorless bodies.

Ophryoglena ovata, sp. nov. (Fig. 2).

Body ovate, soft, flexible and somewhat changeable in form, about one and one-half times as long as broad; ventral surface somewhat flattened; both extremities usually evenly rounded, the posterior one occasionally slightly and obtusely pointed, the frontal one commonly the broader; cuticular surface delicately striate longitudinally, the cilia fine and short; oral aperture ovate, ciliated, obliquely placed at a short distance from the frontal border, followed by a somewhat curved, apparently ciliated pharynx, posteriorly enclosing a vibratile membrane; contractile vesicle double, spherical, situated in the anterior and posterior body-halves, frequently stellate at diastole, and having long filiform diverticula; endoplasm colorless, crowded with irregular, colorless and variously tinted corpuscles; nucleus not observed. Length of body $\frac{1}{100}$ inch. Habitat.—Still water, with *Ceratophyllum* and *Utricularia*. Movements rotary.

Of the unequal corpuscles crowding the body, the smaller more nearly

* Vol. v, p. 22.

colorless ones are probably amylaceous in character, the large, variously tinted plates presumably being partially digested food-masses. The nucleus was not determined. It remained invisible even after the application to the body of reagents and staining fluids.

Dexiotricha centralis, sp. nov. (Fig. 3).

Body elongate sub-reniform or bean-shaped, longitudinally striate, about twice as long as broad, widest posteriorly, both extremities rounded; dorsal surface convex, ventral aspect anteriorly concave; oval aperture ovate, situated somewhat in advance of the centre of the ventral surface; pharyngeal passage short, recurved; cilia long and fine, those of the posterior extremity longest and most setose; caudal seta single, subequal to the body in length; adoral setæ fine, adcurved, extending in a single row obliquely across the right-hand lateral border, from a point posterior to the centre of the dorsal surface to near the centre of the right-hand margin of the oral aperture; endoplasm colorless, granular, transparent; nucleus not observed; contractile vesicle single, spherical, near the posterior extremity. Length of body $\frac{1}{400}$ inch. Habitat.—Stagnant pond water, with *Lemna* and other aquatic plants.

This is readily distinguished from *D. plagia*, Stokes (*Amer. Journ. Sci.*, April, 1885), by the more posterior position of the adoral setæ and of the contractile vesicle, by the much greater proportionate length of the caudal seta, but especially by the entire absence of the apparently bi-concave corpuscles so abundantly present within the endoplasm of *D. plagia*.

As is usually the habit with the last named form, *D. centralis* when taking food rests upon one side, the cuticular cilia in the rear of the adoral setæ then being comparatively quiescent, while those clothing the frontal region are in the most active movement, the currents thus produced, in both species, carrying the food-particles against the oblique setose hedge which deflects them toward the mouth.

Stentor globator, sp. nov. (Figs. 4 and 5).

Body subspherical, changeable in form, free-swinging or temporarily adherent by a long, narrow, retractile tail-like prolongation protruded from the centre of the posterior extremity; peristome field elevated, rounded, finely ciliated in concentric circles; cuticular cilia fine, arranged in longitudinal lines, longest posteriorly; hispid setæ long and numerous, extending at right-angles to the general surface; nucleus not observed; contractile vesicle double, spherical, posteriorly located. Diameter of the body $\frac{1}{300}$ inch. Habitat.—Still water, with *Myriophyllum*.

This remarkable stentor widely differs from any hitherto observed, possessing some characteristics that will necessitate changes in the generic diagnosis as formulated by Kent. Most members of the genus are noted for the ease with which they change their shape, the alteration, however, being confined chiefly to a contraction and consequent change in the form of the entire body. Several species have been observed with very fine pseudopodic filaments emitted from the posterior extremity, but none, so far as I am aware, have been recorded with the peculiar ability which *S. globator* possesses of posteriorly protruding a soft, flexible, attenuate tail-like prolongation equal in length to the diameter of the body, to be subsequently entirely withdrawn, and again protruded when the exigencies of the situation demand. The appearance of this temporary caudal prolongation brings to mind a pseudopodic protrusion, since it has the ability to somewhat alter its contour by the formation of several irregularly distributed enlargements which may be speedily absorbed, the part then becoming a long, simple, attenuate prolongation, the extreme

tip of which forms the easily detachable point of support for the body. The entire tail-like part seems to be covered by a cuticulum similar to that of the zooid, and is ciliated. When about to be absorbed or withdrawn into the body, it becomes very flexible, being flourished and curved and twisted in an amusing manner. Both protrusion and absorption are

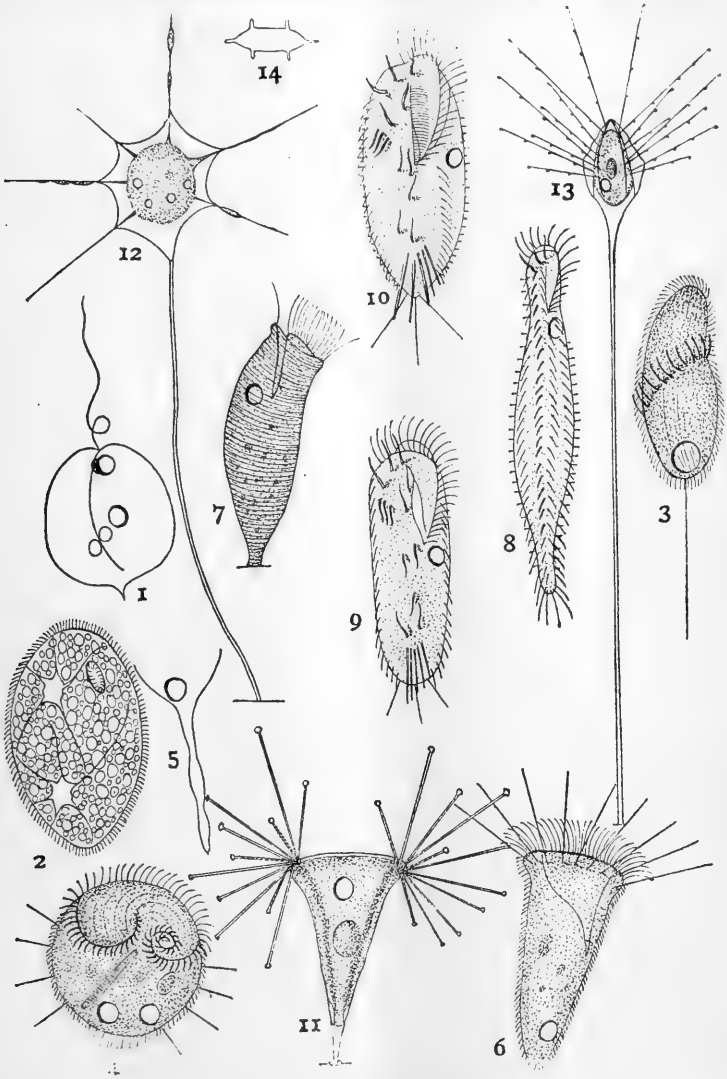


FIG. 29.—New Fresh-Water Infusoria.

EXPLANATION OF THE FIGURES.

Fig. 1. *Phacus acuminatus* × 700.
Fig. 2. *Ophryoglena ovata* × 110.
Fig. 3. *Dexiotricha centralis* × 700.
Fig 4. *Stentor globator*. Contracted body × 240.
Fig. 5. " " " Tail-like prolongation.
Fig. 6. *Strombidinopsis setigera* × 450.
Fig. 7. *Scyphidia constricta* × 300.
Fig. 8. *Uroleptus limnetis* × 216.
Fig. 9. *Stylonychia putrina* × 260.
Fig. 10. *Stylonychia vorax* × 260.
Fig. 11. *Acineta fluviatilis* × 330.
Fig. 12. *Acineta lappacea* × 1200.
Fig. 13. *Acineta alata* × 200.
Fig. 14. " " Ideal horizontal optic section of the lorica.

accomplished rapidly. If this caudal prolongation is present, the convex peristome-field is conspicuously flattened, the body is narrowed and lengthened, and only at this time does the infusorian present any resemblance to the trumpet-like form so commonly assumed by other members of the genus. The entire body is soft and changeable in shape. Even when the tail-like part is not protruded, the infusorian then being a free-swimming animalcule, the changes are quite marked and extensive.

That the peristome field of Stentor is ciliated I have not personally observed in any other species except *Stentor polymorphus* and *S. Barretti*, in which the condition obtains, nor have I been able to find that such a state of the part has been noticed or recorded. It is probable that the peristome field is ciliated in all the species, but that it has not been recorded is somewhat difficult to understand. In *Stentor globator*, however, the ciliation is conspicuous. The peristome field is furrowed by concentric lines, fine cilia clothing the depressions. The nearest recorded approach to this condition is found in *S. pediculatus*, From., in which the peristome field gives origin to numerous papillæ bearing fine non-vibratile setæ.

The cirri composing the peristomal fringe are large and numerous. When at rest each one presents an appearance remotely similar to that of the adoral ciliary wreath in *Tintinnidium semiciliatum*, where each cilium is distally pectinated. After careful scrutiny, however, I have been unable to demonstrate the existence of such a structure. The appearance is probably due to a confused image of the intermingling adoral cirri and the finer cilia of the peristome field. The last named part is much more convex and more elevated than in Stentor generally, and the infusorian seems to have the amount of convexity under quite complete control.

The cuticular setæ are long and numerous. They are more conspicuous and apparently more abundant anteriorly than on the posterior parts. They also seem to vary in length in the same row, but the appearance may be due to the convexity of the cuticular surface. They may be extensile and retractile, but this I have not noticed.

The double spherical contractile vesicles are uncommon in the genus. Their existence in the present species would afford a ready clue to its identification, if anything more were needed than the peculiar form of the body and the characteristic changes of the posterior extremity.

In figure 4 is shown the globular body; in figure 5 the outline of the protruded tail-like prolongation.

Strombidinopsis setigera, sp. nov. (Fig. 6).

Body ob-conical, twice as long as broad, finely striate longitudinally; widest at the frontal border beneath which it is constricted, tapering thence to the rounded posterior extremity; peristomal cilia abundant, curving outwardly, their length not exceeding one-half the greatest width of the body; a series of fine, outwardly directed, hair-like setæ projecting from the cuticular surface behind the peristome border, their length equaling one-half the length of the zooid; pharyngeal passage wide, ciliate, extending to the centre of one lateral body margin; endoplasm colorless, transparent; contractile vesicle single, spherical, posteriorly located. Length of body $\frac{1}{150}$ inch. Habitat.—Pond water.

This differs from *S. gyrans*, S. K., from English waters, the previously only known species, chiefly in the shortness of the peristomal cilia and the length and presence of the fine setæ springing from the anterior surface. Its movements are rapid and erratic. It has the habit of frequently darting backward for a short distance, at the same time contracting the frontal portion and partially

closing the peristome field, the adoral cilia being thrown inwards, some of them arching above the oral region, the frontal setæ then being almost parallel and directed forwards.

Scyphidia constricta, sp. nov. (Fig. 7).

Body elongate, gibbous, about three times as long as broad, constricted beneath the even, everted peristome border; widest near the centre, tapering posteriorly to the short intermedium of attachment; surface finely striate transversely; ciliary disc small, slightly elevated; contractile vesicle single, spherical, placed near the termination of the vestibulum; contracted body ovate, curved, strongly and transversely plicate on the concave side, the anterior border protruding as a conspicuous snout-like projection; parenchyma transparent, granular. Length of body $\frac{1}{450}$ inch. Habitat.—Pond water; on *Nais*, often attached in pairs or in clusters of three or four.

In contour this resembles *S. inclinans* (D'Udek), S. K., but it is readily recognized as a distinct form by the conspicuous anterior construction, the more posterior position of the pulsating vacuole, and by the transversely striated cuticular surface. When contracted, although the two still resemble each other, they may be diagnosed by the presence, with *S. constricta*, of the prominent snout-like projection of the frontal border.

Uroleptus limnetis, sp. nov. (Fig. 8).

Body elongate, sub-fusiform, five times as long as broad, widest centrally, tapering posteriorly to a tail-like prolongation forming about one-fifth the length of the entire body; constricted anteriorly into a neck-like portion, less in diameter than that of the body-centre, and about one-fourth the entire body in length; frontal border expanded, rounded, the lip conspicuous, crescentic; peristome field extending to the base of the neck-like constriction, the right-hand margin ciliate; frontal styles three; ventral setæ in two closely approximated median lines, beginning immediately behind the frontal styles and continued through the caudal extremity; marginal setæ projecting, largest and most numerous posteriorly; contractile vesicle single, spherical, on the left-hand side near the apical extremity of the peristome field; nucleus double, ovate; immotile dorsal setæ long and numerous. Length of body $\frac{1}{120}$ inch. Habitat.—Pond water, with *Lemna;* marsh water, with *Sphagnum*.

In its extended form this resembles the contracted condition of *Uroleptus longicaudatus*, Stokes, but, aside from the absence of the prolonged caudal extremity of the latter, differs in the absence also of the undulating peristomal membrane. The anal aperture was not observed. It, however, probably opens on the dorsal surface, as is so frequently the case in members of the Hypotricha.

Stylonychia putrina, sp. nov. (Fig. 9).

Body elongate elliptical, less than three times as long as broad; the frontal extremity slightly widest, the posterior border evenly rounded or truncate; lateral margins flattened, almost parallel, or the left-hand border somewhat concave; peristome field extending to near the centre of the ventral surface, the right-hand border ciliate and bearing an undulating membrane; marginal setæ large, projecting posteriorly only; four of the five anal styles extending beyond the posterior border; caudal setæ short, arising from the dorsal surface; nucleus double, ovate; contractile vesicle single, on the left-hand side; immotile hispid setæ short, arranged in four longitudinal lines on the dorsum; endoplasm often filled with dark granules. Length of body $\frac{1}{175}$ to $\frac{1}{200}$ inch. Habitat.—A stale vegetable infusion. Movements rapid and erratic.

This is readily distinguishable from other species by the shape of the body, the elongated, subelliptical

contour being thus far characteristic. The truncated posterior extremity is apparent only in the largest and presumably the oldest individuals, and not always with even them. Reproduction is by transverse fission and by encystment with subsequent binary fission, the external cyst wall being smooth.

Stylonychia vorax, sp. nov. (Fig. 10).

Body elongate, obovate, more than twice as long as broad, tapering and obtusely pointed, sometimes evenly rounded or obliquely truncate, posteriorly; frontal border prominent, obliquely crescentic; lateral margins often flattened and parallel; marginal setæ large, scarcely interrupted posteriorly, those on the left-hand side remote from the body-margin and projecting only at the posterior extremity; distal extremities of all the anal styles extending beyond the body-margin; caudal setæ stout, not widely separated, rising from the posterior margin of the body; peristome field extending to the centre of the ventral surface, the right-hand border nearly straight, ciliate and bearing an undulating membrane; contractile vesicle single, spherical, near the termination of the peristome, on the left-hand side; nucleus double, ovate; dorsal surface bearing one or more longitudinal rows of short, immotile, hispid setæ; frontal and anal styles often fimbriate. Length of body $\frac{1}{300}$ inch. Habitat.—Shallow ponds in early spring.

This is the smallest member of the genus yet observed, and its characters are so obviously different from those of previously recorded species that it is easily recognizable. Two specially noteworthy features are that all the anal styles project beyond the body, and that the caudal setæ spring directly from the edge of the posterior border, and not, as in *S. mytilus* Ehr., *S. notophora*, and *S. putrina*, from the dorsal surface.

The infusorian is voracious, devouring the numerous flagellate organisms so abundant in the shallow pools in early spring, until the body becomes not only colored by them, but gorged and often distorted by the internal pressure. It was this remarkable appetite that suggested the specific name.

Acineta fluviatilis, sp. nov. (Fig. 11).

Lorica sub-triangular, compressed, transparent, thin and delicate; about one and one-third times as long as broad, widest at the distal border, somewhat constricted anteriorly, thence tapering posteriorly to the pedicel; lateral borders flattened, the lorica thus presenting a quadrangular outline in horizontal optical section; frontal margins united anteriorly except at the two ovate antero-lateral apertures for the passage of the tentacles; pedicel short, not exceeding one-third the length of the lorica, usually slightly widened at the distal extremity; enclosed zooid generally entirely filling the cavity of the lorica, to which it is attached at the posterior extremity and apparently by the entire lateral surface; endoplasm granular; tentacles distinctly capitate, in two antero-lateral fascicles; contractile vesicle single, spherical, anteriorly situated; nucleus ovate or broadly subspherical, conspicuous, subcentrally located. Length of lorica $\frac{1}{300}$ to $\frac{1}{600}$ inch. Habitat.—On *Vallisneria spiralis* from a tide-water creek.

This may be regarded as the connecting link between the marine *Acineta tuberosa*, Ehr., and the fresh water *A. lemnarum* Stein, both of which it resembles in the form of the lorica. Its systematic position is evidently between these species. From *A. tuberosa* it conspicuously differs in the short pedicel, the apparent adhesion of the entire body to the internal walls of the lorica, except at the anterior or distal border, and by its fresh-water habitat. The irregularly quadrilateral outline of the loricæ in horizontal optical section are similar, as well as the habit;

possessed by both, of withdrawing the entire fascicle of tentacles at one time. In *A. tuberosa*, however, the tentacles do not possess the external spiral ridge-like film often visible in *A. fluviatilis*. The latter may very justly be considered the fresh-water representative of the marine type. From *A. lemnarum* it is recognizable chiefly by the short pedicel, the posterior adhesion to the lorica, and especially by the presence of but a single contractile vesicle.

The lorica walls are often seen to be variously indented, bent and folded, the entire lorica being often reversed or inclined either by contact with Rotiferæ or other comparatively large denizens of its habitat, or by the necessary manipulations of the observer. Occasionally a portion of the soft body exudes through the apertures at the antero-lateral angles, thus lifting the extended tentacles for some distance beyond the walls; in a single instance a fascicle was entirely withdrawn and an irregular, curved process of sarcode was extruded from the tentacular orifice until its length equalled that of the entire infusorian, its shape and position slowly changing, a few minute vesicles appearing in it, but until I was compelled to leave the microscope no further alterations took place. The next morning the extruded part had been partially withdrawn, but the creature was weakened by prolonged confinement and the tentacles were not protruded. The act may have been induced by the discomforts of extended imprisonment and the consequent diminution of the oxygen supply.

The spiral film external to the tentacles is not always present. It is most frequently developed during the withdrawal or partial extension of the tentacle, when it is thrown into irregular, closely approximated ridges, the full extension of the organ elongating the spirals until they become merged into its substance.

At the systole of the contractile vesicle a narrow channel very frequently becomes visible leading from the vacuole to the distal border of the zooid.

Acineta lappacea, sp. nov. (Fig. 12).

Lorica hyaline, subspherical, the borders projecting outwardly in numerous, conspicuous, irregularly distributed tubuli through which issue the fine tentacles; pedicel slender, often flexuous, two to three times as long as the lorica; enclosed body sub-globose, not attached to the lorica posteriorly; nucleus small, spherical, subcentral; contractile vesicles several, small, scattered. Diameter of the lorica $\frac{1}{1500}$ to $\frac{1}{1900}$ inch; of the enclosed zooid $\frac{1}{3000}$ inch; length of pedicel $\frac{1}{750}$ to $\frac{1}{500}$ inch. Habitat.—Pond water; on rootlets of *Lemna* and on *Riccia fluitans*.

This approaches more nearly to *A. stellata*, S. K. than to any other member of the genus, differing from it in the greatly increased length of the pedicel, and in the multiple contractile vesicles. The tentacles are very fine, but exhibit conspicuous, irregular protoplasmic thickenings. Their length is often twice the diameter of the lorica. They vary in number from fourteen to eighteen or more. They are apparently not capitate.

Acineta alata, sp. nov. (Figs. 13 and 14).

Lorica irregularly ovate, widest centrally, the length not greatly exceeding the breadth, tapering anteriorly to the rounded or obtusely pointed border, and posteriorly to the pedicel, the walls thin, transparent, continuous, traversed longitudinally by from five to eight posteriorly diverging, compressed, wing-like elevations, each pierced by about four ovate, equidistant, longitudinally arranged apertures for the passage of the fascicles; pedicel six to eight times as long as the lorica, straight or slightly curved, its hollow cavity continuous with that of the sheath; enclosed zooid ovoid, somewhat changeable in shape, occupying the

anterior part of the cavity of the lorica, apparently not attached to the walls; endoplasm granular; tentacles fasciculate, all the distinctly capitate extremities usually placed on the same side of the fascicle, each of which consists of about six tentacles; nucleus ovate, subcentral; contractile vesicle single, spherical, posteriorly situated near the lateral border. Length of lorica, with pedicel, $\frac{1}{56}$ inch; of the enclosed zooid $\frac{1}{560}$ inch. Habitat.—Fresh water, on *Ceratophyllum*.

A single individual of this curious and beautiful acineta was first observed about three years ago; none have since been seen until recently, when they were obtained in some abundance. The projecting wing-like additions are very strongly flattened, the margins usually being undulate or irregularly crenate. It is difficult to rotate the lorica on its long axis so as to obtain a view of all the projecting alæ in succession, and to be certain of the exact number, the observer being forced to content himself with an examination of the opposite surface through the entire thickness of the semi-transparent animalcule. The usual number seems to be five; it varies, however. I have not succeeded in obtaining an end view; figure 14, showing a horizontal optic section of the lorica, is therefore not only diagrammatic, but to a certain extent ideal. The tentacles rarely exhibit an external spiral film.

——o——

The Pseudocyclosis in Amœba.

BY G. C. WALLICH, M. D.,

Surgeon-Major Ret'd List, H. M. Indian Army.

In the March (1885) number of your valuable journal, Dr. S. Lockwood draws attention to the fallacy of the view still prevalent amongst naturalists in relation to the characteristic movements of granular and other particles within the body-substance of *Amœba;* and he furnishes the only rational explanation of the phenomena which is compatible with the readily observable facts of the case. The title of Dr. Lockwood's brief but highly interesting paper, coupled with the arguments he brings forward, at once establishes his rejection of the idea that the movements of the particles referred to are indicative of the existence of a special circulatory function in the protoplasmic structure of this organism.

