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The malarial germ of Laveran. By Geo. M. Sternberg, M.D.*

The view that malarial fever was due to the presence of micro-organisms was suggested by Lucretius (95 B. C.) and was ably advocated in this country by Dr. Mitchell in 1859. The specific germ was announced by Klebs, 1879, and Tommasi-Crudeli (1879), as *Bacillus malariæ*, and observations were made by a number of independent observers which tended to confirm the belief in *Bacillus malariæ* as the demonstrated disease germ, entitled to rank with the spirillum of relapsing fever, the anthrax bacillus, and the tubercle bacillus. Soon after the publication of Klebs and Crudeli the writer instituted a series of control experiments in New Orleans, with the following results:—Organisms were found in the swamp-mud and gutters of New Orleans, some of which closely resembled the *Bacillus malariæ*, but these, when injected hypodermically into rabbits, did not produce malarial fevers resembling the paludic fevers of human subjects.

Notwithstanding confirmatory evidence published by several Italian observers, the writer remained skeptical, and in 1884, in his work on malaria and malarial diseases, was not prepared to entitle the more recently discovered germ of Laveran to any greater confidence. The discoveries of Laveran were investigated by a number of students, and among them by Marchiafava and Celli, who had formerly confirmed the *Bacillus malariæ* doctrine, but were converted to Laveran's view as a result of their investigation. During a recent visit to Rome these investigators demonstrated this germ of Laveran to the writer, and there is good reason to believe that it is the long-sought malarial germ.

For a long time there have been recognized dark-colored granules and irregular masses of pigment in the blood and tissues as regularly present in victims of malarial disease. Virchow, Frerichs, and Mosler believe that these are formed in the spleen, where they occur in large quantities, the older view being that they were formed in the blood. According to Arnstein the pigment granules are formed by some destructive change in the hæmoglobine of red corpuscles, and they are taken up by the white corpuscles, in whose interior they are found; finally, these are destroyed in the spleen, and their burden deposited.

Recent investigations go to show that this explanation of *melanæmia* is correct, or, at least, that granules are formed in the blood in large numbers during fatal attacks of malarial fever, and they may be plainly seen in the interior of the red blood corpuscles lying in capillaries of the brain, liver, and other organs (see fig. 1). These granules not only are seen in the red corpuscle, but within a hyaline body which lies within the corpuscle (fig. 2). In the original figure both the hyaline body and the granules are shown within the corpuscle, but this is not shown in the wood-cut.

A recent paper by Drs. Councilman and Abbott† confirms the observations

* Abridged from original article in Medical Record, p. 489 and p. 517, May 1 and 8, 1886.
† Contribution to pathology—malarial fever—Am. Jour. Med. Sci., Apl., 1885.

of Laveran and Marchiafava and Celli, but they also found the hyaline bodies free from the granules and not included in the red corpuscles.

It is evident that the question as to the nature of these 'hyaline bodies' is likely to have a very important bearing on the etiology of malarial fevers, for, if they are parasitic organisms, their position in the interior of the red corpuscles, their presence in vast numbers in quickly fatal 'pernicious' forms of malarial disease, and their association with the pigment granules recognized as pathognomonic of malarial poisoning, makes it appear extremely probable that they bear a causal relation to the morbid phenomena which constitute the disease. That the red blood corpuscles are destroyed in large numbers in the disease is proven by actual count, and profound anæmia is a known accompaniment. This result will be easily comprehended if we have to deal with an organism which destroys the red corpuscle, and the evidence tends to prove that such is actually the case.

There can be no doubt that the hyaline bodies above referred to correspond with the similar bodies described by Laveran and found by him in blood freshly drawn from the fingers of patients suffering from intermittent fever.

The writer at this point quotes extensively Laveran's own words, descriptive of his results and modes of study; these we shall be compelled to abridge somewhat, retaining the sense so far as possible.

Laveran says that his work is the fruit of five years' researches in Algeria. An analysis of anatomical lesions, occurring in patients who died of malarial fever, showed in every case, as the only constant lesion, the presence of pigmented elements of the blood. These had been previously known, having been described by Frerichs, but their nature was obscure, and in studying these it was that he recognized their parasitic nature. In 1880 he recognized the existence of mobile filaments attached to the pigment bodies of which the animated nature was not doubtful. Their presence he verified in four hundred and thirty-two patients attacked with the disease, and he never encountered them elsewhere. In 1882 he made a special trip to Rome and convinced himself of the presence of the same microbes in malarial patients from the Campagna.

Laveran recommends the following methods of study:—1. Blood from patient at the outset of the access of fever, or during the hours which precede the invasion of fibrile paroxysm, contains the parasites in greatest numbers, and should therefore be used; better also to choose patient who has suffered several malarial attacks, and is consequently very anæmic, and the patient must, above all, not have taken sulphate of quinia for some time. 2. Prepare two thin covers and two glass slides which are first to be thoroughly cleansed. After cleansing patient's finger, first with water then with alcohol, compress the finger at the base and puncture with a new needle. The drop of blood is then caught upon the slide, which should not be allowed to touch the skin, and then at once covered with one of the glass covers; it is well to slightly moisten the cover-glass and slide from the breath before using. The blood should be examined pure without any diluting fluid, the serum preserving the vitality of the parasites best. No cement need be applied. As the blood around the margin dries it will protect the central portion, which one generally finds fluid after 24 or even 48 hours. 3. In examining the slide an amplification of 400–500 diameters suffices.

Those places should be chosen where the red corpuscles lie flat and form but a single layer. Corpuscles, at first united, frequently become isolated after a few moments and present themselves *en face*, hence the examination is best 10 or 15 minutes after the preparation has been made. The search is rendered more difficult by the fact that the parasites are generally present in small numbers. The pigment granules found in the parasitic elements call

attention to them, the parasites themselves being very transparent. The observation of the movements of the filaments is aided by use of the hot stage at a temperature of 37°–38° C.

The parasitic elements of Laveran present themselves under several forms, viz:—No. 1. Cylindrical elements having pointed or rounded extremities,

PLATE 1.—Malarial Germ of Laveran.

crescentic curve pigmented toward the centre. Length about 8 or 9μ, diameter about 3μ. Contour generally a single line, but in some preparations double, transparent colorless except the pigment bodies. The body may be attached to a corpuscle, but not very closely, and adhesion seems to be purely accidental. Besides the crescent-shaped bodies certain oval forms are found intermediate between the crescent-shaped and the round bodies, and the granules in these are placed in the form of a crown. These bodies are far less frequent in the blood than body number 2.

PLATE 1.—GERM OF LAVERAN.

Fig. 1.—Section of brain showing blood-vessel containing affected corpuscles, stained with methyl blue, from a case of 'comatose pernicious fever.'

Figs. 2, 3.—Bodies No. 1 with pointed extremities; 4. Body No. 1 attached to red blood-corpuscle; 6. Oval body intermediate between Fig. 2 and Fig. 3. (Magnified about 1000 diameters).

Fig. 7.—Body No. 2, of average volume; 8. Body No. 2 enclosing mobile pigment granules; 9. Body No. 2 in which a double contour may be distinguished; 10. Bodies No. 2 of small size, free and isolated; 11. Bodies No. 2 of small size, aggregated; 12, 13, 14, 15, red blood-corpuscles to which are attached the bodies No. 2 of small size to the number of one, two, three, and four; 16. A red blood-corpuscle to which is attached a body No. 2 of average size; the corpuscle is very pale. (× 1000 diameters).

Fig. 17–28.—Changes in form of a single plasmodium included in a red blood-corpuscle within a period of about fifteen minutes.

Fig. 30.—Motionless plasmodium emerging from a red blood-corpuscle, blood taken after the paroxysm of fever and administration of quinine. (From latest paper of Marchiafava and Celli, Dec. 15, 1885).

Fig. 32.—Body No. 2 with three mobile filaments, seen Dec. 1, 1880, 3 P. M.; 33. Same at 3.15 P. M.; 34. Same at 3.30; 35. Same at 3.35; 36. Same at 8.30 A. M., Dec. 2, 1880. (× 1000 diameters).

No. 2. These elements are, without question, most frequently encountered in the blood of malarial patients. Form is spherical, but under certain conditions may exhibit amœboid movements; dimensions vary from 1μ in diameter to 10 or 11μ. Contour may be either single or double. Seem to be made up of a transparent hyaline mass, enclosing black or deep red pigment granules, in number from one or two to many disposed in a circle, or without order. The spherical bodies are free in the serum, or attached to the red corpuscles; sometimes but a single body, sometimes several, are attached to one corpuscle; sometimes the body fills the corpuscle, which is only recognized as a zone of pale yellow color surrounding the parasite. Sometimes red corpuscles are seen which contain very minute clear spots; it is probable that these are produced by the spherical bodies just born, and which do not yet contain pigment. The existence of these bodies (No. 2) in the blood, independently of the red corpuscles, shows that they have a proper existence. The bodies do not exist in the corpuscle, but attached to it and nourished by it.

This view of Laveran's as to the position of the body is not shared by Marchiafava or Celli, and is not to be regarded as definitely settled.

Laveran further says, that when one examines one of these bodies at a temperature of 31°–35° C., it undergoes changes of form, proceeding slowly after the manner of an amœba, and further is observed to divide into several portions, which latter is believed by Marchiafava and Celli to represent its mode of reproduction. In some cases the close examination of the margin of the hyaline body shows the filaments in active motion, which impart to the neighboring blood corpuscles rapid and varied movements. These appear to represent the adult stage of the microbe. The filaments are at least three or four times as long as the microbe, but so transparent as to elude observation when at rest, and further, are present only in a certain developmental stage of the microbe. They are very active and varied in their movements, and may continue so for two or three hours, or cease in a much less time.

The nature of these filaments as flagelliform pseudopodia is discussed, and the question is left open; but there is no doubt that they may entirely sever connection with the spherical body to which they were attached, and swim about freely among the corpuscles in the plasma.

No. 3. Laveran describes a third form of body which he regards as a cadaveric form of the parasite. This body is a hyaline mass enclosing pigment granules variously disposed. That they are cadaveric forms of Nos. 1 and 2 is shown by the fact that slide at first containing only No. 1 and No. 2 will, after standing 24–48 hours, contain No. 3 in large numbers. Further, in bodies of individuals dead from malarial fever, No. 1 and No. 2 rapidly take the aspect of No. 3, and it is in this condition that they are found in large numbers as the hyaline concretions observed in sections in the blood-vessels of brain, liver, and notably the spleen, and described by Frerichs.

The parasite of Laveran he at first called *Oscillaria malariæ*, because the name implies a recognition of the parasite as vegetable in nature, while the discoverer regards it rather as animal. He considers it one of Harckel's *protista*. Marchiafava and Celli in their latest paper term it *Plasmodium malariæ*.

Having set forth largely in Laveran's own words the researches he made, the writer then proceeds with his exposition of the position which he considers most consistent with the present state of our knowledge.

The etiological relation of this parasite to the malarial disease can hardly be questioned if additional researches fall into agreement with those thus far reported. The idea that a parasite of this kind, which attacks directly the blood corpuscles, and is found in fatal cases in vast numbers in or (according to Laveran) attached to the essential histological element of the blood, is to

be considered a mere epiphenomenon until its causal relation can be proved by inoculation upon lower animals, is not to be entertained in the present state of scientific investigation. The lower animals seem to be immune to this disease. But some recent inoculation experiments upon man give support to the belief that the parasite is the essential cause of the malarial fever. Marchiafava and Celli have, in five cases, made the direct experiment of injecting blood from malarial patients, and which was observed to contain the parasite described, into the veins of individuals free from malarial disease and from exposure to malarial influence (?), and claim that typical attacks of intermittent fever have resulted, and the temperature charts leave no doubt of this in three of the five cases. Examination of the blood in the case fully described was followed by the discovery in the blood of the presence of many pigmented leucocytes and of the 'initial form of the parasite.' Quinine was now administered, and both disappeared. In a second case similar results were obtained—the appearance and rapid increase of parasites until the use of quinine, then their sudden disappearance.

Laveran finds additional evidence in favor of his view of the rôle of the parasite in the operation of quinine. He found that the parasite quickly disappears from the blood under the operation of quinine. In blood drawn from a vein and rich in parasites, notably those of form No. 2, with motile filaments, a drop of solution of the salt of strength $\frac{1}{10}$ of 1 per cent., or 1.1000, quickly arrested the motion of the filaments and caused them to assume the cadaveric form.

The writer of this paper and others have produced results which show that the amount of quinine in a dose of ten grains, if absorbed at once into the blood of a man of 160 pounds, would only form in the blood a strength of 1.15000. The experiments of Ceri and others show that a solution, 1.800 to 1.3000, of a soluble salt of quinine is required to prevent the growth of bacteria, and hence it was concluded that drugs did not possess any parasiticidal efficacy in relapsing fever. It is then evident from these facts that *bacteria* are not the organisms dealt with. But there is evidence to show that the *infusoria*, on the other hand, are far more sensitive to quinine, and the evidence favors the belief in an *amœboid* blood parasite like that discovered by Laveran.

Further researches are no doubt required to establish the claim of this parasite to admittance to the family of disease germs. It may be that we shall find eventually that its life-history is more complex than at present supposed. But the fact seems undoubted that the organisms described by him as found in the blood of malarial-fever patients are, in truth, parasitic micro-organisms, and, further, that they are directly concerned in the etiology of the malarial fevers.

If this proves in the end to be true, it will be another illustration of the fact that we often arrive at the truth through a series of errors, and that veritable discoveries are often viewed with unreasonable skepticism because they do not correspond with preconceived ideas, while pseudo-discoveries, which fall in with the current of prevailing opinion, may receive general credence upon a very poor foundation of experimental evidence.

Notes from Japan. By Romyn Hitchcock.

Writing as 'foreign correspondent' of the *Journal*, in this distant land, with only such books of reference as we have brought from our own library, our contributions henceforth must be classed among those of which it is usually announced, and always understood, that 'the editor does not hold himself responsible.' etc. For the present editor of the *Journal* should not be sub-

jected to criticism for the occasional blunders or speculations that may be made in this far-off island.

October 31st, 1886.—There was a cool, bracing air in the early morning, but a couple of hours of clear sunshine made a great change in the temperature, and it was a delightful day for a walk. Starting out about ten o'clock with some Japanese youths who had called to see us, we passed the old Castle of Osaka, one of the historic memorials of old Japan. The citadel, as it now stands, with the massive stone walls and broad moat, is probably three hundred years old. Near it we made our first dip, in Japan, for algæ, and found one of our old acquaintances in America, the *Hydrodictyon*, which needed no microscope to reveal its name. The plant is not different from its representative in America, at least not noticeably so. We may find, however, that this climate will enable us to observe some new features in the course of its development. Certainly climate, or perhaps we should use the word environment, greatly influences the growth of algæ as well as of higher plants. We cannot but observe this when we see, for example, that certain species of *Œdogonium* will not mature their fruit in some localities, while elsewhere their fruit is well known. This has been observed even where their vegetative growth is luxurious.

Continuing our walk we passed south of the castle, which, by the way, is but a few rods from our own bungalow, and soon reached the great level rice-fields that stretch across the wide valley of the Yodo-gawa. Here and there we made a dip, and wrapped our finds in paper for examination at home.

The afternoon was taken up by a trip to the *Chrysanthemum* display of Megatsuzi, a florist celebrated for his beautiful flowers of that genus. The sight was wonderful, but if we were to speak of the wonders of gardening in this country which we have already seen, time and space would fail us before completing the story. But we cannot omit to mention a characteristic which seems to pertain to the whole people, high and low, rich and poor. It is their admiration and love for flowers and trees, and, indeed, for all the beautiful things in nature. To-day hundreds visited the chrysanthemum display, most of them on foot, and probably many of them walked six miles or more before they reached home again. The display here is celebrated throughout Japan. Some of the flowers were a foot in diameter and of most delicate and beautiful colors.

But we must pass on to the examination of our algæ. Our finds were not very rich as the locality was not a very favorable one. The first one that appeared under the microscope was *Vaucheria*, but not in fruit. Then came a complete surprise in the form of *Bacillaria paradoxa!* This interesting diatom occurred in great abundance and in most vigorous action. Whether this is a new discovery for Japan we do not know; but, having searched many a time at home for this same species and found it not, it is certainly a long distance to come to find it here. It is, indeed, interesting to observe the relation between the microscopic flora of Japan and our eastern coast, for among the higher orders of plants there is a remarkable similarity.

Among the other algæ noticed in our cursory examinations, which alone are referred to here, as time has not yet permitted the identification of species, were several species of *Spirogyra*, *Oscillaria*, *Anabæna*, desmids of various forms —but not numerous, or Mr. Wolle would have some for study—and diatoms in great variety. Some of the latter seem to be new to us; but the species of diatoms are far beyond our ken, so we will not venture upon further remarks.

As will be inferred from the forms observed, the finds were mostly in brackish water, which fact doubtless accounts for the limited number of genera represented.

Reply to arguments against Cholera Bacillus. By G. W. Lewis.*

Koch, in 1884, expressed the belief that comma bacillus is etiologically related to Asiatic cholera; that the organisms gain entrance through the mouth; that they depend for passage on a diseased condition of the stomach; that the real seat of the disease is the lower part of the ileum, including Peyer's glands; and that inoculation has had but negative results. He pointed out the remarkable relation between the history of the disease and the life-history of the organism—short development and rapid decline—statements based on 300 autopsies in France, Egypt, and India.

Much opposition to his idea arose. Some of it was weak, *e.g.*, spontaneous origin of the disease; also that the comma is only a transition stage to the true but unknown bacillus form, which is etiologically related. There is no evidence that their life-history shows such a harmless comma stage and hurtful later stage, though some under culture do lose pathogenic properties. It is also true that other intestinal bacteria are only $\frac{1}{10}$ as frequent as comma form.

One theory assumes that the comma is scavenger, not disease agent. The objection to this is their remarkably constant presence and their flourishing so well in other media than the cholera surroundings. If scavengers, they should not flourish so well when their occupation is taken from them, yet they live well and without change up to 20th culture.

Klein suggests that cholera favors growth by furnishing nutrient soil for the bacteria, and on this hypothesis accounts for their presence. If this is so, we must start with them in the healthy body. But here they have never been found. If it were possible to cause cholera by inoculation with the comma bacillus, its etiological relation would be unquestionable. But its action upon the digestive process is *nil* so far as regards the healthy digestive system. This seems a strong barrier to the acceptance of Koch's view, and would be insurmountable in case lower animals were ever affected by this disease. But the unanimous evidence is that they are exempt. It seemed from the experiments that in healthy animals, even including man, the bacillus cannot survive a passage into the digestive tract. Klein proved this upon his own system.

Experiments show that Mondays and Tuesdays are the most fatal days; that is, days which are preceded by excess in eating or drinking. In 1884 the writer, under Koch's direction, experimented on rabbits and guinea-pigs. He found that feeding them on pure culture produced no deleterious effects, but when bacilli were introduced directly into the duodenum the guinea-pigs, or rabbits, exhibited some six hours later symptoms of cholera infection. Upon examination after death, large numbers of the bacilli were found in the Peyer's glands, and the glands were large and inflamed. Experiments on mice yielded only negative results.

If we accept the doctrine that the disease is caused by a specific germ, we cannot accept the notion of the spontaneous origin of cholera any more than we could the spontaneous origin of the organism itself. It must obey the laws of living things, and cannot spring haphazard from other things or nothing.

Apochromatic eye-pieces and compensating eye-pieces—(*continued*).

Compensating eye-pieces.—These new eye-pieces have been designed for the purpose of compensating certain errors in the image formed by the objective outside the axis, which cannot be corrected in the objective itself. They are especially arranged for use with the apochromatic objectives, and materially improve their performance by giving a uniformly colorless image.

The eye-pieces may also be effectively used with relatively wide-angled objectives of the old form, but when used with the ordinary medium and low

* Buffalo Med. Jour., Oct., '86, p. 137.

power dry objectives the images which they give outside the centre of the field are inferior to those obtained with the eye-pieces hitherto used. On the other hand, the apochromatics of 0.95 and upwards allow of the use of ordinary eye-pieces without any material detriment to their performance. The dry objectives of 0.60 and 0.30, however, are absolutely dependent on the compensating eye-pieces; if used with the ordinary ones the images will be confused by color fringes.

The compensating action of the eye-pieces on certain chromatic aberrations in the objective image can be well seen with the higher powers, where the diaphragm limiting the field of vision is outside the lenses. The edge of this diaphragm will be found to show a deep red border, whilst, when used with the apochromatics, the image remains quite colorless up to the margin.

The classification of these eye-pieces is carried out on the principle suggested by Prof. Abbe, viz., on the increase in the total magnifying power of the microscope obtained by means of the eye-piece as compared with that given by the objective alone. The ratio of the magnification obtained with an eye-piece and a given body-tube to the real magnification of the objective itself (or, in other words, the number which denotes how many times an eye-piece increases the magnifying power of the objective when used with such a body-tube), gives the proper measure of the eye-piece magnification, and, at the same time, figures for a rational numeration.

On this basis the series of eye-pieces is ranged according to their magnifying power—

1 2 4 8 12 18 27

the figures serving, at the same time, as the designation of the eye-pieces.

The magnification obtained by combining an eye-piece with any objective is arrived at directly by multiplying its number by the magnifying power of the objective, as given in the preceding list. An objective of 3.0 mm. focal length gives a magnification of 83.3 (at the conventional distance of 250 mm.); eye-piece 12, therefore, gives, with this objective, $12 \times 83.3 = 1000$, for the same distance of vision.

In order to obtain the most favorable results it is necessary that the eye-piece used on Continental and English microscopes, respectively, should be of different formulæ, because of the very different paths which the rays take in the two cases, owing to the great difference in the lengths of the body-tubes. Both series are arranged to give precisely the same magnifying powers, the difference in the body-tube being compensated for by the focal lengths.

The settings are so adjusted in both series that the lower focal point of all the eye-pieces lies at the same plane when inserted in the body-tube. No alteration of adjustment is, therefore, required on changing the eye-piece, and the optical tube-length (*i. e.*, the distance between the upper focal point of the objective and the lower one of the eye-piece), which is the standard factor for the magnifying power, remains constant. This optical tube-length in the Continental microscope (excluding small differences between the various objectives) is equal to 180 mm., and in the English 270 mm., provided that the length of the body-tube, from the upper surface of the setting of the objective to the upper end of the tube on which the eye-pieces rest, is 160 and 250 mm., respectively.

Compensating Eye-pieces.

	Finder eye-pieces.		Working eye-pieces.				
Eye-piece magnification	1	2	4	8	12	18	27
	For Continental tube.						
Equivalent focal length in mm.	180	90	45	22.5	15	10	—
	For the English tube.						
" " "	—	135	67	34	22.5	15	10

The eye-piece 1 is only made for the Continental microscope and 27 only for the English, as the former would be too large for the English body-tubes, while the latter would have an inconveniently short focus with the Continental.

The eye-pieces of unusually low power designated 'Finders' serve for the purpose of reducing to its lowest limits the available magnification with each objective, thus facilitating the preliminary examination of specimens and avoiding the labor of searching for particular points with high powers. The Finder eye-piece enables an objective to be employed with its own proper magnifying power, *i. e.*, as if it were used as a magnifier without an eye-piece. In both, the diameter of the field of view amounts to fully a fifth of the focal length of the objective used with a relatively small angle, 12° in 1 and 24° in 2. This is particularly favorable for rapid searches.

These Finder eye-pieces are of special service for water and oil immersion objectives, where great inconvenience is caused by having to change an objective already adjusted for another of longer focus.

The working eye-pieces for regular observation are likewise of entirely new construction. They commence in both series with a magnifying power of 4, and are convenient to work with, even in the highest numbers. The eye-point in all lies so high above the upper surface of the eye-lens and the diameter of the lens is so large that the usual inconveniences attending the use of the eye-piece of short focus are completely obviated.

The ordinary drawing prisms, and particularly the Abbe camera, may be used without difficulty on Nos. 4 to 18 inclusive.

All the eye-pieces are supplied in cylindrical mounts, the external diameter of which is 23.3 mm. for the Continental body and 35.0 mm. for the English. Adapters to fit them to larger bodies can be made by any workman.

On each eye-piece is engraved the magnifying power, the focal length, and the tube length for which it is adapted, as well as the name of the firm.

Table of magnifying powers of the apochromatic objectives, with the compensating eye-pieces for a visual distance of 250 mm.