Having published, in *The Annals and Magazine of Natural History*,* upwards of thirty years ago, a series of articles on the Amœban and Difflugian Rhizopods, in the course of which the quasi-circulatory movement of particles in the body-substance of *Amœba* was fully explained on precisely the same basis as that recently advanced by Dr. Lockwood (the term pseudocyclosis having then been assigned by me to the phenomenon, as will be presently shown), I venture to hope you will give the present communication a place in your columns. I would, however, at once assure Dr. Lockwood that I feel perfectly confident his conclusions on the subject have been arrived at quite independently of mine; and that it is a source of great satisfaction to me to find my own views have been thus verified by so painstaking an observer.

The following extracts from my papers, which could be multiplied were it necessary, will doubtless suffice to prove my statement:—

'Another fact is deducible from the appearances presented by the sarcode-substance of the largest of these *Amœba*. The rush of granules does not follow upon a previous contractile effort exercised at the posterior portion. As the animal progresses, occasionally altering its course, there are periods during which perfect quiescence is maintained by the granules; and the rush or flow of these seems to take place, as it were, to fill up the vacuum engendered by the sudden projection of a portion of the ectosarc in the shape of a pseudopodium. Hence it would appear that

* London: Taylor & Francis.

notion is dependent on the contractile power of the external sarcode-layer, and that the endosarc only passively participates in it. If this view be correct, it involves a very important consideration; for it proves that the old German doctrine of a "primary contractile mucus" is essentially correct, and that the circulation is not dependent, even in part, on the alternate expansion and collapse of the contractile vesicle. Further than this, it affords the strongest confirmation of the high degree of "differentiation" existing between the endosarc and ectosarc of the amœban group.

'The mysterious faculty, resident in the latter portion of the structure, of forming *extempore* orifices for the inception or extrusion of food-particles, etc., may be witnessed in these specimens in a very singular manner, and one which, so far as I am aware, has not hitherto attracted attention. I allude to the projection of the ectosarc from some area of the general surface, in the form of a hemispherical mass with a broad base, only a very small portion of the original contour line seeming to give way at first, so as to admit of the passage of the endosarc and other granular contents into the newly projected part, but its entire floor appearing to be gradually dissolved, as it were, and free communication between the main body and the new pseudopodial cavity not being established until the completion of the process. Whilst this is progressing, the endosarc-granules seem to rush round a corner into the cavity, the corner itself gradually receding, so to speak, and being ultimately altogether obliterated. From these facts it is obvious that the ectosarc and endosarc are not permanent portions of the protean structure, but are mutually convertible one into the other; and that it is an essential feature of sarcode that, while the outer layer for the time being becomes, *ipso facto*, instantaneously differentiated into ectosarc, the same layer reverts to the condition of endosarc under the circumstances just described.* In the latter part of the process—that is, the reversion to the condition of endosarc—the action is by no means so instantaneous as when the converse takes place. In the actinophryans, both processes are, comparatively speaking, slow.'—(Further Observations on an undescribed Indigenous Amœba (*Amœba Villosa*, Wal.), by Surgeon-Major Wallich, M. D., *Annals and Mag. Nat. Hist.*, May, 1863.)

'The conversion of endosarc into ectosarc I regard as analogous in character, if not actually identical, with coagulation; the effect being produced by the mere contact of sarcode with the medium in which the animal resides, whilst the converse process constitutes an inherent vital function of the animal protoplasm. Should this view be admissible, we have presented to us a phenomena bearing, in a most important degree, on the general question of development, and one which, I venture to affirm, is far more largely engaged in the production of specific type, not only amongst the lower but also amongst the higher orders of being, than we have heretofore been inclined to allow. I allude to the reciprocal action of physical and vital forces.' (On the Value of the Distinctive Characters in Amœba. By the same author. *Annals & Mag. Nat. Hist.*, Aug., 1863.)

'It is only necessary to watch a specimen of *Amœba* carefully to become convinced that the appearance of a returning as well as an advancing stream is illusory. The stream, it will be observed, is invariably in the direction of the preponderating pseudopodial projections. The particles simply flow along with the advancing rush of protoplasm. There is no return stream, but only the semblance of one engendered by one layer of particles remaining at rest while

*The conclusion here arrived at and the facts on which it is based have very recently been published as new and original by Herr Grüber. (See *Journ. Royal Micr. Soc.*, April, 1885, pp. 260–1.)

another is moving past them. In short, the effect is similar to that which would be produced were a transparent bladder or caoutchouc sac, containing granular bodies of greater specific gravity than the viscid fluid within which they were sustained, to be slowly rolled along a plain surface. In such a case it is obvious that only the granules on the upper or free aspect of the sac would be carried onwards, and that, having arrived at the most advanced point, they would be deposited (by their own weight) and remain stationary in common with that portion of the sac on which they rested, until the rest of the mass should again have flowed over them, causing them now to appear at the posterior extremity, when they would once more be carried along as before. * * * The essential attributes of sarcode, namely extensibility and contractility, coupled with the polymorphism evident in every example in which definite form is not partially maintained by the presence of a shell or test, necessarily involve the power of retracting as well as projecting these processes. Whereas the tenacity of the substance is not such that a pseudopodium once projected can be retracted toward the body in the same way that a piece of rope thrown forwards from a given point can be hauled in again, inch by inch. In the broad pseuopodium of *Amœba*, as also in the attenuated filaments of the Foraminifera, or the still more subtle filaments of *Acanthometra* or *Englypha*, the process is the same, and is brought about by a reciprocal outward and inward flow of the sarcode substance; and thus the granular particles are merely the passive exponents of a vital force which acts quite independently of them. For these reasons I would still regard the circulation of granules in the rhizopods as a pseudocyclosis, analogous, I grant, in appearance, but not in origin, to the cyclosis observable in certain vegetable cells, as, for example, in *Tradescantia*.' (Further Observations on the Distinctive Characters and Reproductive Phenomena of the Amœban Rhizopods. By the same author. *Annals and Mag. Nat. Hist.*, Nov., 1863.)

'It is deserving of special notice, moreover, that the facility with which coalescence takes place between the pseudopodia, and the adhesive faculty of the ectosarc, are such mutually dependent conditions as to be inseparable. In *Lieberkuhnia*, the Foraminifera, and the Polycystina, these characters are at a maximum. In *Amœba* they are at a minimum, and consequently denote the closeness of the relation existing between the degree of differentiation, as thus manifested, and the presence or absence of a true nucleus and contractile vesicle. The higher the degree of differentiation, or, in other words, the higher the grade of the organism, the more completely does *Amœbasis** take place in it. In *Amœba*, which occupies the highest position amongst the true rhizopods, the distinction between the external and internal portions of the sarcode-substance is at a maximum, and hence there exists an opposite condition to that present amongst the Herpnemata (the lowest order of rhizopods in my classification), and we meet with the smallest amount of inclination to coalescence, and the least degree of adhesive viscidity in the ectosarc. Lastly, and equally worthy of note, is the fact that the lower the degree of differentiation of the sarcode-substance, the more distinctly is the pseudocyclosis of granules observable, and the more completely does it approach, and even involve, the immediate surface of the pseudopodia; being dependent as already shown, not in an inherent faculty of the protoplasm to circulate, but on the inherent contractile power of sarcode, by means of which a con-

* The term applied by me to denote the reciprocal convertibility of endosarc and ectosarc. As stated in another paper, it is singular that the word '*Amoibe*,' from which the generic name *Amœba* is derived, signifies reciprocity or return, and yet that the true significance of the phenomena should not have been recognized.

stant interchange takes place between the interior mass and the external layer, and an equable distribution of nutritive material is secured in the bodies of the most rudimentary and testaceous types. When it is borne in mind that in none of the families of rhizopods is the circulation uninterrupted, and that it not only continually varies in rate, but frequently ceases altogether for a time, it will, I think, be allowed that any analogy between the phenomena and a special circulatory force is altogether discountenanced.' (Further Observations on the Distinctive Characters, Habits, and Reproductive Phenomena of the Amœban Rhizopods.' By the same author. *Annals and Mag. Nat. Hist.*, Dec., 1863.)

Lastly, the results already referred to 'could not take place if the two phenomena, namely, the vital contractility of the proloplasm itself and the circulating force by means of which the granules are impelled, acted independently one of the other. Did they act independently, any cessation or alteration in the one would not necessarily involve a cessation or alteration in the other, but the circulation of the granules would continue unchecked even when the protoplasmic mass had attained a state of perfect rest. And, notably, when the direction in which the protoplasmic mass had for a time been moving became suddenly reversed, the direction of the granular movement would remain unaltered, at least for a period, were the force producing it an independent one. But the direction which the granules continue to take under these circumstances almost immediately becomes reversed likewise, proving thereby that it simply follows the direction which has been imparted to it by the protoplasm. It only remains to be stated that these results are observable whenever a fresh pseudopodium is projected; every modification in the direction taken by the current of granules being distinctly referable to some corresponding change in the form assumed by the protoplasmic body generally.' (On the Rhizopods as embodying the Primordial Type of Animal Life. By the same author. *Monthly Microscopical Journal*, April, 1869.)

London, August 12th, 1885.

—o—

The Actinic and Visual Focus in Photo-Micrography with High Powers.*

BY JACOB D. COX, LL. D., F. R. M. S.

We find it commonly said that whilst the difference between the visual and the actinic focus is considerable when making photo-micrographs with low powers, it is not appreciable when using high powers. My experience does not accord with this statement, and some notes upon my own experiments may have interest to others.

If the statement had been that a sharp picture may be taken when the object is exactly in focus with a high power, I should not take exception to it, and I incline to think that this is what has been meant. But a sharp picture may be either a positive or a negative of the visual image seen in the microscope, and in my own work so many examples have turned out to be positives when I expected them to be negatives, that I have been led to make an investigation of the subject, in which the evidence tends strongly to show that with our best high power lenses the image fixed upon the sensitized plate is a positive instead of being a negative, and consequently the paper prints from this are negatives and not positives.

It would be very easy to overlook this difference in a large class of micro-photographs, because, in an alternation of dark and light lines, or dark and light spaces, it often matters little which of a pair is light or dark; the picture may be equally clear and satisfactory either way. In the case of a large majority of the microscopic objects photographed, either the posi-

* Read before the American Microscopical Society. Revised by the Author.

tive or negative image would be good enough for the purpose intended: so good that a close examination of the point I am now suggesting would hardly occur to one. This, in fact, was my own experience until, in efforts to get a good picture of the broken edge of fragments of the finer diatoms, my attention was arrested by the fact that the appearances seen by the eye were often reversed in the print from the supposed negative which I had taken. As, in dealing with minute areolæ this often amounted to showing a projection where I had seen an apparent depression, and *vice versa*, it became in effect a failure to photograph what I had seen, and challenged my best efforts to overcome the difficulty. If the illumination of such transparent objects as diatoms were always by a perfectly central beam of parallel rays of light, there would be no practical difference whether they showed light upon a dark ground, or the reverse. But we rarely get such exactly central illumination, even after our best efforts to do so. For example, plate No. 23 of my broken shell series was thus taken with light intended to be strictly central, a diaphragm being behind the achromatic condenser. which had a small circular hole in it, limiting the illuminating rays to the small central portion of the condenser, Yet in one position the central areolæ of the *Coscinodiscus* which it represents, appear as deep cups, whilst, if it be turned around so as to change places of top and bottom, they appear as projecting bosses.

No. 51 of the same series was the first in which I distinctly marked in my note-book the fact that the dots in that diatom, *Mastogloia angulata*, appeared dark in the instrument, but light in the photograph print. The difference of effect was least important in shells which are an even, smooth film of comparatively little thickness, and greatest in those in which the diatom seems to have strongly marked bars separating the lines of areolæ, as in *Pleurosigma Balticum*.

In a number of cases in which the plates were originally taken with a sharp focus upon the view of the shell which I desired, I have taken transparencies from them by contact, and using these last as negatives from which to print the paper prints, I have found that these last are, according to my notes, what the former should have been if there were no difference between the visual and the actinic focus. A few of these have been prepared for exhibition to the Society. The prints taken from the second plates are marked 'positives' of the originals, and are in fact the true representation of the object as I saw it when taking the original photograph. They are, No. 66, *Navicula serians*, Kutz., taken with a Spencer $\frac{1}{10}$ objective, balsam angle 125°, with No. 118 as the positive from it.

No. 60, *Pleurosigma Formosum*, W. Sm., taken with a Spencer $\frac{1}{10}$ objective, balsam angle 108°, with No. 122 as the positive from it.

No. 83, *Pleurosigma Formosum*, W. Sm., taken with a Whales $\frac{1}{15}$ objective, balsam angle 82°, with No. 119 as the positive from it.

No. 110, *Pleurosigma Balticum*, W. Sm., taken with a Zeiss $\frac{1}{18}$ objective, balsam angle 116°, with No. 113 as the positive from it.

The objectives are all of the first class, and it is safe to assume that what holds true with them will be found true with any of our best glasses.

In taking the original photographs, I used a plain plate of glass instead of the usual ground glass screen in the camera, and focussed by the aid of a Dorlot focussing glass.

The examples to which I have referred would seem to warrant the conclusion that in using high-power objectives the difference between the visual and the actinic focus is the equivalent of that between a positive and negative image of the object, when the details have passed a certain limit in fine-

ness. But some experiments, made for the purpose of finding how far the tube of the microscope must be moved to secure the proper actinic focus upon the sensitive plate, have had such unsatisfactory results as make me unwilling to venture any positive conclusion, but content myself with stating the facts above given, until further investigations which I am making shall be completed.

In the course of the experiments referred to, I noticed that the image taken on the plate was apparently of a lower plane in the object than the visual one which I was seeking to get. This was shown in the diatoms with a convex surface, by the sharper image, in the print or plate, of areolæ nearer the margin of the object than those upon which I had focussed. It showed also that the difference seemed to be the same in kind as in the use of low power objectives, with which it is necessary to raise (withdraw) the tube after getting a sharp visual image of the object. Acting upon this, I tried in several instances the gradual raising of the tube, taking pictures at slightly varying departures from the visual focus, until the image was quite spoiled and blurred to the eye. I made some series of as many as five or six plates, thus progressively varying, but without satisfactorily establishing any point (different from the visual focus) at which the objective should be placed to secure in the photographic image the true characters of the visual one. I was surprised to find at what a distance from the visual focus a sharp image could be taken, but it was not the image for which I was in search. Examples of this sort are among the prints which I will exhibit to the Society.

I design to add to my experiments on the subject, the examination of the effect of changing the focus of the focussing glass to correspond with the difference between the visual image of a diatom showing light dots or areolæ and that which shows dark ones. Everybody has noticed that a slight change of focus with a high power produces this change of appearance, and if the focussing glass were adjusted for the image which is complementary to the one desired and then the focussing done in the usual way, the result might be that which is sought. It has at least seemed worth the experiment, but a press of other work has prevented my making a satisfactory test of it before the time of our meeting.

—o—

American Society of Microscopists.

On the second day the proceedings were opened by some remarks by Dr. Detmers on the poisonous dried beef which caused violent sickness in Momence, Ill., some time ago. Dr. Detmers found abundance of bacteria in the specimen he examined.

Dr. Thomas Taylor demonstrated his methods of distinguishing fats with the microscope. This subject attracted considerable attention and a committee was appointed to examine the processes and report upon the results. The committee was first composed of Dr. Fell, Dr. Detmers and Mr. Vorce, but Dr. Curtis and Mr. Atwood were afterwards added. The work done by the committee before separating indicates that Dr. Taylor's methods are reliable. The members of the committee are individually at work on the subject. The method of observation was described in these columns last month.

Mr. J. Kruttschnitt presented a paper entitled 'Pollen Tubes Again.' This was followed by a contribution by Dr. Lester Curtis describing the method of cultivating micro-organisms. Dr. Curtis' method is to take a good potato, clean and boil it, being careful to get a potato that is not mealy. The potato is then immersed in a solution of corrosive sublimate. A scalpel is heated to a red heat and laid edge upward, as the bacteria which continually float in the air are less liable to attach themselves to the sharp edge than to the side or back

of the knife. The potato is carefully cut and the matter containing the germs spread over the cut surfaces. Then the potato, which must be carefully handled by a hand immersed in corrosive sublimate mixture, is placed on a blotter under a glass dish. The hand that touches the potato must be allowed to come in contact with nothing else until the operation is finished. Bacteria thus carefully planted will grow amazingly.

Professor H. L. Smith then spoke on 'Some Formulæ for Highly Refracting Media for Mounting,'* and described a simple instrument for testing homogeneous immersion fluids. (See page 181.)

Dr. L. M. Eastman then read a paper on 'Fatty Infiltration of the Liver,' which was discussed.

A paper by Professor W. A. Rogers, 'The Measurements of Eight Rowland's Gratings at 62° Fahr.' was read by title. Prof. Burrill presented a paper on 'Uredineæ of Illinois.'

A paper by Mr. Gundlach, 'Immersion Objectives,' was read by Mr. H. A. Turner, and Professor Kellicott read by title a paper on 'Some Fresh-Water Infusoria, with Descriptions of a Few Species Regarded as New.'

On the third day Professor S. H. Gage made some remarks on the blood-corpuscles of *Necturus*, which led to some discussion. Two papers by Dr. M. L. Holbrook, 'First Development of Muscle in Embryos of Chicken and Man,' and 'Studies on the Development of Cartilage in the Embryos of Chicken and Man,' were read by title. Dr. A. H. Tuttle spoke briefly on tumors in the mammary gland of the lower animals. Mr. Dutton, of Chicago, made a short speech in regard to the need of a publication devoted to microscopic subjects, and offered the following resolution:—

Resolved, That a committee be appointed by the chair to report upon the advisability of publishing a quarterly microscopic journal, to be published by the American Society of Microscopists.

The idea involved in this resolution did not seem to be regarded favorably by many of the members, and it was lost, although the vote was close.

A committee was appointed whose duty it was to select names for officers of the society for the ensuing year and report to a subsequent meeting.

The afternoon was taken up with the working session at Le Grande Rink. Perhaps we can do no better than to quote directly from the *Plain Dealer* the account of this meeting, which, although not strictly such as 'our special correspondent' would write, is sufficiently suggestive of what was to be seen:—

'It is not the purpose of this article to treat of the exhibits for the benefit of microscopists alone but to publish matters of interest to the laity as well. At one table were some wonderful micrometers. Rulings away up beyond the 150,000th of an inch were shown. One man, Professor Rogers of Cambridge, has won a wide reputation for the accuracy of his rulings of standards of fine measure. Dr. Fell, of Buffalo, showed a platino-iridium plate that had been ruled and adopted as the standard of microscopic measurement. The unit of measure is the millimetre, which on the plate is divided and subdivided until a powerful microscope is required to see the delicate lines. This plate, which looks so valueless to the uninitiated, is so highly prized that it is allowed to go out of the hands of Dr. Fell, who is treasurer of the American Society, only upon a resolution of the society. It is proposed to secure copies of the delicate measure in the future as soon as possible. There are not five men in the world who could prepare even an approximate duplicate, the making of which requires the most delicate machinery and carefully prepared metals. An extremely cold or hot day would make a vast difference with a standard not prepared with the utmost care.

* See this Journal, current volume, page 161.

'At another table a delicate apparatus was cutting a tumor into slices so thin that sharp eyes were required to see them. The keenest razor is a dull and clumsy edge compared with the blade of the delicate knife that was slicing the tumor, producing specimens to be mounted.

'A gentleman from Newark, O., had at one of the tables an apparatus for freezing specimens in order that they may be the more readily sliced. He froze a kidney firm as a rock before the eyes of the visitors. Then he took the lower jaw of a mole and ground it down, teeth, flesh, and all, several degrees thinner than the most delicate tissue paper. Not a tooth fell out of place in the operation.

'Professor Walmsley, of Philadelphia, well known to all microscopists, exhibited an apparatus for taking the photograph of anything, from a diatom to a bug. A little insect smaller than the period at the end of the preceding sentence loomed up when photographed larger than the top of a frying-pan.

'Nearly all the instruments were illuminated with little brass lamps, but some of the exhibitors were shown specimens by the light of electricity.

'Dr. James, of St. Louis, with a simple device, was mounting specimens rapidly.'

Dr. A. Y. Moore showed *A. pellucida* resolved by a Gundlach half-inch objective with an auxiliary lens attached in front (as first done by Mr. Wenham), which converted the objective into an immersion with a power midway between a $\frac{1}{3}$- and a $\frac{1}{4}$-inch. Mr. Spencer was present with a new $\frac{1}{15}$-inch of his own make, and the resolution was tested by that, and decided to be true, the lines being 96 to 0.001 of an inch. A photograph of this valve is to be made for the purpose of accurately counting the striæ.

The exhibit of photo-micrographs by Mr. Vorce was one of the finest and largest ever seen. There were about 350 prints from fourteen different workers.

Among other interesting demonstrations at the working session may be mentioned the following:—

The use of the micro-spectroscope and its application to original research, by Lee H. Smith.

The use of the polariscope in original research, by J. D. Hyatt.

Photography and its applications as an aid to research. Photo-micrography by lamplight, by William H. Walmsley. Gelatino-bromide enlargement by lamplight, and photo-micrography by sunlight, by Robert Dayton.

Micrometry. Expositions of methods, by George E. Fell, M. D.

Staining tissues in mass, simple and compound stainings, by A. H. Tuttle.

Staining sections, simple and compound stainings, animal sections, by L. M. Eastman.

Practical demonstration of the relation of aperture to power in microscope objectives, by Allen Y. Moore.

Special methods of cell making, cementing, etc., by Rev. T. J. Brownell.

The preparation and application of cements, formulas, etc., by Frank L. James.

In the evening the soirée was held, which is thus described by the *Plain Dealer*:—'It was a unique entertainment and attracted over fifteen hundred persons, including ladies and gentlemen of prominence. A more satisfactory place for holding the soirée could not have been selected. The success of preparing the affair largely depended on the exertions of the following soirée committee:—Chairman, C. M. Vorce; R. Dayton, M. D.; F. O. Nodine, M. D.; A. Y. Moore, M. D.; J. R. Owens, M. D.; M. Rodgers; John Sawyer.