Focal length of obj.	Finder eye-piece.		Working eye-piece.				
	1	2	4	8	12	18	27
24.0	.....	21	42	83	125	187	281
16.0	15.5	31	62	125	187	281	—
12.0	.....	42	83	167	250	375	562
8.0	31	62	125	250	375	562	—
6.0	.....	83	167	333	500	750	1125
4.0	62	125	250	500	750	1125	—
3 0	83	167	333	667	1000	1500	—
2 5	100	200	400	800	1200	1800	—
2.0	125	250	500	1000	1500	2250	—

Projection eye-pieces.—For such purposes as require the projection of a real image, but more particularly for overcoming the inconveniences which arise in photo-micrography when the objective alone is employed, as also in the use of the ordinary eye-piece or amplifier, a specially constructed projection series is supplied, which externally resemble eye-pieces, and fit into the body-tube of the microscope in the same manner.

They consist of a convex lens and a compound system, which, like the apochromatic objective, is most carefully corrected both spherically and chromatically, and is entirely free from any secondary chromatic aberration, and free from difference of focus between the visual and chemical rays. Between the convex lens and compound system a diaphragm is introduced for limiting the field. The system can be made to approach or recede from the diaphragm.

When used to project an image on a screen for demonstration, or upon a photographic plate, the objective of the microscope remains exactly in the

same condition as when observing with an eye-piece. After a preliminary adjustment of the specimen by means of the ordinary eye-piece, the projection eye-piece is put in its place and its projection lens so adjusted that the edge of the diaphragm is focused as sharply as possible on the screen or ground glass of the photographic camera. This is accomplished by drawing out the projection lens more or less, according as the distance between the screen or plate and the microscope is reduced or increased. Finally, the image of the object is sharply focused on the screen or ground glass by the usual adjustments. The length of body for which the objective is adjusted for observation with an eye-piece must always be exactly retained.

The cap of the projection eye-piece forms a diaphragm, by which any false light from the body-tube is completely shut off. The size of the aperture of this diaphragm corresponds with the highest aperture of the apochromatics. When using either those of 0.6 or 0.3, it may occasionally be desirable to decrease the available aperture of the objective in order to obtain uniform sharpness of definition up to the margin of the field. For this purpose each projection eye-piece is supplied with two diaphragms of smaller apertures, which fit in place of the normal one. It must not be forgotten to remove these from the eye-piece if the full aperture of the objective is to be effective.

Projection by this method gives extremely sharp uniformly illuminated pictures of any desired degree of magnification.

The projection eye-pieces are speedily corrected for the apochromatics, on the principle of the compensating series of eye-pieces, but may, nevertheless, be advantageously employed with ordinary achromatic objectives of large aperture. They are constructed for both Continental and English microscopes on somewhat different formulæ, according to the difference in tube-length. There are two numbers for each series, giving an eye-piece magnification of $\begin{cases} 2 \text{ and } 4 \text{ for } 160 \text{ mm. body.} \\ 3 \text{ and } 6 \text{ “ } 250 \text{ “ “} \end{cases}$ These figures indicate, as in the compensating eye-pieces, the ratio in which, by means of the eye-piece and the given length of body-tube for which it is adjusted, the focal length of the whole microscope is less than that of the objective alone (in so far as the eye-piece is adjusted to a great distance).

For instance, the projection eye-piece 2 diminishes the focal length of each objective by exactly one-half; an objective of 3 mm. therefore will, with this eye-piece, project as large an image as an objective of 1.5 mm. without it, the screen or plate remaining at the same distance.

As the linear magnification of a projected image is the quotient obtained by dividing the distance of the image from the posterior focal point of the objective by the equivalent focal length of the latter, we can determine the magnification at any distance of the image from the eye-piece by dividing this distance, expressed in mm., by the focal length of the objective used, and multiplying the result by the number of the projection eye-piece employed. Thus the objective of 3 mm. gives, with the projection eye-piece 2, an image magnified 1000 times at a distance of 150 cm. $\left(\frac{1500}{3} \times 2 = 100\right)$. This rule holds good for greater distances, but in the case of smaller it gives too high a reading.

The diameter of the image, or the screen or plate, when the eye-pieces 2 and 3 are used, is about $\frac{1}{5}$ of the distance of the image, and with 4 and 6 about $\frac{1}{3}$ of that distance.

The image distance may be reduced in the case of 2 and 3 to about 400 mm., and in 4 and 6 to about 250 mm., reckoning from the eye-piece. It can be increased to any desired amount.

For purposes of demonstration and for photo-micrography, where only small pictures are required, or in cases where the plate can be placed at a

long distance, the projection eye-pieces of low magnifying power, such as 2 or 3, are to be preferred. For photographing with a short camera, however, the higher ones should be used.

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Pasteur's latest report.—M. Pasteur, on Nov. 2, submitted a report to the Paris Academy of Sciences on the results obtained from treating hydrophobia by inoculation during the past year. The report is divided into three parts—statistical, on modification of his former methods, and results of fresh experiments.

1. Up and to Oct. 31, 2,496 persons were inoculated by him, and at first treatment was the same for all. Of this number, 1,726 were from France and Algeria, 191 from Russia, 165 from Italy, 107 from Spain, 80 from England, 57 from Belgium, 52 from Austria, 22 from Roumania, 18 from United States, 14 from Holland, others from Europe, 3 from Brazil, and 2 from British India. Of the 1,700 French patients, apart from 2 who arrived too late, 10 only succumbed, whereas, of the small minority not treated, 17 died in the same period, while, for the last five years, the average in the Paris hospitals alone was 11. Last year it arose to 21, but since November, 1885, when the Pasteur system was introduced, only three died, two of whom had not been inoculated and the third had been imperfectly treated.

2. Led by the case of the 19 Russians bitten by one mad wolf, one of whom died while under treatment and two shortly after, Pasteur has modified his system, and substitutes for the milder treatment, using only 14–5 days' virus, virus of 43 or even two days' standing. To the repeated treatment, with stronger virus, should be attributed the recovery of the remaining 16 Russians, who are reported to be still in excellent health. Led on by these results, Pasteur has modified his treatment, making it still more rapid and active for bites on the face. In such cases inoculations are hastened. Thus, on day of arrival, virus of 12, 10, and 8 days will be used at 11, 4, and 9 o'clock; on the second day that of 6, 4, and 2 days at the same hours; on the third day, virus of 1 day; on the fourth day, virus 8, 6, 4; fifth day, virus 3 and 2; sixth, 1 day; seventh, virus of 4 days; eighth, virus of 3 days; ninth day, that of 2, and tenth day that of 1 day. This system, lately brought into operation, has met with excellent results.

3. With regard to fresh experiments on dogs, an objection to the inoculation of human beings, after being bitten, might be raised on the ground that the immunity of animals treated before being bitten had not been sufficiently demonstrated after that undoubted infection by the virus. In reply to this objection, M. Pasteur points to the immunity after trepanning and intracranial inoculation with the virus of ordinary street rabies. Trepanning is the surest method of infection, and its effects are constant. The first experiments on this point, dating from August, 1885, had but partial success. They were resumed during the last few months, with certain modifications, which produced the best results. The vaccination is begun the day after inoculation, and proceeded with rapidly, the series of prophylactic virus being all administered within twenty-four hours, and even a shorter period, and then repeated once or twice at intervals of two hours. The failure of Dr. Frisch, of Vienna, in experiments of this kind is due to the slow process of vaccination adopted by him. Success can be secured only by the rapid method here described. The immunity conferred under such conditions is the best proof of the excellence of this method.—*Nature*, 35, p. 30, 1886.

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The coagulation of blood.—Some recent experiments on the coagulation of blood have led to surprising results, which may prove to be of great importance in microscopical investigations. Blood can be kept for days in

a perfectly fluid state, if protected from dust, dirt, and foreign bodies, which may serve as points from which coagulation may start and spread. It may be kept in this condition if drawn under oil, or into a vessel thoroughly greased. A vessel lined with vaseline affords an excellent receptacle for such experiments, and the blood will remain liquid in it for days if protected from dust, and if the surface is not allowed to dry. It may be stirred with a greased rod, and still remain fluid.

It seems to us this will afford an excellent means of investigation of the growth of certain organisms in blood. If the organisms to be cultivated can only be introduced without producing coagulation, much interest will be attached to any experiments upon their growth in the fluid. H.

MICROSCOPICAL TECHNIQUE.

Cutting sections of animal tissues.—Dr. James Reeves, of Wheeling, W. Va., contributes to St. L. Med. and Surg. Jour. (Dec., 1886), an article upon section cutting, which receives the name of 'Reeves' method.' We will recapitulate its chief points, none of which are, however, new in histotomy :—

1. The tissue is to be first well soaked in ice-cold water, when as fresh as possible, for one hour or two ; then in small pieces about ½ in. square and ¼ in. thick, placed in twenty times its volume of absolute alcohol. The alcohol should be changed as often as it becomes cloudy, and the hardening should occupy several days, though it may be performed, if haste is necessary, in twenty-four hours.

2. Clearing and embedding.—After complete hardening and dehydrating in absolute alcohol, the specimen is to be transferred to spirits of turpentine or benzóle, to remain from thirty minutes to twelve hours, until thoroughly permeated or cleared. Then transferred to bath of melted paraffin, at temperature of not more than 140° F. (= 60° C.), to remain from fifteen minutes to 8 or 10 hours, according to the density. The time in the bath may be determined by the disengagement of air from the specimen, and is concluded when no more bubbles are given off.

3. After this interstitial imbedding, the 'cast' is ready to be made. For this, take a piece of writing paper and spread it on any plane surface, and pour on it paraffin till it forms a mass of the diameter of a quarter of a dollar. Then, before the paraffin has had time to harden firmly, lift the preparation from the bath, place it on the cooling paraffin, press it gently down with the finger, set a mould around it, and pour melted paraffin over it until the mould is full. If the process has been properly performed, the tissue will be entirely surrounded and permeated with paraffin. If, in any part, it is not hard and firm, and well attached to the paraffin, the operation is a failure.

4. The mass then embedded is to be cut in the microtome, or otherwise, and the sections then placed upon the slide. The slide first receives a coating of a mixture of collodion, 1 pt., and oil of cloves 20 parts, and the section is laid upon this. The slide with the section is now heated at not over 130° F. till the paraffin is melted, plunged in turpentine, and left until it is cleared.

5. Staining is now applied. The slide, with the cemented section, is transferred from turpentine to 95% alcohol, and kept there until the turpentine is washed out. The stain is now applied.

6. For a mounting medium, balsam 'cut with' collodion is recommended, and the cover-glass finishes the operation.

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Measuring refractive index.—Some time ago Professor H. L. Smith described a convenient and very simple device for this purpose, which afforded

approximate or comparative results. A method that is said to give absolute numerical results very expeditiously has lately been proposed by Mr. Gordon Thompson. His method is as follows:—

A fine mark is made on an ordinary glass slide with a writing diamond. A large and very thin cover-glass is cut in half and the pieces cemented to the slip on either side of the mark, leaving a space of about one-eighth of an inch between their edges. A very thin cover-glass is then placed upon them, thus forming a cover to a rectangular cell, in which the liquid to be examined is placed.

The fine mark is now viewed with the highest power available, and when the focus is sharp the position of the fine adjustment is noted. The slip is then removed, another fluid substituted, using the same cover-glass, and the operation repeated. The change in the focal adjustment required is a measure of the difference in the refractive indices of the two fluids. In this way the relative refractive powers of two or more media can be immediately determined.

To measure the absolute index of refraction of a fluid it is necessary to obtain a numerical value of the graduations of the fine-adjustment. To do this, choose two liquids of known refractive power, one of low index, as water, and the other of high, as oil of cassia. Focus through them both successively, and note the alteration of focus required. The indices of the fluids being known, a value for each division of the fine-adjustment is easily obtained by calculation. The method is based upon the formula of refraction, $v = u + \frac{t}{\mu}$, in which v is the position of the geometrical focus of direct rays passing through a plate whose thickness is t.

It is not, however, a new method, nor can it be depended upon for absolutely accurate results, although for all practical purposes of the microscopist it will serve perfectly well. Far better determinations can be made with Prof. Abbe's refractometer.—H.

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Absorption of coloring matters by the living protoplasm of vegetable cells.—The following extract from a recent work on vegetable physiology expresses in a few words the generally-accepted view relative to the action of dyes on vegetable cells:—'It is impossible to stain living protoplasm; it is when protoplasm is dead that coloring matters can penetrate into it.' The first part of this statement requires an important qualification.

Passing by certain well-known facts relative to the transient tinging of animal protoplasm in certain cases, noted by Heidenham, Brandt, and Dreser, attention is asked to the recent discovery by Pfeffer in Unters aus dem botan. Inst. Tübigen Bd., ii, iv. Professor Pfeffer shows that when living vegetable cells are placed in *very dilute* solutions of certain coal-tar coloring matters, the protoplasm becomes distinctly colored, and remains so for a time. The best results are obtained by placing roots with attached root-hairs in half a liter of pure water, to which is added one ten-thousandth of one per cent. of almost any of the so-called methyl colors, such as 'methyl-green,' 'methyl-violet,' 'methyl-orange,' and such colors as safranin, Bismarck-brown, and the like. Nigrosin and eosin, and two or three others, are not well adapted to the purpose. After a short time, especially if the specimen is shaken in the solution, the protoplasm will be found distinctly tinged. But a few colors, notably methylene-blue, do not color the protoplasm at all, but impart to the cell-sap an intense color. In this case the dye has passed through the protoplasm, without tinging it, into the cell-sap which receives it.—*G. L. G., Am. Jour. Sci., vol.* 29, *p.* 486, 1886.

New histological microscope.—W. Watson & Sons, opticians to H. M. government, 313 High Holborn, London, W. C., advertise, with illustration of the instrument, a microscope which they term the 'New Histological,' mounted on firm brass feet (tripod), has sliding body for coarse adjustment-plane and concave mirrors, with universal motion tube-fitting of universal size for understage apparatus, with special arrangements for oblique illumination, set of diaphragms, pin-hole stop fitted with same improved form of fine-adjustment as supplied to their best instruments. The entire instrument finished in the best manner. From the figure in *Nature*, Nov. 11, '86, it would seem that the body is very short indeed, thus rendering it a very convenient shape, according to our notion. The instrument is furnished with 'C' eye-piece, and $\frac{1}{6}$ and 1-inch first-class English objectives, giving range of from 75 to 700 diameters; in mahogany cabinet, at the very low price of £4 15*s.* 0*d.*

EDITORIAL.

Volume I and Number 1 of *The Dental Review*, devoted to the advancement of dental science, and published by W. T. Keener, Chicago, Ill., has recently been received. We are pleased with its appearance and its claims, and most heartily wish it a successful, and that means, we trust, useful career. It contains articles on the periosteum and peridental membranes, with a very creditable plate; the germ theory in its relation to daily practice; gold foil; oral surgery; doings of societies; correspondence; editorial review, and other matters. This first number is a well printed pamphlet of 56 pages, and in every respect a creditable magazine. We are especially glad to note the high-toned manner in which its editor introduces himself, proposing for his guidance the maxim, 'With malice toward none, with charity for all,' and trust that he may be able to so maintain the difficult position of stating the truth fearlessly, and yet so impersonally, as to be able to leave out the element of rancor which we regret to ever see in the columns of any journal.

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Reeves' method of section cutting.—We print in another portion of this number of the *Journal* a summary of a method of section cutting, which is highly recommended in a contemporary journal. We are not inclined to be censorious of the methods of other workers, or conservative regarding our own, but we believe that the method followed by Dr. Reeves, while it is in the main one of the best, has some defects which seriously limit its usefulness.

If any of our readers should try Dr. Reeves' method, and we hope that they will do so, we should be very glad if they would communicate their results to us. It seems that there are several points in the methods which experience teaches us are open to serious objection.

First, the bath in the cold water for one hour or more cannot, so far as we can see, have any beneficial result. Certainly water cannot be regarded as a hardening reagent, and we see no object in washing out the tissue, as excess of blood, etc., will not affect the cell structure, not being in the cells. On the contrary, the more unnecessary changes the tissue is subjected to the worse. Water is well known as almost the most destructive reagent to all structure, and will work most effectively on the outside cells—the very ones which the histologist expects to be the best, as they are best situated for hardening action.

A second mistake, as we think, is the direct transfer from turpentine to 60° C., paraffine. This we have often tried, with the invariable result that the tissue suffered seriously from shrinkage, and often grew too hard and brittle to be cut afterwards. This difficulty is, however, readily obviated by transferring from turpentine to a mixture of turpentine and paraffine fluid, at room temperature, *e. g.*, 70° F., and leaving it there at least 5 or 6 hours, or, if

large, 12 hours, and then transferring to paraffine at 60° C. The curling of the section, obviated by Dr. Reeves by a section flattener in the form of a piece of wire on the back of the knife, may be entirely prevented by varying the grade of paraffine, using hard in warmest atmosphere, and soft in coldest, also by varying the thinness of the section. We do not find any difficulty in section cutting from that source.

We have not tried the mixture of collodion and oil of cloves recommended, but use one where the oil of cloves is in a much smaller proportion—1.4 instead of 1.20. The purpose of the oil of cloves is to keep the collodion in solution until the manipulator has had time to place all the sections on the slide, and the ratio of 1.4, or even less, affords ample time.

We venture to say, after repeated experience, that the oil of turpentine cannot be removed with 95% alcohol, preparatory to staining, and that for this purpose an alcohol of higher proof is necessary. We prefer not to stain the section after cutting, but to stain the tissue in mass before imbedding. This can be very successfully done with borax carmine, Kleinenberg's hæmatoxylin, and a number of other staining reagents. The method which Dr. Reeves has followed, as remarked in the article referred to above, is a tedious one, but with the modification we have suggested it has been followed by a number of histologists whom we know well with the best results, with the exception of the absolute alcohol hardening, when by most the corrosive sublimate, chromic acid, Müller's fluid, or some of the picric-acid methods are preferred for general purposes. But though it is a tedious method, it gives sections of the utmost thinness perfectly preserved, thoroughly and evenly and permanently stained, and well repays the careful worker for his pains.

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We have received from the author, R. H. Ward, M. D., F. R. M. S., Troy, N. Y., 1886, pages of a 'catalogue of microscopical collection, with an appendix for long note, etc., and an alphabetical index.' This catalogue, like others of its kind, gives a space for each number, blank spaces for the record. While it is a very convenient form for those who prefer the catalogue in bound form, it presents a defect which we consider to conflict with the best possible record of a microscopical preparation. That part of the record which refers to the specimen itself and its history receives the smallest portion of space of all the record. We conceive that for scientific purposes the treatment of the specimen from the time it is taken alive till it reaches its permanent resting place under a cover-glass is, by a long odds, the most important part of its history and most worthy of full record. We would see every catalogue of collections tell, in so far as it is to be most useful, just what fluids and just how long each fluid operated upon all animal and vegetable preparations.

The record before us is far better than no record, and so far as it goes is good, and provides for the entry of many details too often neglected, but we would gladly see more importance attached here, and even in such records, to the history of the tissue itself.

NOTES.

— At a recent meeting of the Physiological Society of Berlin, in February last, Dr. Müllenhoff referred to a treatise by Kepler on the structure of the cells of bees. He treats the subject mathematically, as might be expected of the great astronomer. A fact was communicated at this meeting which is very interesting, and perhaps new to many. It is that when the bee has filled the cell, either with pure honey or a mixture of pollen-dough and honey, and has completed the lid, a drop of formic acid obtained from the poison bag connected with the sting is added to the honey by perforating the lid with the sting. Numerous experiments show that this formic acid preserves honey and every other sugar solution from fermentation. If this be well established it will

show that the sting and the poison apparatus of the bee has a further purpose than that of a defensive or an offensive weapon. Another interesting fact suggests itself in connection with this: So far as I know, most of the insects that have a stinging apparatus similar to that of the bee are collectors and storers of honey.—*Sci. Gossip*, 227, '86.

— The structure of the diatom valve is the chief subject considered in the last number of the *Journal of the Quekett Micr. Society*. The paper by Mr. Deby is of special interest, as the author has based his conclusions upon a study of untreated valves from living diatoms, supplemented with those treated with reagents and by fossil forms. He finds that the valve may (for convenience of elucidation) be said to consist of three layers—an outer continuous one, which is thin, rarely silicified, and readily dissolved by acids; a thicker inner one, also continuous, but silicified, and an intermediate wall of silica completely perforated, giving the valve its appearance of arcolation. This view, as elaborated by the author, seems more in accord with our knowledge of the structure of other vegetable cells than those of the well-known diatomists, Müller, Van Ermengem, Flogel, Cox, and Van Heur, etc.—*Bot. Gaz.*, Nov., '86.

— Professor Poncet, at a meeting of a Medical Society in Lyons, France, narrated an extremely interesting case in which pieces of bone were taken from a kid and grafted on to the tibia or leg-bone of a boy, who had so suffered from the death of the bone as to necessitate the removal of a considerable portion of it. The wound in the leg healed and the boy has now a firm and solid tibia.—*Science*, viii, 511, 1886.

— Aug. Zung, in *Moniteur du Practicien* (October, 1886), presents the introductory chapter of a course of microscopy, medical and pharmaceutical. Averring that such works as exist upon the subject are either too general or too special to be a convenient guide, he proposes to present one which will attain a mean between these positions. He thinks that such works as he mentions, as those of Robin, and Bizzozéro, and Finket, have the effect of causing the microscope to assume a position either secondary or of entire uselessness to physicians and pharmacists, and it is with a view to counteract this indifference that the course of practical microscopy in medicine and pharmacy is proposed. The work is to appear regularly in each number of the journal beginning with the description of the apparatus, accessories, etc., illustrated so far as necessary. We shall attempt to follow this series of articles for the benefit of our readers and present the essential points of M. Zung's course from time to time.

— The new optical glass.—At the meeting of the Royal Microscopical Society on Nov. 10th, '86, Mr. T. Myall, Jr., called attention to an apochromatic objective worked out by Powell & Leland. They had procured some of the new kinds of optical glass from Java and made a ½-in. homogeneous immersion objective on their own formula. The objective which they manufactured compared favorably with those of Zeiss. The instrument was upon exhibition, and stood well tests applied to it with both axial and oblique illumination. Mr. Powell's eye-piece had a magnifying power of 40 diameters *per se*, and even under this severe test the new objective did not break down. This eye-piece was higher than the highest in the Zeiss series, which is only 27. The formula of the Powell lens was less complex than the Zeiss, fewer lenses being employed. Dr. Dallinger, the president of the Society, said that he had had the opportunity of examining the new lens of Mr. Powell and was quite astonished at its definition. He had had the opportunity of examining very carefully a set of the new lenses by Zeiss and was perfectly convinced of the immense gain they would be to the microscopist so long as they were made by the best makers.

— Dr. V. C. Vaughan, of Michigan, presented at the meeting of its Board of Health in October, 1886, a report upon the present status of the tyrotoxicon question. He shows that the various picnic and hotel cases of gastro-intestina irritation were due to the use of milk in some form, all other possible sources having been eliminated. It was learned that in one case the milk was milked at noon and placed while hot in cans and carted eight miles during the hottest part of the day, and delivered in the evening. Milk is usually cooled in vessels surrounded by very cold water for 8 to 12 hours before transportation. Examination of milk like that which had caused illnesss by chemical treatment revealed the presence of a substance which produced a burning sensation upon the tongue, and when administered to a cat caused retching and vomiting and collapse, followed by recovery. The conclusion was that the illness was due to tyrotoxicon, the product of a fermentive change in the milk, due to improper management of the same. He traces a connection between tyrotoxicon and cholera-infantum.

— The death of the distinguished physiologist, Paul Bert, occurred during last November, in the 54th year of his age.

CORRESPONDENCE.

Benzine, Benzole, and Alcohol.

To the Editor :—I notice in the November number an inquiry as to the above substances.