'As usual at such gatherings certain tables were centres of intense interest. The crowds around these tables were so great that it was with difficulty that one could get near them.

'H. E. Summers, of Ithaca, N. Y., has a curious looking animal lying under a rag with its gills in range of the microscope. He kept it still, and one could see through the glass the wonderful sight of the blood swiftly circulating. The animal was a hideous looking affair, sometimes called by the wicked name of "hell bender." Next to it was a microscope showing the circulation of the green matter in a peculiar growth. R. N. Reynolds, of Detroit, shows specimens of grass from the Detroit river in which the circulation can be plainly seen.

'Mr. Reynolds had a most important exhibit. Few persons have an adequate idea of what lively stuff printers' paste is. Mr. Reynolds obtained a specimen from the paste barrel of the *Detroit Post and Tribune*. Having looked at the wriggling worms that made the mass literally alive one could understand why it is that newspaper paste so seldom sticks. The insects literally walk off with the pasted clipping on their backs.

'Mr. G. W. Stockley, of the Brush Electric Company, had an attractive table. He is a temperance man, and that too in the face of the fact that Lake Erie water that people in this city have to drink is liable to contain specimens of the *Rotifer vulgaris*, which he exhibited.

'Dr. Thomas Taylor, of Washington, showed samples of butter. The mieroscope reveals the peculiar cross that the doctor says characterizes the fat. He declares that it is a St. Andrew's cross, a trade-mark as it were from nature to distinguish it from adulterated compounds that never show the cross. Specimens of pure lard were also shown and also of butterine, which, under the glass, looks as little like butter as ink resembles limpid water.'

The program of the exhibition is too long to reproduce here. Looking over it we find many familiar names among the exhibitors, and many objects not often seen at exhibitions. There are one hundred and fifty-nine objects on the list.

On Friday morning, the last day of the meeting, the officers for next year were nominated and elected. They are as follows:—President, T. J. Burrill, of Champaign, Ill.; vice-presidents, Dr. F. S. Newcomer, of Indianapolis, and W. J. Lewis, of Hartford; executive committee, Dr. L. F. James, of St. Louis, John Kruttschnitt, of New Orleans, and E. H. Griffith, of Fairport, N. Y. The secretary was instructed to cast the ballot of the society for these gentlemen.

A resolution was adopted thanking Professor C. M. Vorce, of this city, for his efforts in behalf of the society. Judge J. D. Cox then made the following remarks:—

'Mr. Chairman, the custom of giving our retiring officers a vote of thanks is a good one, but there is some danger that it may become too formal. Our president, whose necessary absence this morning we regret, has not only discharged his official duties with ability, courtesy, and dignity, but I know I speak the feeling of the whole society when I say that it has been a constant delight to us to have him in our midst, and that we have constantly followed him with our warm affection as well as our heartfelt respect. We all earnestly hope he may many years be spared to lead us in everything which pertains to microscopy, and to raise the character of our deliberations by the wisdom and sweetness of his influence. In this spirit I move that the most hearty thanks of this society be tendered Professor Hamilton L. Smith for the manner in which has discharged the duties of the presidency during the past year.'

Dr. Lucien Howe, of Buffalo, read an interesting paper on the imperfection of the eye and test objects. This paper was discussed by Dr. Newcomer, who said that no two persons' eyes are the same; that we ought to consider astigmatism.

James E. Whitney's paper on 'Rapid Section Cutting' was read by title only. Dr. Manton's paper on preparing chicken embryos for the microscope was listened to with much attention. Mr. Hudson recommended the incubator as preferable and more regular than the hen.

Judge Cox's paper on 'Some Diatom Hoops' was carefully described and illustrated on the black-board.

The society received a communication urgently requesting that the meeting next year be held at Chautauqua. It was referred to the executive committee.

Dr. Detmers, in speaking of the value of such gatherings of microscopists referred to the importance of reliable microscopical evidence and cited an interesting case recently on trial in Illinois where a murder was committed in an old ice-house. The murdered man was found lying on a pile of pine sawdust. A man was arrested for the murder upon whose boots and pantaloons small particles of sawdust were found clinging. He claimed that he had not been near the ice-house where the murder was committed, but had been sleeping in another ice-house several yards away. It was conclusively shown that all the sawdust in the house where he claimed to have been was from hard wood. There was no hard wood sawdust in the house where the murder was committed. Particles of sawdust from the prisoner's boots and clothes were placed under the microscope by an expert, who conclusively proved that it was pine sawdust, exactly like that found at the scene of the murder. The microscopist's evidence led to the conviction of the prisoner.

The closing session was devoted to the reading of a few papers. H. E. Summers presented a paper on a new method of making a cabinet. C. M. Vorce, of Cleveland, read a paper on a combined focussing and safety stage for micrometry with high powers, and James H. Logan, of Pittsburg, on a new life slide. Professor Burrill talked about a new heliostat.

Treasurer Fell announced that the Royal Microscopical Society had given five guineas toward the Tolles and Spencer fund. It is proposed to build up an endowment, the proceeds of which shall be used in the way of prizes toward encouraging original research in microscopy.

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, $1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be $1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

POSTAL CLUB BOXES.—The boxes were started on their circuits from Troy on the 15th of last month. The plan of operations is the same as last year. Members should remember that new boxes to be filled will be sent out, probably in January, and they should be prepared to fill them with good specimens.

Box F contains the following specimens:—

1. Garden pea. W. C. Gorman. A vertical section of the germ, showing radicle and plumule, and cells stored with starch.

2. Sea mat, *Canda* sp. Miss Grace E. Edwards.

3. Group of diatoms, *Arachnoidiscus ornatus*. F. J. Seidensticker.

4. Gypsum crystals. C. M. Burgess. From copper queen mine, Arizona, supposed to be colored by copper.

5. Finger of monkey. Prof. Arthur B. Morrill.

6. Young horse-shoe crab. M. S.

Wiard. Mounted in glycerin. Mr. J. D. King writes:—'If these had been soaked in liquor potassa, followed with alcohol and glycerin, and mounted in a medium colored with eosin, they would have been both transparent and beautiful.'

NOTES.

—The best set of plates illustrating the diatoms is undoubtedly those of Schmidt's 'Atlas der Diatomaceen-kunde,' a large quarto work, of which 22 parts have been published, embracing about 88 fine plates. A set of these plates is now offered by a reader of the Journal at considerably less than cost, and any reader who may wish to purchase the set may write to the Editor for further information. The actual cost of the plates as received is $49.28.

—Mr. W. J. Simmons, in a communication to *Science Gossip*, describes a diatom in the fresh-water canals of Calcutta, which resembles in its form and manner of progression the *Bacillaria paradoxa*. The same diatom has also been found in the Lehigh River at Bethlehem, Pa., by Rev. Francis Wolle. It appears, therefore, that the species is not absolutely confined to brackish water.

—We have received six very fine mounts of vegetable and animal preparations from Mr. Arthur J. Doherty, of Manchester, England, who has recently offered sections cut and stained ready for mounting, on one of our advertising pages. The sections are evenly cut and stained perfectly. An excellent opportunity is thus offered to microscopists to obtain first-class sections for mounting. The specimens received include sections of human spleen, ovary of *Rhododendron ponticum*, root of *Rubus fruticosus*, and leaf of *Ficus elastica*.

—We have received from Mr. A. B. Leckenby, of Rochester, a combination of a pencil case and a microscope, which he has devised for the use of school children in the study of botany. It consists of a thin tube of brass to hold the pencils, at one end of which is a lens mounted in such a way that when drawn out of the tube it is a simple microscope, well adapted for studying seeds and parts of plants, insects, etc. In addition to the microscope pencil case, Mr. Leckenby has prepared sets of fifty slides of seeds, neatly mounted on stiff paper, to accompany it. The case and sets of seeds will be a source of pleasure and instruction to children, and also to persons more advanced in life, for this little microscope can reveal a world of beauty.

—*Entomologica Americana* is an excellent monthly magazine covering the whole field of entomology, published by the Brooklyn Entomological Society. It is a combination of the *Bulletin* of the Society and *Papilio*. The editor is Mr. John B. Smith, who is writing 'An Introduction to a Classification of the N. A. Lepidoptera,' now being published in the magazine.

—The report of the botanist of the New York Agricultural Experiment Station, Prof. J. C. Arthur, for 1884, has recently been published. It is a pamphlet of about thirty pages, and contains much interesting information concerning fungus diseases of trees. The production of gum on the limbs and trunk of peach, pear, and other fruit-bearing trees, and also upon the fruit itself, has received attention. The results of experiments indicate that the abnormal production of gum is caused by a fungus of some kind, possibly a bacterum, but more likely a filamentous fungus, not necessarily a single species. The observations recorded in the report indicate that a large field for investigation is open in connection with the fungus affections of trees, fruits, and vegetables.

—Dr. T. B. Redding has prepared a report of '*Trichina spiralis* and Trichinosis, including an examination of Indiana Hogs,' under direction of the Indiana State Board of Health. It seems to be mainly a compilation from other documents treating of the subject. There is, however, a valuable bibliography of the subject appended. The author examined 610 Indiana hogs and found 4¾ per cent. infected. Other observers found from 4 to 12 per cent.; about Lawrenceburg, of 245 hogs examined in 1875, 16⅓ per cent. were infected, but this seems to be an exceptionally infected locality.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Diatomaceous clay from this place, and fine slides of Foraminifera, for fine slides, material or back numbers of A. M. M. Journal.

E. H. RICHARDS,
Woburn, Mass.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., NOVEMBER, 1885. No. 11.

Photo-Micrography.—I.

BY THE EDITOR.

It is after considerable deliberation that we have decided to prepare a series of articles on this subject, the first of which is published this month. There are so many small and inexpensive but excellent manuals for amateurs and beginners in photography, that it has seemed in the past quite unnecessary for us to devote so much space to the subject as the proposed scheme will require. However, when we consider the special branch of photo-micrography as distinct from general photography, it will be seen that the literature is not so exhaustive or readily accessible as may at first appear.

It is customary to begin a series of articles like this with a general notice of the literature of the subject, but this we cannot do. Perhaps a review of what has been done in this connection may be prepared for a future article. Recent literature of the subject is well represented by Dr. G. M. Sternberg's book, 'Photo-micrographs and How to Make Them,' which is a useful book of reference.

We have been led to undertake the preparation of these articles in response to the expressed wish of some of our subscribers, and it is proposed to make them comprehend all the operations from focussing in the camera to finishing the silver print on paper, including also certain approved methods of treating negatives to correct imperfections. They will, therefore, afford the reader a complete treatise, embracing all the operations an amateur, either in photo-micrography or field photography, is likely to undertake.

The subject will be treated in successive articles under the following divisions: —

1. General consideration of photographic methods.
2. Apparatus for photo-micrography.
   - *a*. Microscope and accessories, camera, etc.
   - *b*. Plates, chemicals, developing apparatus, dark room, etc.
3. Exposing the plate.
4. Developing the negative.
   - *a*. Ordinary process of development.
   - *b*. Correcting errors of exposure or development.
5. Making transparencies.
6. Making silver prints on paper.

With so much by way of introduction, we proceed to take up the first division of the subject.

1. GENERAL CONSIDERATION OF PHOTOGRAPHIC METHODS.

One of the first questions that will present itself to the beginner in this work is the kind of light to be used. If he begins to look through the photographic periodicals for information on this subject, the result may not be quite satisfactory. Very likely he will find an article by Maurice N. Miller, M. D., evidently an operator of experience, who thus expresses his views on this subject: 'The minor methods of lighting—by oil, gas, etc. —do not deserve any consideration at our hands at this time. We are engaged in the attempt to produce the very best results obtainable, and I know very well that no amateur is

going to be satisfied with silhouettes made with a dark lantern attached to a camera box.' Even the electric light is condemned by this writer, who says: 'The incandescent lamp is of no use, except as previously indicated, for very unambitious attempts with low powers.'

There is no mistaking the author's meaning in this regard. Nevertheless, we venture to express an opinion more or less opposed to his; for not only is it true that photographs of delicate objects of all kinds have been made, by artificial light, perfectly sharp and satisfactory in every way, but it is possible that lamp-light may be found in certain cases to be even better than sunlight. But the practicability of using artificial light is fully demonstrated by the excellent work of the Hon. J. D. Cox on diatoms, with powers of 1000–1500 diameters and more. Mr. W. H. Walmsley, who is also an experienced worker in this field, and who gave some eminently practical demonstrations of photo-micrographic work at the meeting of the A. A. A. S. last summer, which have been highly commended, will fully confirm the value of artificial light for this purpose. As for the incandescent electric light, we need only refer the reader to the work of Dr. Van Heurck, with powers of $\frac{1}{12}$ or $\frac{1}{18}$-inch,* and to the article on the Electric Light in Microscopy, published last year. (Vol. v, p. 222.)

It shall be our endeavor, in writing these articles, to make them eminently practical. Only well-tried and reliable methods will be given, and not one that the writer cannot fully recommend from personal experience with it. While we hope to make the directions and explanations so clear that any person can follow them and perform the operations, yet it is desirable that the beginner should spend some time in the developing room with an experienced operator to see the methods of working.

In order that the beginner may work intelligently it is advisable he should know something of the chemistry of photography. The sensitive plate is a piece of glass (or other material) coated on one side with emulsion. The emulsion is prepared by dissolving silver nitrate in a solution of gelatin in water, and adding thereto potassium chloride, bromide or iodide, or a mixture of these. The result of this addition, which must be made in a room lighted with ruby-glass windows, is to throw down, or precipitate, very finely divided particles of silver chloride, bromide or iodide, since these silver compounds are quite insoluble. These minute particles remain suspended in the gelatin. It is these minute particles that are sensitive to light, and from this time until the plate is exposed in the camera, and the picture is fully developed, the emulsion must be carefully protected from all except red light, to which the particles are not sensitive. The emulsion thus prepared is cooled, the gelatin solidifies, and is then thoroughly washed in water. It is then melted, flowed over glass plates set perfectly level, and allowed to dry, thus making a thin, hard coating which is the sensitive film.

The degree of sensitiveness depends upon many conditions, but primarily upon the silver compounds used. Thus the chloride is less sensitive to ordinary daylight than the bromide. The chloride is sensitive to blue and ultra violet rays, the bromide is also sensitive to green and yellow light, and the iodide has its special range of sensitiveness in the spectrum. Advantage is taken of these peculiarities for particular purposes, hence we have gelatino-chloride emulsions, gelatino-bromide emulsions, etc. The plates generally used for ordinary photographic work are made with bromide emulsions containing some iodide.

When such a plate is exposed to light in a camera, the particles of sil-

* This Journal, current volume, p. 44.

ver chloride, bromide or iodide are changed in some way, not very clearly understood; where the light is strongest the change is greatest, and where it is weaker the change is proportionally less, and thus an image is impressed upon the plate, known as the invisible image, because it is only brought into view by the subsequent process of development. The image is not, however, absolutely invisible, for it can be seen on a plate that has been long exposed. The change produced by the light is not entirely understood, but the weight of evidence indicates that it is purely a chemical change. It is supposed to consist in a partial separation of the bromine, chlorine or iodine, as the case may be, from the silver. This change once effected is permanent, and plates may therefore be exposed at any time, and developed months afterward.

Coming now to the subject of development, it will suffice to say that a developer is a solution which completes and intensifies the action begun by the light. Thus, if we suppose the silver bromide is partially decomposed by the light, having lost a portion of its bromine, the developer removes the remaining portion of the bromine, leaving metallic silver, in the form of a black deposit. The quantity of silver thus reduced to metal in different parts of the film corresponds exactly to the intensity of the action of the light at those parts; hence, wherever the lights are brightest, we find the thickest and most opaque deposit of silver, and in those parts where there was least light—in the deep shadows of the picture—there may be no reduction whatever. Thus it is that what is light in the object is dark on the plate and vice versa; hence we designate the plate a negative.

The next operation, known as fixing, consists in dissolving from the film all the unchanged silver compound that is still sensitive to light. When this is done the negative has only to be washed and dried. It will then consist of a film of gelatin retaining the metallic silver picture produced by light and development.

[*To be continued.*]

—o—

The Magnifying Power of an Inch Objective.

Seeking to answer the question at the head of this note, reference was made to two or three catalogues with unexpected results. It must be understood that in all cases referred to, the standard length of tube and a two-inch eye-piece are supposed to be used.

So far as the data go, the inch objective has assigned to it magnifying powers ranging from 46 to 55 diameters. On computing the inch-value of objectives of higher and lower power, the same data being used, the differences expand and the extremes are 36 and 60 diameters. These figures require no comment.

The system of nomenclature recommended by the committee on eye-pieces of the American Society of Microscopists will no doubt soon be universally adopted; why cannot a similar committee be got to settle the standard value of an objective, which, with standard length of tube, and a two-inch eye-piece, shall have a certain magnifying power and be called a one-inch? To this standard it will be necessary to fix limits of deviation to meet the mechanical difficulty in making systems of lenses with precisely the same magnifying power:—from this standard inch, all other objectives can have their standards calculated and their limits of deviation decided.

These suggestions are made in the hope that microscopy may be placed in possession of standardized tools, whereby its results may approach as closely as possible to precision and uniformity. Owing to the defective nomenclature now in use, much confusion and not a little nonsense is frequently presented.

In the following table the power of the inch is taken at 50, supposing a

single lens of that focal length to magnify 10 diameters. Of course the value of such an arrangement depends on its authority. The table was made for my personal convenience, and I send it solely for the purpose of giving a better idea of what I have in mind.

A tube of standard length (ten inches) and a 2-inch eye-piece are to be used in all cases where this table is referred to.

Focal Length.		Limits of Variation.	Linear Magnifying Power.	Limits of Variation.
4-in.	4.000		12.50	
		3.750		13.39
3½	3.500		14.28	
		3.250		15.47
3	3.000		16.66	
		2.750		18.33
2½	2.500		20.00	
		2.250		22.50
2	2.000		25.00	
		1.875		26.78
1¾	1.750		28.57	
		1.625		30.95
1½	1.500		33.33	
		1.375		36.66
1¼	1.250		40.00	
		1.125		45.00
1	1.000		50.00	
		.9375		53.57
⅞	.8750		57.14	
		.8125		61.90
¾	.7500		66.66	
		.7016		70.83
⅔	.6666		75.00	
		.5833		87.50
½	.5000		100.00	
		.4687		107.14
7/16	.4375		114.28	
		.4187		119.64
4/10	.4000		125.0	
		.3666		137.50
⅓	.3333		150.0	
		.2916		175.00
¼	.2500		200.0	
		.2250		225.00
⅕	.2000		250.0	
		.1833		275.00
⅙	.1666		300.0	
		.1547		325.00
1/7	.1428		350.0	
		.1339		375.00
⅛	.1250		400.0	
		.1180		425.00

—o— W. M.

Rotary Object Carrier.

BY J. M. FLINT, SURG. U. S. N.

The following described device for exhibiting a series of mounted microscopic objects, without the inconvenience of a change of slides, though probably not entirely new (few things are so), is yet original so far as the writer is concerned, and has been found efficient in practice. As described it is arranged for showing foraminifera, which are viewed as opaque objects, with a low power. The selected foraminifera are mounted on small brass disks furnished with a stem, by means of which they may be carried in a 'Beck's disk holder' when it is desired to make a thorough study of the specimens.

Ordinarily these disks are inserted in thin wooden slides of regulation size and kept in the usual boxes made for the purpose, until the series is complete or ready for transfer. In order to protect the specimens from dust or injury, and at the same time maintain their accessibility, movable covers are constructed and secured as follows:—A score or more of curtain rings, not flattened, are slipped upon a squared rod of wood, and brushed over freely with thick shellac. On the following day, before the shellac has become hard, the rings are slightly separated in pairs. When the pairs are firmly united, a thin glass cover is secured to the upper surface of each pair, and thus a little box cover is formed, deep enough to enclose disk and specimen. Now, by driving two small gimp tacks into the wooden slide, at the proper distance apart, and deep enough so that the heads of the tacks will just enter the groove between the rings, a simple catch is formed, by means of which the cover may be secured, and also be removable at pleasure.

For exhibition—and for convenience of reference as well—these disks, bearing the specimens and the covers, are transferred to a thin circular plate six inches in diameter, in this case made of three or four sheets of card-board glued one upon the other. This makes a firm plate, not liable to warp, and in which holes may be readily bored for the insertion of the disks, and the tacks driven to secure the covers. By inserting the disks as near the edge of the plate as possible, a line fifteen or more inches in length is obtained on which to display the objects. The circular plate bearing the specimens as above, is made

to rotate upon a pivot passing through its centre in such a way that the objects are brought successively into the field of the microscope.

The manner of support of this pivot and its attachment to the stage of the microscope must depend upon the instrument used, which, however, should have a stage with mechanical movements, and the attachment be made to the upper stage-plate, thus giving control of each object when brought to the field, in the same manner as if it were mounted upon the ordinary slide. The writer, having a Beck's first-class stand, constructed a pivot support out of a piece of thin board (cigar-box), two inches wide and three inches long, the pivot being a common wood-screw inserted near one end, and carrying a wooden nut to steady the revolving plate, and the attachment to the stage-plate being effected by means of four small screws driven nearly home on the under side of the thin strip bearing the pivot, the heads of the screws being so arranged that they slide into grooves on the stage-plate, which ordinarily carry one of the clamps for securing the object slip. A more elegant, but not more efficient, support of brass has since been obtained of the instrument maker.

Shallow notches made with a round file on the edge of the revolving plate, into which drops the curved end of a light spring serve to inform the observer when the object is in the proper position in the field. The space within the circle of object is utilized for labelling the specimens.

Though requiring much verbiage for a description which may still seem not very clear, the apparatus is really very simple, and was entirely constructed by the writer out of materials at hand. Designed solely for the purpose mentioned—the exhibition of foraminifera—yet with slight modifications it seems capable of serving a more general purpose. Transparent objects might be mounted on small squares of glass, made transferable from wooden or glass slips to the revolving plate as above, the necessary holes being made in the plate to allow the passage of light from below.

The convenience of such an arrangement is obvious, whether for exhibition of objects to the unskilled (the only manipulative skill required on the part of the observer being adjustment of focus), or for personal reference and comparison, a series of specimens being examined in this way as readily as if they were plates in a bound volume.

U. S. Fish Commission Steamer
Albatross,
July 30th, 1885.

—o—

Bausch & Lomb Microtome.

A short time ago we had an opportunity to examine and use one of the microtomes recently introduced by the Bausch & Lomb Company. The results of our short trial were eminently satisfactory, and we take pleasure in presenting our readers with an illustration of the instrument this month. It is not so elaborate as some of the foreign devices, which are no more efficient, so far as we are able to judge. Some minor improvements have been made since the cut was prepared, to facilitate the removal of the pan and in the movement of the block which carries the knife. It will cut successive sections without interruption $\frac{1}{1500}$ to $\frac{1}{2000}$ of an inch in thickness. We can do no better than give the description of the makers, which is as follows :—

'The base, curved arm, upright and v-shaped beds are made of one continuous casting, thus insuring extreme rigidity, without excessive weight. The knife-carrying block is fitted in the angular way and rests upon five points; this latter feature insures the least friction and consequent ease of movement with the greatest stability, and is the nearest approach to a perfect plane. Contained in the block is a spring which

bears against a projecting flange on the upper end of the v-shaped bed, so that no matter how hard the material may be, the knife moves steadily through it without deviating from its plane and without requiring any extra pressure. The upper surface is provided on its entire length with a grooved slot, to which is fitted a sliding thumb-screw, so that the knife may be fastened at any point upon it.

'The knives, which are specially made for these instruments, have a curved arm with slot, so that any part of the cutting edge may be used; they are made of the finest steel and are guaranteed. Stop-screws with soft rubber cushions are fastened at the ends of the angular way.

'The front vertical bed is planed and polished and is arranged with a grooved slot its full length. The adjustable carriage is fitted to it and may be securely fastened at any point upon it by means of two heavy screws. The tightening pin for these, when not in use, has a receptacle in the solid bed. It will thus be seen that, whether it is desired to make a straight or very oblique cut, the carriage with object may be placed at such a point where it is the most convenient in its relation to the cutting edge.

'To the carriage are directly fitted the micrometer screw with graduated disk and a slide which is acted upon by the former. A provision is made for taking up the possible wear on the screw. At one side of the carriage a spring is attached which works in the grooves on the edge of the disk with a pronounced click, so that the feed may be controlled without watching it; this may be loosened, so that it will not act, when it is desired to use the index only. A lever with ivory handle is connected with the slide, so that this may be returned after the screw has come to the limit of its motion.

'The slide is provided with a grooved slot, which admits of the quick adjustment of the universal joint and clamp for specimens of different lengths. The universal joint permits inclination in any direction and the clamp will receive objects up

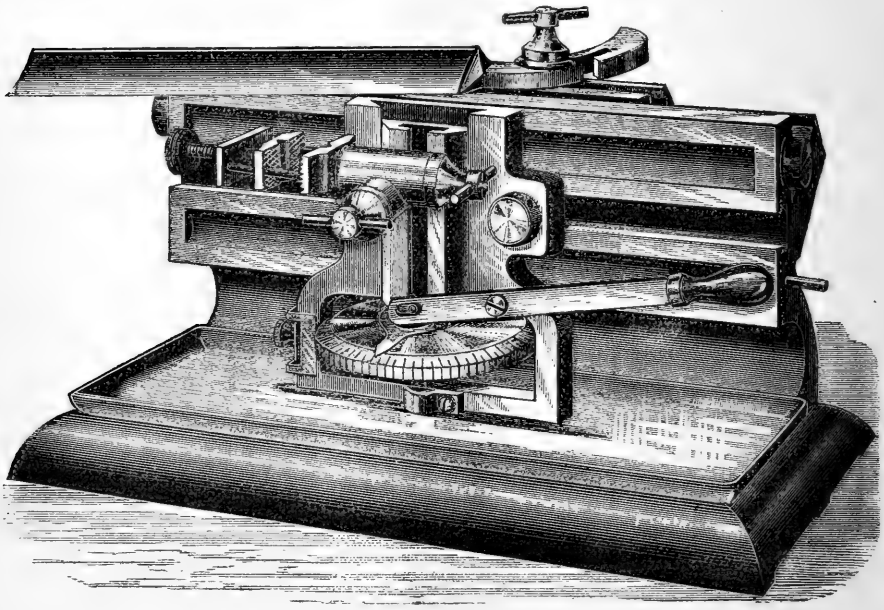


FIG. 30.—Bausch & Lomb Microtome.

to one inch diameter. A nickel plated drip-pan is fixed to the upper suface of the base.

'The solid portions of the instrument are japanned, while those which come in contact with the hands are highly polished and nickel-plated.'

Two sizes are made, for $40.00 and $47.00, respectively, complete with knife. A still cheaper form of microtome, designated the Student's Microtome, is made by the same company for $32.00.

—o—

On the Precise Relations of Micro-Organisms to Disease and the Science of Disinfection.*

BY CHAS. T. KINGZETT, F. I. C., F. C. S.

While the connection of micro-organisms with the chief contagious fevers is, as yet, a matter of pure inference, it is impossible, in the face of the results of modern investigations, to deny the intimate relations of micro-organisms to certain other diseases, including puerperal fever, pyæmia, septicæmia and anthrax of cattle; but of the nature of the precise relations next to nothing is known. The physiological effects produced by inoculation experiments can be readily observed, but the physiologist can not lay his hands upon the active principles which cause them. In this connection, I am convinced he can ascertain nothing of a final character without the aid of a chemist; and because this fact seems to me to have been entirely neglected in all recent investigations, I now beg to direct special attention to this matter, and to indicate how far reliance is to be placed upon the germ theory of disease, and the use of disinfectants as controlled by that theory. In the first place, then, I shall endeavor to show that the effects which are witnessed in certain diseases are not caused by micro-organisms, but by chemical substances which are elaborated in or by them by way of secretion, excretion or otherwise; and, secondly, I shall show that the methods now commonly employed by many microscopists and physiologists for testing the action of disinfectants are entirely and radically erroneous.

To demonstrate my views upon the first of these subjects, I will take three well known facts, and consider each very briefly.

In the report of the Medical Officer of the Privy Council for 1876, there is a description of some carefully conducted and important experiments made by Dr. Burden Sanderson, in confirmation of the earlier investigations of Panum. In these experiments a septic solution was prepared by precipitating putrilage with alcohol, re-dissolving the precipitate in water, evaporating the extract to dryness and re-dissolving the dried residue in water. From a series of physiological experiments made with this solution, Panum arrived at the conclusion that 'there exists in putrid fluid a specific chemical body which is soluble in water, and is endowed with the property, when introduced into the circulating blood, of calling into existence that peculiar group of symptoms which are recognized as those of septic infection;' and, to use the words of Mr. Simon in reviewing these results, 'Dr. Sanderson, though apparently still supposing that the septic ferment is particulate, seems to regard, as proven by Prof. Panum's experiments, as well as approximately by his own, that it "does not consist of living organisms."' It has been proved then that micro-organisms, in course of putrefactive fermentation, initiated by them, produce one or more chemical products, which act as specific poisons and as infectants in pyæmia, septicæmia, etc.

The attenuation of the virus of chicken-cholera, which has been described by Pasteur, admits only of a chemical explanation. How can it be explained that micro-organisms,

* British Medical Journal.

freshly cultivated in clear *bouillon de poule*, exhibit a murderous fatality when inoculated under the skin of previously healthy fowl, while the same micro-organisms, in equal number and activity, taken from a cultivation mixture which has been freely exposed to the air for a long time, are devoid of this property? To suppose that a morphological change can account for the observed difference in effects is, if not actually absurd, at least entirely unwarranted; and the only explanation is that the micro-organisms in question have nothing to do directly with the poisoning effects we are considering, but that they are due to a specific chemical product which is present in the freshly cultivated mixture, but which is absent in the stale mixture. Possibly it is destroyed by oxidation carried on by atmospheric oxygen.

Again, in the thirteenth annual report of the Local Government Board, Dr. Klein has described experiments which seem at first blush to indicate a variability in the degree of virulence of the *Bacillus anthrasis*, but further experiments proved that the observed facts were 'irreconcilable with the assumptions (1) that the bacillus is in reality capable of undergoing a diminution of its physiological activity—that is, suffering a real attenuation, and (2) that there exist anthrax bacilli having an intrinsic virulence of various degrees.' He then adds, 'The fact seems, however, capable of another explanation. Owing to different conditions of growth, for example, high temperature, or other artificial conditions, or owing to different soil on which they grow, for example, the body of a mouse or of a guinea-pig, the bacilli, although themselves the same, embody or appropriate, chemically or otherwise, some new or different substance, which produces the alteration for a particular species of animals. Whether this substance is comparable to a ferment or not, I am not in a position to say: possibly it is some ferment produced by the new conditions.'

It will at once be seen that Dr. Klein almost embraces the chemical theory of disease, which for some years I have persistently advocated; at least, he has himself furnished evidence which gives immense support to my views.

Prof. Virchow also, while hesitating to allege the inadmissibility of a mechanical hypothesis of disease caused by micro-organisms, yet clearly thinks the assumption of chemical action remains as the only real explanation, as will be evident to all who are conversant with his writings, and notably with his article on 'Infectious Diseases in the Army,' which has been translated from the German by Dr. J. James.

The chemical theory places us at once upon ground with which we are familiar, and gives us an assurance of security. Just as the yeast-cell decomposes a solution of sugar by the agency of a soluble zymase which it is supposed to produce, and as the *Mycoderma aceti* oxidizes (by the assistance of the air) alcohol into acetic acid, and as the *Bacterium lactis* sours milk and produces lactic acid, so also do the micro-organisms which initiate putrefaction produce definite chemical products, which act as blood poisons; and the micro-organisms which are known to be intimately associated with certain specific diseases act as the excitants, not in a primary or mere mechanical sense, but in a secondary sense, viz., by the agency of chemical substances elaborated by them under suitable conditions.

These reflections necessarily take us a step further. If there be no sugar present in its soil, the yeast-plant can not produce alcohol; but it is not to be assumed (at least, in the absence of sufficient evidence) that this micro-organism can live only upon sugar. It is highly probable, indeed, that any one micro-organism can live and thrive under a

variety of conditions and upon a great number of soils; and so the products of fermentative change must necessarily vary accordingly. Many of them may be poisonous in character while many others may be innocuous. So also it must be with the micro-organisms which are associated with disease, in consequence of which it follows that so-called zymogenic organisms may become pathogenic in character—simultaneously with a change of soil or other condition—and *vice versa*.

Reviewing all these possibilities and facts, is the science of disinfection to throw overboard all accumulated knowledge, experience and faith in the action of all disinfectant substances which are not under all conditions germicidal in property? Is the object of mankind henceforth to be the destruction of micro-organisms? If such an object could possibly be regarded as well founded, even then it were idle to attempt its consummation, for micro-organisms are ubiquitous and constitute a necessary order in creation. By acts of hydrolysis, and oxidation carried on upon all dead organic matter by their agency, such substances are resolved into final innocuous products of change, which are essential to the well-being of the higher orders of creation (plants and animals).

The fact is, that men always outstep the natural limits of a discovery and jump at conclusions which are not warranted by the results of further investigation. The somewhat sudden discovery of the intimate association of micro-organisms with disease led many to think that, in order to prevent the spread of disease, the micro-organisms must be killed wherever met with; but, now that scientific investigation has proceeded to a further stage, it is being found that it is not the micro-organisms themselves that are poisonous to man, but the products to which they give rise under certain conditions. Those, therefore, who have the charge of the public health must now trim their sails anew, and henceforth the study of this matter enters upon a new phase, which is chemical in its character. We must now seek to discover under what conditions and from what substances various micro-organisms elaborate poisonous substances, and also to determine the chemical composition of these products.

In the meantime physiologists and microscopists must abandon their old methods of testing disinfectants. It will no longer serve, in order to ascertain the value of a disinfectant, to take a particular colony of micro-organisms and expose them to the presence of the disinfectant, with the view of ascertaining if they are killed thereby, by means of subsequent attempted isolation and culture; nor will it suffice to expose a colony of micro-organisms to the presence of disinfectants, and, after isolation, to inoculate animals therewith. On the other hand, the infectants must be introduced into the bodies of animals simultaneously with and in the presence of the disinfectant, and if the specific disease do not follow upon the inoculation the disinfectant is a reliable one for that particular set of circumstances.

After all, then, we fall back upon old lines of policy, and must have recourse to chemical substances which act on the one hand as antiseptics, thereby preventing micro-organisms from multiplying and producing poisonous substances (real infectants) and substances which by chemical changes, such as oxidation and chlorination, act in a destructive sense to the same chemical poisons if they happen to be already in existence. Indeed, the idea of employing some active chemical poisons, such as carbolic acid, sulphurous anhydride, absolute alcohol, creosote, chlorine and corrosive sublimate for the treatment of diseases like cholera, typhoid fever and dysentery is, of course, absolutely out of the question; and the only hope is that a non-poisonous

antiseptic, such as 'sanitas' fluid—which may be administered internally—may be found to supply the means that is urgently called for, of combating such fearful diseases.

Of the nature of the chemical poisons referred to in the preceding paragraphs as constituting infectants related to specific diseases, I can only suggest that they are derivates of albumen produced by a series of chemical changes involving hydrolysis, and in connection with this subject the investigations of O. Nasse and P. Schutzenberger have already paved the way for the comprehension of results which may be expected to speedily attend new researches into the chemistry of diseases. I particularly refer to such investigations as those conducted by Selmi with reference to pathological basis formed in the tissues and to the experiments of the same investigator, Paterno and others concerning the formation of ptomaines and the alkaloids produced in putrefaction. It may be remembered that Selmi, suspecting that in various diseases poisonous substances are formed in the tissues, and that these determine the death of the patient, analyzed the urine of patients affected with progressive paralysis, miliary fever and rheumatic tetanus and found in all cases that poisonous bases were present. One of these bases resembled nicotine in its properties, while another had the odor of conine, and a third substance (among others) was obtained which was white and crystalline and was capable of determining the conversion of starch into glucose.

These facts, and the well ascertained formation of poisonous alkaloids among the products of putrefied albumen, not to speak of what is known regarding the physiological action of alkaloids generally, including abrin (from jequirity-seeds), may all be regarded as preparatory evidence of the production both in and out of the human body of highly poisonous substances, or infectants, by the agency of micro-organisms. In conclusion, I wish to add that I am now carrying on a series of investigations concerning the chemical history of some micro-organisms, and I am confident, from the results already obtained, that they will lend strong confirmation to the views I have herein expressed concerning the relations of micro-organisms to disease and the qualifications of disinfectants.

—o—

Staining Tissues in Microscopy.* V.

BY PROF. HANS GIERKE.

[*Continued from p. 156.*]

96. Calberla. Ein Beitrag zur mikroskopischen Technik. Morph. Jahrbuch, iii, 1877, p. 625.

Calberla introduced methyl green and indulin into microscopy. A watery solution of the first differentiates the elemental tissues. The nuclei of the cells of the subcutaneous connective tissue, of the vessels and nerve-sheaths, stain red, the corium cells violet and those of the Malpighian network greenish blue. A combination of methyl green and eosin is highly recommended. (See double staining). Indulin is soluble in warm water and dilute alcohol. A dark blue aqueous solution is best, or a concentrated solution diluted with six times its volume of water. Sections remain in this 5 to 20 minutes, and may be cleared up in glycerin or oil of cloves. Indulin stains the cell contents, and especially the intercellular substance, never nuclei.

[* *Note by translator.*—The anilin colors are chiefly obtained from coal tar by a series of complex chemical reactions. The manufacture began in 1856, and nearly all are made in Germany. The first samples put on the market were not all permanent, but by improvements in the manufacture of some, and substitution in other cases, they are now as unfading as any other class of dyes. Their coloring power is very great, a few grains would color all the material required by a microscopist, and they can readily be obtained by mail from importers, such as Pickhardt and Kuttroff, 98 Liberty st., and Lutz and Movins, 15 Warren st., New York City, Read Holliday Sons, 45 N. Front st., Philada., H. A. Gould & Co., 17 Pearl st., Boston.]

97. v. Thanhoffer. Ueber die Entzündung nebst einigen Bemerkungen über die Structur der Hornhaut und über die Eosin Reaction. Centrabl. d. med. Wiss. 1877, No. 49, p. 881.

Eosin was used in investigating blood corpuscles and blood vessels. (See No. 87). Treatment by a one per cent. solution of perosmic acid for a few seconds or a minute before staining, intensified the color and made the preparation more permanent. (This modification of Wissowzky's method is very much to be recommended. I have found best a 3 minute dip in a ½ per cent. osmic acid bath, then wash well and put in the eosin-alum-alcohol of No. 87).

98. Cech C. O. Eosin als Tinctionsmittel. Zeitschr. f. Mikrosk. i, p. 65–73.

Eosine is recommended for staining.

99. Renaut. Applications des propriétés élective de l'éosine soluble dans l'eau à l'étude du tissu conjonctiv. Arch. de Phys., 1877, 2 Sér., iv, p, 211–243.

Sections are treated ½ to 1 minute by an aqueous solution of eosin to which ⅓ part of alcohol is sometimes added, then washed in distilled water and preserved in glycerin containing one per cent. of salt. The latter is required to counteract the solubility of eosin in glycerin. Protoplasm takes the dye readily. In investigating subcutaneous connective tissue, a solution of one part eosin to 500 water may be injected. Elastic fibers color strongly, granulated protoplasm masses show an intensely red nucleus, fixed cells become rose color, and the bundles of fibrillæ and striated tissue remain colorless. Tactile corpuscles are no darker than protoplasm. Cartilage cells show dark nucleolar granules, but the cartilage proper or fundamental tissue does not stain. The nuclei of the endothelium, those found between Ranvier's cords and those belonging to Remak's fibres, all stain more intensely than their surroundings.

100. Erlicki. Sur les moyens de durcir et de colorer les tissus de centres nerveux. Progrès méd. 1877. Sep., 29. Revue des Sc. méd., XI, 13; Warschauer med. Zeitschrift. xxiii, No. 15 und 18.

Erlicki used green methyl anilin in his examination of the large nerves. He made a 2½ per cent. aqueous solution and left sections 24 hours therein. The nuclei of the neuroglia became green, while the axis and ganglia cells remained uncolored. (The dye I have used with the above name does not produce such differentiation).

101. Weigert. Bismarckbraun als Färbemittel. Arch. mikr. Anat. xv, 258–260. 1878.

Bismarck brown, an anilin dye, is recommended for microscopic work and preferred to carmine, picrocarmine, and eosin. Weigert names the following properties of a good dye. It must stain with certainty, quickly and not in excess, and should bear long washing without extraction, must be permanent and capable of preservation in mediums not too highly refractive. The Bismarck brown of the Berliner Actiongesellschaft für Anilin farbenfabrication has these qualities in a higher degree than any other stain. A concentrated solution in water, or a weak alcholic solution is employed. The first is prepared by boiling the dye in distilled water and filtering. Material hardened in alcohol or chromis acid stains equally well. The staining may be done in a few minutes, but no injury occurs if the sections lie in the dye some time. Mounting is done in Canada balsam after washing in absolute alcohol, or if glycerin is used preferably in distilled water. The nuclei stain most deeply, protoplasmic masses and connective tissue light yellow. Amyloids are not clearly differentiated,

but many plasma cells and bacteria-like forms are. Colonies of micrococci are most deeply stained, and the preparations are especially adapted to photography. (I cannot deny the great value of this dye, but cannot consider it so generally useful as carmine. It undoubtedly has advantages for certain purposes).

102. Ehrlich. (*a*). Uber die specifischen Granulationen des Blutes. Verhandlungen d. Berl. Phys. Gesellsch. May 16, 1879.
(*b*). Arch. f. Anat. u. Phys. 1879. Phys. Abth. p. 571–579.
(*c*). Methodologische Beiträge zur Physiologie und Pathologie des verschiedenen Formen der Leukocythen. Zeitschr. klin. Med. Berlin, I Heft 3.

Ehrlich finds in the anilin dyes a means of distinguishing subordinate groups of similar cells. Each dye brings out clearly the granular contents of the cells which are different and characteristic of each type. These 'specific granules' are clearly shown by taking the blood or parenchyma of the organ under examination, making a thin layer of it on the cover-glass and drying it in a warm place. The cover will be stained, and in this manner Ehrlich made five distinct typical forms of grains in the blood corpuscles that he called α, β, γ, δ, ε. Other peculiarities enable these cells to be distinguished. The staining of the granules is a chemical process analogous to the formation of a double salt. The anilins may be divided in two groups differing chemically and histologically. 1. Basic anilins made by combining a dye-base and an acid, such as fuchsin, Bismarck brown, safranin and many others. 2. Acid anilins, in which the active dyeing principle is an acid. The granules or 'eosinophilen' (so called because of their affinity for eosin) stain in all acid anilins, of which Ehrlich has tried thirty. The γ granules or fatty cells, on the contrary, take the basic dyes. A neutral stain may be made by mixing an acid and a basic dye together, it will be insoluble in water, but soluble in excess of acid dye. For example, add to a strong solution of methyl-blue a concentrated solution of acid fuchsin which is the soda salt of rosanilinmonosulfosäure. To five volumes of the last add, with stirirng, 1 volume methyl blue, and five of water, allow it to settle and filter. Red blood corpuscles stain deeply in this solution, leucocytes show crowded violet granules, the ε–granules absorbent of neutral dyes. These are very small and do not correspond either to the well-known albuminous bodies, or to fat. The α–granules stain in strong glycerin-eosin, in glycerin-indulin, and in concentrated watery solution of orange. Eosin-indulin-glycerin is most appropriate for the β–granules.

103. Curschmann. Ueber das Verhalten des Methylgrün zu amyloid-degenerirten Geweben. Arch. path. Anat. und Phys. lxxix, 556.