The first, benzine, is a trade name for one of the liquids into which crude petroleum is separated by the process of fractional distillation, usually that which comes off between the temperatures of 200° and 300° F.(approximately) just before kerosene. It is a mixture of several compounds of carbon and hydrogen, C_9H_{20} and $C_{10}H_{22}$ being usually present. It has a well-known rank odor, is a good solvent of fats, but is not miscible with alcohol, and hence not adapted for microscopic work. It is very cheap and much used for cleaning clothes without water; hence the French say 'dry cleaning.' Benzole is a chemical compound, C_6H_6, named by Mitscherlich, because made by distilling benzoic acid and lime. It is *not* obtained from petroleum, but is now chiefly got from the distillation of coal tar or oil shale. Its odor is much more agreeable than that of benzine, being slightly aromatic; it mixes in all proportions with alcohol, and I have thought it did not extract the color from stained preparations, when used as a solvent for balsam, so much as alcohol; and, on the whole, I prefer it for mounting. As it is not produced in the state of purity required by the microscopist, on a large scale, it is necessarily expensive, most of what I have used being prepared by Merck. Besides the differences noted, benzole, with nitric acid, makes nitro-benzole, but benzine does not; a crystal of iodine dropped into benzole gives a violet color, but with benzine red. Benzole has specific gravity, 0.86; benzine about 0.73 to 0.76. Absolute alcohol may be prepared most easily by Squibbs' method. Have a row of several jars; for small quantities fruit-cans will do. Provide fresh-burned lime and partly fill the jars. Fill the first jar with common alcohol, and after a day or two pour it into the second jar, refilling the first with more common alcohol. Blue vitriol or cupric sulphate contains water of crystallization, all of which is driven off at 430° F., when it turns white. This may be done on a shovel. After passing the alcohol through several jars, as above, drop in it a white crystal of the copper salt; if it stays white, all the water is removed. The time and number of jars required will depend on the strength of the alcohol first used. After the alcohol is made anhydrous, or nearly so, it will absorb moisture from the air; if kept in a bottle partly full or left open, it is difficult to maintain it more than 96%. Frequently the cloudiness that forms in a preparation by precipitation of gum, when the alcohol is not quite absolute, will vanish in a short time if left to itself.

1424 Eleventh st. N.W., Washington, D.C. Wm. H. Seaman.

[A method of making absolute alcohol, referred to in brief in the November number of this *Journal*, is described in the *Am. Micr. Journal*, vol. vi, p. 119, 1885, from Jour. Roy. Micr. Society.—Ed.]

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To the Editor :—Some time ago a German calling himself H. Hensoldt called on us, and offered us objectives with the name, etc., of Carl Zeiss, in Jena, pretending that they were the new apochromatic objectives, and that he was one of Mr. Zeiss' former workmen and knew all about these lenses. The low prices he offered them at, and the difference in workmanship (his being made in an inferior manner), induced us to inquire of Mr. Zeiss. The answer was that such a man was not known to him, nor did he ever get any objectives out of his place. Mr. Zeiss further requests us to do our best in counteracting the swindle of this person, and even to have him arrested if found out. We request you to give this information publicity in your *Journal* so as to warn your readers and the public from purchasing or believing in the assertions of this swindler.

138 Fulton St., N. Y. Fr. J. Emmerich & Son.

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To the Editor :—I have a slide of diatoms from Ichabœ guano of 1844, mounted by Topping. In looking it over, a few days ago, I noticed quite a large number of dermal spicula of the fresh-water sponge, *Spongilla lacustris*. There are also many skeleton spicula of several forms, but these may be marine, while the dermal spiculum, with its characteristic curves and spines, are unmistakably of the fresh-water species. There are also some half-dozen large and well-formed birotulate spicula, which are only known in fresh-water sponges. All this proving that the birds must have lived on food from fresh water. Having supposed that guano was the product of *sea birds*, which, as a matter of course, obtain their food from the ocean, I was surprised to find

such evidence to the contrary. If you or any of your numerous readers can set me right in the matter, I shall be greatly obliged.

Respectfully, HENRY MILLS.

162 Fargo ave., Buffalo, N. Y.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO MICROSCOPICAL SOCIETY.

At the regular semi-monthly meeting, Nov. 24, 1886, Mr. Wickson stated that recent experiments had shown quite conclusively that the recently-observed insects of the genus *Psocus*, formed on scale-infested laurel trees, would not, unfortunately, attack the scale insect itself.

Specimens of an Australian Polyzoan, *Bicellaria ciliata*, were shown by Mr. Howard, who also exhibited an alga (*Trichodesmium* sp.) found floating in immense quantities in the Pacific. It consists of red-like filaments, transversely striated and of a light olive-green color. The average length and diameter are, respectively, .015 and .0003 of an inch. One peculiarity of growth is that the filaments arrange themselves in bundles of about twenty-five to fifty. This minute plant forms a considerable part of the food of the right whale, and is, in fact, known to many mariners as 'whale-feed.' The process of spore formation does not seem to have been observed as yet.

Some remarkably fine examples of insects, preserved in amber and in fossil copal, were shown by Prof. Hanks.

Dr. Montgomery exhibited a number of interesting slides, illustrative of the minute structure of the eye. Alum-carmine had been used as the staining agent, and the nuclei of the various cells were thereby very clearly defined.

A 'Holman Life Slide,' containing an unusually rich collection of pond organisms, was shown by Mr. Payzant. Germinating gonidia of *Vaucheria*, many Desmids and other algæ, Arcellæ, Amœbæ, and other Rhizopods and innumerable infusoria, were observed. Noteworthy among the latter were several examples of a species belonging to the beautiful genus *Epistylis*. As the individuals each showed a peculiar band or collar just below the posterior margin, a characteristic apparently hitherto undescribed, the little animals are quite probably specifically new.

Dr. Ferrer promised a demonstration, in the near future, with the new Zeiss photo-micrographic apparatus recently received, and the meeting adjourned.

A. H. BRECKENFELD, *Sec'y*.

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SAN FRANCISCO, CAL.

The San Francisco Microscopical Society held its regular semi-monthly meeting Dec. 8, 1886, at the rooms of Dr. Henry Ferrer. Vice-President Wickson occupied the chair, and explained that the meeting had been called for the special purpose of examining the new Zeiss photo-micrographic camera and stand.

Dr. Ferrer then briefly described the salient points of the instrument. A special microscope stand is provided, having an unusually short and thick body-tube. It rests upon a large and firm adjustable tripod foot, and is fitted with a roomy mechanical stage, and with a sub-stage for carrying an Abbe's condenser or other accessories. The coarse adjustment is made by the usual rack and pinion. The camera itself is of very large size, permitting a range of nearly eight feet from the object, when fully extended. Its front bears a metal sleeve or nose-piece which racks out to the body-tube of the microscope, forming a light-tight connection with it. In addition to the ordinary ground-glass focusing plate, one of clear plate-glass is provided, furnished with a focusing-glass sliding vertically between brass guides. By this means an exceedingly delicate adjustment can be obtained. The fine adjustment is regulated by a milled head attached to a long brass rod, which latter translates the movement to the fine adjustment micrometer screw by means of two very ingenious universal joints. The illumination used on this occasion was a very large oil lamp, with a bull's-eye condenser interposed between it and the Abbe condenser in the sub-stage, and for work with low powers. Dr. Ferrer stated that he had found the light fairly satisfactory, but he hoped to improve upon it by using the electric light in some way, and several patterns of incandescent lamps were now being tested by him. He also stated that he had ordered the best obtainable heliostat, for photographing with sunlight, and he therefore hoped soon to be in a position to do excellent work with high amplifications. Hitherto he had dispensed with the oculars, using only the objectives and specially-constructed amplifier, but he intended

very soon to make a thorough test of the new 'projection' oculars of Zeiss, in combination with the apochromatic objectives of the same maker.

After those present had duly inspected the details of the exquisitely-finished instrument, a demonstration of its practical working was given by taking a photograph of a stained section of the eye in the embryo of the calf. The plate was given an exposure of eight minutes and, notwithstanding the unfavorable conditions caused by the crowded room, the resulting negative was, upon development, found to be excellent. A number of prints from negatives of other subjects were handed around, and were examined with much interest. Several histological preparations were also shown under the microscope, with a novel monochromatic illumination.

The proceedings terminated with a cordial vote of thanks to Dr. Ferrer for his interesting demonstration. A. H. BRECKENFELD, *Rec. Sec.*

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WASHINGTON MICROSCOPICAL SOCIETY.

At the 52d regular meeting the paper of the evening was by the president, Dr. Seaman, and was on marine algæ. Prof. Seaman said:—My purpose this evening is only to supplement Prof. Burgess' very interesting paper on fresh-water algæ with some remarks on particular relations of certain marine algæ, and to exhibit the specimens I now lay before you. Marine algæ are particularly fond of a rocky bottom. Except the *Sargassum*, which floats in the water without attachment and forms the well-known mass in the central portion of the Atlantic ocean, but few species are found in large quantities away from the rocks. Hence on our Atlantic coast south of New York, although the diligent collector might gather almost as many species in very small quantities, the total bulk of algæ is extremely small compared with what are found on the New England coast. Especially is this the case if we add, to the rocky bottom, the great area alternately exposed and covered with water by the extremely high tides of our northeastern coast. Along the shores of the Bay of Fundy I have seen hundreds of acres thus conditioned covered with a heavy burden of *Fucus vesiculosus*, on which sheep pasture in winter without any care save to warn them off the rocks in time to escape the incoming tide. In cold and stormy weather they retire to the dense hackmatack swamps, and thus thrive with far less care than the flocks of the middle State farmer. Along the shores of Maine the country people flock to the shore at the proper time for miles around to gather the *Chondrus crispus* that makes an extremely delicate and delightful blancmange. On the same coast may be found some of the great Laminarias which on the N.W. coast grow to such an enormous size. Those I have seen were like a broad-bladed oar with very little handle, and some of them from 25 to 30 feet in length. The stem in such cases would be as thick nearly as my wrist, and when cut in pieces may have the tangs of knives inserted and dried on, making a fair handle. Much less care is required in mounting the marine algæ than is necessary with the fresh-water species, as their consistence is somewhat greater. So highly is their beauty appreciated that some ladies living near the sea-coast summer resorts of New England make quite a business of preparing specimens of these 'flowers of the sea' for sale to those who admire them as ornaments only. The paper was illustrated by a portfolio containing above sixty of the most beautiful and delicate forms. E. A. BALLOCH, *Rec. Secr.*

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CENTRAL NEW YORK MICROSCOPICAL CLUB, SYRACUSE, N. Y.

The first annual soiree was held at Greyhound Hall, Nov. 24, 1886. A very large number of exhibits were reported and a large number of different instruments. Besides the usual interesting objects exhibited on such occasions there were shown: Embryo chick—60 hours' incubation; bolting cloth; fresh-water Rhizopods; itch insect; sozodont tooth-powder, composed of diatoms from Keene, N. H.; Bacillus cholera Asiatica; micrococcus rabies, or germs of hydrophobia; method of enumerating blood-corpuscles; native-gold crystal; circulation of blood in tail of fish; willow-blight in place; broken spore fruits of willow-blight; eye of lobster; crystals of maple-sugar; anchors and plate from Synapta.

NOTICES OF BOOKS.

Electrolysis in Gynecology; with report of three cases of fibroid tumor successfully treated by the method. By F. H. Martin, M. D., from *Journ. Am. Med. Assoc.*, Jy. 17 and 24, '86. Chicago, 1886. (pp. 47).

Incubation of the Larynx for Diphtheritic Croup. By E. F. Ingals, A. M., M. D., from *Journ. Am. Med. Assoc.*, Jy. 10, '86. Chicago, 1886. (pp. 7).

Surgical Lesions of the Brain and its Envelopes. By Nicholas Senn, M. D., from *The Medical News*, Aug. 28, 1886. (pp. 23).

Erysipelas, and other Septic and Infectious Diseases incident to Injuries and Surgical Operations, prevented by a Method of Atmospheric Purification; with an original new wood-cut, and a report of a case of Laparotomy. By David Pierce, M. D.; from *American Practitioner and News*, Apl. 3 and 17, 1886, 2d edition. (pp. 20).

The scheme proposed by the author of this paper is to surround the patient during the operation with air which has been entirely disinfected before the operation is begun. The plan is to operate in a room placed over a second room, called the basement, in which the air is purified. In the basement room stands a pot of burning sulphur, and air is introduced into the room near this through a jet of steam, which catches up much of the solid matter. This pot is in a chamber of the basement, and the air of the room must all pass first through the first chamber of the basement. From this it passes through a spray of water near the floor into a second chamber warmed by a stove. This warmed air ascends to the ceiling of the second chamber, passes over into a third chamber, and ascends back and forth under shelves dripping with water in the third chamber. The air is thus filtered through water three times before it passes into the operating room. The operating room is free from closets or other places where any unclean thing may be hidden. A stove on one side of the room, with a partition open only near the floor shutting it off from the room, secures a draft from the room, while fresh air is furnished to the room by a pipe which opens over the operating table. Before the operation sulphur burned below thoroughly fumigates the room, and then fresh filtered air is supplied and continued through the operation. If additional precaution is required, spray of carbolic acid or mercury bichloride, or other antiseptics locally applied, may be resorted to. To test the air in the room ten flasks of culture fluid were allowed to stand open in it a few minutes and then sealed up, and at the end of four months all but one were still perfectly clear. A bottle of culture liquid was opened to the air of the room, left open for several minutes, then closed by a cotton seal, and did not go into decomposition. Other similar experiments showed that the air of the room was sterilized. Operations were conducted in the room without any septic or erysipelatous sequel, and the peritoneal cavity opened, up to time of writing, six times.

Some Reflections on Medical Ethics, Medical Legislation, and Jury Trials of the Insane. By D. R. Wallace, M. D., LL. D. Terrill, Texas. Read Apl.,'86. (pp. 21).

The paper deals first with the question of the issuance of license to practise medicine, and advocates that as in law no one is admitted to the profession except he be examined by a number of practising lawyers of the district in which he desires to practise, so in medicine a man be not allowed to practise except after medical examination satisfactory to the associated practitioners.

The statute law of Texas, which 'requires the jury trial of the insane as precedent to admission into the State lunatic hospitals,' is denounced 'as contrary to humanity and common sense.'

The Relation of the State and the Medical Profession :— An Address before the Alumni Association, Dept. Medicine and Surgery, Univ. Mich. By Charles J. Lundy, A. M., M. D. Ann Arbor, 1886. (pp. 12).

Exchanges.

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

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On the Schwendener theory of the constitution of Lichens.

By Fred'k Leroy Sargent.

If we may judge of the importance of a subject by the amount of its literature, it cannot be doubted that one of the most important questions that have been raised by the application of the microscope to the study of lichens is in regard to the origin and significance of their so-called gonidia. These are well known as the green cells which form a constant and conspicuous element of the lichen thallus, and to understand them is to understand what a lichen really is. The various hypotheses which have been offered to account for the existence of these gonidia accept as fundamental either one or the other of the following propositions. Either it is believed that these structures, green with chlorophyll, arise from the chlorophylless part of the lichen, and so may be considered as organs of the plant, or it is claimed that the gonidia are algæ living among the tissues of a fungus and giving nutriment to it as host to parasite. In the first case a lichen is looked on as an autonomous plant; on the second view it is considered to be an association of two widely different kinds of plants living intimately together, and forming as it were a dual organism. It will be most convenient for us, therefore, to speak of those holding the above views as either *autonomists* or *dualists* respectively.

It is the object of this article to deal more especially with the doctrine of the dualists—that doctrine first brought to the attention of lichenologists through the researches of the illustrious Schwendener, and which now is most widely known as the Schwendener theory. It is not proposed to give here all the proofs which have been offered in support of this theory, nor on the other hand shall we attempt to answer all the objections which have been made against it; but we shall confine ourselves chiefly to a description of what we believe to be the views most generally held to-day by the followers of Schwendener, and to a brief statement of the more important facts on which such views are based.

As we have just intimated, all lichens consist of a chlorophylless, fungus-like portion, and a chlorophyll-bearing alga-like part. Autonomists have claimed, however, that this resemblance of the lichen elements to fungi and algæ respectively is merely a superficial one, and that there are, indeed, profound differences which can be demonstrated. Thus they say that not only do most lichens differ widely in the form of their so-called fungal part from any known fungi, but there are many lichen-gonidia unlike any algæ that have been described. It may be freely admitted that the fungal and algal parts of many lichens, especially the more highly developed ones, differ considerably from any free-living fungi or algæ; but it must be urged that the differences are exactly such as would be expected on the supposition that we have two kinds of plants living together under conditions more or less different from that of their non-lichenose relatives. For, while it must be admitted that the lichen-elements differ in many cases from the algæ or fungi to which they are

supposed to be related, we must not lose sight of the fact that there are undoubted resemblances, and that the points of resemblance are of just that kind which is held by naturalists to indicate close relationship.

If we exclude entirely the gonidia, there is then no reason why all lichens should not be distributed among the following fungal orders, viz: *Pyrenomycetes*, *Discomycetes*, and *Hymenomycetes*. Not only are the resemblances sufficient for including the various forms under the orders given, but scarcely a new family would need to be made, and in many cases the lichens would go without difficulty into fungal genera already established. We do not believe that such a classification of the lichens among the fungi would be a convenient arrangement for purposes of lichenological study, but the facts are as stated.

With gonidia the resemblances to free algæ are even stronger. So far as structural characters go, the following families of algæ are surely represented among lichen gonidia: *Chroöcoccaceæ*, *Nostocaceæ*, *Sirosiphoneæ*, *Scytonemoceæ*, *Rivulariaceæ*, *Palmellaceæ*, *Confervaceæ*, *Chroölepideæ*, and *Coleochæteæ*. There are scarcely any forms of gonidia that cannot be referred to established algal genera, and many exhibit no specific differences from well-known forms of algæ.

It has been suggested by some autonomists that these resemblances between gonidia and free algæ may be explained on their theory by supposing that all the gonidia-like algæ are in fact gonidia, which were originally produced by lichens, but which now lead an independent existence and multiply. Famintzin and Baranetsky were led to this conclusion by their researches on the behavior of lichen-gonidia when they are set free by the decomposition of the hyphal tissue in water. They found that the gonidia lived in every way like the algæ they resembled; all differences of form disappeared, and they multiplied not only by fission, but in some cases zoöspores were produced. These observations, while they greatly strengthen the view that there are no differences between gonidia on the one hand and certain algæ on the other, except such disagreement as can be accounted for by their dissimilar conditions of life, still give us not the slightest proof that gonidia are ever developed from hyphæ. If this explanation of the autonomists be true, should we not have every reason to expect that it would be a comparatively easy matter to demonstrate the various stages in the development of these gonidia from the lichen-hyphæ? Fully formed gonidia have been repeatedly observed at the extremity of hyphal branches, and it has been inferred that they were developed in much the same way as are certain spores by the differentiation of a terminal cell; but intermediate stages have never been demonstrated to the satisfaction of first-class observers. We have no unquestioned proof that hyphæ give rise to gonidia in this or in any other way. In the higher lichens, where the gonidia form a comparatively small part of the thallus, it was not unnatural to at first suppose that they were products of the hyphæ. But with some of the more simply organized forms, such, for example, as the byssaceous lichens, the case is far different, for we have here the gonidia forming much the larger and more important part of the thallus, so much so indeed that in places it requires some little care and rather a high power to even see the hyphæ. Under such circumstances it would seem as if we had about as much reason to believe that the gonidia were produced by the hyphæ as to suppose that the mistletoe gives rise to the oak tree on which it is found.

Let us pass now from these structural considerations to the results of some experiments that have been tried in the germination of lichen spores and the culture of lichens. These experiments, performed by Rees, Treub, Bornet and Stahl, deserve a large share of our attention, but we have space for only a brief summary of the most important results which were obtained.

Lichen spores sown among algæ germinated by sending out a tube, which by lateral branches soon came in contact with the algæ. Following this union there ensued a more vigorous development of both the hyphæ and algæ which were connected, and, although in some of the experiments the observations extended over a period of some months, not the slightest indication was found of a development of gonidia from hyphæ. The same kind of lichen spores placed under conditions in every way the same, except that all algæ were excluded, germinated by sending out hyphal tubes, but these soon ceased to grow, and died without having exhibited the least tendency to produce gonidia. In some experiments spores were sown with the isolated gonidia of another species of lichen, with the result that union took place and development proceeded as already described.

These attempts at the synthesis of a lichen have been held to be inconclusive, since the innumerable difficulties of manipulation prevented the experimenters from carrying their cultures along until well-developed fruiting lichens were produced. No such objection, however, can be urged against some cultures of *Endocarpon pusillum* made by Stahl. This lichen differs from those previously employed in the fact that it has, in addition to the gonidia found in its vegetative part, others scattered through the hymenium among the spore-sacs. These hymenial gonidia, as they are called, multiply in the hymenium, keeping pace with the development of the spores, and when the spores are ripe both spores and gonidia are ejected from the perithecium for some little distance, each spore being accompanied by several adhering gonidia. At the time of their ejection spores and gonidia were collected on a clean, moist surface and placed under conditions suitable for growth. Germination was seen to take place after the manner already described, and there was a similar union of hyphæ with gonidia, and by careful management the cultures thus started were kept along until there was produced a fully-developed thallus of *Endocarpon* bearing spermagones and perithecia.

It would surely seem that the evidence of such experiments, so ably conducted, ought to far outweigh in the minds of all botanists any amount of negative results obtained by observers less skilled in such work and less trained in microscopy.

There are writers who have expressed a difficulty in understanding on the dualists' theory how it is that they find lichens so widely distributed on bare rocks, dead wood, and the like, while algæ are pre-eminently aquatic. In the first place it may be said that algæ are much more numerous in the situations where lichens are found than these writers apparently suppose, and in the second place we have in lichens not only a reproduction by spores, but a multiplication by soredia (to be described presently), which throws much light on those cases where lichens are found in places unfrequented by algæ.

While it is, of course, a well-known fact that the great majority of algæ live only in the water, still there are a certain number of common species which appear to have become well adapted to the frequent dry periods incident to terrestrial life; and it is significant that these are the very species which the dualists recognize as forming lichen-gonidia. Such, for example, are species of *Pleurococcus*, *Cystococcus*, *Stichococcus*, *Chroölepus*, *Rivularia*, *Nostoc*, and other genera that might be added, and it is often an easy matter to collect specimens of these algæ in the vicinity of lichens possessing them as gonidia.

As we have already said, the appearance of lichens in situations destitute of algæ may well be accounted for as due to reproduction by soredia. These are minute protrusions at the surface of the thallus, often so numerous as to give it a powdery or granular appearance. Each soredium consists of a cluster of gonidia enveloped by hyphæ, and, being very readily detached and so

extremely minute, it is easily carried to a considerable distance by wind or water. When a soredium is borne to a place where it can grow, it starts life as a miniature thallus, possessing the essential elements of a lichen, and future enlargement to the size of the parent is a matter of simple growth. Reproduction by soredia is a method very frequently used by lichens for their propagation, and indeed the species are not a few in which soredia seem to have almost entirely taken the place of spores. Some of our very commonest lichens are rarely seen in fruit, but they have usually a copious supply of soredia. Such facts as these, it seems to us, should clear away any difficulty in understanding how lichens may be dual organisms and still grow in profusion where no free algæ are found.

There remains for us to consider one phase of the theory of dualism, which, although it has perhaps not always been accepted by dualists, is, we believe, accepted by the majority to-day, and it is one which affords an answer to an objection that seems to underlie a large share of the opposition encountered by the Schwendener theory. This objection is to the effect that, since there is a direct antagonism between a parasite and its host, the supposition that a lichen consists of a fungus parasitic on algæ is untenable. For if the gonidia are algal hosts we should expect them to speedily succumb under the attacks of their parasite, and development of the lichen would be impossible. If, however, on the other hand, we view these gonidia as products of the hyphæ, generated continually, their increase along with the development of the thallus becomes comprehensible. Let us view this objection in the light of physiology. Whether these gonidia are produced by the hyphæ, or are algal hosts, there is but one opinion warrantable regarding their physiological relation to the rest of the lichen. They all possess chlorophyll, while in all other parts of the lichen this substance is absent. Now, there is perfect agreement among vegetable physiologists in the belief that all cells possessing chlorophyll are capable of utilizing the energy of sunlight to decompose carbon dioxide, and that then they combine the carbon with other inorganic substances to form such energized food as starch and other carbohydrates. Cells destitute of chlorophyll require for their growth a supply of such energized food and soon die without it. Suppose we take now a lichen growing on the bare surface of a rock; all the food it can get is of an inorganic nature. The only parts of the lichen which can make use of such substances are the gonidia, and if the hyphal part of the lichen is to live it must obtain energized food from these chlorophyll-bearing structures, and that is just what a parasite would do.

It thus becomes apparent that if there is any force in the objection which supposes that a mortal antagonism necessarily exists between a parasite and its host, the autonomists have as grave a difficulty to face as the dualists. But the difficulty itself is, we believe, an entirely imaginary one, as we shall proceed to show in taking up that phase of dualism to which we have referred above.