Methyl green is recommended as reagent for amyloid substances. It is better than methyl-violet, staining the degenerate tissue violet, the normal green. Sections may be hardened in alcohol or chromic acid, and finally put in a 1 per cent. or, better, a weaker solution of glycerin or levulose. Canada balsam is not admissible. Degenerate kidneys give the best results. The hyaline urinary tubules become ultramarine blue, the amyloid substance violet, the normal green.

The dye that produces these results is made by Meister, Lucius & Browning, Höchst a Main, and is known as green powder M.

104. Test for Amyloid Substance. Journ. R. Micr. Soc., 1880, p. 500.

Safranin is recommended for amyloid substance because it tinges it orange yellow, all the rest red. May be used in water or alcohol, but not after chromic acid. Acetic acid destroys the differentiation be-

cause everything becomes a uniform red.

(Safranin, as a reagent for amyloid, is much inferior to iodine violet, methyl green, or Leonard's ink (80), and cannot be recommended.)

105. Kyber. Weitere untersuchungen über die amyloid Reaction. Arch. path. Anat. u. Phys., lxxxi, 1–6.

Kyber denies the advantages of the anilins as reagents for amyloid substance. He admits they are pretty dyes, but for the demonstration of amyloid far inferior to Virchow's reaction with iodine and sulphuric acid.

106. Loomis. A simple and speedy method of staining animal and vegetable sections. Amer. Monthly Micr., Journ., i, 143.

Anilin red, 1–300 is used, and cleared in potassium acetate 2–1 of water. The preparations bleach out in a short time.

107. Pfitzer. Die Epidermis der Amphibien. Morph. Jahrb., vi, 479.

Safranin is recommended as the very best nucleus dye. Chromic acid preparations are the best, and after them those made with picric acid. The sections are first washed, then put for a few minutes in a solution of safranin 1, absolute alcohol 100, water 200 parts, then into absolute alcohol. The color is permanent in dammar, but bleaches in glycerin and water.

108. Wolff. Zur Bacterienlehre bei accidentellen Wundkrankheiten. Arch. path. Anat. u. Phys., lxxxi, 139.

Warning is given against certain mistakes liable to occur from the production of fine precipitates that may result from the use of anilin dyes on micro-organisms through alkaline reaction of such fluids, as blood. Treatment with a little acid by dissolving the precipitate will prevent errors.

109. Brandt, K. Farbung lebender einzelliger Organismen. Biol. Centralbl., 1881, pp. 202–5.

Bismarck brown with hematoxylin is used to stain amœbas, heliozoa, flagellates, etc. The stain should be dissolved in the water in which the organism lives; 1 pt. to 3–5000 of fluid. The Bismarck brown stains the oil granules and the cellulose-like gummy substance peculiar to the protozoa, and leaves uncolored the nucleus and protoplasm that stain so vividly in dead matter.

110. Certes. Sur un procédé de coloration des infusoires et des éléments anatomiques pendant la vie. Zool. Anz., 1881, pp. 208–212. Comptes Rendus, xcii, pp. 424–26.

Ditto. Dosage de la solution de Cyanin pour la coloration des infusoires. Zool. Anz., 1881, pp. 287, 288.

Like Brand, Certes wished to stain unicellular organisms. He used cyanin or bleu de quinolein in very dilute solution, 1–100000, 1–500000. For staining infusoria ordinary water, not distilled, was employed, for white blood and lymph corpuscles, serum. The solutions should be kept in the dark. The oil globules only take this stain, while the nuclei, protoplasm, cilia, cuticle and vacuoles remain uncolored.

111. Flemming. Ueber das Hermannsche Kernfärbungsverfahren. Arch. Mikr. Anat., xix, pp. 317–330.

Ditto. Notiz zur Geschichte der anilin färbungen l. c., pp. 742, 743.

On trying Hermann's methods (No. 80), using a variety of anilins, it was found a large number were not suitable, while some gave very satisfactory results. In the first class were eosin, ponceau, and orange, which did not stain the nucleus distinctly. The same deficiency was found in mauvein, fluorescent red, and fuchsin. If applied to chromic acid preparations, even Bismarck brown is not desirable. But the following are very useful and suitable for chromic acid preparations without hardening in alcohol, viz., magdala red, dahlia and especially safranin. Solid green

furnishes beautiful though pale preparations. Osmic acid did not do so well as chromic, the latter preferred. The sections are carefully washed in water, then laid in the dye as safranin 12–24 hours, then in equal parts alcohol and water. Then washed and put into white boxes with absolute alcohol for half a minute till transparent, then into clove oil, cleared up and mounted in dammar, in which they are permanent.

112. Pfitzner. Ueber den feineren Bau der bei der Zelltheilung auftretenden fadenförmigen Differenzirungen des Zellkerns. Morphol. Jahrbuch. vii, 289.

Having repeated many of the experiments with safranin described in former numbers of the Jahrbuch, Pfitzner condemns them all, and asserts that no commercial safranin stains a nucleus well. He employed a good dye from Friedrich Schäfer in Darmstadt.

(A good safranin as well as most of the anilin dyes may now be bought at various places, as from Dr. Georg Grubler, Leipzig, Dufour Strasse, 17).

113. Ehrlich. Ueber das Methylenblau und seine klinisch-bacterioscopish Verwerthung. Zeitsch. f. klin Med., ii, 1881, p. 710.

Only basic dyes are suitable for investigations of bacteria. Those commonly used, like Bismarck brown, fuchsin, methyl and gentiana violet stain too deeply, some form granular precipitates liable to cause errors. Methyl blue appears to be free from these objections. A solution in water is used, and the dried preparation, soaked for a suitable time, 1 to 24 hours, then washed, dried, and mounted in Canada balsam. The blue used is from Hesterburg, Berlin, Louisenstrasse, 39.

114. Griesbach. Ein neues Tinctious-mittel für menschliche und thierische Gewebe. Zool. Anz., 1882, p. 406.

Iodine green proves to be a superior dye, and in many respects surpasses any of the anilins heretofore used in microscopy. It does not appear to have been before applied, and is preferred in a water solution of 1 part to 35, though it does very well in alcohol. Staining is instantaneous, and the mounts may be in balsam. Unfortunately, iodine green is no longer manufactured, because too costly, and methyl green offers an inferior substitute, which may be applied in a similar manner.

115. Flesch. Kleine Mittheilungen zur histologischen Technik. Zool. Anz., 1882, p. 554.

The application of iodine green and methyl green, supposed by Griesbach to be new, is shown to be old in England, where it was recommended for double staining. Combinations of green and red anilins are recommended. (I have myself used iodine green in 1881).

116. Weigert. Ueber eine neue Untersuchungs-methode des Centralnervensystems. Centralbl. f. d. med. Wiss., 1882, pp. 753 and 772.

Acid fuchsin stains the central nerves in a way hitherto unknown. Fuchsin (of the Badische Anilin Soda Fabrik, No. 130) is used in concentrated solution. Also add 1 gramme of caustic potash to 100 c. c. absolute alcohol in a closed flask, allow it to stand 24 hours, filter, and mix 10 c. c. with 100 c. c. alcohol as solvent for the dye. Alcohol saturated with salt is used as a dehydrator.

If nerve sections are merely treated with acid fuchsin, the differentiation is feeble, but if after staining they are put in alkaline alcohol, and the dye soaked out, the structure becomes distinct because the grey matter chiefly retains the color. The following is the exact process :—Sections hardened in chrome salts are laid in the dye for an hour, then in water and washed, then in dilute alkaline alcohol, in which they remain till the gray substance is distinctly seen.

This must be carefully observed not to miss the best moment. Lay again in fresh distilled water several times changed. If successful, the gray matter will be more transparent than the white, and the whole section reddish. If too pale, put again in the dye, if not distinct, soak in the alkaline alcohol. If satisfactory, dehydrate in salt alcohol and mount in balsam. Such preparations are superior to all others in clearness of detail. A part of the gray matter only is thoroughly stained called by Weigert 'erythrophile' or redloving, but as this matter surrounds the finest fibrillœ in thin layers they become very clear.

(This method is undoubtedly of great value in the examination of nerves, especially in following the very fine fibrillœ, but we think it should be used in connection with the sometimes despised carmine staining. The nerve cells are not colored, and the many details are a serious objection. Seven changes of fluid are required before the section finds a rest in its balsam; and it is difficult to treat a series of sections at the same time).

117. Weigert. Ueber Schnellhärtung der nervösen Centralorgane zum Zwecke der Säurefuchsinfärbung. Centralbl. f. d. med. Wiss., 1882, p. 819.

In order to prepare the material for the dye treat it with Müller's fluid or dry in an oven at 30°–40° C. about 4 days; without heat, 8–13 days is required. Or a fluid of $2\frac{1}{2}$ per cent. potassium bichromate and $\frac{1}{2}$ per cent. cupric sulphate may be used.

118. Mayer S. Beitrag zur histologischen Technik. Sitzb. d. Wien. Acad., lxxxv. Abth., iii, Februar.

Violet 'B' of Bindschedler and Busch is tried for the first time, and washed in $\frac{1}{2}$ per cent. salt solution 1 to 30. Staining requires from a second to 1 minute. The finer vessels are clearly made out, also fatty tissue, the substance and the nucleus of the connective tissue cells. Elastic fibres appear ultramarine blue on violet ground. Unstriped muscle. and smaller nerves stand out clearly. They must be preserved in potassium acetate, or dried and put in dammar. (It is very difficult to buy a good sample of this dye, and we think it inferior to others).

119. Bizzozero. Ueber einen neuen Formbestandtheil des Blutes und dessen Rolle bei der Thrombose und Blutgerinnung. Arch. path. Anat. u Phys.

Blood disks are stained with methyl violet, 1 part concentrated solution in water to 5000, 75 per cent. solution of salt. Uses also gentian violet 1–3000 per cent.

120. Eloui. Recherches histologiques sur le tissu connectiv de la cornée, Paris, 1881.

Eosin is dissolved in pure glycerin, and fixed by adding alum to the glycerin to saturation.

(Alum is an excellent mordant for many anilins).

121. Errera. La nigrosine comme réactif colorant pour les noyaux. Procès verb. Soc. Belge de micr., 1881, p. 134.

Nigrosin soluble in water is recommended as good for nuclei. Permanent in glycerin and resin.

122. Le Vert de Jade. Nouveau réactif colorant. Journ. de Microgr., vi, p. 470.

Recommends iodine green. (See 110, etc.)

123. Strasburger. Ueber den Theilungsvorgang der Zellkerne, und das Verhaltuiss der Kerntheilung zur Zelltheilung. Arch. mikr. Anat., xxi, p. 476. Zellbildung und Zelltheilung 3, Auf., p. 141.

A little methyl green is dissolved in 1 per cent. acetic acid to arrest and fix the figures of dividing cells. These take a temporary color. A solution in dilute glycerin is used to tinge preparations in alcohol, which are fixed in a 50 per cent. solution nitric acid. Staining takes place

rapidly, and the spindle-shaped fibres stand out clearly, but the preparations are not permanent.

124. Nörner. Beitrag zur Behandlung mikroskopischer Präparate. Arch. mikr. Anat., xxi, 351.

Magdala red anilin is highly praised as quick, intense, and differentiating. May be applied to alcoholic and chrome preparations. Besides animal tissues it is especially recommended for plants, and especially the lower fungi. The preparations appear permanent, but are not yet old enough to rely on.

125. Certes. On the processes of coloring living micro-organisms. Amer. Micr. Journ., vol. iii, p. 224. Sur les procédés de coloration des organismes vivants. Note complémentaire. Bull. Soc. Zool. France, 1881, p. 21, 226.

Another method of staining unicellular beings. A drop of alcoholic solution of cyanin, Bismarck brown, etc., is placed on a glass slip, and spread. The alcohol evaporates, and when nearly dry put on the drop of water containing the infusoria that will be quickly stained. (See 110).

126. Weigert. Zur Technik der Mikroskopischen Bacterienuntersuchung. Arch. Path. Anat. u Phys., lxxxiv, 275.

The best description of the application of anilin dyes in pathological investigations, and especially as relates to micro-organisms, is in Friedländer's book.

127. Koch. Die Aetiologie der Tuberculose. Berl. klinische Wochenschrift, 1882, No. 15. Ditto. Mittheilungen des Kaiserl. Gesundheitamtes.

128. Friedländer. Mikroskopische Technik, etc., Kassel und Berlin, 1882.

The following process is given by Koch for demonstrating tubercular bacilli:—The section, or dry preparation, is put for 24 hours in a mixture of distilled water 200. concentrated alcholic solution methyl blue 10, 10 per cent. caustic potash, 0.2. From this the dark blue sections are put in a concentrated aqueous solution of vesuvin for 15 minutes. Then wash, dehydrate with alcohol, clear up in oil of cloves. Nuclei and micrococci will be brown, the bacillus of tubercle a deep blue.

[*To be continued.*]

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price $1 per year, strictly in advance. All subscriptions begin with the January number.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

A pink wrapper indicates that the subscription has expired.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884), Nos. 2–12, $1.00.

SPECIAL NOTICE.—We have not hitherto deemed it necessary to send special notices to subscribers requesting them to renew their orders, but since it occasionally happens that the matter is neglected merely from forgetfulness, we have adopted the plan of sending the journal in a conspicuously colored, pink wrapper, to indicate the expiration of subscription. Many such will be sent out next month.

It has also happened several times in the past, that some who have taken the journal since its beginning, and who, as we are well aware, will continue to take it for years to come, have been inclined to expostulate with us for stopping their journal when their subscriptions have expired.

In explanation we can only say that we do not give personal attention to the subscription list, and it is only when we have occasion to refer to it to find an address, or for some such purpose, that we are likely to notice the absence of a familiar name. The

rule is that subscriptions must be paid before a name is entered on the list; and as this involves making an entirely new list each year, we cannot, except at the expenditure of much more time than can be well afforded, compare new and old lists to find the delinquents, and then write to remind them of the matter.

The list for 1886 is already begun, and we are prepared to enter subscriptions as rapidly as they may arrive.

—o—

New Mounting Media.—A correspondent has requested information concerning the stannous chloride used by Professor Smith in his highly refractive medium described on page 161. Since others may also be uncertain concerning the tin compound employed, we may state that stannous chloride is not the bichloride of pharmacists, but is commonly known as the protochloride of tin, the 'salts of tin' of dyers. Professor Smith uses the chemically pure compound, which costs about sixty cents a pound, and this may be obtained of F. A. Reichardt & Co., 96 Liberty street, or of Eimer & Amend, 205 Third avenue, New York.

A good quality of gelatin should be used, such as is sold for photographic purposes. Professor Smith has been using what is known as boro-glyceride instead of gelatin, which fastens the cover-glass as securely as balsam, and is easily cleaned off around the cover.

It is advised to use wax rings for protecting the mounts in this medium, as affording the best and quickest means of finishing the mounts. White sheet-wax is recommended, rings being punched from it of the proper size, and attached by careful heating. Colored cements may then be applied as a finish, but they are not required.

We notice an error in the name hydrochloric acid on page 161, line 15 from bottom of second column. It is rather remarkable that the proofs should have passed through the hands of author, editor, and proof reader, and still such an error remain, but so it is.

—o—

Postal Club Boxes.—Box Cy came to this circuit October 5th, with two of Cole's preparations, one a cross-section of cucumber stem, the other a longitudinal section of sunflower stem. Both are very instructive, and the description makes them far more so than they would be without it.

Box E was received at the same time as the preceding one. The preparations are:—

1. *Pleurosigma formosum*. Louis H. Noe.

2. Jaws of water-spiders. T. D. Hodges.

3. Cluster of eggs of elm-leaf beetle. Prof. S. Lockwood.

There is an interesting account of the life and habits of the voracious beetle. The cluster of egg-shells is a very pretty object.

4. *Crisia eburnea*. E. A. Apgar. A very neat preparation, but, unfortunately, not a word of explanation accompanies it. The name is not correctly given in the letter accompanying the box. The specimen is one of the polyzoa, quite common, growing on seaweeds, etc.

5. Infant's tongue, section. R. H. Chase.

6. Brand of May-apple, *Puccinia aculeata*. E. A. Rau. The mounting medium was water, the cement, asphalt; the natural consequence is a dry preparation.

Box Cx was received Oct. 13th, with two preparations of Mr. Cole.

1. Section of nerve.

2. Ossification of cartilage.

Box D was received October 23d, with six preparations of interest. Professor Lockwood writes that the original letter-package of this box had been lost, and the managers had replaced it by memoranda obtained with some difficulty. He commends the preparations as 'unusually interesting.'

1. Unknown fly in fossil gum copal. A. T. Veeder.

2. Transverse section of tea-leaf and stem. F. T. Aschman.

3. Striated muscular fibres. injected. T. D. Biscoe.

4. Section of cat's tail, injected. G. W. Worcester.

5. Conjugation of algæ. E. L. Cheeseman.

6. Lung of fœtus. Chas. K. Wells.

Box Cw came to hand October 31st, with two of Cole's preparations. The objects contained in it are:

1. Primary tissue.

2. Epidermal tissue.

NOTES.

— We have received a new edition of the catalogue of Mr. Carl Zeiss from Messrs. Emmerich & Son, who have just received a supply of them. The catalogue is issued in far more attractive style than hitherto, and is much larger than previous editions. It affords a complete list of the microscopical apparatus, including the objectives, made by Mr. Zeiss, with numerous illustrations. Glancing over the pages we notice many changes and additions.

Among the additions may be mentioned an apparatus for measuring the growth of plants, devised by Reinke. In addition to the spectral-ocular, so well known, there is now offered a micro-spectral objective, devised by Engelmann for observations on the action of spectral colors upon microscopic objects. The device is fitted beneath the stage of the microscope, and projects a spectrum upon the object in the field of view. The Abbe analysing-ocular, hitherto advertised, and the polarizing apparatus connected with it, is no longer made, owing to the difficulty of obtaining sufficiently good calc spar for the prisms. Two forms of apparatus for photo-micrography are described, with an illustration of a method of quickly uniting the microscope tube and camera with a light-tight joint.

The catalogue is in German. Mr. Zeiss might find it advantageous to arrange with the Messrs. Emmerich for an edition in English.

— Mr. Zeiss still prefers cedar oil (from *Juniperus Virginiana*) for his homogene immersion objectives, and he has lately succeeded in overcoming the most serious objection to its use, its extreme fluidity. He now offers the oil in a thickened condition, and with a refractive power almost identical with that of cover-glass. We notice that Mr. Zeiss has ceased to make, except by special order, the water immersion objective of 0.75 mm. focus, since experience has shown that such a short focus in a water immersion lens offers no advantage that cannot be more effectively obtained by the use of the $\frac{1}{18}$-inch homogene immersion.

— The September number of the *Kansas City Review*, an excellent magazine for general reading, published at Kansas City, Mo., contains its usual variety of interesting and valuable articles. The Review comes to us in a new dress, and is henceforth to be an illustrated monthly magazine, but the price is only $2.50 per year.

— The San Francisco Microscopical Society seems to be most active of any during the summer months. We receive reports of its proceedings regularly from the Secretary, Mr. A. H. Breckenfield. At a meeting in July, Dr. J. M. Selfridge read the paper of the evening, entitled 'Bacteria and Their Relation to Health and Disease.' He reviewed the grounds upon which the advocates of the germ theory rest their case. Extensive quotations from the writings of Koch, Pasteur, Cohn, Sternberg and others were cited, and their experimental work alluded to. These eminent authorities, and many others in sympathy with them, claim that it has been demonstrated beyond all reasonable question, that certain diseases, such as anthrax, fowl-cholera, tubercular phthisis, etc., are produced be the parasitic micro-organisms, bacteria. Dr. Selfridge next stated his own view of the case, which is that bacteria are the result but not the cause of the decomposition of organic substances. He fortified his position by quoting extensively from the writings of scientists holding similar views and by pointing out what he considered the fallacies in reasoning of his opponents, and the erroneous deductions drawn by them from their experiments. He argued that in order to prove that one thing is the cause of another, it must be shown that the cause was in active presence before the thing produced was manifest. In the case of bacteria, therefore, he held that it must be shown that they are in the blood of a given case before the disease manifests itself. For, if they be not pres-

ent until after the disease has brought the system under its influence, the inference is that the bacteria in that case, instead of being the cause, are the result of the disease.

The theory that bacteria cause infectious disease is false, because their presence is not necessary to produce the disease ascribed to them. They are only carriers of poisons (ptomaines), which are generated during the decomposition of organic matter.

Bacteria cannot exist in healthy organisms.

The theory that the use of germicides in infective and zymotic diseases is scientific treatment has been exploded, for it has been shown that the patient's life would be jeopardized thereby.

The value of their presence as a means of diagnosis is admitted.

An animated discussion then arose, in which the advocates of the germ theory, led by Dr. Hallard, stoutly maintained the correctness of their views.

Prof. Hanks presented two slides of gold from quartz collected by him at the mines near Dahlonega, Ga. The peculiarity of the gold consisted in its crystalline condition, its purity, and absolute freedom from coating. Slides of this material will be furnished to members interested in the subject.

Mr. Payzant exhibited specimens of *Eudorina elegans* (living), a beautiful little plant belonging to the group *Volvocineæ*. It occurred in such prodigious numbers as to impart a distinct green color to the water in which it was found.

— We are pleased to notice the success with which Mr. Alfred Allen has conducted the *Journal of Microscopy and Natural Science*, originally the *Journal of the Postal Microscopical Society*. It is now a quarterly, with lithographic plates in each issue; the contents are varied and instructive. The volume which ends this year is full of valuable information for the working microscopist. We congratulate Mr. Allen upon his success, and trust his new venture, the proposed *Scientific Enquirer*, will also prove remunerative.

— The August number of Mr. T. Bolton's Portfolio of Drawings and Descriptions of Living Organisms was recently received from the author. The publication is an excellent one for the general microscopist. This number, the price of which is one shilling, is devoted to the animal kingdom, and contains representations of fourteen species of rhizopods, infusoria, etc.—not very finely drawn, to be sure, but useful to one who wishes to determine species. Mr. Bolton's address is Birmingham, England.

— The annual election of the Washington Microscopical Society was held on the evening of October 13th, when the following officers were elected: President, Dr. Robert Reyburn; vice-president, Prof. William H. Seaman; corresponding secretary, Dr. E. M. Schaeffer; recording secretary, Dr. E. A. Balloch; treasurer, Dr. C. T. Caldwell. The society is slowly growing, and the prospects are good for a prosperous year.

— The *Botanical Gazette* is to be enlarged next year, and the subscription price increased. We are pleased to notice such evidence of its prosperity. It will be made to appeal to a larger circle of readers, and will include some more popular articles, of interest to botanists and others. With three editors, in different parts of the country, there should be no dearth of news at any time.

CORRESPONDENCE.

Styrax for Mounting.

TO THE EDITOR:—In the August number of the Journal of the Royal Microscopical Society, I find (page 744) a condensed extract of my article on mounting in American storax taken from the May issue of the American Monthly Microscopical Journal. To the extract is added a short paragraph, stating that Mr. J. Deby finds that styrax never dries completely.

I wish just here to state that my experience with the styrax of commerce has been similar to his; but that our southern sweet gum (the exudation of *Liquidambar styraciflua*), when treated as indicated by me, gives a chloroform solution which hardens as thoroughly as the balsam solution, and has the advantage over it of rendering fine details more visible. As far as I have heard from persons using genuine American styrax (or storax), it has been satisfactory as a mounting medium, hardening thoroughly and giving clear and in every way excellent mounts.

A. B. AUBERT.

—o—

Pseudo-Cyclosis.

TO THE EDITOR:—I do not know which was greater, my surprise or my delight, on reading Dr. Wallich's paper in the October number of the Journal, on The Pseudo-Cyclosis in Amœba. I

certainly was astonished on learning for the first time that I had been precluded in the observations which begat my paper entitled *Pseudo-Cyclosis*, published in the last March number, and my delight was increased on reading Dr. Wallich's extracts from his papers published so long ago, at seeing that, excepting the hyphen used by me, we both had coined the same word as a name for the interesting movement which we both had studied in the *Amœba*. As I was in absolute ignorance of Dr. Wallich's work done in the Old World so many years ago, I am content, as an humble worker in the New World, of re-discovering and re-naming the phenomenon in question. How is it, let me ask, that the learned Doctor's word has not become, ere this, current coin of the realm? Also that good word of his used in this connection to denote the reciprocal convertibility of endosarc and ectosarc in the Amœba, namely, *amœbabasis?*

S. LOCKWOOD.

OCT. 26th, 1885.

NOTICES OF BOOKS.

The Opium Habit. By F. M. Hamlin, M. D., Auburn, N. Y. Reprinted from The Transactions of the Medical Society of the State of New York for 1885. (Pamphlet, pp. 13.)

In these few pages Dr. Hamlin describes his experience with persons addicted to the use of opium, and his method of treatment, which is rapid and effective.

The Microscope in Botany. A Guide for the Microscopical Investigation of Vegetable Substances. From the German of Dr. Julius Wilhelm Behrens. Translated and edited by Rev. A. B. Hervey, A. M., assisted by R. H. Ward, M. D., F. R. M. S. Illustrated with thirteen plates and one hundred and fifty-three cuts. Boston: S. E. Cassino & Co. 1885. (Large 8vo, pp. 15 and 466.)

This is an elegant volume, which should be in the library of every student of botany and histology. The first two chapters treat of the microscope and accessories, adapted to the requirements of American and English students by Dr. Ward. The third chapter deals with the methods of preparing microscopic objects, including the cutting of sections, and mounting, in various ways, examining living organisms, and instructions for making drawings from the microscope. The fourth and fifth chapters are probably the most valuable, since the information contained in them is not to be readily found elsewhere. The former treats of reagents for microchemical tests, the latter describes the method of conducting such observations. The methods for the complete microscopical investigation of vegetable structures are here given in a manner that makes the work invaluable to the student, who is also relieved of the necessity of searching through the very scattered literature of this subject.

The Physician's Visiting List (Lindsay & Blakiston's) for 1886. Thirty-fifth year of its publication. Philadelphia: P. Blakiston, Son & Co., 1012 Walnut street.

This convenient pocket-book is so well known to practicing physicians that no commendation is needed in this place. It is issued in excellent style, and contains valuable tables that the physician should never be without, as well as a most complete system of recording particulars of cases and visits.

Elephant Pipes in the Museum of the Academy of Natural Sciences, Davenport, Iowa. By Charles E. Putnam. Davenport, Iowa, 1885. (Pamphlet, 8vo, pp. 40.)

A vindication of the authenticity of the elephant pipes and inscribed tablets in the museum, from the accusations of Mr. Henshaw in the second annual Report of the Bureau of Ethnology.

Cholera, its Nature, Symptoms, History, Cause, and Prevention, with an outline Review of the Germ Theory of Disease, one of the Sommerville Course of Lectures (extended) provided for by the Natural History Society of Montreal. By J. B. McConnell, M.D., Professor of Materia Medica and Therapeutics, and Lecturer on Practical Histology, University of Bishop's College Faculty of Medicine, etc. Montreal: Published by Robert Miller, Son & Co. 1885. (Pamphlet, 8vo, pp. 40.)

A study of the literature of the subject, which appears to have been conducted systematically and with care.

Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted: Cleaned St. Vincent material, for cash.
E. A. SCHULTZE,
Tompkinsville, Staten Island, N. Y.

THE AMERICAN
MONTHLY
MICROSCOPICAL JOURNAL.

VOL. VI. WASHINGTON, D. C., DECEMBER, 1885. No. 12.

The Red Snow.*

BY THE EDITOR.

The red snow which attracted much attention from scientific gentlemen when it was brought home from the Arctic regions by Captain Ross in the year 1818, was by no means unknown before that time. De Saussure, as early as 1760, observed it on Mount Breven, in Switzerland, and since then many others have noticed it in the Alps, Pyrenees, and it seems to occur frequently in all parts of the world. Particular interest, however, was manifested in the material brought home by Captain Ross, and several botanists secured specimens for examination. It will be interesting to recall the narrative of Captain Ross, as published in the description of his voyage for the purpose of exploring Baffin's Bay and discovering a northwest passage. On the 17th of August, 1818, when not far from Cape York, in lat. 75° 54′ N., long. 67° 15′ W., he observed that 'the snow on the face of the cliffs presented an appearance both novel and interesting, being apparently stained or covered by some substance, which gave it a deep crimson color.....

'At two P. M. it fell nearly calm, and I sent a boat with Mr. Ross, midshipman, and Mr. Beverley, assistant surgeon, and a party, to bring off some of the snow, and to make what remarks they could on the circumstances attending it.....

'They found that the snow was penetrated even down to the rock, in many places to a depth of ten or twelve feet, by the coloring matter, and that it had the appearance of having been a long time in that state.....The snow was immediately examined by a microscope, magnifying 110 times, and the substance appeared to consist of particles like a very minute, round seed, which were exactly of the same size, and of a deep red color; on some of the particles a small dark speck was also seen. It was the general opinion of the officers who examined it by the microscope that it must be vegetable, and this opinion seemed to gain strength by the nature of the places where it was found; these were the sides of the hills, about six hundred feet high, on the tops of which was seen vegetation of yellowish green and reddish brown colours. The extent of these cliffs was about eight miles.'

A colored engraving accompanying this report represents the Crimson Cliffs, as they were named, the color being bright crimson, extending down almost to the water.

An examination of the red snow was made by Dr. Wollaston, who regarded it of vegetable nature. His report is published in the Appendix to the work mentioned above.

In February, 1819, about six months after its first discovery by Capt. Ross, Francis Bauer, F. L. S., received a quart bottle full of the melted snow, which he examined to determine the nature of the coloring matter. His results are given in full in a letter to W. T. Brande, Esq., Secr. R. S., which is published in the *Quart. Journ. of Literature, Science and the Arts*, vol. vii (1819), p. 222.

* Read before the Biological Society of Washington, Dec. 12th, 1885.

At that time it was still a question whether the spherical, red particles were of animal or vegetal nature. Mr. Bauer compared them to the 'pollen of some plants, or to the minute fungi of the genus *Uredo*.' Examining them with higher magnification, he 'soon found several individuals still adhering to their pedicles, the same as I have found in most species of *Uredo*, and which distinguishes these minute fungi from the pollen of some plants.'

In the plate accompanying this interesting article the cells are figured with their pedicels, and also the clusters upon the 'jelly-like spawn,' as the author termed it, which is represented as a mass of small, oval, yellowish, growing cells. The name *Uredo nivalis* was therefore given to the plant.

It is quite evident from the figures that the idea that the plant is an *Uredo* greatly influenced these observations. Yet imperfect instruments may have contributed to the mistakes. There are no pedicels, and the 'spawn' is probably the gelatinous material which surrounds the cells.

In *Philosophical Transactions*, 1820, p. 165, is another article by Francis Bauer, Esq., F. L. S., in which he describes some experiments with the specimens of red snow collected by Capt. Ross. Still maintaining that it is a fungus growth, the writer placed samples in small glass bottles, packed the latter full of snow, and observed a considerable increase of the cells in the course of several experiments. He observed that the plant would not grow on the surface of the snow, but flourished when entirely imbedded in it. The results of these experiments, however, do not seem to possess much value, as they throw no light upon the method of growth or structure of the plant. Even the fact of cell division, under the artificial conditions, seems not to be satisfactorily established.

Professor Hooker, in the Appendix to Captain Parry's Voyage for the Discovery of a Northwest Passage, 1819–20, Supplement, p. 428, regarded the plant as 'not decidedly a *Palmella*,'* since the granules are not immersed, yet approaches much nearer to it than to *Uredo*,' and he suggested that the generic character of Lyngbye's genus *Palmella* might be modified to include it.

The same writer thus alludes to its occurrence in the Arctic regions:—

'That a plant should vegetate in and upon snow, and that it should do so, too, to such an extent as to cover a tract of eight miles in length, and frequently to a depth through the snow of ten or twelve feet, must, indeed, excite our astonishment.'

In Greville's Scottish Flora there is an interesting account of this minute plant, which is there described as *Protococcus nivalis*, the name first given to it by Agardh. Greville states that the red globules appear reticulated on the surface owing to enclosed granules, usually 6–8 in number, which escape by rupture of the mother cell.

I have examined many cells under conditions favorable for observing any reticulation or granules, but have not detected anything of the kind. It is not unlikely, however, that none of my specimens were in the condition of growth to show granules, which perhaps may be seen in other stages.

The description of Greville, however, seems to be based upon observations on a plant found by Capt. Carmichael on the borders of the lakes of Linsmore, in Scotland, growing 'abundantly over the decayed reeds, leaves, etc., at the water's edge.' This indicates a very different habitat from the polar snows or snow-clad summits of mountains, and there may be a question whether the Scottish and the Arctic plants are the same. However, this author, referring to the distribution of the red snow, writes as follows:—'The most probable conjecture seems to be, that the snow is not the natural situa-

* *Palmella* Lyngbye, massa gelatinosa, subhyalina, granulis solitariis globosis farcta.

tion of *Protococcus nivalis*, but that, being tenacious of life, it preserves its vitality when cast upon so chilling a surface, and under favorable circumstances even propagates its species.....Having become once established in the snow, it is possible that, by the intense cold of winter, the vegetating power may be suspended beneath the frozen surface, when, in other situations, it would have perished; and thus, on the annual dissolution of the superincumbent snow, our *Protococcus*, numerous as the grains of sand on the seashore, may start at once into renewed life, and seem indeed to have descended unseen from the clouds.'

I was led to review the literature of the red snow for the purpose of discovering some basis upon which its systematic position among the algæ could be established, but so little has been written about the life-history of the plant that it is impossible to assign it to any genus. The observations of Bauer seem to me very unsatisfactory. Agardh did not observe its method of propagation, but established the genus *Protococcus* upon the characters observed by him—globules aggregated, without mucous. This generic character does not hold even for this plant, as Greville observed, and this author, deeming the plant generically distinct from others then known, adopted Agardh's name *Protococcus*, but characterized the genus as follows:—'Globules aggregated, naked, containing granules, sessile upon a transparent gelatinous mass.' Greville, as already mentioned, observed and figured granules which escape by rupture of the parent cell. It may be presumed that these small red or yellowish granules are young cells of succeeding generations, but their growth has not been observed. Baron Wrangel, who regarded the plant a lichen, to which he gave the name *Lepraria kermesina*, placed some limestone covered with the plant in water, and observed a number of globules of a yellowish color of which the larger red ones seemed to be composed. He also observed the large globules swim about, like infusoria, burst, and give exit to smaller ones. Dr. Hooker, with excellent reason, it seems to me, regarded the plant as a *Palmella*.

In the latest literature of algæ the plant is classed as a *Chlamydococcus*, and it is this that first led me to search the literature for some facts to justify such a classification. It seems to be based entirely upon the fact that Agardh's genus *Protococcus* is now merged into *Chlamydococcus*. Until the method of propagation of this plant is more satisfactorily established, it is impossible to fix its systematic position. I consider the assumption that the red snow is identical with the *Protococcus pluvialis* described by Cohn, is not supported by sufficient knowledge.

The bright red color of this plant may or may not be of special significance in classification. It is not improbable that in its actively vegetating condition the plant is green. This is indicated by the observations of early discoverers. Such a change of color is not unusual among certain algæ. It is a characteristic of many unicellular forms, especially *Chlamydococcus* and *Chlamydomonas*. The change from green to red is of great physiological importance in these instances.

A specimen of the red snow collected by Dr. Kane from the crimson cliffs of Beverly is in the National Museum, designated on the museum register No. 10,119. This specimen was recently brought to my notice by Mr. A. H. Clark. It was in a glass-stoppered one-ounce wide-mouth bottle. The material was evidently put in with water, but is now thoroughly dry. The stopper could not be removed without breaking the bottle, hence I have transferred the contents to another bottle, which is before you.

On examination I find abundance of the cells of red snow in this collection, but the brilliant crimson color is

quite lost, only a faint tinge of red remaining. The diameter of these cells ranges from 10.8μ to 30μ.

A specimen was received in January of this year from Poverty Gulch, Colorado, sent by Mr. Alexander McDougall. It is numbered in the museum register 74,537.

From the letter which accompanied this specimen I quote as follows:—

'Sediment of a small quantity of snow gathered in Poverty Gulch, Crested Butte Co., Colorado, at an altitude of 12,000 feet, on the 16th of September, 1884. The snow-fall of 1883–4 was very unusual, proving a great barrier to mining operations in this district. In the spring of 1884 the uplands and valleys that were still covered with snow presented quite a novel appearance, the red and white blended together in beautiful harmony. What it was or whence it came was quite a mystery to the miners, and in hopes that you will elucidate the mystery I take the liberty of sending you a small quantity.

'The snow-ball that yielded this sediment was gathered from snow that was about six feet in depth. It changed its color to brown, but by wetting a few grains and rubbing on white paper it is red.'

I made a few observations on this specimen, and attempted to cultivate some of the cells, but without success. The cells were of a bright red color, sometimes apparently quite naked, but frequently enclosed singly, or three or more together, in a colorless, shrivelled envelope. The cells, exclusive of the outer envelope, measured from 14.3μ to 29.2μ in diameter. Occasionally small naked cells were observed only 6.5μ in diameter.

The contents of perfect and fresh cells appears to be quite clear and transparent, with occasionally a well-defined sort of vesicle of a deeper color than the rest.

When the endochrome was pressed out from the cells into the surrounding water, it contracted in spherical, oil-like masses.

The surrounding envelope is quite hard, tough, and resisting.

—o—

Photo-Micrography.—II.

BY THE EDITOR.

2. Apparatus.

We have deemed it advisable to reverse the intended order of the sub-heads of this division of the subject, that we may have opportunity to test a form of apparatus which we desire to describe in this connection should it prove satisfactory. We will therefore defer the description of microscope and camera until next month, taking up now

a. Plates, Chemicals, Developing Apparatus, Dark-room, etc.

Plates.—It is not our province to advocate the use of any particular band of plates, since all the large manufacturers doubtless furnish good plates. The kind best adapted to photo-micrography is a moderately quick plate that works clear. A plate that yields a negative covered with a general fog, such as some of the more rapid ones are apt to show, is not to be recommended. It must not be inferred, however, that extremely rapid plates cannot be found that work perfectly clear. Some makers, in attempting to excel in the sensitiveness of their emulsions, go so far that a very slight forcing in the development causes a noticeable general fog over the plates. The advantage of extreme rapidity obtained at the expense of clearness in the shadows, is, to say the least, questionable. So long as the plate works clear, its rapidity is a secondary consideration. Doubtless a moderately rapid plate will be most generally preferred for work with powers up to a $\frac{1}{6}$-inch, and quicker plates for higher powers.

Developing Apparatus.—The necessary apparatus, which should be purchased at the beginning, is the same as would be required for field work. We give a list of the articles, with the current prices appended:—

1 2-ounce measuring glass, - $0.25
1 Minim measuring glass, - - 0.25
3 Developing trays (for 4 × 5 plates), - - - - $0.60—0.90
1 Ruby lantern, - - - 0.75—6.00
1 Negative rack, - - - - - - 0.50
1 Scales and weights (Apothecary's), - - - - - - - 1.00
1 Camel-hair dusting brush (flat, 2 inches wide), - - 0.50
1 Medicine dropper, - - - .05

Trays.—The best developing trays, because the most durable, are made of 'ebonite,' or hard rubber. They are somewhat more costly than those made of japanned iron, but they are well worth the difference in price. Those who intend to do considerable photographic work will do well to use trays large enough to hold two plates at one time. It is a great convenience and saves much time in developing, fixing, etc.

Glass or porcelain trays are also used. Japanned iron trays are quite likely to rust after a time, and finally they will leak. They may then still be used by coating them with paraffin, by melting a piece and flowing it over the bottom of the pan, which effectually stops the leak and protects the metal.

The Ruby Lantern.—There are numerous forms of lanterns especially designed for the dark room. The

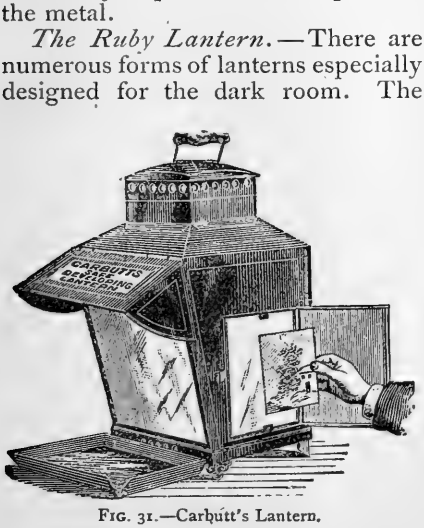


Fig. 31.—Carbutt's Lantern.

most elaborate is Carbutt's 'Multum in parvo lantern,' illustrated in figs. 31 and 32, which is to be highly commended. The price of this lantern is $6.00, but it can be applied to many important uses. It is about nine inches square by fourteen inches high, and has in front a large ruby glass, giving a safe and abundant light for developing. On the one side is an opal plate, useful for examining plates after fixing, and on the other side a door opens to permit the direct use of the lamp-light. A silvered reflector within can be operated from the outside. There are other good features about this lantern, and altogether it is doubtless the best one made. This lantern is used as the source of light in Scovill's photo-microscopic apparatus.

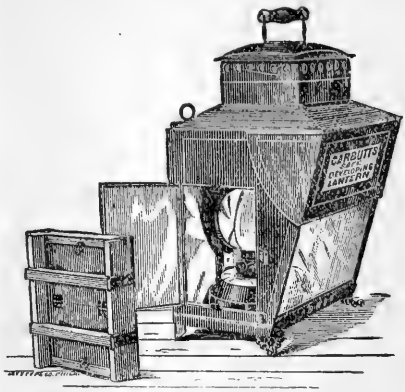


Fig. 32.—Carbutt's Lantern. (Open.)

Next to Carbutt's, and probably quite as good for all practical purposes, is the 'excelsior' lantern devised by Mr. Walmsley, shown in fig. 33. The price of this lantern is only $3.50. It is a very practical lantern, and deserves to be extensively used.

Another very excellent lantern is Scovill's 'Non-actinic dark-room lantern,' illustrated in fig. 34, which is sold for $2.00. This lantern is glazed with orange-colored glass; the light is said to be far more pleasant to work with than ruby light, and at the same time quite as safe for the plates. We cannot speak from experience in this matter, but we

have seen the orange glass in use where it has given perfect satisfac-

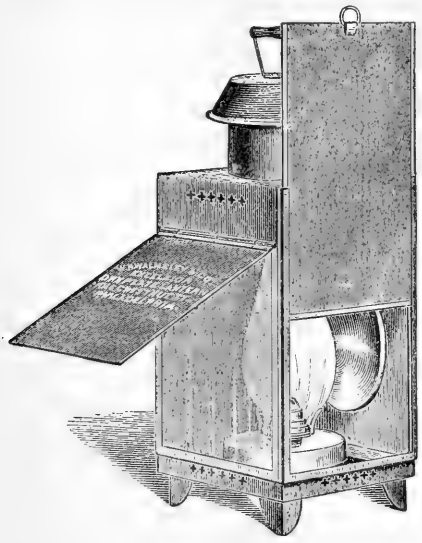


FIG. 33.—Walmsley's 'Excelsior' Lantern.

tion, and have no doubt it is more pleasant, and perhaps less trying, to the sight.

A still cheaper lantern is the 'W. I. A. improved' (fig. 35), introduced by the Scovill Manufacturing Company. The source of light is a candle, and it gives sufficient light for developing, but the reader is strongly advised not to be content with such a small lantern if a larger one can be afforded. Abundance of non-actinic light in the dark room is very desirable, as it obviates the strain upon the eyes, and enables work to be done with far more comfort.

In passing we may mention the very excellent device of Mr. Walmsley known as the pocket lantern, price 90 cents, which is very useful in travelling for changing plates, and even for developing. Another portable lantern is Scovill's 'W. I. A.' lantern, which likewise stows away very well. This, however, is not to be highly recommended, since if the lamp is not very carefully regulated, it produces more smoke for its size than any other apparatus under the sun.