We have already said that gonidia have been observed to grow more vigorously after contact with hyphæ. In this connection it must be added that the formation of soredia takes place as a result of such an unusually rapid multiplication of gonidia that at certain points the cortex of the thallus is ruptured. We would infer from such facts that the reverse of antagonism existed between the food-producing and the food-consuming parts of lichens.

These considerations lead us to the question: Are there not some important benefits which terrestrial algæ might gain by being associated with fungi in the manner which dualists claim takes place in lichens?

First, let us see what are the conditions which favor the life-processes of an alga. A liberal supply of water, containing certain salts in solution, is im-

portant; also a sufficient, although small, supply of carbon dioxide. Finally, there must be exposure to sunlight; but the intensity should be moderate, for it is known that too intense light checks growth. Witness the use of whitened glass in greenhouses.

We are now prepared to contrast the conditions under which free terrestrial algæ are found with what we can see must be the conditions in the interior of a lichen. In such a place as the surface of a rock, or the bark of a tree, the moisture is usually soon dried away, and the sunlight is often very intense. Under ordinary circumstances, there is no lack of all the carbon dioxide that is needed; but possibly, at very high altitudes, the amount may be somewhat scanty. Conceive, now, a tiny alga to be within the hyphal net-work of a lichen. When it rains the felt-like mass of filaments eagerly absorbs the moisture and holds it like a sponge for a considerable length of time. The thin layer of cortical tissue above the alga is translucent, especially when wet, so that at just the time when sunlight is needed a proper amount is allowed to reach the little plant. It is well known that when fungi are growing they give out carbon dioxide in much the same way that an animal does in breathing. We may conclude, therefore, that the lichen-hyphæ do likewise; and thus we have a relation established with the alga not unlike what we find to exist between the animals and the green plants of a well-balanced aquarium—the one absorbing oxygen and respiring carbon dioxide, the other assimilating the carbon dioxide, decomposing it, and returning the oxygen to the water.

If we accept the Schwendener theory of lichen construction, as it is understood to-day, we have not only an explanation which harmonizes best with all that we know of plant life in general, and the life of lichens in particular, but we have presented for our study the phenomena of an association of two widely dissimilar kinds of plants, from the union of which mutual benefit is derived—that is to say, we have a *vegetal symbiosis*.

MADISON, WIS., *January, 1887.*

Key to Genus Grynus.

We insert the following convenient key to the species of the genus *Grynus* for the benefit of collectors of aquatic material who may chance to run against these beetles. The key is from the Journal of Microscopy, and applies particularly to British species.

Chart of species of the genus Grynus.

- Underside entirely rust-red
  - Punctures on elytra scarcely feebler toward suture.—*Minutus*, Fab.
  - Punctures on elytra finer toward suture.—*Urinator*, Ill.
- Underside wholly or chiefly black, legs reddish.
  - Reflexed margin of thorax and elytra reddish.
    - Body ovate or oval.
      - Punctures on elytra distinctly finer toward suture.—*Natator*, Scop.
      - Punctures scarcely finer.—*Suffriani*, Scrip.
    - Body elongate oblong with nearly parallel sides.
      - .....—*Bicolor*, Payte.
    - Body oblong ovate.
      - Interstices on elytra impunctate.—*Distinctus*, Hub.
      - Interstices indistinctly punctured.—*Caspius*, Men.
      - Interstices closely and distinctly punctured.—*Colymbus*, Fr.
  - Reflexed margin brassy black.....
    - Punctures on elytra scarcely finer toward suture.—*Marinus*, Gyll.
    - Punctures much finer.—*Opacus*, Sahlb.

Notes on Pycnogonida.

Mr. Francis P. Pascoe, F. L. S., presented a *résumé* of knowledge regarding the Pycnogonids at a meeting of the Western Microscopical Club at Bayswater, England. Until 1881 but little was known of these animals. In that year Dr. Anton Dohrn and Dr. Hoek published two very important works. These authors considered the Pycnogonida to form a distinct class of the Arthropoda. In old times they were referred to the Arachnida; Linnæus even placed the few species known to him in the genus Phalangium. In later times they were referred by Johnston, Kroyer, and Milne Edwards to the Crustacea. Now they are generally classed again with the Arachnida, between the mites and the spiders. Haeckel divided the Arachnida into the true and the false, the latter comprising the Pycnogonida and the Arctisca (water-bears); he has since, however, referred the latter to the worms. Mr. Pascoe inclines to the view that they are neither crab nor spider forms, but he is unwilling to place them in a sort of no man's land. He has in his "Zoological classification" included them in the Crustacea. They certainly possess eight ambulatory legs, as do spiders, and have a similar arrangement of the eyes; other characteristics appear to approximate them more closely to the Crustacea. Huxley's suggestion that their proboscis is formed, as in the mites, by the coalesced representatives of the cheliceræ and pedipalpi, is shown by Hoek to be untenable. Of the eight legs, which are the main argument to prove that they are Arachnida, the first pair, as well as an accessory pair between them, are attached to a special or independent segment, and this is held to disprove their Arachnidan affinity. The absence of a respiratory apparatus is also a condition of many Crustacea, in which, it must be recollected, the variations of structure are of far higher morphological importance than in the other classes of Anthropoda. And so in the Pycnogonida we find many of them without eyes, some without mandibles and without palpi, the accessory legs sometimes absent in the female—the male only carrying the eggs—and the embryo either resembling the larva of the Copepoda in having three pairs of appendages round the mouth (the ambulatory legs being a subsequent outgrowth from the body), or the young animal when it leaves its larval envelope is already provided with them. The most striking character of the Pycnogonida is the small size of the body, it being in some cases only about one-sixth the length, and even thinner, than one of the legs; the abdomen is reduced to a mere peg-like tubercle. Of the four thoracic segments, the anterior is sometimes suturally marked off from the head, but, according to Johnston, Savigny has proved that the so-called proboscis is the head, that the part behind the proboscis belongs to the thorax, to which the palpi are attached, and, consequently, the latter are only modified legs, which, with the ovigerous legs, would give seven pairs, or three more than any Arachnidan. In consequence of the smallness of the body, the internal organs are almost entirely placed in the legs, the stomach sending very long cæcæ into them. The eggs formed in the legs are emitted through small openings at their base. The eyes are the only organ of sense, but they are frequently absent or rudimentary; when present, they are two or four in number, and, although simple, they have an analogy with the compound eye. The nervous system consists of a brain and four or five ganglia. There are not many known species. We, of the British Islands, have about thirty; a few being found under stones in tidal pools, but the majority in the open sea. In the *Challenger* expedition, over a course of 69,000 miles, there occurred only thirty-six species. One dredged at 38 fathoms had no eyes, while another, at 1,875 fathoms, had 'two extraordinary large kidney-shaped eyes, directed forwards, and two, very small, backwards.' From 2,160 to 2,650 fathoms, a trifle over three miles, the eyes were, in all, rudimentary. Like all long-legged inver-

tebrates, they are very sluggish. It is hard to say what they feed on; apparently, not vegetable matter. As to size, they vary considerably; some are comparatively minute. The largest known (*Collossendeis gigas*) has legs nearly 12 inches long, and a body less than 2 inches. It is doubtful if any are parasitic.—*Eng. Mech. and World of Sci., 1886, p. 235.*

Morphology of the insect-wing. By N. Cholodkovsky, St. Petersburg.*

Contrary to the text-book teaching on the subject, the first and second thoracic somites are not anchylosed in Lepidoptera. After carefully severing the prothorax and cleaning off the soft parts by means of caustic potash, the typical parts, notum, pleura and sternum, may be noted. On the border between the feebly developed notum and pleura on each side is a pouch from the chitinized shell, which is not very noticeable. From its position and form this pouch is precisely like that on the second and third thoracic wings of most insects, so that one would scarcely err if he gave to this appendage the name of the rudimentary prothoracic wing. Such a prothoracic wing have I observed in many Lepidoptera of all the principal families; in some cases very small (Tineidæ), in others nearly as large as the prothorax itself (Noctuidæ).

The presence of such appendage has been observed in other insects. Fr. Müller has reported a rudimentary prothoracic wing in Termite larvæ; here in larva all three thoracic somites bear pouches, of which, later, the meso- and metathoracic ones persist and develop into wings, the prothoracic abort. Woodward† describes and figures a fossil insect whose prothorax bears two wing-like appendages. Gruber, in his work, *The Insects*, vol. 1, 88, inclines to regard the side-flap of the prothorax of the locust as an undeveloped wing.

The fact that the lepidoperous insect, while the most divergent of all the insects from the form of the prot-insect, should possess this ancestral character is remarkable, but accounted for upon the doctrine of reversion.

The physiological rôle of the rudimentary wing-sack is very difficult to imagine. It does not appear during the early larval life, but only during the chrysalis stage, at least such is the case in the form observed, *Vanessa urticæ;* but though the physiological rôle of the part is uncertain, its morphological significance is very clear. After the works of Moseby and Balfour upon Peripatus, it is clear that the insects have sprung from aquatic forms. Such inference is strengthened by the presence in some imagines (*e. g.*, Perlidæ) of gill tracheæ. It seems undoubted that insect-wings are especial appendages of the body which at first pertain to all segments of the thorax, but later survive only upon the two posterior segments. The first function of these was respiratory. When, later, some forms assumed an aquatic life, this structure developed further and became the gill tracheæ. But these sacs may occupy one of two positions, the one more ventral (the gill tracheæ of Perlidæ), and the other more dorsal. The latter position is that of appendages homologous with the dorsal appendages of land hexapods, whereby the direct change in Ephemindæ of the gill tracheæ to wings is explained. In this way the improbable view of Gruber's that they arise from two sorts of sac is rendered unnecessary.

The byssal organ in lamellibranchs.‡—The first portion of Dr. Barrois' article is a very full description of the byssal organs or its remains in forms from almost every family, twenty-one in all, and in forty-nine species of lamellibranchs. There is also a historical résumé of the subject, description of additional glands, and a discussion of the homologous organs in gasteropods.

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* Zool. Anz., p. 615, 1886. † Q. J. Geol. Soc., Lond., 32, 60–64, pl. 9, f. 1.

‡ Les Glandes du Pied et les Pores Aquiferes chez les Lamellibranches—Par le Dr. Ih. Barrois, Lille, 1885, pp. 160, pl. x.

In *Cardium edule* the organ is described in full, and others are compared with it. Its parts are:—1. 'The cavity of the byssus,' a large space in the centre of the keel of the hatchet-shaped foot. 2. '*The canal* of the byssus,' opening on the surface by a pore. 3. 'The byssus,' a hyaline thread running out from the cavity through the canal. 4. 'Byssal glands,' glandular cells lying below the epithelium, and opening separately into the cavity. 5. 'The groove' running forward from the canal along the margin of the foot to the anterior end. 6. 'Glandular cells of the groove' opening into it among the epithelium cells. The epithelium is everywhere perfectly continuous, and in the cavity is thrown into numerous lamellar folds.

Various departures from the plan are described and figured; there may be no functional byssus, but the other parts may all be present, or the groove, or the glands, or even the cavity may be wanting, or there may be in the adult no trace of any of the organs. In the same family, or even genus, wide variations may occur. Thus *Tapes virginea* has no functional byssus, the cavity, glands, and lamellæ are present, while in *Venus rudis* and others of the family no trace of the apparatus remains. In *Anomia ephippium* the ossicle by which the animal is attached is a true byssus, formed in a cavity lined with lamellæ, a precisely similar one being present in the foot of *Arca tetragona*.

The anomalies of its relation to the parts of the body are explained by the lateral attachment of the creature. The '*cornet*' of Anomia, with its groove leading to the byssal cavity, is similar to the muciparous gland on the anterior part of the foot of *Pecten maximus*. In Unio and Anodonta a cavity in the keel of the foot is the only remains of the byssal organ in the adult. This, doubtless the water pore of Kollman, Griesback and others, is lined with continuous epithelium. It is to be regretted that lack of material has prevented research into the embryonic condition of many of the retrograde forms.

Barrois also describes as characteristic of the lamellibranchs special muciparous glands in the anterior portion of the foot; these, in some cases, line the inside of a cavity, *e. g.*, *Pecten maximus;* in other cases, the organ being everted, they line the outer surface under the epithelium of a pedunculated club-shaped body, *e. g.*, *Lucina lactea*. The view that the byssus of the lamellibranchs is homologous with the gastropod operculum is rejected on anatomical and histological grounds, and the muciparous byssiparous glands are thought to correspond with the 'Lippen-drüsen' and 'Fusshöhledrüsen' of Carriere, the one upon the fore-end of the gastropod foot, the other upon the creeping surface.

The second portion of the work is a full historical and critical review of the 'water-pore' controversy. No new observations of importance are recorded, and the position maintained by the writer is the same as already represented in this journal (see vol. iii, p. 130).—*Henry Leslie Osborn*, American Naturalist, *Dec.*, *'86.*

MICROSCOPICAL TECHNIQUE.

A new settling tube for urinary deposits. By Frank Vanderpoel.

It is often found necessary in the microscopical examinations of sediments contained in liquids—notably so in the examinations of urinary deposits—to make use of a settling vessel of such a shape that the deposit, in finding its way to the bottom, shall be caused to gravitate toward a small central spot, whence it can be afterwards removed by means of a pipette. For this purpose conical test-glasses and test-tubes 'on foot' have been devised, and have found a very extended use.

They have one objection, however, namely, that in order to get any of the sediment into the pipette, and keep it all there while the latter is being with-

drawn from the liquid, a considerable quantity of the latter must be taken in with it, and the deposit is, consequently, very much disturbed and diffused. To obviate this difficulty, a form of settling tube was devised some time ago, a description of which appeared in Dr. Deem's Hand-book of Urinary Analysis, published in New York. It consisted of a straight glass tube, large enough to admit a urinometer, and open at each end, the top being provided with a lip for pouring, and the bottom made conical, the lower end being of a convenient size for slipping over it a short piece of rubber tubing, provided with a pinchcock and auxiliary pointed tube.

This piece of apparatus was a decided advance upon the conical test-glass, but it still had a disadvantage in the presence of an organic substance (india rubber), which might prejudice the results, to say nothing of the agitation and mixing of the different parts of sediment in passing the different corners, the ends of the two glass tubes, and the constriction in the rubber tube caused by the pinchcock.

The tube before us has, we think, none of these objections, while it is quite as convenient in other respects. It consists of a glass tube, open at top and bottom, the lower part being tapered to quite a small opening and the upper part provided with a tubulated cap, which fits the settling tube proper rather closely. The joint between the two is secured and made water-tight by means of an elastic band cut from a piece of thin rubber tubing, in size a little smaller than the glass tube. The latter may be of any convenient width, say $\frac{3}{4}$ of an inch to 1 inch, and 6 to 8 inches long. At the upper end of the small tube joined to the cap a short piece of rubber tubing, provided with a pinchcock, may be used, as any sediment which may be caused by contact with the rubber at this part of the apparatus will lodge in the lower bend of the tube immediately below and not be carried into the large tube. Of course, the neatest way would be to have a glass stopcock blown upon the upper end of the bent tube, but this would increase the cost, and would be really unnecessary unless a liquid were to be examined, which, like permanganate of potassium, would be decomposed by the rubber.

To fill the tubes, the parts are put together in such a manner as to be water-tight; the lower finely-pointed end is inserted into the urine or other liquid, and suction is applied at the other end, either by means of a rubber bulb or in any other convenient way. It is necessary that the tube be *entirely full* of the liquid, for any air bubbles which might be allowed to remain therein would, by their contraction or expansion, disturb the sediment to the extent, possibly (if the temperature of the room should be raised a few degrees), of forcing the latter out of the tube. After the deposit has accumulated at the bottom, it can be easily dropped upon a slide by manipulating the stopcock at the top. In this way a number of samples of the sediment can be obtained in the order in which they have fallen to the bottom of the tube.

If it be desired to make use of a settling tube, about which there shall be no rubber at all, the whole tube (bottom and top) can be made of one piece, with a glass stopcock at the top, as suggested above. These tubes can be obtained of Wm. Bætz, glass-blower, 98 Fulton street, New York. The mounting of the instrument may be accomplished in a variety of simple ways, and can be left to the ingenuity of the manipulator.

On treating chicks for section-cutting.

We have printed in another portion of this number of the *Journal* a letter from Mr. Jay L. Smith upon hardening and cutting sections of chick embryos. We have cut a great many series of chick sections of all stages, from the unincubated blastoderm to five days' chicks, and have hardened by a great

variety of methods and experimented in various ways upon both staining and imbedding. The best methods are extremely tedious, but if perfect success results tediousness is by no means a fatal objection. Of all tissues embryonic tissues require the most careful handling. We have had good success by several methods, but we can recommend either picric acid or corrosive sublimate as the best reagents for hardening.

HARDENING.

I. *Corrosive sublimate* is to be used in a saturated solution, the embryo to be left in about one-half hour, then transferred to distilled water, where it may remain one-half hour or a little longer if the chick be of over two days' incubation. The purpose of the water is to thoroughly remove the corrosive sublimate, which has served its purpose in the rapid hardening of the specimen. The corrosive sublimate solution is best made by heating water containing the salt to boiling, dissolving up as much of the salt as possible. Then the solution should stand till cool. A great deal of the salt will be crystallized out of the solution, but a perfectly saturated solution will result. This is to be used at the temperature of the liquid standing in the room. In hardening it is always wise to immerse the specimen in at least ten times its bulk of the reagent.

II. *Picric acid* solution is prepared in a variety of ways. We will give one which is a very good one. At some future time we project a full review of the methods of hardening tissues. Prepare a saturated aqueous solution of the picric acid crystals. Filter the solution and add to it 2% of strong nitric acid. A heavy precipitate will fall; filter the mixture, which is popularly known as *Meyer's picro-nitric*. It will remain unchanged an indefinite length of time ready for instant use. In practice this is generally diluted by the addition of three parts of distilled water to one of the picro-nitric. A specimen should be left in picro-nitric fluid about three hours. If the chick is old enough so that it is bony anywhere, the picro-nitric should be used full strength and the specimen remain in it 6 hours. By this time decalcification will have taken place.

From the water after corrosive, or from the picro-nitric, if that be used, the chick is to be transferred to 30% alcohol ¼ hour, then to 50% alcohol ½ hour, then to 70% alcohol. The corrosive specimen, after a couple of changes of the 70% alcohol, will be ready for staining. The picric specimen must be kept in 70% alcohol, changed every 24 hours, till the alcohol is no longer colored by picric washed out of the specimen.

STAINING.

It is best to color the specimen in borax-carmine, or Kleinenberg's hæmatoxylin is also very satisfactory, before cutting the sections. Picro-carmine would be better with picric acid chicks, if one could be sure of possessing the reagent in the perfect condition, but with borax-carmine there is not the slightest difficulty. The chick should be left 24 hours in borax-carmine, then, after a short wash in acidulated 70% alcohol, it should be transferred to 70% alcohol.

IMBEDDING.

The specimen thus hardened and stained is to be imbedded as follows:— 1. Transfer to liberal amount of 90% alcohol 6–24 hours, according to size. 2. Transfer to absolute alcohol 6–24 hours. 3. From the absolute pass into spirits of turpentine and leave here till no more alcohol can be removed by the turpentine, when saturation is complete, as shown by the absence of current visible about the specimen, as well as by the translucent 'cleared' appearance, 6–24 hours. 4. From turpentine to a saturated solution of paraffine in turpentine, 6–24 hours. 5. From paraffine and turpentine to

melted paraffine, kept at uniform temperature slightly above melting point, 6–24 hours. The kind of paraffine, whether hard or soft, will depend upon the temperature of the room. If the room be cool, then the paraffine must be a soft one; if the section be cut in a warm room, or in summer weather, the paraffine should be hard.

If the chicks be imbedded in this manner, which is certainly a tedious one, it will give the most perfect results. It is the manner in use in the great laboratories, and the way to imbedding for the wonderful 'ribbon method.' We have never had any need of a flattener. The chick may now be removed from the melted paraffine and placed in the centre of a block, which is to be allowed to cool. When perfectly cold the block is placed in the microtome and the tissue will cut as easily as the paraffine. If the temperature conditions be regulated, and the room is neither too warm nor too cold, and the razor sharp, and cut with a straight, not a sliding, motion across the chick, slice after slice may be cut of even thickness and of the same area as the block of paraffine containing the specimen. These slices may easily be kept in their proper sequence and with the right side up, and cemented on the slide for clearing and the cover-glass.

We have already written more on this subject than we at first contemplated, but said as little as possible to explain this method of section-cutting, which, after several years' experience, we unhesitatingly adopt every day, in spite of its tediousness.

A modification of Weigert's method of staining tissues of the central nervous system. By Dr. N. M. Gray, Army Medical Museum, Washington, D. C.

The specimens hardened in Müller's or Erliki's fluid are transferred directly (without coming in contact with water) to alcohol of 70 per cent. They are gradually dehydrated and finally soaked in absolute alcohol for several days. They are then soaked for one or two days in a mixture of equal parts of ether and absolute alcohol; then transferred to a solution of celloidin and eventually imbedded in celloidin on cork. The pieces, still fastened to the cork in the celloidin, are immersed in a solution of neutral acetate of copper (a saturated filtered solution of this salt diluted with an equal volume of water) and allowed to remain in an incubator at 30° or 40° C. for one or two days.

The specimens become pea-green after the copper treatment; the celloidin more of a blue-green. They may now be preserved in 80 per cent. alcohol indefinitely.

After having made sections, which must still be kept clear of water, they are immersed in the hæmatoxylin solution, the formula for which is as follows:—Hæmatoxylin (Merck's in crystals), 1 part; absolute alcohol, 10 parts; water, 90 parts. Boil twenty minutes, cool and filter, and to each 100 parts add 1 part of a cold saturated solution of lithium carbonate.

The time for staining varies. In general, the longer the surer the result; for cord sections, 2 or 3 hours are enough; in brain sections, 24 hours are required to color the very fine fibres of the cortex.

After staining, the sections, now black in color, are differentiated by immersion in the following solution:—Borax, 2 parts; ferricyanide of potassium, $2\frac{1}{2}$ parts; water, 100 parts. Time here varies; for cord, $\frac{1}{2}$ to several hours before desired contrast between the white and the grey is secured. In brain sections, longer. No fear of spoiling the sections need be felt.

From this solution the sections are transferred to water and well washed, then to 80 per cent. alcohol, 90° F., spread on slides and dehydrated with 100 per cent., clarified preferably with xylol or creosote and mounted in xylol or benzole balsam.

If the steps in this method are carefully followed out success is certain; and it is, without exception, the method for tracing nerve fibres or demonstrating nerve lesions.—*Medical News*, Nov. 6, 1886.

Injections.

The following directions are given by Mr. V. M. Latham, F. M. S. :—*

1. **Prussian blue fluid.**—Glycerin 1 oz., alcohol 1 oz., ferrocyanide of potassium 12 grains, tinctr. of perchloride of iron 1 drachm, water 4 oz. Mix the glycerin, water, and alcohol, and divide it into two equal parts. In one part (*a*) dissolve the ferrocyanide, and to the other part (*b*) add the tincture perchloride. Add (*b*) *very gradually* to (*a*), the mixture being well shaken after each addition of the iron solution; keep in a stoppered bottle, and shake well before using.

2. **Turnball's blue.**—Dissolve 10 grains of pure iron sulphate in 1 oz. glycerin, or better, a little distilled water, and add 1 oz. glycerin and 32 grains ferrocyanide of potassium in another oz. of glycerin. Add the iron solution gradually to the cyanide, with constant agitation. To the deep-blue fluid which results, add 1 oz. glycerin, 1 oz. alcohol, and 4 oz. water. This injection will not fade so soon as the Prussian blue, hence its advantage.

3. **Bruckle's soluble Prussian blue.**—(*a*) Ferrocyanide of potassium, 217 grammes, in 1,000 c.c. distilled water. (*b*) Perchloride of iron, 10 gms. in 2,000 c.c. distilled water. (*c*) Saturated solution of sulphate of soda. Mix one part of *a* with one part of *c*, and one part of *b* with one part of *c;* add mixture *a c* to mixture *b c;* allow the mixture to stand about three hours (or longer, if necessary). Collect the deposit on a filter, and wash three or four times a day with distilled water. When the water carries blue color through with it, discontinue the washing, and dry. The powder thus prepared must be dissolved in distilled water, and mixed with gelatin to form a firm jelly.†

4. **Beall's acid carmine.**—Carmine 5 grains, glycerin with 8 or 10 drops acetic or hydrochloric acid ½ oz. (acetic is preferred), glycerin 1 oz., alcohol 2 drachms, water 6 drachms, a few drops of ammonia. Mix the carmine with the water, and add ammonia (5 drops). To the dark red solution add ½ oz. glycerin, and shake well. Add gradually, with frequent shaking, the acid glycerin. Test, and if the reaction is not distinctly acid, add more acid glycerin till it becomes so. Now add alcohol and water very gradually, with frequent shaking. This is one of the very best injection fluids ever recommended. It may be kept ready, and very rapid injections made with it.

5. **Asphalt and chloroform.**—Prof. Ludwig has employed, in studying the bile ducts, a fluid composed of asphalt dissolved in chloroform. The chloroform flows well, being extremely mobile, then readily evaporates, leaving a solid black mass in the vessels.

6. **Alcannin and turpentine.**—Ludwig used for the lymphatics a solution of alcannin in turpentine or chloroform. The solution is of a bright red color; it flows easily. If chloroform solution be used, the chloroform evaporates readily, and leaves the alcannin in the vessels.

7. **Silver nitrate** for blood vessels. Stun a frog by a blow upon the head, expose the heart, strip off its apex, and allow it to bleed thoroughly. Push a canula from the ventricle into the aorta, and inject a stream of distilled water to wash out chlorides. Follow this with a one-quarter of one per cent. solution of silver nitrate, and allow to remain for eight or ten minutes, then wash

* *Journal of Microscopy*, vol. vi ('87), p. 41.

† This method, which is the one given in Burdon Sanderson's Physiological Text-Book, has never given satisfaction, after repeated trial, in our own experience; the difficulty arose in getting the precipitate properly washed. —Ed.

out with distilled water. If desired, the epithelium of the mesentery may be silvered after the injection.

8. **White fluid.**—The salt of sulphate of baryta is reprecipitated from a cold saturated solution of 4 ounces of chloride of barium by adding, dropwise, sulphuric acid. After standing in a tall cylindrical vessel for 12–24 hours decant one-half the supernatant fluid and combine the remainder, well shaken, with a mixture of one ounce each of water and glycerin. This is distinguished for great permeability, and is good for lymph passages or glandular canals. It may be kept for months without alteration, and is ready for instant use.

9. **Seiler's carmine gelatin.**—(*a*) Best carmine 2 drs., dist. water 3 oz., strong ammonia water 20 drops. Dissolve this and filter, covering funnel with glass plate to prevent evaporation of ammonia. (*b*) Cox's gelatin 2 drs., dist. water 2 oz. Soak the gelatin until soft, then dissolve it in the water bath and strain through a fine flannel while hot. Heat the gelatin solution again and add the carmine solution; heat 100° F., and add dilute acetic acid (10% ?), drop by drop, with constant stirring, till the ammonia is neutralized, or until the solution changes from a lilac to a scarlet color.

EDITORIAL.

MATERIAL MOUNTED AND UNMOUNTED.—We shall do a favor to our readers and to microscopy by information of an offer of slides from Miss M. A. Booth, of Longmeadow, Mass., made known to us through correspondence with her. Miss Booth's work is already well known to a great many microscopists. While not one of those who seem to find the sole merit of a preparation in the perfection of the work done with the illuminated label and turn-table, she does pay the most scrupulous heed to those minor details, and her slides, from that stand-point, are irreproachable. But the chief merit of the slides offered consists, not in the mounting, but the objects. These are not ordinary specimens, such as any one can pick up from any pool, but are both varied and rare. Her partial list embraces a great variety of marine algæ, authentically named, named diatoms *in situ* or not *in situ*, diatomaceous earths from America and Europe, fern spores and sporangia, mosses, plant hairs, animal hairs, fish-scales, etc., etc. We have seen a great many of her slides, and feel no hesitation in recommending them to any collectors who may wish to purchase.

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WEST AMERICAN SCIENTIST.—We are glad to congratulate the *West American Scientist* upon its greatly improved appearance and the marked and rapid growth in interest in its contents. The Society which it represents at San Diego is active in scientific work, and the results of its research is shown by the definition in the December number of a new genus of grass by Dr. Vasey, *Orcuttia californica*, and a new lamellibranch fossil, allied to the oyster, named by Dr. C. A. White, *Corallichama orcuttii*.

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POSTAL MICROSCOPICAL CLUBS.—Mr. J. W. Measures, in his presidential address on newly assuming office in the Postal Microscopical Club of Great Britain, adverts to facts which we would most heartily present to our readers. Speaking of the Society, he shows that it exists for the benefit of those who, while anxious to use the microscope, are discouraged by isolation. In no department of work is this felt more than in the mounting of objects. The beginner is unable to learn from the books on the microscope all the minutiæ of so fine an art as mounting. On the other hand, how different with the beginner in our large towns, where he may attend the meetings of a micro-

scopical society, superintended by persons experienced in histological manipulation. To such a person the Postal Microscopical Society is of immense advantage, for it places him in communication with fellow-workers. It is impossible for one who has not tried it to appreciate the disadvantage to one from working ever alone, or the importance of companionship in scientific work. This arises especially from the lack of standards for comparison of one's own work, and suggestions from a fellow-worker, but by no means wholly so; it is also largely due to the lack of mutual or sympathetic interest. The Postal Club was formed thirteen years ago to give a means of communication. The journal of the Society proves that the sole aim of the Society is not to circulate objects for the microscope, but to furnish helps to those who are seeking to become, or who are, students of nature. We commend both this and the sister society in this country. We know that there are many, often teachers of science, who want instruction just such as this, but who cannot attend laboratories where microscopic technique is taught. If they could attend a course, even if short, they would derive great advantage; unable to do so, they would find the club a great help.

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Professor E. L. Youmans.—Our readers have already all learned of the death of Professor Edward Livingston Youmans, the late editor of the *Popular Science Monthly*. Prof. Youmans has been engaged ever since 1851 in the very valuable work of presenting to the reading world, in popular form, the results of scientific studies in a great variety of directions. He is widely known through the *Monthly*, but also through the International Scientific Series, consisting now of 57 volumes, forming the most complete scientific encyclopædia extant. Professor Youmans was personally interested more especially in chemistry and kindred subjects, but he has made the *Monthly* entirely catholic in its subject-matter, and no important scientific work in any line failed to receive full recognition. Prof. Youmans' death is a genuine loss to science, for it takes away one of the men who helped to make a place for the specialists by making their work well known, as they too often do not find the time to do. This is a busy world, and no one can to-day follow all the growth for himself alone. We have to be thankful when a man will do this for us as well. Men like Professor Youmans did it, not descending too low to reach the unscientific, at the same time willing to soar a little lower and within popular reach.

NOTES.

The two great lenses for the Lick telescope are completed, and the plans for shipping them are most ingenious. The two lenses are to be wrapped separately in 15 or 20 thicknesses of cotton drawn very tight, then cotton-batting, then paper; this in a box of wood lined with linen, and this with felt; this box in a cubical steel box packed in curled hair; the steel box to be enclosed in a second steel box, supported inside on all sides by steel springs from the outer box. Both boxes to be air and water-tight, and the outer to be packed with asbestos to render it fire-proof. The outer box will then be supported on pivots on a strong wooden frame, and this to be turned one-quarter way around every day during the trip to California to avoid any disturbance of the molecular constitution of the lenses. The lenses are to be insured for their full cost, $51,000.—*N. Y. Post, 11, 26, '86.*

The Audubon Society, which has been established in the United States for the protection of birds generally, and plumage birds in particular, has a goodly roll of members, for although the certificates were ready only in April last the Society now numbers more than 17,000 members.—*Eng. Mech.*

The ptomaine question is assuming importance. Ptomaines are cadaveric alkaloids—the results of putrefaction—and fish and meat poisonings are common, especially among users of canned goods. These alkaloids were discovered by Armand Gautier in 1870,

and also by Selmi just after, and are treated of in Dr. Clifford Mitchell's new book, The Physician's Chemistry. Pantier lately claimed that these bodies are constantly being formed in life, and that their non-elimination or non-oxidation is the cause of many diseases, thus opening up a new pathology. Gautier's remarkable communication regarding ptomaines and leucomaines, made January 12, 1886, to the French Academy of Medicine (see *Arch. Gin. des Med.*, No. 2, 1886), takes the ground that these by-products of normal vital action came through a putrefactive rather than a combustive process, and he says: 'There would be a continual auto-infection from them if the skin, kidneys, bowels, and lungs did not act freely, and if the oxygen of the blood, which is their great enemy, were not continually supplied to the tissues.' In July, 1884, I advanced the idea that many cases of peritonitis, septicæmia, puerperal fever, and analogous troubles were caused by ptomaines. The fatal tyrotoxicon from cheese, milk, picnic ice cream, etc., is first cousin and is being watched.—*W. B. Clark, in Medical Current, vol. iii, p. 271.*

On the ptomaine question we find also the following: Sickness from the use of meat, milk, etc., formerly unheard of, is becoming alarmingly frequent. This is entirely unlike the well-known troubles from trichina, measely pork, etc., and will not be rendered harmless as those by any amount of cooking. Further, this is not caused by any micro-organism, according to our best authorities, but by a class of poisonous alkaloids known as ptomaines. The question now arises, how is it that these ptomaines have thus suddenly acquired such importance? The answer is, until recently the time-saving schemes were not in operation. The present patent process does not allow the animal time to cool, the meat is not left six weeks in pickle, nor dried and smoked a month or six weeks more. Now animals are killed, cut up at once, injected with a patent preserving fluid, smoked a few days, sacked, and put on the market. It is in this class of meats that ptomaines are most liable to form. If ever so free from decomposition when sent out, they are liable to decomposition, especially in warm weather. The numerous cases of ice-cream poisoning reported last summer were due to similar haste, as shown by Dr. Vaughan. (See this *Journal, Jan.,'87*, p. 16).

In Europe similar cases from the use of sausage, fish, and other foods are reported, and it becomes important to urge that the dealers be placed under such restrictions as will insure the sale of only properly treated articles.—*Dr. R. H. Reed, Mansfield, Ohio, before the Mansfield Lyceum, Nov. 10, 1886.*

Germ of Laveran.—Dr. Osler, at a meeting of the Pathological Society of Philadelphia, states that as a result of the study of over 50 cases of ague he finds the bodies of Laveran constantly present. He is convinced of their parasitic character, and confirms the observations of Laveran, Marchiafava, Celli, Sternberg, and Councilman.

Pure air in mid-ocean.—Prof. F. S. Dennis in a trip across the Atlantic Ocean made tests of the ocean air. He used capsules of sterilized gelatin and exposed one to the air in his state-room. In 18 hours it showed over 500 points of infection. Capsules exposed on the promenade deck showed 5 or 6 points after ten days, and capsules exposed over the bow of the ship were entirely uncontaminated. These experiments show the germless condition of mid-ocean air.—*Am. Practitioner.*

Microscope in brewery.—We were much interested in the following note from the *English Mechanic and World of Science*, in which magazine many things of interest to the student of natural science find a place. The author points out the great value of the microscope to the brewing trade, not but that a man can wash a barrel well enough without its aid, but that the master brewer by its help lifts his labor from the level with empirical soup-making. It is used to determine the purity of the air in the fermenting-room, used in examining water to detect organic impurities, a number of which are figured; among them may be distinguished, algæ, a rhizopod, *Stentor*, a rotifer, a copepod, an ostracod, and some form of arthropod larva. The microscope is also of service in determining the quality of yeast, searching for the presence of such injurious outsiders as bacteria, which cause brewers much trouble by the unhealthy fermentations they produce. He must use the micrometer also. The healthy yeast cell should not be larger than $\frac{1}{2000}$ inch in diameter. The absence of any vacuole in the cell denotes the cell to be too young; the presence of more than three vacuoles in a shriveled cell indicates it to be too old. The discovery of lactic and other ferments indicates that it is time to change the yeast, and examination determines the quality of the new change at once without the cost, perhaps, of experimental failure.

A new experimental station at the sea-shore has been lately established by the Spanish Government for the study of zoology and botany.

Butter tests corroborated.—The correctness of butter tests is a matter of interest to every citizen of Iowa, and the course of the Government officials in this matter has been closely watched. The results of the recent tests made in the city had a very beneficial effect upon public sentiment, which will be emphasized by the knowledge that Dr. Field, of this city, has made a careful microscopic test of the same samples and fully corroborates every one. In conversation with a register scribe yesterday, Mr. Schermerhorn made the following statement of these last tests: 'In view of the fact that the reliability of butter tests has been brought into question, I desire to state that I furnished to Dr. A. G. Field, of this city, eight packages of butter and mixtures for microscopical testing. They consisted of various mixtures of lard, salt, and butter, butterine, and also pure butter of various ages and modes of manufacture. With the exception of one package of genuine butter four years old, they all had the appearance of good butter. They were numbered, and the composition of each recorded, but of which Dr. Field knew nothing before making the examination. In every case his report was correct. He stated that he followed the method of Dr. Thomas Taylor, of Washington, D. C., relying principally upon the form of crystal and the use of polarized light.'—*Iowa State Register, Jan. 9th, 1887.*

The Scientific American, published by Munn & Co., New York, presents weekly to its readers the best and most reliable record of various improvements in machinery, and the scientific progress of the country can at the same time be kept pace with by the regular perusal of its pages. It presents in popular form the discoveries in all departments of natural science, so far as they would be likely to interest a general reader, and is a well conducted periodical.

Heat destructive to comma-bacillus.—At a recent session of the Academy of Sciences in Amsterdam, Prof. Forster stated that he and Dr. Van Geuns had found that the comma-bacillus was destroyed by heating the substance containing it to 55° C. In their work, Les Bactéries, Cornet and Babes state that the comma-bacillus is destroyed by exposure to a temperature of 50° C. for a few days; also that a culture of comma-bacilli can be sterilized by slowly heating to 65° or rapidly to 75° C.—*London Lancet.*

— We note the death of Dr. C. C. Field, of Easton, Pa., graduate of the University of Pennsylvania in 1837. His father and grandfather were physicians and surgeons. He was a very successful operator, and particularly in the region of the neck, having extirpated the parotid gland, ligated and incised considerable portions of the jugular vein, and removed tumor which entirely compassed the carotid artery.—*Easton Daily Argus*, Dec. 3, '86.

— From the *Medical Gazette* of Nantes we learn that the Japanese have a remedy for hydrophobia which they call hoang-nan. It has recently been tried in 24 suspected cases. The daily dose of the drug in the form of the powdered root was from a hundred to a hundred and fifty grains. It is stated that up to the time of the last report none of the patients had died. The histories of the cases are so incomplete that no inferences of value can be drawn from them.—*Science*, viii, 511, 1886.

— The extreme delicacy of the sense of smell in man has been shown by a series of experiments by Messrs. Fischer and Penzoldt. In an empty room of 230 cubic metres' capacity, and tightly closed, a small quantity of the substance to be detected was thoroughly mixed with the air, and the observer then admitted. Among different substances it was found that the smallest amount recognizable was .01 of a milligram of mercaptan. This quantity diffused through the room sufficed to make its distinctive character appreciable in the small volume of air coming in contact with the nerves of the nose, from which it was estimated that a four hundred and sixty millionth part of a milligram of this substance was recognizable. Hitherto the spectroscope has been considered the most delicate of all means of analysis, indicating less than the millionth part of a milligram of sodium; but the sense of smell, in the case of mercaptan at least, is seen to be at least two hundred times more delicate.—*Science.*

— Prof. Samuel P. Langley, of Allegheny, Penn., has been awarded the Rumford Medal of the Royal Society for researches on the spectrum by means of the bolometer.

CORRESPONDENCE.

[We take pleasure in doing our share to circulate the following.—ED.]

TO THE EDITOR: At its last meeting, September, 1886, at Bethlehem, N. H., the Hay-Fever Association decided to offer a prize for the best esssay on some question relating to *Æstivis*, or Hay-Fever.

In order to carry out the above the following is announced officially :—

1. Subject of the Essay, Hay-Fever. (a) Its pathology. (b) The predisposing, and the aggravating causes. (c) Advice to the sufferer.

2. The Essay not to exceed *four thousand words*, and to be as practical and non-technical as possible.

3. The manuscripts to be received at the office of Samuel Lockwood, Freehold, New Jersey, not later than April 30, 1887.

4. Each manuscript to have a Motto under the Title, and to be accompanied with a sealed letter containing said Motto, also the name and address of the author. These letters not to be opened until after the award is decided.

5. The prize to be $25. The accepted essay to be published immediately in the Association's annual report, one hundred copies to be given the author.

6. The Committee of Award :—Samuel Lockwood, Chairman of Committee on Scientific Facts; Frank B. Fay, President U. S. H. F. A.; Charles C. Dawson, Secretary U. S. H. F. A.

Respectfully yours, SAMUEL LOCKWOOD,
Chairman of Committee on Scientific Facts.

FREEHOLD, N. J., *January* 15, 1887.

——o——

TO THE EDITOR: I see in January number of Journal, Prof. Hitchcock states that he has searched many a time at home for the very peculiar diatom *Bacillaria paradoxa* without finding it, and perhaps others may have failed to find it. Last August, while collecting algæ and diatoms near Morris' Cove, New Haven Harbor, I found the above-named diatom quite plentiful and vigorous in the salt marshes back of Fort Hale; but the most remarkable specimens were found while dredging in Morris' Cove in about twenty-five feet of water at low tide. They were so plentiful that a drop of sediment would contain fifteen or twenty groups, each consisting of thirty to fifty individuals, as near as I recollect, and so very active that it was difficult to count them; they would stretch out almost instantaneously to a length of more than ten times the diameter of the field of view, then as rapidly contract to extend again in the opposite direction. The cumulative effect of their individual motions was such as to cause the ends of the line to move with violence and sufficient force to dash all obstacles out of the way. The specimens from the salt marshes were not so large nor nearly so active, having periods of rest, while these appeared constantly in motion. In the same gathering were varieties of Triceratium, *Actinoplychus rendulata* (plentiful), Poscinodiscus, from minute varieties to quite large; six or eight varieties of Pleurosigma, of which *P. balticum* was the largest; but a variety of about the same length, but thinner than *P. angulatum*, and with different markings, was the most active. I think the speed of diatoms has been underrated. Carpenter says that the motion of Surirella, etc., consists of a languid roll. I find that freshly gathered and vigorous Surirellas, Stauroneis, Pymbellas, Pleurosigmas, etc., will move a distance equal to their length in from one to two seconds; a motion far from languid, and rivaling or surpassing the best steamboats in relative speed.

Yours truly, WM. A. TERRY.

BRISTOL, CONN., *January 21st*, 1887.

——o——

JANUARY 24, '86.

TO THE EDITOR :—As you say in the January *Journal* that you would be pleased to hear from your readers on Reeves' method, 'I take my pen in hand :'—

It struck me on reading his method that it was very long, and the number of operations to be gone through would leave the sections in a very dilapidated condition, unless one is satisfied with one or two sections for an evening's work, or mounts sections for the *sake* of mounting them. I have been long troubled to get really good sections of embryo chicks. Alcohol as a hardener is too energetic for such delicate tissue, and chromic acid and Mueller's fluid takes so long that the tissue becomes granular on the outside before it is hardened throughout. Last Friday I placed some eight-day embryos in alcohol about 80%; Saturday evening I placed them in cold turpentine, which was gradually warmed on a water-bath to about 100° Fahr.—the embryo cleared up in about 15 to 20 minutes; then placed them in the melted paraffine according to Reeves, until the bubbles stopped rising; then a cast was made. As soon as it was cool I cut sections with that splendid instrument, Bausch & Lomb's microtome, $\frac{1}{2000}$ inch thick or thin. As soon as the section was cut I dropped it, paraffine and all, into an alcoholic solution of eosin. Contrary to my expectations it stained beautifully, notwithstanding the tissue

appeared to be thoroughly permeated by the paraffine. After washing off the superfluous stain in alcohol 94%, picked up the section with the forceps, and put on a clean cover-glass, one or two drops of benzole dissolved the paraffine and cleared the section, then a drop of balsam on the slide, *draining* off the benzole from the cover and placing the cover on the drop of balsam, as *nearly parallel with the slide as possible*, to avoid displacing the object, the operation was finished. I cut, stained, and mounted eighteen slides between 8 and 10 P. M. The benzole appears to be quite sticky when partially evaporated, at all events enough so to hold the tissue in place on the cover, if the cover is *not* tipped up as advised in every microscopical work I ever read. I believe it is the cause of more lost sections and hard words than any other operation of mounting. The sections may be double stained, and will stand considerable handling. The turpentine hardens the tissue to a slight degree, and the warm paraffine much more so—enough to cut good sections when imbedded according to Dr. Reeves' method, which is the best I ever tried. If the tissue is placed in alcohol long enough to coagulate the albuminous portion, it is, I think, all that is necessary. A prolonged immersion in alcohol interferes with a proper soaking in the melted paraffine, causing the brittleness complained of.

I send you one of the sections cut last Saturday simply as a sample of the cutting; the staining could be much improved on.

Dr. Reeves' section flattener is 'immense.' Hard and soft paraffine as recommended by you I have never had a good result from. With a hollow-ground knife the cutting edge resembles a chisel, and the thicker part acts as a guide, throwing up the section and curling it.

JAY L. SMITH.

89 Beekman street, New York City.

MICROSCOPICAL SOCIETIES.

WASHINGTON MICROSCOPICAL SOCIETY.

At the 53d regular meeting of the Washington Microscopical Society, Dr. E. M. Schæffer gave an account of what was being done in the way of establishing a subsection on microscopy at the coming meeting of the International Medical Congress, which will occur in Washington in September next. The subject will be under the nominal charge of the Section on Pathology, but under the immediate charge of Dr. Schæffer. It is desired to make the exhibit as large and attractive as possible and to vary it during each day of the Congress. Circulars will soon be ready giving full information, and particulars may be obtained by addressing Dr. Schæffer, at 1319 F street N.W., Washington, D. C.

—o—

At the 54th regular meeting, January 25, the essay of the evening was by Dr. E. P. Howland, who gave his experience in microscopic projection, illustrating his remarks by an instrument combining a projecting microscope and a lantern for projection of photographs. He said:—My experience leads me to believe that the direct projection of microscopic objects can only be successfully accomplished in small rooms. For public exhibitions and for projection generally, photographs are to be preferred. The use of a projecting microscope is quite satisfactory with low powers, but it is difficult to concentrate the light sufficiently to admit of the use of high powers. These remarks refer to the use of calcium light. With the electric light better results may be obtained. I have succeeded in making the electric light perfectly steady by getting all the forces into equilibrium, but the cost of using it is a great drawback. I have not succeeded in finding any dynamo which will furnish a steady light, and have been compelled to use the battery as a source of electricity. Where the object is so delicate as to be injured by the heat of the calcium light, the alum cell may be interposed.

The essay was fully illustrated. Mounted objects on ordinary slides were projected, and also photographs of the same objects, showing clearly that the photographs were more satisfactory for projection; living animalculæ and physical experiments were also projected. One of the most striking illustrations was a double projection. By the microscope was projected a small electro-magnet, weighing only one grain, wound with a few inches of No. 40 silk-covered copper wire, while by the lantern was shown the small battery which generated the current. Upon making the necessary connections, they were shown side by side on the screen, the magnet attracting small pieces of iron wire, and the battery at work, with bubbles of hydrogen ascending as the decomposition of the water went on. The objects were erected by use of an obtuse-angled

prism. A number of enlarged photographs, mounted, were also shown, and the mode of taking them, by microscope and calcium light, fully explained.

The Society was favored by the presence of many guests, including a number of ladies. E. A. BALLOCH, *Rec. Secr.*

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THE ESSEX COUNTY MICROSCOPICAL SOCIETY.

This Society was organized on October 8th, 1886. Rev. F. B. Carter was elected president, Dr. Geo. S. Allen, treasurer (both of Mont Clair, New Jersey), and Jay L. Smith, of West Orange, secretary. Meetings are held at the houses of members on the first and third Thursday evenings of each month from October to July. Subjects are chosen for general discussion, and each member works on it during the two weeks and shows the result at the meeting. On January 20 a meeting was held at the residence of the president. The subject for the evening was 'urine,' especially as a diagnostic means. D. J. W. Pinkham had two fluids which were very interesting, showing granular, epithelial, hyaline and waxy casts; blood, pus, epithelia undergoing fatty degenerations, &c. Mr. Frank Vanderpoel showed the heat and nitric acid tests for albumen, and also a collecting tube devised by him for urinary or other sediment, an account of which will be found on page 24. Eleven members were present. Not having time to make the tests for sugar, blood, bile, &c., it was voted to continue the subject at the next meeting on February 3, when Dr. Pinkham will give an account of the changes which take place in some of the kidney diseases.