Negative Rack.—For drying negatives a rack, constructed of wood as

FIG. 34.—Scovill's 'Non-Actinic' Lantern.

shown in fig. 36, is convenient, but by no means essential. The same object can be satisfactorily attained with small plates, by driving long tacks or nails in an upright board in such a manner that the negative will be supported at the lower corner between two tacks.

FIG. 35.—W. I. A. 'improved' Lantern.

Dark Room.—This should not be too small for comfort, and it should be fitted up for convenience of working. Everything should be kept in good order within it, to avoid mistakes in the use of chemicals in the feeble light. Should there be an outside window it may be glazed with orange or ruby glass and an abundance of non-actinic light admitted

to illuminate the room. Glass of the right color can be obtained from dealers in photographic goods. A less expensive plan is to cover the

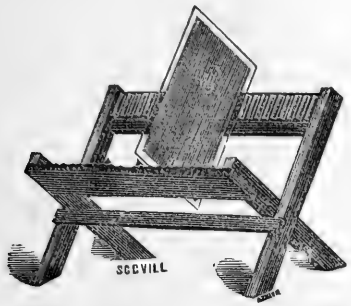


FIG. 36.—Negative Rack.

window with heavy, translucent, orange-colored envelope paper, which admits a tolerably safe light for developing. Mr. E. C. Pickering has made some experiments upon this subject recently, and has concluded that a material known as golden fabric is the best. Some workers prefer to work by the light of the lantern alone, deeming it more uniform, and therefore better, than the light from an outside window. When the window of a dark room opens into another apartment, it is a good plan to place the lamp outside of the window, as the room does not then become heated or contaminated by the products of combustion.

In all cases it is well to test the quality of the light admitted by exposing a plate, partly protected by a strip of opaque paper, to the light, about twelve inches from the window. If after an exposure of fifteen minutes development fails to show any action of light upon the plate it may be considered the light is of good quality to work with.

The light should enter the dark room so as to shine directly upon the plate during development. The operator should face the light.

Running water in the dark room is very desirable. If this cannot be had, a tank should be placed on an elevated shelf with a rubber tube leading the water to the place where it is required. The flow of water may be stopped either by a clamp, by bending the tube upon itself at a sharp angle, or by suspending the open end slightly above the level of the source of supply. This is even more convenient than a stop-cock.

As regards the details of internal arrangements of the dark room, not much can be said, as everything will depend upon the particular circumstances of each case. The water should be close at hand where the developing is done, so the plate may be flooded with water instantly if necessary. There should be a convenient shelf or table for plates and holders, a separate shelf for a tray to contain the fixing bath, and a place for chemicals, developing solutions, and sundry bottles that will constantly accumulate, and be as constantly in demand.

[*To be continued.*]

—o—

Results of Experiments Upon the Adhesiveness of Some Microscopical Cements.

BY PROF. A. B. AUBERT.

In looking over the literature of microscopy, I have often wondered why no tests have been made of the comparative adhesiveness of the various cements used. Personal experience in the use of cements is undoubtedly of very great value, nevertheless, direct experiment may often be equally useful in deciding what cement to use for a certain purpose. In journals and works on mounting, I found so many more or less conflicting statements, that I decided, as soon as time permitted, to make some tests with our most common cements.

For this purpose I chose metallic cells, having an outer diameter of .77 of an inch and an inner of .51 of an inch; thus offering a surface of adhesion equal to about .2262 of a square inch. To these cells was soldered a loop of strong brass wire; they were then attached with the cements to

heavy glass slides, and put aside to harden for one hundred and three days. The slides with rings were put into a rigid frame, supporting them at both ends, and a hook, with a deep pan attached, was slipped into the loops of brass wire. Sand was cautiously poured into the pan, and when enough had been added to occasion the breaking apart of ring and slide, the quantity added was carefully weighed, and the condition of the cement noted, with the following results :—

Name of cement.	*Condition of cement.*	*Wt added. Grammes.*
R. Miller's caoutchouc cement,	dry,	6150
Bell's cement,	nearly dry,	4520
Canada balsam, chloroform solution,	somewhat soft,	4087
Lovett's cement,	dry,	3850
American styrax, chloroform solution,	a little softer than the Canada balsam,	3538
King's cement,	nearly dry,	3274
Gold size (Winsor & Newton's),	very soft, dry only around edges,	2423
Dissolved marine glue,	nearly dry,	1867
Zinc white,	dry,	1481

By calling Miller's cement 1000 we have the following table representing the comparative adhesiveness of the cements tested :—

Miller's caoutchouc cement,	1000
Bell's cement,	735
Canada balsam,	664
Lovett's cement,	626
American styrax,	575
King's cement,	532
Gold size,	395
Dissolved marine glue,	304
Zinc white cement,	241

Gold size would undoubtedly have stood much higher in the list had it been sufficiently hardened. It certainly showed considerable tenacity when the fact that the edges only were hard is taken into consideration. Most of the other cements were dry enough to make the results sufficiently accurate for comparison.

R. Miller's caoutchouc cement is of English manufacture, and is well recommended. Having only used it for a short time I cannot say much in regard to its qualities from personal observation.

Bell's cement is said to be a solution of shellac in alcohol. It has always worked well in my hands for glycerin, camphor, water, and some other liquid media.

Canada balsam I have only used as a mounting medium, and should fear that it might become too brittle in time to be reliable as a cement.

Lovett's cement* consists of thoroughly mixed, finely powdered white lead 2 parts, red lead 2 parts, litharge 3 parts. For use the powder is mixed with gold size to the consistency of cream, and the cells immediately fastened to the slides. They will be found quite secure in two weeks. It is the best cement I know of for liquids containing alcohol.

American styrax is an excellent mounting medium. It would probably remain tough longer than Canada balsam. I have never used it as a cement, however.

King's cement, prepared by J. D. King, Cottage City, Mass., I have found to be a pleasant cement to finish mounts with. The label states that it is 'strong and reliable to attach cells and secure fluid mounts.'

The gold size I use is of Winsor & Newton's make, it dries rapidly and is very tough; my experience with it is such that I consider it one of the safest, if not the safest, of our common cements. Cells made many years ago, which have been roughly handled, show no tendency to crack or loosen.

Dissolved marine glue is a fusel oil (amylic alcohol) solution put up by Robert Howard, of Birmingham, England. The label states that it is 'very good for fixing cells, or making zoophyte troughs, etc.' My experience with it is so limited that I am unable to say anything additional.

The zinc white cement (benzole solution of gums) was prepared by Geo. F. H. Markoe, 61 Warren street, Boston, Mass. I like this cement very well for dry mounts, but have always been in the habit of covering it with a ring of gold size.

* Vol. v, p. 98.

I have found asphalt cement and Brunswick black so brittle that I did not test them, but hope to do so hereafter, when I expect to add still other cements to my present list.

Let it be remembered that the foregoing tests must be looked upon as comparative only, not as absolute; they were made to assign places to cements in a comparative list. To determine the absolute adhesive strength of a cement a large number of tests of that one cement would have to be made under various conditions. I have at present too little time at command to undertake so complicated a series of experiments.

ORONO, Maine.

—o—

The New Star Microscope.

Through the courtesy of Mr. Walmsley we are enabled to present an illustration of the 'star' microscope, recently introduced by the Messrs. Beck. It is an attractive, low-priced microscope, with rack adjustment, fine focusing screw at the back of the limb, according to the latest and most approved design, sub-stage ring, and swinging mirror-bar. The base is solid, and the instrument is admirably arranged throughout. Its simplicity and general utility will cause it to be in great demand during the holiday season. Mr. Walmsley declares it is 'the most wonderful cheap instrument ever made.' It is represented in Fig. 37. The demand for low-priced but useful microscopes is increasing, and we are glad to encourage it as it tends to make microscopy more popular and increases its usefulness.

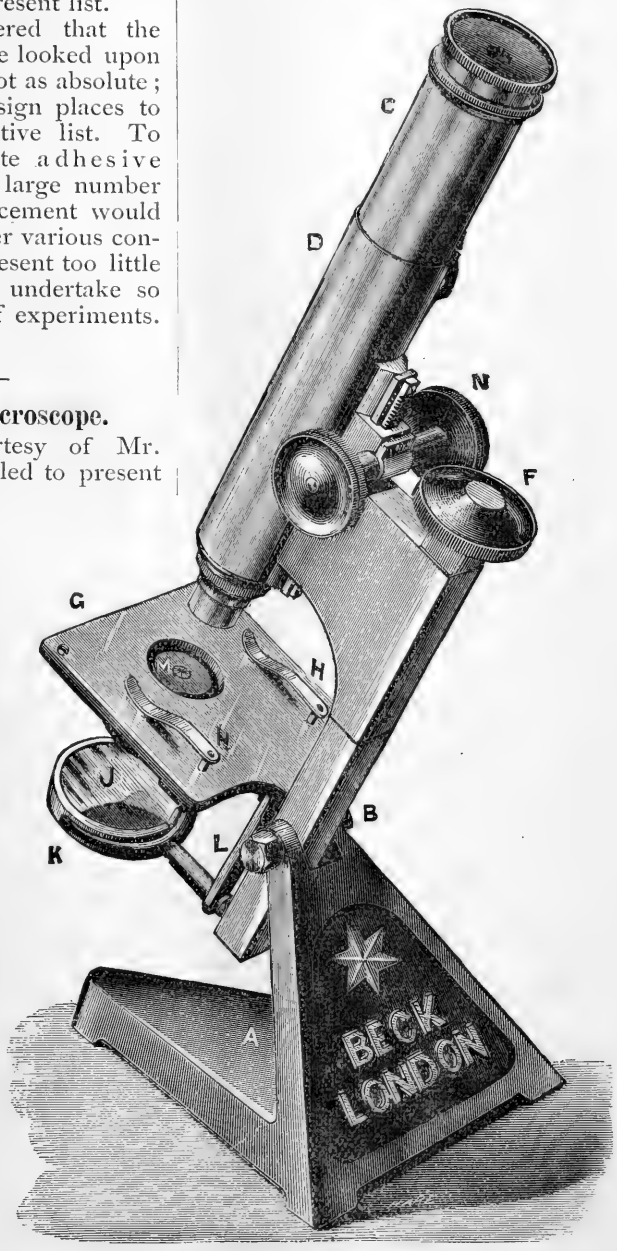


FIG. 37.—New Star Microscope.

Diatoms and How to Collect Them.*

The diatoms or bacillaria are small and single celled microscopic plants, belonging to the class of kryptogams. Their color is due to a peculiar coloring matter, diatomin. When living, the plants are colored greenish-brown or brown. The walls are composed of silica, and resist decomposition after the plant has died. To this circumstance is due the origin of infusorial earths, and you well know what colossal deposits are found in different localities, and what a large share these little organisms have had in the formation of the surface of the earth. The walls are composed of two parts, which fit one in another, like the cover of a paper box, forming the two principal sides, which show the beautiful markings of the diatoms.

The belts (hoops) of the diatoms are smooth or striped and otherwise marked, and if you boil them with strong acids they will come off; so that the two principal sides will be isolated. If you want to make a preparation you always have to remove the belts, which costs sometimes a great deal of trouble.

Small as these forms are, their difference in size is sometimes enormous. As regards the larger forms you will, in some cases, be able to observe them with the eye as small white spots; the smallest, however, are only visible when in large numbers, heaped together.

The diatoms are distributed in both fresh and salt water. The first are, as a rule, small, single forms; the latter, however, large and diversiform.

I will give you some information about collecting them. The marine species are partly attached and partly free forms. You have to take a spoon and a walking-cane to which to fasten the spoon, some well corked glass bottles, and some pieces of blotting-paper. The locality where to collect will be a brackish swamp, or parts of the sea-shore within the ebb and flood tide. The free-living forms you will find on the algæ that float in the water, and the browner these algæ look the more certainly you may expect to find diatoms upon them. Stones lying in the water and covered with a slimy substance will also yield diatoms. If you take these algæ and press them carefully you can keep them in the blotting-paper.

The mud on the ground will yield a great quantity of diatoms, but where the ground is sandy or stony you need not look for them, except where the ground has a slimy touch.

Take the surface of the mud away one inch thick with the spoon and put it in the bottles. When you get home put the mud on a plate and let it dry. In spring or autumn, when the diatoms are copulating, you will be able to observe them. The mud then will change in color to brown or yellow. In this mud some air-bubbles will be formed by the diatoms, which tear the tender, thin skin, and will float on the surface of the water. You then only need to catch these flakes, or take up the mud with the spoon. This is immensely rich material and is composed only of diatoms.

I have discovered a new system of obtaining specimens from poor material. Take the material and dilute it well with water in a bowl, and let it stand about a quarter of an hour. The mud must be well stirred in the water so that it looks like muddy water. Let it stand and rest again. The heavy mineral particles will sink down. After a quarter of an hour the water will be clear again, but on the top all vegetable particles will float. If you have a small, fine sieve, pour the water through and all the rough parts will remain in the

* Translated by Mr. Brunno Muller. It should be stated that this article is a translation of a familiar, private letter of Mr. Carl Muller, an experienced collector and preparer in Germany, to his brother, who, at the editor's request, has translated it for the Journal.

sieve, while the diatoms will go through and will float on the surface of the water; let it stand about a quarter of an hour, when the diatoms will have settled on the edge of the plate, and there form a greenish-black border, which you can take off and put under the microscope.

—o—

Provisional Key to Classification of Algæ of Fresh Water.—V.

BY THE EDITOR.

[*Continued from p. 174.*]

III. ORDER CONFERVOIDEÆ Kirchner.

c. ULVINÆ. Group 3.

Synopsis of Genera.

1. Foliaceous; cells in a single layer.

Thallus crustaceous. *Protoderma*, 69.

Thallus attached, erect, leaf-like. *Prasiola*, 70.

Thallus membranaceous, crisped, attached or floating. *Ulva*, 71.

Thallus filiform. *Schizomeris*, 72.

2. Membranaceous, tubular or vesicular.

Thallus vesicular, globular. *Physodictyon*, 73.

Thallus tubular. *Enteromorpha*, 74.

Thallus open or saccate; cells rounded, not close. *Monostroma*, 75.

69. Genus *Protoderma* Kützing.

Thallus crustaceous, indefinitely expanded, closely adherent to the substratum; cells angular, irregularly arranged, closely connected. Propagation unknown.

70. Genus *Prasiola* Agardh.

Thallus leaf-like, erect, spreading from an intricate mass of colorless filaments forming a root-like attachment. Cells angular, more or less arranged in groups of 2–8–16, separated by clear spaces.

Division of cells in two directions.

[Sometimes the thallus arises from a slender petiole-like attachment and expands into a broad, palmate leaf.]

71. Genus *Ulva* Linn.

Thallus membranaceous, expanded, undulately curled or crisped, composed of a single stratum of cells, angular from mutual pressure.

Division in two directions. Propagation by zoospores, 4–8–16 formed in a single cell.

[*Ulva* is a marine genus, not often represented in fresh water. The fronds closely resemble *Prasiola*, and it is doubtful whether *Prasiola* may not be regarded as the fresh-water representative of *Ulva*. See also *Merismopedia*.]

72. Genus *Schizomeris* Kützing.

Thallus filiform, cylindrical, attached, cells in a single plane, dividing first in one direction, later in two directions forming groups of four. Frond constricted here and there.

73. Genus *Physodictyon* Kützing.

Thallus vesicular, globular; cells angular.

74. Genus *Enteromorpha* Link.

Thallus tubular, branched, attached while young, later free; cells in a single layer forming the tube. Propagation by zoospores.

75. Genus *Monostroma* Thuret.

Frond plane or saccate, simple or lobate; cells somewhat rounded (sometimes quarternate).

[The frond may be either flat and open, or in the form of a tube. The cells are not so closely aggregated as in the preceding genera, and they are frequently surrounded by special, hyaline envelopes, enclosing 1–2–4 cells. We are not acquainted with the genus, but take the description and figures of Cooke for authority.]

Family VII. PITHOPHORACEÆ Wittrock.

Filaments like *Cladophora*, but with some of the cells distinctly swelled in their upper part. The spores are formed in such cells, the entire endochrome of the cell passing into the upper, turgid portion, which is club-shaped, leaving the lower part colorless.

Genus 76. *Pithophora* Wittrock.

Character same as the family.

[Representatives of this interesting genus have been found in various parts of the country; first by Mr. Wolle, near his home and in New Jersey. We have it now growing in an aquarium in Washington, but the source of this specimen is uncertain.

The mode of branching, and the general appearance of the cells are precisely like *Cladophora*. The peculiar method of spore-formation is distinctive.]

b. Oosporeæ.

Oogonia and antheridia.

After fructification the oosphere produces an oospore, while the former becomes surrounded with a thick wall and becomes a resting cell. Spermatozoids are formed in different cells, and are of variable form. They find their way through an opening into the oogonium, and there complete the fructification by fusing with the oosphere.

In most of the members of this division propagation by zoospores is also observed.

FAMILIES.

Filamentous, confervoid, aquatic or terrestrial; rootless.

Sphæropleaceæ, VIII.

Filamentous, aquatic, basal cell root-like, attached; spores in globular swellings. Œdogoniaceæ, IX.

Flat, spreading, cells with bristles.

Coleochætaceæ, X.

Family VIII. Sphæropleaceæ.

Filamentous algæ, living in water or on land, green, unbranched and rootless, of conferva-like appearance.

Propagation sexual, the vegetative cells becoming sexual organs. The oogonia form their protoplasmic contents by balling it together into a single or many oospheres, throwing out a watery fluid. In the cells destined to produce antheridia the plasma-contents divide into reddish-yellow spermatozoids, which leave the antheridium, enter the oogonia through openings in the walls, and fertilize the oospheres by fusing with them. These become oospores surrounded with a tough membrane, and their green contents become colored red by an oily substance. After a long time they germinate, while they (in *Sphæroplea*) divide into 2–8 parts, which leave the spore as swarm-cells (zoospores), and, coming to rest, give rise to new filaments.

Synopsis of Genera.

Green spherical cells, separated, in linear series, in hyaline tube.

Cylindrocapsa, 77.

Filaments of long, cylindrical-cells, with numerous, regularly spaced vacuoles dividing the endochrome into bands. *Sphæroplea*, 78.

77. Genus *Cylindrocapsa* Reinsch.

Young filaments attached, at first consisting of a linear series of cells, later often producing, by dividing walls parallel or inclined to the long axis, irregular or complex bands.

Cells short, cylindrical, spherical, or oblong, with dense, bright green contents, and starch granules, and thick, colorless envelope.

The oogonia are produced in vegetable cells, which become spherical, the entire contents formed into a single, spherical or egg-shaped oosphere. The walls of the oogonium consist of 3–6 broad, colorless layers (of the cell-wall), widely separated at the poles, but close laterally.

The antheridia are produced in the same filament by division of a vegetative cell in 2 or 4 daughter cells, not surrounded by special envelopes, in each of which 2 spindle-shaped spermatozoids of yellow color with a hyaline anterior portion, containing 2 contractile vacuoles and 2 cilia, are formed. Escaping, these make their way to the oogonium, the wall of which has opened on the side, enter, and fertilize the oosphere. The latter then becomes covered with a double contoured membrane and becomes an oospore; the contents change to a reddish-yellow color, and a long resting period fol-

lows. Its further history is not known.

[The oval or spherical cells, which may or may not be surrounded by thick, lamellose, hyaline envelopes, are arranged in a linear series within a tubular, hyaline, gelatinous cylinder (or vesicle, as Reinsch designates it). The cells are full to repletion with green, granular contents. Immediately after division the cells are in contact, and therefore truncate in form. Propagation by swarm spores has not been observed. Compare *Hormospora*, 16.

The cylindrical sheath is closed at both ends, the upper end rounded, sometimes expanded, with several green cells in the club-shaped interior; the lower end is narrowed and attached.]

78. Genus *Sphæroplea* Agardh.

Filaments composed of long, cylindrical cells, which, in the vegetative condition, have green, protoplasmic contents, which is divided by large, regularly placed vacuoles, into a number of equidistant rings or bands. The vacuoles are enclosed in a membrane, and the single cells appear, therefore, to be divided by false septa.

All vegetative cells are transformed into sexual organs. Oospheres numerous in a mother cell, of a dark green color. The oospores, after fertilization, produce three membranes, the outer of which is thrown off, leaving a colorless, widely separated, longitudinally or irregularly wrinkled or plaited epispore, a colorless close-lying endospore, and red contents.

The spermatozoids are formed in innumerable number by the division of other vegetative cells into yellow portions; they are yellow, elongated, with a thick hinder end, a beak-like, colorless anterior portion, with two cilia, and escape through openings formed in great number in the wall of the antheridium, and find their way to the oospheres.

The zoospores coming from the oospores are spherical, cylindrical or pear-shaped form, carmine-red or red and green, with hyaline end and two cilia.

[The contents of the cells sometimes appears quite frothy from the numerous vacuoles, especially just previous to fructification.]

—o—

Fixing arranged Diatoms and Sections.

Among the many methods of fixing diatoms and other minute objects upon a slide or cover-glass, the method of M. Threlfall has been very highly commended. The diatoms are arranged upon a perfectly dry surface of caoutchouc spread upon the slide, and fixed in place by application of gentle heat. The details may be briefly given as follows:—First prepare a solution of caoutchouc in benzene, adding sufficient caoutchouc to produce a jelly-like mass. Of this take a portion as large as two peas, and dissolve it in thirty cubic centimetres of benzene. This dilute solution is the one that is used. Crude caoutchouc should be used, or such as has not been vulcanized.

This solution affords an easy means of attaching thin sections in series as well as diatoms to a glass slip. In either case the slip is coated with a thin layer of caoutchouc by flowing it with the solution as a photographic plate is coated with collodion. The solvent rapidly evaporates, leaving the caoutchouc in a thin film on the glass. The sections, ordinarily included in paraffin, are arranged in series on the caoutchouc. The slide is then warmed to a temperature of 56°–60° C., when the caoutchouc softens, and the sections become fixed in place. The paraffin is then removed by petroleum spirit, and if it is desired the sections may be stained in position.

To attach diatoms it is only necessary to arrange them on the layer of caoutchouc and warm gently.