86 Beekman street, New York City. JAY L. SMITH, *Secr.*

NOTICES OF BOOKS.

A Manual of Microscopical Technology for use in the Investigations of Medicine and Pathological Anatomy. By Carl Friedlænder. Trans. by S. Y. Howell, M. D. G. P. Putnam's Sons, New York, 1885. (pp. 249).

The book before us is a presentation in comprehensive form of the facts for the ready reference of the medical man who would use the microscope. It sets forth as briefly as possible the most important of the 'methods employed in microscopical investigations of a diagnostic or pathological nature.' After a brief description of instruments, and some hints on their selection and use, also brief directions for the use of the microtome, a considerable space (pp. 26–47) is devoted to the theory and practice in the use of various re-agents and other preparatory methods. To illustrate the value of the work, let us abridge the account of *Amyloid Staining with Violet Aniline Dyes.*

These exhibit peculiar reaction on amyloid substances, staining them a deep red, while the nuclei, etc., are colored blue. The red is unaffected by weak acid, but extracted at once by alcohol, hence in washing a 1% acetic acid is employed. Glycerin is employed for mounting and examining. The distinction between the red amyloid and remaining blue portions is very clear. As a caution in the use of methyl violet it is said that some non-amyloid hyaline bodies, viz., certain urinary casts, are tinged red by the re-agent.

Besides these directions for staining are modes of preservation of material, also for imbedding and injecting. The latter half of the book is occupied with observation of living tissues and the examination of fluids.

The author discusses the subject of the presence of bacteria in the sputum very fully, giving the proper methods for their detection in the sputum and other fluids of the body. He has several pages with *diagnostic and prognostic significance of tubercle bacilli in the sputum*, in which he concludes that the presence of the bacilli is not to be taken as sure evidence of disease, but their absence may be regarded as sure evidence of the absence of disease. While the work is mainly one treating of technique, and not intended as a manual of information, it contains considerable of the latter, including description for recognition of the appearance of pus corpuscles and fat granule cells. The examination of urine receives a good share of attention, particularly in crystals, hyaline, waxy, and brown casts, epithelial cells and tumor components. Under secretion of the genital apparatus we find, besides other lesser matters, *diagnosis of uterine carcinoma.* But we cannot give an entire index of this valuable little book; it is literally full of valuable hints for the physician who would or ought to use the microscope. We regret that it is not illustrated, for this would make it valuable not merely as a work on technique but on descriptive histology as well. It contains one plate

representing the typical form of ten different characteristic micro-organisms. The form of the book is square, 16mo, with flexible covers, and is very pleasing.

Outlines of Lectures on Physiology. By T. Wesley Mills, M. D. W. Drysdale & Co. Montreal. (pp. 200).

Dr. Mills, in this little volume, has condensed a truly enormous mass of material. It would be utterly impossible for a beginner to read the book. On the other hand, for a student of physiology the work would be simply invaluable as a clear and convenient statement of hard, dry facts. It has evidently been the author's purpose to schematize the existing information upon human physiology, and with it anatomy, with at the same time very free reference to comparative physiology. Science, then biology, then morphology, then physiology are defined, and then the characters of living things and those which distinguish animals from plants are tabulated in the first three pages. The work throughout is synoptical in its treatment, and is, so far as we are aware, the only work of the kind for sale. To better indicate the method of the book, let us glance over SECTION IX—DIGESTION; general physiology of secretion. I. Digestion in the mouth: (*a*) anatomical facts; (*b*) physiological facts. Salivary glands: saliva, digestive action of saliva, nervous mechanism of salivary secretion, gland histologically considered before and after secretion, deglutition. II. Digestion in the stomach, etc.

It is not at all a discount upon this work that it states the fact and at once leaves the reader for the next one. Any discussion would have violated the present plan, and no limit to the work could well have been assigned. At present any physiologist who reads the work finds there a most convenient tabulation of the facts, and any student who should possess it would find it a most valuable guide to him as an outline for his reading. In addition to the tabulation of facts is also the tabulation of a very large amount of experimental matter, fully one-fourth of the work being occupied with this, so that it is a guide and summary of a full course in laboratory work. The work is brought down to the present time, as is assured by the fact that Dr. Mills is himself an active and enthusiastic original worker in the field of physiology, and has contributed to science many new communications, those especially in physiology of voice having attracted very great attention.

We desire to acknowledge here, with thanks, the receipt of the following articles from the authors:—

1. *The Surgery of the Pancreas.* By N. Senn, M. D. Reprint from Trans. Am. Surgical Assoc. Apl. 29, '86. 2. *Proceedings and Addresses at the Sanitary Convention*, Kalamazoo, Mich., June 1 and 2, 1886. 3. *Certain Hereditary and Psychical Phenomena in Inebriety.* T. D. Crowther, M. D. Hartford, Conn. 4. *Simple Method of Photographing Biological Subjects.* T. C. White. London, England. 1886. 5. *The Curitee as a Diagnostic and Therapeutic Agent in Gynecology and Obstetrics.* B. B. Brown, M. D. Baltimore, Md.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium* sp.) in exchange for good mounted slides in animal histology.
HENRY L. OSBORN, Lafayette, Ind.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one.
K. M. CUNNINGHAM,
Land Office M. & O. R R. Co., Mobile, Ala.

Pathological and Histological Slides (very fine) in exchange for other good slides.
F. M. HOYT, 160 Washington Park, Brooklyn, N. Y.

Wanted histological and pathological mounts. Send list for exchange.
JOHN H. SMITH, M. D., 909 South Charles St., Baltimore, Md.

Publisher's Notices.—All communications, exchanges, etc., should be addressed to Henry Leslie Osborn, Lafayette, Indiana, Purdue University.

Subscriptions, and all matters of business, should be addressed to the Business Manager, P. O. Box 630, Washington, D. C. The address of Mr. R. Hitchcock is Osaka, Japan.

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The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the following prices which are net:—Vol. II (1881) complete, $1.50; Vol. III (1882), $2 50; Vol. IV (1883) complete, $1.50; Vol. V (1884) complete, $1.50; Vol. V (1884), Nos. 2–12, $1.00; Vol. VI (1885), $1.50; Vol. VII (1886), $1.00.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

VOL. VIII. MARCH, 1887. No. 3.

Photo-micrography—IX. By R. Hitchcock.

(Continued from vol. vii, p. 141).

In continuing these articles, after an unexpectedly long, but unavoidable, intermission, we have thought it well to bring them to a close by an account of the ordinary method of silver printing. Of all the various methods of printing that are now known and practised, we are of the opinion that for microscopical subjects there is not one that is so generally satisfactory as the ordinary method with albuminized paper. It is true, excellent prints can be made with paper coated with silver emulsion, and particularly by the platinotype process; and for purely artistic effects, with suitable negatives, we are disposed to favor the platinotype process more than any silver process. But for the more delicate details required in microscopical prints—details which sometimes are exceedingly faint even in the best negatives—the smooth albuminized surface alone, in our opinion, will give entire satisfaction. On the other hand, for most of the work of amateurs with ordinary subjects, the other methods leave nothing to be desired.

Sensitizing the paper.—The sensitizing solution is prepared by dissolving sixty grains of nitrate of silver in each ounce of water. A sufficient quantity should be prepared to cover the bottom of the sensitizing tray to the depth of half an inch. Albuminized paper comes in sheets measuring 18 by 22 inches. If one has a tray large enough, it is well to silver the sheets entire, but usually the amateur will find it convenient to cut the sheets in quarters and to sensitize the smaller pieces in an ordinary 10 × 12 or 8 × 10 porcelain or rubber tray. To do this, filter the solution into the perfectly clean tray, and, taking a sheet of the paper, lower it, working by yellow light or by lamp light, upon the solution, slowly and steadily, beginning with the left-hand corner. Do not get any silver on the back.

Be very careful not to include any air bubbles in this operation. They can be detected by raising the paper and examining the surface. As the edges of the paper tend to curl up, breathe upon the back and they will again flatten out. Allow the paper to float about two minutes, at ordinary temperatures. Then remove it by taking hold of the two corners and drawing it slowly over the edge of the tray, to avoid waste of silver. Lay the paper, face up, on a clean smooth surface, and immediately take up all superfluous fluid from its surface with a sheet of blotting paper. Then hang it up to dry.

As it is desirable to keep the silver as much on the surface of the paper as possible, in order to give brilliancy to the prints, the more rapidly it can be dried the better. Artificial heat may, therefore, be employed with advantage, and it may be of interest to some of our readers if we describe the method of drying we have adopted in Japan, where the appliances at hand are quite different from those at home. We have a very large covered box in which is placed a Japanese *hibachi*—a kind of earthen brazier, with glowing char-

coal resting on fine ashes. This gives the heat necessary, and the papers are suspended one by one on wooden strips which run across the box and which slide along on pieces of wood nailed on the inside of the box near the top. When a sheet comes from the silver bath it is laid on the cover of the box, the blotting paper applied, and it is then picked up on one of the wooden strips, which has two hooks made of bent pins for the purpose, and, sliding the cover aside, the paper is suspended over the hibachi and the drying goes on rapidly.

The time required for floating the paper will vary with the temperature, the strength of the bath, and the character of the paper. It is, perhaps, a good plan to put a drop of a solution of potassic chromate on the back of a sheet of paper on the bath, and note how long it takes for the silver solution to pass through the paper and produce the orange-colored precipitate of silver chromate. This will certainly serve as a guide, for when such a coloration is observed, the paper should be removed.

Care should be taken to keep up the strength of the bath by adding about 15 grains of nitrate of silver for each full-sized sheet of paper sensitized.

After the solution is used it is well to stand it in the sun for a while. It should always be filtered before using, and it should be neutral to test-paper. The addition of other chemicals to the silvering solution, such as ammonium nitrate, for example, does not offer any advantages, so far as we are aware, but the addition of alcohol may possibly be of value when the paper shows a tendency to 'blister' in the subsequent operations; but of this we cannot speak from experience.

Fuming.—Fuming is not universally practised, but it is unquestionably advantageous, for several reasons. After the paper is sensitized and dried, it is exposed in a closed box to the vapor of strong ammonia for ten or twenty minutes. It should then be stored in a tight box.

Preserving Sensitized Paper.—The amateur who wishes to work economically will find it a serious inconvenience to frequently prepare fresh paper; but the ordinary paper will not keep many days unless certain precautions are taken to preserve it. In warm weather even twenty-four hours will bring about a discoloration. Sensitized paper that will keep for a long time is sold by the dealers, but it is not to be recommended. It is usually prepared by the addition of citric acid in some way. The paper prepared as above described may be kept for a long time by adopting the following simple method of storage:—Take some sheets of bibulous paper and float them on a rather strong solution of washing soda, and when they are saturated with the solution hang them over a line to dry. Arrange the sensitized papers in pairs, face to face, and place the pairs between sheets of the soda papers. In this way a pile of silver and soda papers may be made in which the former will remain perfectly white in the hottest weather. No doubt prints might also be kept in the same way when it is inconvenient to tone them for some time after printing.

Printing.—The negative is placed in the printing frame, the sensitized paper pressed evenly upon it, when it is exposed to the light. The printing should be continued until the print is decidedly darker than it is desired to be when finished.

First Washing.—The object of this operation is to entirely remove the soluble silver salts from the paper. First place the prints in a tray of water containing some common salt, and as they turn red throw them into a considerable quantity of water and wash, with several changes of water.

Toning.—The washed prints are now placed in a tray of water standing beside another tray containing the toning solution, near which should be a vessel of clean water.

There are innumerable formulas for toning-baths, but the simplest are the best. We give two. A stock solution of chloride of gold should first be prepared, which should have about two grains of the pure chloride to an ounce of water. The dealers sell what purports to be a 'double chloride of gold and sodium;' in other words, a mixture of pure chloride of gold with an equivalent of common salt. This is not an economical preparation to buy, and we should not be greatly surprised if this were partly due to the temptation to sell salt at the price of gold. If the pure chloride of gold cannot be obtained, it is advisable, if one is to do much toning, to prepare the chloride himself, for which instructions can easily be obtained from any druggist or chemist.

Toning Bath No. 1.		*Toning Bath No. 2.*	
Stock gold solution, . .	1 oz.	Stock gold solution, . .	1 oz.
Water, ...	16 ozs.	Water, ...	16 ozs.
Baking soda, ...	8 grns.	Acetate of soda, ...	60 grns.

The bath must be distinctly alkaline to litmus paper. If it becomes acid it will not tone. If toning proceeds slowly, and the reaction is distinctly alkaline, more gold should be added.

No. 1 can be used immediately, and should be preserved, and more gold solution added when it is required for use.

No. 2 works after standing twelve hours, and should also be kept, and gold added as required.

Take the prints singly and put them into the toning bath, keep moving them about and turning them over. The reddish color will be observed to change to a brown and finally to a deep bluish color. Experience will be the only reliable guide here, so on the first trial of this operation take a single print, tone it until it seems to be done, then put it in the fixing solution given below, and observe the final color it assumes. In this way learn how far to carry the toning, and as the prints are toned one by one, put them in the vessel of clean water, to remain until all are toned.

Fixing.—The toned prints are now transferred to the fixing solution, which is composed of hyposulphite of soda 1 part, water 4 parts, made distinctly alkaline with ammonia. The ammonia is not necessary, but it is a safeguard against any possible acidity of the solution, and seems to improve the tone of the pictures. About 20 minutes will complete the fixing.

Final washing.—This should be very thorough. An abundance of water should be used, and frequently changed until every trace of hyposulphite is removed; otherwise the prints will fade and turn yellow.

Drying.—The prints may be spread out singly and allowed to dry, but if they are not to be mounted on cards it is better to let them partly dry and place them face to face between sheets of bibulous paper under moderate pressure until quite dry, when they will remain flat.

Mounting.—This can best be done by a practical photographer, as a burnisher is required to finish the prints, and a good burnisher is a costly machine to buy. If, however, it is desired to put the prints on cards, that may be done, and they may be sent to a photographer's to be burnished. The prints are thrown into water, taken out singly, and made into a pile on a wetted glass plate, faces down. The superfluous water being removed by a cloth, the paste, which is sold by dealers but may be made of flour and water, is applied to the back of the uppermost print, and it is then picked up and applied to the card. Considerable skill and practice are required to do this neatly. The paste must be just right, and it must be properly applied, and only experience will enable one to know when the work is properly progressing. When it is all done, however, the burnisher has a habit of revealing any imperfections, and it is likely to spoil improperly mounted prints.

Sometimes it is desired to mount prints on paper so they will not cockle in drying. For this purpose a special paste is required, and a formula that is recommended for the purpose is as follows:

Nelson's photographic gelatin, No. 1, 4 ozs. Water, ... 16 ozs.
Glycerin, ... 1 oz. Alcohol, ... 5 ozs.

A formula for a rapid printing paper that is said to give very good results is as follows:—Plain white paper is floated on a saturated solution of corrosive sublimate in water, and then thoroughly dried. It is then sensitized by floating on a solution of nitrate of silver, 1 part of nitrate to 12 parts of water. This operation must be conducted by yellow light, and, as the paper is very sensitive, it must be carefully protected from daylight while drying. The printing is conducted in the usual manner, except that the exposure for an ordinary negative will only be a few (5–10) seconds in clear weather, and perhaps one minute at other times. The best way to make the exposure is to carry the printing frame out into the light covered with a black cloth, and expose by removing the cloth for the required time.

The picture will then appear very faint, and requires to be developed. The developer is a solution of one part of ferrous sulphate in thirty parts of water, with about three ounces of glacial acetic acid. Development is carried on in the usual manner for dry plates, and care must be taken not to carry the operation too far. The picture is then washed and fixed in hyposulphite.

The tone of such pictures is said to be of a fine neutral black, and very pleasing.

Notes on diatom study. By Wm. A. Terry.

The most convenient method I have found for the study of the motions of diatoms is by means of a shallow cell an inch square, made with varnish upon an ordinary glass slip. By filing, the cell can be made of the desired thinness, to be governed by the size of the objects examined and the power used. About the one-hundredth of an inch I have found useful. When a small drop of water containing the objects is placed in this cell and the cover applied, a slight pressure will force out the superfluous water, which should be wiped off; the cover will then remain in place in any position of the slide. I generally cut with a knife a small channel through the varnish at one corner of the cell for the admission of air. With this simple arrangement the life, motions, and habits of the diatoms, desmids, and infusoria can be easily studied; by moving the slide with the fingers the objects can be kept in the field of view continuously. I have studied the motions of diatoms for hours at a time, and have watched the growth to maturity, and the multiplication by self-division of infusorians. By carefully adding minute quantities of water from time to time when needed, applied at the edge of the cover, the object can be kept under examination any desired length of time.

The rapidity of the motion of diatoms varies greatly in different stages of their development, and it appears also to be varied by the temperature of the water from which they are taken. In the heat of summer I have found those taken from cooler waters to be the most active, that is, in waters exposed to sunlight. I have never found diatoms very plentiful in waters flowing in dense shade. One striking feature of their motion is their great force; they are often seen pushing or dragging a mass of debris of twenty times their bulk. I have never been able to detect any decided current caused by them in the water, although this is so easily seen in the infusoria in like circumstances. A mass of sediment is frequently caught by them in passing and carried forward, passing over the diatom from rear to front in the same di-

rection in which it is travelling. How is this done? If the motion of the diatom is caused by currents it produces in the water, then any sediment coming in contact with it should be carried from front to rear and there thrown off; precisely the contrary happens; a small piece of sediment will sometimes come against the side and be carried to the rear, then it is generally taken up and carried back to the front over the top of the diatom, and may circulate back and forth in this way several times while the diatom is steadily moving on in one direction. None of the sediment or other matter appears to be disturbed by the passage of the diatom unless it comes in actual contact with it.

In my previous communication* I mentioned dredging for diatoms in Morris' Cove; perhaps some of your readers would like to know how I managed. I first went out with the oystermen and examined the sediment brought up on the oysters without finding anything rich enough to be satisfactory. I became convinced that the coveted forms were in the lighter ooze which was washed off before the dredge reached the surface. As I could find nothing else that would answer, and time was an object, I took a wire from a bale of hay, and by doubling and twisting it firmly made it sufficiently rigid to answer. I then bent it into a frame for the mouth of a dredge about eight by sixteen inches opening, with a handle to hold it in position when used, then fastening a bag or pocket of strainer cloth from the open mouth and a strong fishing line about one hundred feet long to the handle, I was ready for a trial. Being rowed out by a friend who was familiar with the cove, I had him stop where he said there was a muddy bottom, and threw over my dredge, starting the boat sufficiently to expand the pocket and get the dredge into the right position for work. I then paid out the line and let the dredge sink slowly to the bottom, then moved the boat carefully so that the dredge just skimmed along on the bottom; a little greater speed would have raised it entirely off on account of the resistance of the water. The very first trial was eminently successful. I saw, as soon as the dredge reached the surface, that I had what I wanted, and the first drop I placed under the microscope showed at least fifty forms of *Pleurosigma*, beside *Coscinodiscus*, *Actinoptychus*, *Campylodiscus*, *Auliscus*, *Navicula*, etc. The Pleurosigmas were very active; there was little, if any, pause for rest—commencing their backward movement almost immediately. By the next morning they formed a film on the sediment of a reddish brown color, and by pouring a quantity of the water into a wash-bowl I got a supply of them absolutely clean. A drop of this supply placed in the microscope was an astonishing sight; the field of view was filled with rapidly moving forms, crossing and re-crossing over and under and alongside of each other without ceasing.

In subsequent trials of my dredge I found it necessary to wash it thoroughly at every cast, as the quantity of minute jelly fish caught so covered it with slime as to make it water-proof. I tried it outside the breakwater and light-house in the open sound, hoping to find larger forms. The water was here about fifty feet deep, and the mud softer than in the harbor. I found no Pleurosigmas here, and the other forms were no larger than I had found inside; but there were multitudes of small forms. I placed this gathering in a wooden water-pail to settle. In the morning I noticed a peculiar granular appearance of the surface of the deposit, and on examination I found several inches of minute round clams. I skimmed off about two quarts of them without disturbing the sediment below and returned them carefully to their native element. They were about the size of pinheads. All the material procured

* See page 37.

by the use of my dredge was fairly rich in foraminifera, every drop examined containing more or less, sometimes half a dozen living specimens, generally of the spiral varieties.

The refuse organic matter of this material was almost entirely of animal origin, and was more difficult to get rid of than the vegetable refuse of fresh-water gatherings. On reaching home with my material I attempted the water-washing process, previously published in this *Journal* by Dr. George H. Taylor, of Mobile, Ala.* I placed about a pint of material in a quantity of fresh water, but found it very slow to settle; if I poured off the water too hastily I should lose a large proportion of the diatoms. After the second washing the material refused to settle at all, and was rapidly becoming offensive. I therefore stirred in a small quantity of chromic acid, which soon changed the previous black color to a light grey, and precipitated all the material in a compact form. The after-cleaning was by an original process of my own, of which I will hereafter give particulars in a future paper.

Colonial Radiolarians.†

The thirteenth volume of the monographs of the Naples Zoölogical Station contains an account of the Sphærozoa or colonial radiolarians by Dr. Karl Brandt. The monograph treats of these forms under the four heads:—(1) Morphology, (2) Biology, (3) Reproduction and Development, and (4) Systematic; and in its exhaustive historical survey and independent investigation, as well as its wealth of illustration, well supports the character of the splendid series. From the nature of the group the number of new results is not, of course, very great.

I. **Morphology.**—After a general introduction and historical sketch of the progress of our knowledge of the Sphærozoa, Dr. Brandt proceeds to a morphological survey. (1). *The protoplasm.*—The central protoplasm differs physically and chemically from the peripheral. The latter consists of pseudopodia and assimilative protoplasm darkened by super-osmic acid. The central substance is not so darkened, and this is but an index to other differences. (*a*) *The central substance* is divisible into two masses: the inner surrounding the oil globules, the nucleus, containing vacuoles in spore formation, as also pigment granules and large crystals; the outer surrounding the nuclei. (*b*) *The cortical substance* often contains abundant granules, while the central contains none, or *vice versa*. It consists, as noted above, of assimilative and of pseudo-podic protoplasm. (2). *The nuclei.*—In the vegetative period the nuclei are homogeneous. Those of the isospores are doubly refractive, which probably expresses a very fine differentiation. Those of the anisospores and of the intra-capsular bodies formed in the young vegetative colonies are further differentiated. The phenomena of nuclear division in the anisospores of Collosphæridæ appeared to be very simple. (3). *The central capsular membrane* is regarded as homologous with the cell wall. In some vegetative colonies it appeared to be absent, but even then the central and cortical protoplasms were not exactly continuous. Pore canals were observed in *Collosphæra huxleyi*. The membrane cannot be detected during or after the escape of the swarm-spores. (4). *The oil globules* appear early and remain till the close of the vegetative life. In very young colonies and in the swarm-spores they are represented only by fine granules. Only in one form is there more than one large globule in each individual. The author doubts the existence of an albuminoid basis, and regards the enclosed sub-

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* See vol. vi, p. 147.
† Copied from the abstract in Journ. R. Micr. Soc., 1887, p. 102.

stance as fat. (5). *The crystals*, which are present only during the reproductive period, are distinguished into large forms, which do not pass into the spores, and small forms which do. They are never truly crystalline. The large forms are excretions; the small ones consist of an organic substance and are reserve material. (6). *The pigment* also occurs in the reproducing forms, is never diffuse but always granular, varies from blue to reddish violet, and appears simultaneously with the crystals. They are excretory masses, formed during the spore-building, and are left behind. Their chemical reactions are noted in detail. (7). *The connecting jelly-like substance* is normally present and is of great importance in keeping the colony together. It increases throughout the vegetative period both in mass and consistence, and becomes sometimes almost cartilaginous. It disappears rapidly in confined specimens. After the appearance of the zoöspores it also decreases, first slowly and then rapidly. Even in dead spirit-specimens some physical properties, *e. g.*, of swelling out again in water, remain. Morphologically this substance is an excretion of the protoplasm. Physiologically, it is essential to the connectedness, protection, hydrostatic, and even nutritive functions of the colony. (8). *Vacuoles* are not present in very young colonies. As the jelly-like substance becomes separated from the penetrating fluid, vacuoles are formed, to disappear again as spore-formation begins. They are surrounded by a fine plasmic layer. The variations in form and distribution are noted. The author regards them as entirely comparable to the vacuoles of other Protozoa. (9). *The skeleton*.—The presence or absence of a skeleton cannot be regarded as establishing a natural division. In noting the mode of growth Brandt maintains the existence of an organic basis with subsequent silicification. He deprecates the erection of species on the variations of the spicules. (10). *Yellow cells*.—These symbions, which Brandt has named *Zoöxanthella*, are regarded as perhaps allied to the Peridineæ. The results of assimilation are starch grains, and also granules of different composition. Their presence at different periods, their behavior when isolated, and other points are then noted. (11). *Individuality of the colonies*.—Colonies of different species cannot fuse, but colonies of the same species may, and that independent of the developmental stages of the two fusing forms. As Schneider has shown, artificial division is readily practicable. There is more division of labor within the colony than Hertwig allowed. The functions of intra- and extra-capsular protoplasms are quite distinct. The central capsule even, which solely forms the spores, is not homogeneous in its functions.

II. **Biology.**—(1). *Nutrition*.—After noting general facts as to food material, Brandt emphasizes the truly nutritive function of the symbiotic algæ, which contribute the results of their assimilation (starch, etc.) to their animal host. The breaking up of these "yellow cells" during swarm-formation is specially noted, and also the changes in the assimilative protoplasm. (2). *Movement*.—The plasmic portions being much heavier than sea water are floated by the vacuoles and by the gallert substance, which sometimes appear to be lighter than sea-water, and enormously increase the surface. Mechanical and thermal stimuli produce changes which effect sinking and rising. The pseudopodia affect the specific gravity through their influence on the vacuoles. (3). *Occurrence of different forms*.—The distribution of the species is described in detail, and graphically expressed in curves. The principal result shows their varied occurrence at different seasons. (4). *Environment*. (*a*) The Sphærozoa are very sensitive to changes of salinity. (*b*) They are uninfluenced by light; even extreme illumination does not affect their vertical distribution. The statement of Geddes that radiolarians move from the light is denied. (*c*) Apart from seasonal changes, alterations of temperature

do not appear to have much effect on these forms. On gradual cooling several forms were observed to sink. These forms withstood a prolonged cooling to 1°, but exhibited changes which, after 2–3 days, led to a reascent. (*d*) Movements in the water due to wind caused the sphærozoa to sink; the direction of the wind, *e. g.*, the sirocco, had a marked influence, which is discussed in detail. Certain currents also influenced the distribution to a noteworthy extent. (*e*) Dr. Brandt's observations are, on the whole, against any periodicity in the development of the Sphærozoa. (5). *The geographical distribution.*—The derivation of these forms from the Atlantic, their absence in colder seas, etc., are then discussed. (6). *Phosphorescence.*—The Sphærozoa are phosphorescent, but not with great intensity. The central portion alone is illuminated. The oil-globules are regarded as the seat of the process. (7). *Parasites and 'Inquilinen.'*—Colonies of *myxosphæra cærulea* frequently contain a living amphipod, *Hyperia*, also Copepoda and Appendiculariæ; living diatoms also occurred in young Collozoa.

III. **Development and reproduction.**—(1). *Division of the colony* seems certainly to occur, but Brandt was not able to observe the mode of formation of collozoum chains supposed to occur by Haeckel and Hertwig. (2). *Division of the individuals* was observed only in young vegetative colonies, and not in the older or in reproductive forms. (3). *Swarm-spore formation.* (*a*) *Isospores.* Hertwig's observations are generally corroborated, the main difference consisting in Brandt's denial of the statement that the whole mother organism is resolved into the spores. The greater part of the cortical substance is left behind and breaks up. The isospores of all Sphærozoa are said to have two flagella. (*b*) *The formation of an anisospore* is distinguished from the above by the occurrence of groups of nuclei in the individuals, by the differentiation of the nuclei, and by the distinct macrospore and microspore nuclei. The anisospores differ further in their more or less bean-like shape, in their difference of size, in the character of their nuclei, and in the absence or peculiarity of crystal. The anisospores have much less reserve material than the isospores. The extra-capsular changes are essentially similar. The cortical substances again break up; the yellow cells persist as before. (*c*) *Alternation of generations.* According to Brandt, all the Sphærozoa have two modes of reproduction. In seven out of ten species the twofold method has been demonstrated. The Sphærozoa exhibit an alternation of generations, as in algæ and fungi. He believes that from the union of the sexually dimorphic anisospores a fused mass will result, which will produce isospores. He has not, however, observed the conjugation of the anisospores. (4). *Extra-capsular bodies* only occur in young colonies, which contain a few individuals. They always exhibit a more or less striking resemblance to the incipient stages in the intra-capsular formation of anisospores. They arise by budding from the individuals; are refractive and without granules, but often with an oil globule, usually with a fatty mass, and always with a nucleus. Some extra-capsular bodies have not been observed in Collosphæridæ, but in young forms a somewhat similar phenomenon occurs. In some cases these budded bodies are normally modified into anisospores. In other cases they simply become individuals. In Collosphærids this reproduction within the young forms always results in rapid multiplication of the individuals. In Sphærozoa anisospores sometimes are formed, though it is quite likely that in the latter, also, the extra-capsular bodies may often form individuals. (5). *Development.* Five phases in the life-history are distinguished:—(i) the swarm-spore, (ii) the young vegetative phase, (iii) the young reproductive phase, with formation of extra-capsular bodies, (iv) the older vegetative phase, (v) the older reproductive phase, with formation of isospores and anisospores. In the vegetative phases the nuclei are homoge-

neous and singly refractive; in the reproductive they are distinctly differentiated or doubly refractive. The different phases are discussed at length, but the problems of length, transition, and conditions are still unsolved. Some notes on the reproduction of Acanthometridæ are then added.

IV. *Systematic.*—The Sphærozoida are distinguished from the Collosphærida chiefly in these points:—In the formation of the anisospores in S. the grouped arrangement of the nuclei persists till the spores begin to be formed, while in C. it is of a very short duration; in S. macro- and microspores are formed in the same individual; in C., however, in different individuals; in S. true extra-capsular bodies are formed, but these have never been observed in C. On account of these developmental differences, therefore, the two families are distinguished. Since it is impossible to summarize the systematic portion of the work, it must suffice to summarize the net results.

SPHÆROZOA.

Fam. I. Sphærozoida.

Collozoum, Hkl.—Usually without skeleton, occasionally with isolated spicules.

1. C. inerme, Müller sp.
2. " fulvum, n. sp.
3. " pelagicum, Hkl.
4. " Hertwigii, n. sp.

Sphærozoum, Mey.—With siliceous spicules.

5. Sph. punctatum, Huxl. sp.
6. " neapolitanum, Brandt.
7. " acuferum, Müll.
8. " Haeckeli, n. sp.
9. " spinulosum, Müll.

Fam. II. Collosphærida.

Myxosphæra, n. g.—Without skeleton.

10. Myx. cærulea, Hkl. sp.

Collosphæra, Müll.—With smooth latticed shell.

11. Coll. Huxleyi, Müll.

Acrosphæra, Hkl.—Latticed shell with pointed spines.

12. Ac. spinosa, Hkl.

Spinosphæra, Müll.—Latticed shell, in which the principal apertures are drawn out into tubes.

13. Sp. tubulosa, Müll.
14. " tenera, n. sp.

MIROSCOPICAL TECHNIQUE.

Reagents for clearing celloidin-imbedded sections for balsam mounting. By Ira van Gieson, M. D., assistant at the laboratory of the Alumni Association of the College of Physicians and Surgeons, New York.

The reagents used in clearing celloidin-imbedded sections for balsam mounting may be divided into two classes, depending upon their property of dissolving or of not dissolving the celloidin from the section. The oils of the former class are useful in clearing compact sections in which the celloidin is used merely to give proper consistency for cutting. In such sections the ordinary oil of cloves is the most convenient. The latter class of oils is desirable for

clearing sections in which the presence of the celloidin is essential to the integrity of the section; for example: in clearing porous specimens, specimens consisting of loosely-united lamellæ, serial sections prepared by the method of Weigert, in which the series are held in place between two thin adherent films of celloidin. Among the oils which do not dissolve celloidin from the section, in clearing, thyme and origanum are commonly employed.

Oil of Thyme—Thymus vulgaris.—A large part of the oil of thyme of commerce is made in southern France from the cultivated plant. There are two varieties—white and red. The white oil is made by rectifying the red variety.* The disadvantages of both of these varieties. in clearing, are:—1. The sections require very thorough dehydration; in damp weather absolute alcohol must be used. 2. The celloidin frequently remains clouded for some time after the section is clear, and is much folded and corrugated. 3. These oils contain an acid holding oil† which fades the copper hæmatoxylin preparations of Weigert, if the section remains in the oil from one to two hours; or, if the sections are removed from the oil as soon as possible and mounted in balsam, they frequently fade in a few days. The white French oil of thyme clears specimens much more readily if a small quantity of absolute alcohol is added to it. To obviate the objections to oil of thyme, Minot and Dunham‡ suggest diluting it with from $\frac{1}{3}$ to $\frac{1}{4}$ of its volume of oil of cloves. In our experience this mixture very frequently fades the copper hæmatoxylin preparations of Weigert. There is a second variety of oil of thyme made from the uncultivated plant, known as Oleum Serpyllum—*Thymus Serpyllus.* This is open to the same objections as the French oils.

Oil of Origanum.—There is some confusion in this country about this oil, for the reason that oil of thyme has largely been substituted for oil of origanum.§ With some of the dealers the terms 'origanum' and 'thyme' are used synonymously, and most of the samples purporting to be origanum are simply the pure French oils of thyme or the impure grades diluted with varying proportions of turpentine. This is notably the case with the reddish brown commercial varieties of these so-called 'oils of origanum.' Hager‖ mentions two varieties of the true oils of origanum.—1. Ol. Origani Cretici, Spanisch Hopfen-öl. 2. Ol. Origani Gallicum. The first of these does not dissolve celloidin in clearing, and is far superior to oil of thyme. It clears sections rapidly even in moist weather after their dehydration in 95% alcohol. It sometimes folds the edges of the celloidin to an inappreciable extent. It is free from acid and does not fade sections stained by Weigert's hæmatoxylin method if the preparations are hardened for a long time in Mueller's fluid, and are subsequently mounted in thick balsam. Specimens containing bacteria, stained by either Gram's method or the simple anilin colors, may be cleared by this oil without fading. It does not remove the color from hæmatoxylin and eosin-stained specimens.

When the sample is freshly opened it has a light amber color and does not clear readily, but after it has been exposed to the air for some time and a number of sections have been cleared in it, it becomes darker in color and clears without difficulty. Among the makers of this oil of origanum the house of Schimmel & Co. is to be preferred. It has but recently been imported to this country, and may be obtained of their agents, Fritsche Bros., Barclay st., New York.

Anilin Oil.—Merck's anilin oil clears sections readily and leaves the celloidin intact and pliable. It changes the tint of eosin-stained specimens slightly. It does not fade the Weigert hæmatoxylin staining, and may also

* Pflückiger and Handbury Pharmacographia, '79. † Hager, Pharmaceutische Praxis, vol. ii.
‡ Zeitschrift für Wissenschaftliche Mikroscopie und für Mik. Technik, Band iii, vol. ii.
§ U. S. Dispensatory, 83. ‖ Op. Cit., vol. ii.

be used in clearing sections stained for bacteria by Gram's method or by the simple anilin colors. The oil must be thoroughly removed from the section in mounting, for any superfluous portion tinges the balsam a light yellow color. The oil is easily removed from the section, after it has been placed on the slide, by pressing a piece of filter paper folded several times on it, as in blotting a sheet of letter-paper.

Xylol, Creasote and Oil of Bergamot.—Merck's xylol does not dissolve celloidin, but unless absolute alcohol is used in dehydration the sections clear slowly and are much corrugated. Beech-wood creasote is recommended by Flesch.* In this country creasote is variable in its composition, some varieties dissolving the celloidin completely. Only one of four samples which have been tested does not dissolve the celloidin and has an acid reaction. Oil of bergamot clears sections rapidly and does not affect the celloidin; it, however, removes the color completely from eosin-stained specimens. Thus far the most satisfactory of the reagents tested at the laboratory for clearing sections without dissolving the celloidin from them is Ol. Origani Cretici.

EDITORIAL.

The proceedings of the American Association for the Buffalo meeting last summer are at hand, and with a truly partisan spirit we turn at once to the papers upon biological topics. We must admit that we are somewhat disappointed to find that the papers of deep interest are few, compared with what our biological workers are doing, and, with partisan spirit again, that the interesting papers reported are mainly, though by no means wholly, botanical, while zoological topics are much more weakly represented. For the activity of the botanists we most heartily commend them, and we think their example might well be imitated by other portions of the Association. The botanists have formed themselves into a club, which has its bonds of special interest, and links them closer to the Association, and insures the presence at its meetings of a large number of interested members.

We are not mistaken in judging that one of the greatest benefits which results from the Association to science is secured through the influence of personal contact between enthusiastic workers and others who have somewhat cooled. These latter form an audience which stimulates and helps the enthusiasts, and they themselves are again inflamed and blaze up into rekindled enthusiasm, which is not a mere instantaneous burst to be succeeded by even greater quiet. The man who has been forced to isolation, and has thus lost his old impetus, has his strength renewed by these annual gatherings. The botanists have done well in forming a club which, by its drawing, in addition to the call of the Association, will bring back some who need to have their fires rekindled.

We should be glad to see other sections, and particularly that of zoology, form a similar organization to attract a larger number of our zoologists, and improve the attendance as well as the interest. We miss from the roll of members in attendance many of the men whose zoological work is the finest done in the United States. We do not mean this to be understood as universally true, for there are many who were present who are properly recognized as leaders in that field; but we think all will agree that the attendance of zoologists was by no means what it should be to properly represent zoology. If the

* Zeitschrift für Wissenschaftliche Mikroscopie und für Mik. Technik, Band i, vol. iv.

zoologists could be induced to imitate the botanists in securing a strong attendance it would add very greatly to the interest of the biological section as well as to the great good of scientific zoology. It is not to be understood from this that we entertain any feeling of jealousy toward the botanists; such is by no means the case. We are catholic in our opinion of all science-workers, and entertain the deepest interest toward the science of botany, which is so closely linked with zoology that neither can go alone. We do not contemplate any division between these sections or consider it at all desirable. We do not write this because of any feeling lest we as zoologists are beaten by the botanists. We only feel that at present the zoological work of the Association is not up to the high standard which the workers in that subject are abundantly able to maintain if their interest for the society could be aroused.

This condition of affairs is not to be explained wholly upon the apparent ground of lack of interest on the part of the zoologists; for the most part they are kept very busy at their posts of observation in the summer and cannot leave. The Fish Commission, the members of Prof. Agassiz's party, the Chesapeake Zoological Laboratory, under Dr. W. K. Brooks; the Anisquam party, the Princeton workers, and others, who are the leaders of zoological work in America, are obliged to use the summer for work, and many, no doubt, feel that they cannot find time to attend. Some of these, through the interest of a zoological club, might often be brought to the meetings or furnish matter helpful to the cause when unable to be present.

Microscopic slides.

We are glad to speak a word of hearty commendation in favor of the histological work of Mr. Arthur J. Dougherty, who has sent us a number of slides for examination and comment. As for the workmanship in the matter of mounting it is fully equal to that of the famous Cole slides and in the same style. But far more important than the finely ground slides, handsome printed labels on neutral-tinted paper, and perfect rings, is the mode of treatment of the specimens. One fine section is of the injected liver of cat; hepatic vein blue and portal vein red; it exhibits the vascular arrangement perfectly. A second section is of the bronchia of sheep at the root of the lung, with air-cells showing finely. This is double-stained with logwood and eosin. The eosin has not added to the value of the section, except to redden the parts which the hæmatoxylin failed to stain. As these are merely the connective tissues, they could have been left unstained without essential detriment to the value of the specimen for illustrating the lung histology. The epithelium of the air-cells is beautifully shown; sections of the pulmonary aorta fairly well shown. The piece is too large to permit of thin enough section to demonstrate perfectly the bronchial epithelium, but the shapes of the cells can be well seen and, in some few places, the cilia upon the free surface. Apparently the tissue was not preserved with a view to demonstrating such minute details, but to show the general relations of parts with as much detail as possible. A transverse section of the stem of *Ruscus aculiatus*, stained with carmine and iodine-green, is very fine. Besides these are preparations of tongue of hive-bee and opaque mounts of Foraminifera from Jersey and Polycestina from Bermuda.

It is not too much to say that in these mounts Mr. Dougherty exhibits the finest kind of work in this line, and also that his mounts are among the most valuable for the purposes of the student of histological structure.

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We are pained to notice the death of Dr. Bernard Persh, late hospital

steward at the U. S. Arsenal at Frankford, Penna. He died on February 3d at about the age of 35 years, of typhoid pneumonia. He was a member of the American Society of Microscopists and also a fellow of the American Association for the Advancement of Science. A German by birth, he served in the late war.

Dr. Persh was a most amiable, painstaking, and unselfish man, an expert bacteriologist, microscopist, and photographer. He contributed, from slides prepared by Dr. Thomas Taylor, sixty finely executed negatives and photographs of the crystals of butter and various animal fats in illustration of discoveries relating to the morphology of fats, which will be published in the forthcoming report of the U. S. Department of Agriculture.

Many of these photographs have been seen by us and are most admirable. We feel that in the death of Dr. Persh science has to regret the loss of one of its faithful followers and supporters.

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The Trenton Natural History Society has recently published a second number of its Journal (January, 1887), which contains several papers of general interest and great worth. Among these we make mention of Key to the Rotifera, by Dr. I. S. Stevens, and a key to the Fresh-water Polyzoa. Both of these papers are of general interest, and we hope to be allowed to present them at some future time to our readers.

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The Swiss Cross, numbers 1 and 2, have reached us. The magazine is a monthly one, the publication of the Agassiz Association. The Association is now well known as a young people's natural history society. It has done a great deal of good among the boys and girls by directing them into useful lines of collecting and observing natural objects. The growth of the society is evidenced by the appearance of the magazine, which will be read with interest and profit by the young people, and perhaps direct some surplus energy from the tales of the borders to less exciting but more healthy topics than the adventures of youthful prodigies among the Indians, etc. The magazine appeals to older readers as well, but is primarily for the youth, and we trust it may meet with a hearty reception from them, for, if they read it, it will do them good.

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American Naturalist.—The January number of this leading American magazine in this department has been greatly delayed, but has at length reached us. The *Naturalist*, as it enters upon volume xxi, changes both editorship and publishers. Prof. Packard, who has so long conducted it, and done so much to bring it to its present successful estate, has relinquished its editorial management to Profs. E. D. Cope and J. S. Kingsley, who are both of its former staff and known through this country as among our ablest scientists. We have no hesitation in expecting increased success for the magazine. Lippincott, of Philadelphia, has taken charge of it, and begun by giving it the handsomest cover it has ever had. Within the covers there are the usual contents, among others a most interesting article by Julius Nelson, of Johns Hopkins University, upon the significance of sex.

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Dr. Thomas Taylor, in his official report as microscopist to the Commissioner of Agriculture, which has been recently submitted, presents a monograph upon butter and fats, containing 114 micro-photographic illustrations. The photographs, very handsomely executed, comprise 'primary,' 'secondary,' and 'tertiary' forms of the butter crystal, as well as beautiful types of lard, beef, oleomargarine, oleo, etc., and are the work of W. H. Walmsley and the late Dr. Bernard Persh, of Philadelphia—gratuitous labor in the interests of science.

Microscopy in Pharmacy.—Mr. H. M. Whelpley, editor of the *National Druggist*, in an address before the Missouri Pharmaceutical Association, says that the microscope will be one of the important instruments of the drug store of the future. Drugs now come into the market in such altered forms that the naked eye cannot detect the adulteration. The instrument will grow in popularity as the public learn the importance of guarding against inferior and adulterated drugs. The first principles in the use of the instrument must be learned from a teacher, and cannot be gained from a book; but future advance by the help of a book is practicable. An instrument need not cost the pharmacist much, and will last a lifetime. Even a simple microscope, as the Coddington lens, is a great help, and will surprise many by its revelations, while it costs but an insignificant amount.

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To sharpen razors.—Mr. V. A. Latham suggests, in the *Scientific Enquirer*, that the simplest method of sharpening a razor is to put it for half an hour in water, to which one-twentieth of its weight of hydrochloric acid is added, then wipe and set it on a hone, the acid acting the part of a whetstone by corroding the whole surface uniformly. The process never injures good blades, and bad ones are often improved by it.

NOTES.

The diatoms have received attention of C. Henry Kain in the opening article of the February number of the *Bulletin of the Torrey Botanical Club*. The author calls attention to the fact that diatoms are mostly known in the cleaned state, and then speaks of collecting diatoms, which, if the collector be experienced, may be found free from sand and other annoyance. Among his hints may be mentioned the richest and purest gatherings of marine diatoms are found at the mouths of inlets from the ocean, and especially in the little coves. At lowest tide the sand ripples are often densely packed with diatoms, and the sand is brown-hued from their presence. These may be gathered in bottles with as little sand as possible and shaken well in water. The sand settles and the water with the diatoms may be poured off, and after the water has settled the supernatant water may be decanted. In this way often a large amount of very clean material may be collected. Pure gatherings of quite distinct species may be found very close together. The article then mentions several places conveniently accessible from New York, and a list of the diatoms from Shark River, 30 genera and 84 species, completes the article.

A new journal.—*The American Journal of Biology*, edited by H. D. Valin, M. D., is announced for publication in Chicago.

Women members of the Royal Astronomical Society.—The name of Miss Pogson, daughter of N. R. Pogson, director of the Madras observatory, was proposed for membership on January 14th. The president said that though the admission of women to membership was not contemplated when the Society was founded, it was doubtful if they could be legally excluded if proposed, except by ballot, one black ball in four excluding. The ballot is to be taken in March.

Measurements of skulls of the seventh century.—C. F. Dight, M. D., Professor at the Medical College in Beirut, Syria, during a recent visit in Jerusalem, had an opportunity to examine and make measurements of a large and rare collection of human skulls, believed to be of early Christians who were massacred in 614 by the Persians. They were, in all probability, Caucassian skulls.

The results of the measurements and of the comparison with other Caucassian skulls are believed to demonstrate:—

1. That the Caucassian skull has, during the past 13 or 14 centuries, increased in horizontal circumference 1.72 inches, to a less extent in height, and not at all in width, and has gained a cranial capacity of 3.7 cubic inches.

2. That, since there is no gain in width, the increased capacity must have been gained by increase in height and length, which corresponds with increase in size of the

upper and anterior part of the brain. This is the part which, on *a priori* grounds, we should expect to increase most by education and civilization, since it is those parts of the brain that especially perform the moral and intellectual functions.

3. The lower parts of the brain, being the parts which preside over selfish propensities, give no increased breadth to the head, being called into play comparatively less and less with the advance of education and civilization.

The skulls were all those of adults, and probably all males. Among them were, of course, many abnormalities. The number in the collection was estimated at 10,000.

Rudiments *vs.* vestiges.—Prof. J. A. Ryder, formerly of the U. S. Fish Commission, now recently in the faculty of the University of Pennsylvania, suggests the restriction of the term 'rudiments' to structures which are appearing, and the employment of the word 'vestiges' for structures which are disappearing.

Only the pain of hunger fatal.—Henry Howard explains, in an article on 'Fasters and Fasting,' in the March *Cosmopolitan*, that it is not hunger itself, but the *pain* of hunger, that kills starving people.

What is hunger? It is not the result of a local condition, but a sensation that is only an expression of the general state of the organism, since it may be satisfied without introducing food into the stomach, as is proved by the injection of nutritive substances into the veins; and Schiff has demonstrated the same fact as regards thirst. On the other hand, a very small quantity of food introduced into the stomach of a person succumbing to starvation, and still susceptible of the pangs of hunger, will cause these pangs to cease immediately, even before any absorption has had time to take place; and, consequently, before there has been any possibility of assimilation. This proves, furthermore, that hunger is a reflex sensation of which the stomach is the point of departure.