This method of fixing diatoms is highly commended by P. Francotte.*

* *Bull. Soc. Belge de Micr.*

The Striæ of Diatoms on the Möller Probe-Platte.

The following table is presented for convenience of reference. It was prepared a number of years ago —the date we do not remember, but it is of no great consequence, as we are not aware of any corrections of the numbers given in the last column.

The first column gives the number of the diatom on the test-plate, the second the name of the diatom, the third the person who named it, the fourth the direction of the striæ, and the fifth the number of lines in the thousandth of an inch, as determined by Professor E. W. Morley, whose experience gives authority to the results.

—	Eupodiscus Argus,	C. G. Ehrenberg.		
1	Triceratium Favus,	C. G. Ehrenberg,	Hexagonal,	3.7
2	Pinnularia Nobilis,	C. G. Ehrenberg,	Transverse,	13.0
3	Navicula Lyra Var.,	C. G. Ehrenberg,	Transverse,	16.0
4	Navicula Lyra,	C. G. Ehrenberg,	Transverse,	24.5
5	Pinnularia interrupta,	W. Smith,	Transverse,	26.0
6	Stauroneis Phœnicenteron,	C. G. Ehrenberg,	Transverse,	34.5
7	Grammatophora Marina,	W. Smith,	Transverse,	38.4
8	Pleurosigma Balticum,	W. Smith,	Transverse,	33.1
9	Pleurosigma Acuminatum,	F. T. Kützing, A. Grunow,	Transverse,	46.4
10	Nitzschia Amphioxys,	W. Smith,	Transverse,	49.2
11	Pleurosigma Angulatum,	W. Smith,	Diagonal,	47.0
12	Grammatophora Oceanica (*G. subtilissima*, J. W. Bailey),	C. G. Ehrenberg,	Transverse,	61.6
13	Surirella Gemma,	C. G. Ehrenberg,	Transverse,	53.5
14	Nitzschia Sigmoidea,	W. Smith,	Transverse,	62.0
15	Pleurosigma Fasciola,	W. Smith,	Transverse,	58.0
16	Surirella Gemma,	C. G. Ehrenberg,	Longitudinal,	67.0
17	Cymatopleura Elliptica,	A. DeBrébisson,	Transverse,	63.0
18	Navicula Crassinervis (*Frustulia Saxonica*, L. Rabenhorst),	A. DeBrébisson,	Transverse,	86.2
19	Nitzschia Sigma Var.,	W. Smith,	Transverse,	90.0
20	Amphipleura Pellucida,	F. T. Kützing,	Transverse,	95.2
—	Eupodiscus Argus,	C. G. Ehrenberg.		

Staining Tissues in Microscopy.—VI.

BY PROF. HANS GIERKE.

[*Continued from p. 216.*]

129. Ehrlich. Börner's d'tsch. med. Wochenschr., 1882, No. 19.

The modification of Koch's method, introduced by Ehrlich and now everywhere adopted, consists in substituting for potash, anilin, which is a yellowish, oily fluid, that, diluted with water, dissolves the dye much better than the dilute alkali. Strong mineral acids are used for bleaching. He thinks the bacillus of tubercle is inclosed in a sac, which is only penetrated by alkalies, not by acids or neutral solutions. If the dye is alkaline it will be bleached by acids. These dissolve the dye and remove it from the other constituents of the preparation, but cannot enter the inner part of the tubercular bacillus, hence it remains colored. The recipe is as follows :—Sprinkle a little anilin in water to make a 3 per cent. solution, filter. Add a strong alcoholic, basic anilin color, as gentian violet or fuchsin, till a precipitate forms. Filter, and the stain is ready. Let the material soak for 24 hours in the cold, or one hour in a warm chamber at 50°. The sections are then transferred to 30 per cent. hydrochloric acid till they appear bleached, which only takes 1–3 minutes; they are then dehydrated in absolute alcohol and cleared in oil of cloves. The tissues may be subsequently stained with other colors.

130. Baumgarten. Ueber ein bequemes Verfahren, Tuberkelbacillen in Sputen nachzuweisen. Centralbl. f. d. med. Wiss., 1882, No. 25.

A modification of the two preced-

ing processes. Sputa is dried in the usual way, and moistened with a very little dilute potash lye (1–2 drops of the 33 per cent. solution to a watch-glass of water). The bacillus may now be easily seen with a power of 400–500. To avoid changes, dry the cover-glass again, pass two or three times through a gas flame, then treat with a drop of rather dilute anilin violet, or other anilin adapted to stain nuclei. The bacteria of putrefaction will become intensely blue, but the bacillus of tubercle will remain colorless.

The numerous processes of 1883 cannot yet be brought together and presented here.

From the text-books on Microscopy may be added:—

131. Beale. How to work with the Microscope, 5th ed., 1880, p. 127.

Solferino and magenta are old names for our fuchsin, and they appear to have been much used in England. The dyes are boiled in water, to which a little alcohol is added, 10–15 drops to the ounce. Magenta was recommended by Dr. Roberts in 1863, in Proc. R. Soc., xiv, p. 481, on peculiar appearances exhibited by blood corpuscles under the influence of solutions of magenta and tannin.

132. Frey. Das Mikroskop und die mikroskopische Technik, 7. Aufl., Leipzig, 1881, p. 101.

Anilin blue that is insoluble in water but soluble in alcohol, may be made soluble in water by treatment with sulphuric acid, and may then be used in water, or as follows:—Soluble blue 2 cg., water 25 cc., alcohol 20–25 drops. This fluid is especially to be recommended for those materials that are hardened in alcohol.

DIFFERENTIATION OF TISSUE ELEMENTS BY THE REDUCTION OF SILVER SALTS, ESPECIALLY SILVER NITRATE.

Out of the great number of articles relating to this method, we select only those methods that have a particular technical or histo:ical interest.

133. Flinzer. De argenti nitrici usu et effectu præsertim in oculorum morbis sanandis. Diss, 1854, bei Coccius gearbeitet.

The observation is here recorded that after treatment with lunar caustic a precipitate is formed between the cells of the cornea.

(After v. Recklinghausen See No. 138.)

134. His. Beiträge zur normalen und pathologischen Histologie der Cornea. Basel, 1856.

On treatment of the cornea with lunar caustic a granular precipitate forms in the canals, or in the fundamental tissue. He calls the first intercellular, the latter extracellular. He applies the pencil to the cornea.

135. V. Recklinghausen. Eine Methode mikroskopische hohle und solide Gebilde von einauder zu scheiden. Archiv pathol. Anat. xix, 451.

Fresh or dried animal tissues are put into a weak solution of silver nitrate, then in a dilute brine in order to arrest the further action of light. A fine, thick, black silver precipitate is thus formed in all parts containing much water, while portions more solid escape the feeble action of the silver salt and remain colorless, or with longer treatment show scattered grains, or diffuse staining.

(The best method of staining with silver is to lay the material in a $\frac{1}{4}$ to $\frac{1}{2}$% solution of a silver salt for 20 to 40 seconds, moving it about in the solution, taking care that sections do not cling together. Then drop at once in a .75% salt solution, moving them actively as before, then expose to the light).

136. V. Recklinghausen. Die Lymphgefässe und ihre Beziehung zum Bierdegewebe. Berlin, 1862, p. 5.

The results of continued experi-

ments with silver nitrate are here described. The exterior lines of the epithelium are stained black. In connective tissue the silver salt seeks the finer vessels, which are the beginnings of the lymphatic system, and is deposited there as a fine black grainy precipitate. The fundamental tissue of the cornea stains yellow or dark brown. Low powers are recommended, 400 to 500.

137. His. Ueber die Einwirkung des salpetersauren silber oxyds auf die Hornhaut. Schweitzer Zeitschrift f. Heilk. ii. Heft 1, p. 1 (1862).

Weak solutions of silver nitrate, according to His, in former essays, develop the inner cell-substance, strong solutions the outer. His now thinks that the time of treatment is important.

The salt is first deposited in the intercellular substance of the cornea but is soon dissolved out by the surrounding fluids and may enter the cells to be again precipitated under the influence of light or by contact with peculiar compounds in the cells. The method is essentially causticising by silver nitrate.

138. V. Recklinghausen. Zur Geschichte der Versilberungsmethode. Arch. pathol. Anat. xxvii, 419 (1863).

139. His. Ueber das Epithel der Lymphgefässwurzeln und über die v. Recklinghausenschen Saftkanälchen. Zeitschr. Wiss. Zool. xiii, 455.

Each of these authors claims priority in the use of silver nitrate. Von Recklinghausen insists he discovered the method as a 'new mode of anatomical investigation,' but His (see 134) in 1856 showed that silver in the cornea differentiated intra and extra cellular substance, and Flinzer and Coccius (No. 133) made a similar statement in 1854, but did not carry the application any further.

[*To be continued.*]

EDITORIAL.

Publisher's Notices.—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Subscription price $1.00 PER YEAR *strictly in advance. All subscriptions begin with the January number.*

A pink wrapper indicates that the subscription has expired.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, $1 50.
Vol III (1882) complete, $2.00.
Vol. IV (1883) complete, $1.50.
Vol. V (1884) complete, $1.50.
Vol. V (1884). Nos. 2–12, $1.00.
Vol. VI (1885), $1 00.

— To our many subscribers and readers whose faces are not known to us, as well as to the many others whom we number among our friends, we extend a hearty Christmas greeting and wishes for a happy New Year. In a few days the whole civilized world will celebrate a day that has been observed for ages, and comes down to our own time as a day of good cheer to rich and poor. But few are so entirely wrapped up in their own affairs that Christmas tide does not bring out the generous impulses of their nature. On Christmas eve and Christmas morning there is probably more genuine happiness in the world than any other day of the year. Christmas is therefore a great blessing to the world, and we trust all our readers will enjoy it fully.

——o——

WILLIAM B. CARPENTER.—The death of Dr. W. B. Carpenter, the eminent English physiologist and microscopist, was announced last month. Dr. Carpenter has been so closely associated, and intimately acquainted, with the progress of microscopy in England during his long career as a leader in scientific thought, and so well known among microscopists, that we have deferred an extended notice of his life until January, when we shall present our

readers with a portrait which is now being engraved for us from a photograph by Bogardus, taken while Dr. Carpenter was in this country not long ago.

The portrait is, we believe, better than any yet published, and will form an appropriate frontispiece to the next volume, which our readers will no doubt highly prize.

——o——

THE JOURNAL FOR 1886.—The past year has been, unquestionably, the most entirely successful year the journal has yet enjoyed. Owing to a variety of causes, among which we may mention the increased demand for illustrations, the profits of the business have been somewhat less than in some past years; but when we say this has been the most successful year of all, we consider only the journal as a medium of information. We need not pass in review the many articles of value it has been our pleasure to publish this year. Those who have read the journal already know of them, and those who have not read it will probably not read this paragraph.

However, at this time it is proper we should say a few words about the next volume. It is our intention to improve the journal in several respects. We have been very much annoyed this year by irregularities in the paper upon which it has been printed. This we propose to obviate in future, and next year a better paper will be used, upon which illustrations can be printed to better advantage.

With the January number will be issued a fine portrait of the late Dr. W. B. Carpenter, to be the frontispiece of the volume. The portrait will be engraved especially for this journal, and will only be furnished to those who subscribe for the year. Single copies will not be sold.

Among the subjects that will be treated at length next year, photomicrography will have a prominent place. The articles on the genera of algæ of fresh water, by the Editor, will be continued and brought to an end; as will also the translation, by Professor Seaman, of the valuable historical account of staining processes. The value of both these contributions will be best recognized when they are completed and indexed. A considerable number of interesting articles on different subjects is already in hand awaiting publication, and others are promised.

The very satisfactory condition of the journal, especially as regards the character and value of the articles contributed during the past year, encourages us to devote more time to it in the future than hitherto, for it has now become a publication of recognized value in the field it covers. We shall persevere in the course that has been followed thus far with such satisfactory results, preferring to merit the appreciation of the large and increasing body of earnest students and workers, rather than attain notoriety, and a trifling transient increase of circulation, by a less conservative course.

——o——

MICROSCOPICAL SOCIETIES.—Some time ago we stated our intention to publish each year a list of the microscopical societies in the country, and requested the officers or members to favor us with the names of officers, number of members, and such other information concerning the societies with which they are connected, for this purpose. After waiting several months, we find the number of responses surprisingly small. Although we cannot present the list as representing all the societies in existence, it may fairly be assumed to include, with a few notable exceptions—such as the New York, and the Wellesley College for example, from which we have not received information concerning present membership, etc.—all the societies that are active and prosperous. Omissions can be made up next year. The list includes only those societies whose officers have re-

sponded to our request for information, hence, so far as it goes, it is reliable. The information, however, is quite incomplete in many cases. We hope next year to publish a more perfect list, that will prove of greater interest. It was intended to publish the names of the officers in this connection, but some of the reports came in so late that the officers were named for 1886, while others gave the officers for 1885. We shall be pleased to publish the names of officers of all societies for the year 1886, if the necessary information is received before the first of March.

Bethlehem Microscopical Society, Bethlehem, Pa.

Organized January 10, 1884. Meetings the first Thursday of each month. Membership 16.

Microscopical Society of Camden, Camden, N. J.

Organized Nov. 7th, 1878. Meetings at Microscopical Hall, 46 N. 3d street, on the first and third Thursdays of each month, (usually excepting July and August). Membership 51, average attendance 10. Twenty microscopes are owned by members. Lectures are frequently given. This year Prof. C. H. Kain, Dr. A. P. Brown, Dr. G. T. Robinson, and Prof. E. F. Moody have lectured before the Society. The Society is in good financial condition.

California Microscopical Society, San Francisco, Cal.

Incorporated August 20, 1883. Meetings monthly. A society of ladies who manifest considerable interest in microscopical work.

Cleveland Microscopical Society, Cleveland, Ohio.

Organized May 23, 1882. Meetings on the first and third Mondays of each month. Membership 55. Average attendance 11. The society subscribes for some periodicals, and has the use of the library and museum of the Kirtland Society of Natural Science.

State Microscopical Society of Illinois, Chicago, Ill.

Incorporated March 31, 1869. Meetings on the second Friday of each month from October to May, inclusive. Active members 82, corresponding members 22, honorary members 5. This is one of the oldest established societies in the country; nearly as old, as a corporation, as the Royal Microscopical Society of London, whose royal charter was obtained in 1866.

Iron City Microscopical Society, Pittsburg, Pa.

Meetings once a month. Membership 43. The objects of the society are declared to be 'to bring together all of kindred tastes.... and to disseminate a knowledge of and encourage the use of the microscope as a means of research, and of private and social recreation.' The programme of the meetings indicates that the presentation of papers is not regarded essential to the interest of the meetings, but each member is expected to bring at least one object, and the first part of the programme is exhibition of objects. Then follows the 'occasional reading of papers,' then exhibition of books, drawings, photo-micrographs, etc., and finally practical illustrations of microscopical work. The business session begins at 9.30. Saturday afternoon excursions are made for collecting.

Lehigh Valley Microscopical Society, Easton, Pa.

Organized May 19, 1881. Membership 13, and 1 honorary member. The society is in a prosperous condition.

Minneapolis Microscopical Society, Minneapolis, Minn.

Meetings on the first and third Mondays of each month, well attended, and much interest is manifested by members.

Central New York Microscopical Club, Syracuse, N. Y.

Organized April 6, 1880, incorporated May 18, 1883. Meetings on the last Monday of each month, except during July and August.

Richmond Microscopical Society, Richmond, Va.

Organized and chartered 1880. Membership 18. Owns a good library, and subscribes to many scientific journals. Members have the use of a laboratory for research.

San Francisco Microscopical Society, San Francisco, Cal.

Membership 28 and 2 honorary members.

St. Louis Microscopical Society, St. Louis, Mo.

Organized May 24, 1869, incorporated August 17, 1872. Meetings on the first Thursday of each month. Active members 23, honorary members 2.

Washington Microscopical Society, Washington, D. C.

Organized 1884. Meetings on the second and fourth Tuesdays of each month. Membership 27.

In addition to the strictly Microscopical Societies there are several associations having microscopical sections, or which give occasionally microscopical exhibitions. We have before us programmes of the microscopical soiree of the Purdue Scientific Society, Lafayette, Ind., given in June, 1885, and also of the Portland Society of Natural History, Portland, Me., given in April.

NOTES.

—We are indebted to the Palmer Slide Company, whose advertisement is to be found on another page, for a number of samples of their bevel-edge slides, but recently introduced. These slips are certainly very attractive in appearance, and are well adapted for ornamental preparations. Some are plain glass, very colorless and free from defects, others are flashed with a color on the under surface, which modifies the light, or adapts them very well for opaque mounting. The only criticism we would make of these slides is, that we anticipate careless handling will result in chipped corners. The company also manufactures plain slides of the ordinary kind, but of a superior quality of glass, at very reasonable prices.

— Mr. Woolman has been sending out a circular and a preparation mounted on the new bevel-edge slide to illustrate the beauty of the mounts on such slips. Mr. Woolman, in further recommendation of the slips, says: 'Aside from the great beauty of the finished object, making them the most elegant slide yet introduced, their bevel-edge allows them to glide smoothly under spring clips on the stage of the microscope. They are made of Chance's crystal plate and Chance's flat crown, and with ground edges, or ground and polished edges.' They vary in price from $4.00 to $6.00 per gross.

— Dr. Otto A. Wall has recently assumed charge of the microscopical columns of the *National Druggist*, of which he is associate editor, and has begun a series of articles on the microscopical examination of drugs, which promise to be very useful to pharmacists. The editor of the *Druggist*, H. M. Whelpley, Ph. G., is also instructor in the microscopical laboratory of the St. Louis College of Pharmacy. The laboratory is well equipped with microscopes and apparatus, as we learn from the Prospectus of the college, and claims to offer the best facilities for instruction in the West.

— Thirty-two parts of 'Our Living World,' an artistic edition of the Rev. J. G. Wood's Natural History of Animate Creation, already noticed in these columns, have been issued, leaving only ten more parts to complete the work. There is no illustrated popular natural history that equals this, in the interest of the text or the excellence of the illustrations, all of which are accurate. The wood-cuts are well executed and numerous, mostly taken from living animals, but the colored plates are especially fine; for example, the group of young leopards and mother—but they are all worthy of praise, and some of the birds are particularly good. For a popular natural history, this is far better than any systematic work on the subject. The classification of animals has not been disregarded, but this has been made subordinate to the descriptions of the animals themselves, their appearance, habits, and distribution. The publisher is Selmar Hess, New York city.

—A form of cobweb micrometer has been introduced by Mr. Bulloch, which is certainly one of the best we have seen. The workmanship of it is first-class, leaving nothing to be desired in that respect. In addition to the movement of one set of lines with the micrometer screw, another screw, worked with a milled head on the other side of the instrument, moves

both sets of lines together, so that it is possible to set the graduated screw-head at zero for any particular measurement. This is a very convenient as well as useful feature.

CORRESPONDENCE.

About Magnification.

TO THE EDITOR:—Being somewhat interested in the article on page 203, 'The Magnifying Power of an Inch Objective,' I wish to propound the following questions:—

First. What is the magnifying power of an inch lens at 10 inches between object and lens?

Second. What is the formula of a two-inch eye-piece as used in the microscope; not in the telescope?

Third. What is the magnifying power of a two-inch eye-piece, 10 inches between object and diaphragm?

Fourth. Are there fifty microscopes in this country that are furnished with two-inch eye-pieces?

Fifth. What is the length of a ten-inch tube?

Any person who has used the microscope for only a few days will doubtless think himself able to answer any one of the above questions. I want the actual measurements.

WALTER H. BULLOCH.

[Our columns are open for replies to any of these questions. Evidently Mr. Bulloch has been studying this subject of magnification, and now desires to draw out some ideas from others. The questions are worthy of careful consideration. —ED.]

NOTICES OF BOOKS.

Methods of Research in Microscopical Anatomy and Embryology. By Charles Otis Whitman, M. A., Ph. D. Illustrated. Boston: S. E. Casssino & Company. 1885. (8vo, pp. viii and 255.)

Dr. Whitman's admirable manual is undoubtedly the most practical treatise on the subjects with which it deals at present accessible to the student who wishes to know how to prepare his materials properly for staining, and how to imbed, section, and mount delicate objects and tissues in accordance with the most recent and approved methods. These methods which have been developed by the workers in the laboratories of continental Europe, and have been still further improved upon by the untiring efforts of the corps of investigators gathered together at Naples, under the direction of Dohrn, are fully explained in this book. While the work deals very largely with the methods pursued by the embryologist, the working histologist and anatomist cannot fail to be instructed by reference to its pages. It is, in fact, a laboratory manual, explaining clearly the steps by which definite results are to be reached. It is not a mere collection of formulæ, but a treatise by the aid of which the student may instruct himself in that comparatively new art, microtomy, which is revealing so much that is of importance in modern biology. It discusses general and special methods, the enlarged stereogrammatic reconstruction of minute objects from serial sections, the times and places of ovulation of a considerable variety of forms, fixatives, and gives full directions for successfully cutting serial sections. Formulæ for the preparation of reagents are given, and two very useful micrometic tables complete the book. There is a good index. Nothing is said of microscopes and accessories, and their construction or theory. The methods useful to the actual investigator are alone dealt with, leaving the work unencumbered with details which have already been capably handled by Carpenter in his hand-book. J. A. R.

Recherches Anatomiques sur les Organes Végétatifs de l'Urtica Dioica. L. Par A. Gravis, Docteur en Sciences Naturelles, assistant du cours de botanique à l'Université de Liege, Secrétaire de la Société Belge de Microscopie. Bruxelles; Libraire Médicale et Scientifique de A. Manceaux, 1885. (4°, pp. 232, plates 23, with explanations.)

An adequate review of this valuable work would require more space than can be here given to the subject. In the introduction the author concisely states his object in preparing the memoir, which was to present an anatomical study of the vegetative organs of a plant throughout its whole extent and in all stages of growth. The result is a knowledge of the variations of structure which these organs undergo.

The structure of the plant has been thoroughly studied and described in detail, with the aid of beautifully drawn figures. We have not even space in which to give a summary of the results, but must refer botanists to the original work, which will reward careful study.