It is the *pain* of hunger that kills quickly, and not hunger itself. It is certain that a man in good physical health may live a long time without eating or drinking, if he does not suffer too much from the pangs of hunger. The history of the miners of Bois-Mouzil, as related by Soviche, is a proof of this. Eight miners were shut up in a coal-mine one hundred and thirty-six hours. The first day they divided among them a half-pound of bread and two glasses of wine, which one of them had brought with him. That was all the food they partook of during their imprisonment. It would generally be believed that these eight unlucky miners must have felt the torments of hunger in their most frightful form at the moment when the drill penetrated the gallery of the mine; but, according to their assertion, this long abstinence had occasioned them little inconvenience.

Speed of the toboggan.—It has been reported to President Bowditch, of the Ridgefield Athletic Club of Albany, that the toboggans on the club chute have been timed at the point of greatest speed, which is when they leave the chute and strike the ground, and found to attain a velocity of ninety-three miles an hour. The timing calculations were carefully made, and repeated again and again by a civil engineer. If they are not fallacious, the toboggan is the fastest of vehicles, and outstrips even the ice-boat.—*From the March Swiss Cross.*

CORRESPONDENCE.

To the Editor:—I noted with surprise in the January number of the *Journal* Prof. Hitchcock's mention of never having met with Bacillaria paradoxa in America. And I am glad that Mr. Wm. A. Terry has recorded his experience in collecting by a note to the *Journal*. Anything from the pens of experienced collectors—such is, as yet, the poverty of our microscopical literature as to collecting—has much value. And in this connection I would especially commend to all collectors, and particularly to that still larger class who would collect, *if they only knew how*, Prof. Kain's article in the February number of the '*Torrey Bulletin*.'

We have found Bacillaria paradoxa in great abundance and vigor, almost ceaseless in its activity while the material remained fresh, by simply scraping the spiles between tides near the R.R. depot at New Haven. Two deductions from our personal experi-

ences in collecting diatoms are these :—there is no time for collecting diatoms like that when they are to be found, and, like the old lady in 'The Hoosier Schoolmaster,' 'when you're getting, get enough.'

LONGMEADOW, Mass. M. A. BOOTH.

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To THE EDITOR :—Will you kindly inform me where, or how, I can obtain *No. 4* of Vol. I of *The American Month. Micr. Journal?* and oblige—

Yours truly, C. O. WHITMAN.

443 MARSHALL ST., Milwaukee, Wisconsin.

[If any one can respond to this request we shall be glad to hear from him.—ED.]

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.

The San Francisco Microscopical Society held its regular fortnightly meeting Wednesday evening, January 26, Dr. S. M. Mouser occupying the chair.

D. W. Parkhurst, of this city, was elected a resident member.

Dr. Stallard reported from the committee to which was referred the investigation of the alleged finding of *Bacillus tuberculosis* in milk supplied by dairies of this city. He stated that several conferences had been held by the individual members of the committee with the microscopist of the Board of Health, but owing to the amount of work and time necessary for the full investigation of the subject, a complete report could not be presented. He was of the opinion that the method of Ehrlich, used in the preparation of the slides of milk submitted to the committee, would have to be modified, as while it was perfectly successful when applied to slides of sputum, its results were not so satisfactory for determining *Bacilli* in milk, owing probably to the fact that the oily matter in the latter interfered with the proper color reaction of the contained organisms. In this view the other members of the committee emphatically concurred.

With reference to the actual finding of tubercle-bacilli in the slides submitted to the committee, the experience of the individual members was somewhat different. Dr. Mouser stated that after a patient search of some two hours, using a Zeiss oil-immersion $\frac{1}{18}$-inch objective, he did not come across any undoubted specimens of the sought-for bacillus. Dr. Stallard, who used a Powell and Lealand $\frac{1}{12}$-inch objective (homogeneous immersion), had about the same experience. The third member of the committee, Dr. Henry Ferrer, after a protracted search with his Zeiss objectives, succeeded in finding two undoubted specimens of *Bacillus tuberculosis*. A more extended report will be filed by the committee at a subsequent meeting.

As the subject is one of great importance, Dr. Ferrer gave an interesting *résumé* of the late researches of Dr. Bang on "Udder-tuberculosis and Tuberculous milk." During the winter of 1884 this observer examined some thirteen cows affected with udder-tuberculosis in the various dairies and slaughter-houses in Copenhagen. The characteristics of the disease were minutely described, so as to be of service in diagnosis. Although the udders of the infected animals soon became greatly swollen, yet the milk continues for a while to *appear* perfectly normal. This is a fact of great importance, for during this stage the milk is liable to be still used as nourishment and can thus be the cause of infection in man. Bang found that the milk of tuberculous cows contain *Bacilli* often in very large numbers and usually bearing spores. In the course of his experiments he fed three rabbits and five guinea-pigs with such milk, and all soon died from tuberculosis. Analysis of tuberculous milk showed that in the course of the disease the amount of albuminous compounds increased, while the fat and sugar of milk diminished.

Mr. Howard exhibited a slide of *Enteromorpha intestinalis* (an alga growing both in salt and fresh water), with several specimens of attached marine *Vorticellæ*, both social and solitary forms.

The State Mining Bureau asked for a report on a sample of diatomaceous earth found on the beach near Santa Monica, and said to be nearly, if not quite, equal to the celebrated fragment found near the same locality some years ago. The specimen was referred to Mr. Norris and Mr. Howard for examination.

A. H. BRECKENFELD, *Rec. Secr.*

San Francisco, Cal.

The fifteenth annual meeting of the San Francisco Microscopical Society was held at its rooms, No. 120 Sutter street, Feb. 9, 1887, the president, Dr. Mouser, in the chair.

Mounted slides were presented by Mr. Howard and Mr. Breckenfeld, showing the general character of the diatomaceous deposits, samples of which had been received from the State Mining Bureau at the preceding meeting with a request for a report. The slides showed diatoms of the following genera: *Asterolampra*, *Coscinodiscus*, *Actinocyclus*, *Naviculæ*, *Arachnoidiscus*, *Grammatophora*, and *Triceratium*, together with some *Polycistina*, and many sponge spiculæ. Although a marine deposit, and containing many of the forms of the celebrated original Santa Monica fragment, the new find did not equal the original in many respects, especially as regards the diversity of contained organisms. In the original, more than one hundred perfectly distinct species have been determined. Many interesting facts were related regarding this unique fragment, which did not weigh over two pounds, and was found on the beach near Santa Monica, in March, 1876. Many attempts have been made to discover the deposit from which this 'ocean waif' must have become detached, but its location still remains a mystery.

The retiring president, Dr. S. M. Mouser, read an address in which he referred to the increase in membership of the society during the past year, and said 'from every quarter we hear of renewed interest in microscopical matters, and find our own society keeping pace with the times.' He referred to the visits of many distinguished microscopists during the year. 'In our earlier days,' he said, 'the microscope was, in our hands, more of a toy with which to pass a few pleasant hours than an instrument of real value in all matters requiring minute examination in scientific investigation, but now it has become an absolute necessity in not only the hands of professional men, but to those who pursue almost all branches of industry. Any attempt to enumerate the purposes to which it is now of every-day application would consume too much of your time, and only tell you what you already know. It is gratifying that you have early recognized its value, and not allowed yourselves to relapse into indifference or neglect, but have been constantly on the alert for new fields of labor in which its application will aid you.'

Meetings were reported to have been well attended, very enjoyable and beneficial, and have contributed to the advancement of microscopy generally. More than the usual number of matters of importance came before the society, and every member manifested deep interest in the proceedings.

'A number of valuable papers have been read and illustrated in a manner that would do credit to any society. So much has been done that it would hardly be possible to enter into detail, though I cannot refrain from mentioning a most exhaustive paper by one of our members, which graced the first pages of the *American Monthly Microscopical Journal* for December, 1886, and I have no doubt will afford great pleasure to all who are interested in the subject. In mentioning this I do not mean to disparage the splendid work done by many other members, a detailed account of which would be too long for the present occasion.'

The annual exhibition was greatly enjoyed, and probably excelled in all of its appointments any previous effort of the society. The annual receptions are much appreciated by guests. Valuable donations were received during the year, notably among them the splendid collection of diatoms from Wm. Norris, who had, with great pains, been years in accumulating them.

The retiring president had no suggestion to make as to the future, 'other than that you pursue the course you have already adopted, of patient and industrial labor, each member laying out for himself the work best suited to his taste, or the facilities at his command. By this co-operation we bring into the common store an amount of knowledge that could not be acquired by any one working single-handed.'

In conclusion, he thanked the members of the society for uniform courtesy and kindness.

The reports of the secretary and treasurer were read, showing a gratifying condition of affairs, financially, and in every other respect.

On motion, a vote of thanks to the retiring officers was passed, and the president's report was ordered spread on the minutes.

The balloting for officers to serve during the ensuing year resulted as follows: President, E. J. Wickson; Vice-President, Dr. Henry Ferrer; Recording Secretary, A. H. Breckenfeld (re-elected); Corresponding Secretary, Dr. C. P. Bates; Treasurer, F. L. Howard.

A. H. Breckenfeld, *Rec. Secr.*

San Francisco, Cal.

At the regular semi-monthly meeting, held on Feb. 23, 1887, the retiring president, Dr. Mouser, presented his successor, E. J. Wickson, who thanked the society for the honor conferred on him in brief but fitting terms.

Professor Ashburner exhibited a slide which had been mounted by J. Kinker, of Amsterdam, from a specimen of the diatomaceous earth found by Mrs. A. E. Bush, of San José, in 1880, among some tidal refuse in Santa Monica Bay. The specimen shown in the slide contained two hundred and thirteen arranged diatoms.

The original 'Santa Monica' find has become notable in the history of microscopy as the largest ever discovered on this continent, and Professor Ashburner sent samples of it to many of the leading microscopists of the world. M. Bourgoyne, of Paris, the famous mounter of microscopical objects, so highly appreciated the liberal share sent to him that he forwarded to Professor Ashburner a beautiful mounted slide containing a specimen of the earth, in which were two hundred and fifteen arranged diatoms. Where the original deposit is to be found is so far unknown, the Santa Monica specimen being only a fragment. There are one hundred distinct species to be distinguished in the Santa Monica sample.

The value of the diatomaceous earth arises from its adaptability for use in the transportation and manufacture of nitro-glycerin and other explosives, of which it forms the absorbent. The diatomaceous earth known as *Kieselguhr*, which is universally employed for that purpose, is lighter and richer in diatomaceous forms than the Santa Monica sample. No earth has been found in California, so far, well adapted to this purpose.

Secretary Breckenfeld exhibited a slide by Dougherty, of Manchester, England, containing a section of the intestine of a rabbit, which had been slit longitudinally and the blood-vessels injected with carmine, showing the villi and the capillaries of each villus with great minuteness and beauty. A remarkable feature in the preparation was the perfect success with which the fine network of capillary vessels was injected with the carmine.

The president said an interesting subject for microscopical investigation by the members would be the reason why pop-corn pops, while other kinds do not. Chemists claim that it is on account of the greater quantity of oil contained in the pop-corn becoming volatilized by the heat, and he would like to have the matter looked into from the microscopical point of view.

A specimen of the *kieselguhr* was exhibited by Professor Ashburner, and found very rich in diatoms.

A. H. Breckenfeld, *Rec. Secr.*

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Brooklyn, N. Y.

A meeting of Brooklyn physicians interested in microscopy was held at the house of Dr. Herbert Fearn, 196 Clermont ave., Brooklyn, on Wednesday evening, Feb. 16th, 1887, whereat a society, to be known as the Medical Microscopical Society of the City of Brooklyn, was organized, the specific object of which will be the consideration of medical microscopy. Hereafter a regular meeting will be held on the first Wednesday evening of each month.

The following officers were elected:—William A. Bates, M. D., president; Arnold Stub, M. D., vice-president; Frank M. Hoyt, M. D., secretary; Henry D. Bliss, M. D., corresponding secretary; Albert Brinkman, M. D., treasurer.

Frank M. Hoyt, *Secr.*

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Essex County, N. J.

This society held its regular meeting at the residence of Dr. J. W. Pinkham, at Montclair, N. J. The subject for the evening was 'Cancer.' Dr. Pinkham stated that cancer was a proliferation of the normal cells, which assume different shapes and forms, and exhibit an abnormal tendency. He reviewed the different kinds of cancer, and, among other remarks, stated that Fribroma is not generally accepted as a malignant tumor, but it is a question if it may not become so when neglected.

Dr. Allen took exception to Dr. P.'s statement that there is no typical cancer cell, and said that the expressed 'juice' of a cancer showed a multitude of forms which when once seen could never be mistaken for anything else. A large number of typical cancerous growths were shown under a number of microscopes. Meeting adjourned till March 3d, at Dr. Berry's, Montclair. Subject: 'Development of teeth,' with original paper by Dr. Geo. S. Allen.

Jay L. Smith, *Secr.*

NOTICES OF BOOKS.

Modern Petrography :—An Account of the Application of the Microscope to the Study of Geology. By G. H. Williams. D. C. Heath & Co., Boston, 1886. (pp. 35). Paper covers.

This little work, as its title suggests, is not a manual of the science, or, in any sense, a guide to be used in work, but it is rather an essay addressed to teachers more scientific than a popular magazine article can be, and not too profound for those of our teachers who are not most deeply learned in the science. The purpose of the book is to sketch the science of Petrography in such a way as to present a clear view of it. It is the study of rock-sections, or, more exactly, it aims to show the principle of interpretation of rock-sections for geological purposes. In doing this, it follows, in historical summary, the growth of the science as a special branch of geological study from 1862, when Zirkel first began, in Vienna, to study rock-sections, and active study was commenced in various places, and the detection of the minerals constituting a rock, by microscopical character, became a science and an important division of lithology.

At first *petrography* was only of assistance to mineralogy as furnishing additional diagnostic tests of mineral species. But 'as time goes on petrography will not yield her best services to the mineralogist, but to the geologist, by placing at his disposal a new and potent means for successfully dealing with many of the problems presented in the earth's crust.'

For historical geology it is for unfossilferous rocks what palæontology is for fossiliferous, or is rapidly becoming so understood as to be so used. The economic application of the microscope in geology is seen in the study of building-stones, whereby their durability can be predicted with far increased reliability.

In addition to the excellent historical sketch and the statement of what petrography is to-day and will be, there is a bibliography and four pages upon (1) the method of preparing rock-sections, (2) note upon Petrographical Microscope, (3) names of *preparateurs* from whom slides may be purchased.

The book is a thoroughly satisfactory little book, admirably presenting the subject. It is one of a series of *Monographs on Education*, published by D. C. Heath; others published are on Latin in Preparatory Course, Mathematical Teaching and its Modern Methods, and How to Teach Reading, and what to Read in the Schools, and others are promised.

The Journal of the Royal Microscopical Society, February number, has just reached us, and we find that it contains a very admirable paper, by Prof. Abbe, upon the new optical glass, a full account of which we shall hope to present at some future time. The same number contains an article by Dr. A. C. Stokes upon the Infusoria, with a beautifully executed plate, and in addition the usual summaries of current researches in biological science.

An Elementary Course in Practical Zoölogy. By B. P. Colton. D. C. Heath & Co., Boston, 1886. (pp. 185).

In this work its author has succeeded well in filling a gap in the series of American science text-books by preparing for high-school classes a book which is a great step in advance of anything hitherto in the field. It would be more proper to call the work a natural history of animals, perhaps, than a zoölogical work; but laying aside any bickering over the name, the thing itself is a good one. The work is a practical guide of the sort so much in vogue at the present time, and following the original suggestion of Huxley & Martin's 'Biology,' directing the young pupil's steps in observations upon the coarser anatomy of a great variety of animals. Among those treated may be mentioned the grasshopper, cricket, bumble-bee (which is properly called humble-bee), butterfly, house-fly, squash-bug, spider, crayfish, cyclops, earthworm, fresh-water mussel, snail, amœba-fish, frog, snake, turtle, pigeon, rabbit, starfish, Hydra, and sponge. In all thirty-two forms are treated, and the pupil works them through, and can study out for himself, without greater skill than a young boy or girl should possess, all the features which are pointed out. It is the purpose of the work to set tasks for the elementary student, the performance of which is within his power. It is a good thing to set young pupils at work upon these anatomical studies, which will require close and discriminative observation. Unlike many elementary works and some manuals, the work is very free from misstatements of fact, the author having had the benefit of thoroughly testing his descriptions and their thorough revision by several able zoölo-

gists. We believe that in its sphere the work is calculated to do what should be done for younger students, to open their eyes to facts, and teach them how to see and to see closely. Since the work is likely to come into use in colleges, we feel compelled to call attention to one serious limitation of its value for this purpose. It is not full enough, and stops usually when it reaches the hard places. Thus in the description of the crayfish, the dissection of the ear and the fine dissection of the nervous system are omitted, also the entire omission of the green gland and of all direction for histological study may be noted. These omissions, arising out of consideration for the early and untrained powers of a too young pupil, are the ones best calculated to train and help the college student as well as to teach him zoölogy. The arrangement of the creatures studied is peculiar, and we hardly see upon what ground it is based, for it is apparently entirely hap-hazard. First come the arthropoda, then the molusca, in somewhat orderly fashion; following them protozoa, then vertebrates, then echinoderms, cœlenterates, and finally sponges. The work attempts but slightly to inculcate principles of classification, and herein it is right; but we think that little would be lost and much gained by taking the subjects in an order which is a somewhat nearer approach to the recognized systematic arrangement. We must say one brief word by way of commendation to the genius who thought of placing the table of contents on the inside front-cover, and the index on the inside back-cover. This scheme makes these tables of the utmost accessibility, and, so far as we know, is an entirely novel plan.

We desire to acknowledge, with thanks, the receipt of the following articles from the authors:—

1. *The Naturalist Gleaner, a Teacher's Journal of Elementary Zoology, etc.* By W. E. Taylor, College Springs, Iowa. 2. *Rhinology in the Past and of the Future.* By C. H. Von Klein, M. D., Dayton, Ohio. 3. *Report on Diseases of the Rectum.* By J. M. Mathews, M. D., Louisville, Ky. 4. *President's Address, 10th Annual Meeting, Detroit Medical and Library Association.* Detroit, Michigan. 5. *Sterility and Management of the Secundines.* By W. N. Wathen, M. D., Louisville, Ky. 6. *The Source of the Mississippi.* From Science, Dec. 24, '86. Ivison, Blakeman, Taylor & Co. 7. *Uric Acid: its Medical Relations and Quantitative Determination.* By T. Wesley Mills, M. D., Montreal. 8. *Heart of the Fish Compared with that of Menobranchus.* By T. W. Mills, M. D., Montreal. 9. *Rythm and Innervation of the Heart of the Sea-Turtle.* By T. W. Mills, M. D., Montreal. 10. *Follicular Amygdalitis.* By A Jacobi, M. D., New York. 11. *Record of Experiments in Manufacture of Sugar from Sorgum and Sugar-Canes.* By H. W. Wiley, Washington, D. C. 12. *Researches into the Etiology of Dengue.* By J. W. McLaughlin, M. D., Austin, Tex. 13. *Contribution to the Embryology of the Prosobranchs.* By J. P. McMurrich, Ph. D., Haverford, Penn.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology. HENRY L. OSBORN, Lafayette, Ind.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired. M. A. BOOTH, Longmeadow, Mass.

Wanted, exchange of slides, and correspondence on unusual urinary products.
J. M. ADAMS, Watertown. N. Y.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one. K. M. CUNNINGHAM,
Land Office M. & O. R.R. Co., Mobile, Ala.

Pathological and Histological Slides (very fine) in exchange for other good slides.
F. M. HOYT, 160 Washington Park, Brooklyn, N. Y.

Publisher's Notices.—All communications, exchanges, etc., should be addressed to Henry Leslie Osborn, Lafayette, Indiana, Purdue University.

Subscriptions, and all matters of business, should be addressed to the Business Manager, P. O. Box 630, Washington, D. C. The address of Mr. R. Hitchcock is Osaka, Japan.

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The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the following prices which are net:—Vol. II (1881) complete, $1.50; Vol. III (1882), $2.50; Vol. IV (1883) complete, $1.50; Vol. V (1884) complete, $1.50; Vol. V (1884), Nos. 2–12, $1.00; Vol. VI (1885), $1.50; Vol. VII (1886), $1.00.

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Spengel's olfactory organ, or osphradium in crepidula.

BY HENRY LESLIE OSBORN.*

In the various writings upon the anatomy of the gastropoda, prior to 1880, there will be found references to an organ which is variously called the 'rudimentary gill,' 'accessory gill,' etc. It is figured in very many of the drawings of the anatomy of prosobranchs, and in general has somewhat the appearance of the gill, but is smaller and lies parallel to the gill and upon its left. A number of conjectures respecting its physiology are to be found. Williams, in his article upon the Mechanism of Respiration,† conjectures that it is of use as a color gland. Kieferstein, in the article, Mollusca of Bronn's Klassen und Ordnungen, teaches that it is the aborted gill of the left side of the body, and that conjecture, which is a very obvious one, on superficial examination, was the general view as to the use of this problematical structure, and is indicated in the use of the term 'rudimentary gill' by Claus in his Zoology (vol. 2, p. 48). This idea was based upon a merely superficial view of the relations of the parts, and led to a conclusion as to the homology of the organ, which was erroneous, viz :—that it was the gill of the left side crowded out and aborted by the translocation of the functional gill from the right side. That the functional gill of Ctenobranchs is the one of the right side, though actually found on the left side, is hardly doubtful at present in view of our knowledge of the twist in the visceral nerves of the group ; but that the so-called rudimentary gill is not a gill at all has been well shown by Spengel.‡

The structure of this organ has never been very thoroughly elucidated ; indeed there is nothing published which gives a complete description of its fine structure in any species. Spengel, in the paper already alluded to, treats of the nervous system and its relation to the area in question, but does not treat of the histological structure of the organ itself. It is seen in its most typical form in Strombus and Buccinum. Here it is seen as a median rod, carrying transveral flaps. It runs parallel with the gill upon its left, but is shorter and roughly resembles that organ in shape. Sections across the organ show that the central longitudinal axis contains a nerve-trunk, from which fibres are distributed to the transverse leaves, the final destination of which fibres has never been determined except conjecturally. They appear, however, to terminate in cells upon the surface of the flap or leaf as their active end-cells.

Spengel in his paper shows that close to the gill, or gills, there exists an area of modified epithelium, and in close relation with this a nerve which in every case he finds to be derived from the supra-intestinal ganglion. He finds

* Read before the Indiana Academy of Sciences Dec. 20, 1886.
† Ann. and Mag. Nat. Hist., 1854.
‡ Geruchsorgan der Mollusken.—Zeitschr. f. w. Zool., 35, p. 333.

this latter condition present even where there is no proper differentiated organ. Spengel further regarded this organ as a special sense organ, used to determine the quality of the water furnished the gill; and further, he consider it an organ of smell as implied by the term, *Die geruchsorgan*, which he applies to it. His view of it is the one taught by Prof. E. Ray Lankester in his article on the mollusks, in the ninth edition of the Encyclopædia Britannica, and he further applies to it the name Osphradium. Just why the organ is believed to serve for smell rather than taste is not made very apparent. The latter would seem to be a better name for its function since it is bathed in liquid.

In looking through the descriptive accounts of the genus Crepidula, with reference more particularly to the anatomy of the gill, it was noticed that no reference was made, and no figure drawn, which represented anything which could be considered at all homologous with the osphradium of forms like Buccinum, etc. In the earlier writings of Cuvier, Quoi, Gaimard, and others who have given fine figures, as well as in various later writers, as Bronn and others, no reference can be found to a structure comparable with the 'accessory gill' of other Ctenobranchs. There is, however, in this creature, or certainly in *C. fornicata*, a structure which is plainly the osphradium, though very unlike the typical form as described above.

The anatomy of the gill in *Crepidula fornicata* was described in a former paper,* and may be summarized as follows:—The body is distorted from the form common among the Ctenobranchs, and is very considerably flattened; the gill cavity is very low and broad, the mantle forming the broad roof of the chamber. The cavity is triangular in outline, with the apex pointing posteriorly, and with a base curved outward obtusely. Along the left side of the triangular roof of the chamber, from a point near the middle of the base to near the apex, there runs a low ridge—the branchial ridge. This ridge lies so far over to the left as to leave only a very small space between it and body-wall, where the mantle fold arises. The gills are blade shaped, long, narrow filaments, which originate at one end upon the branchial ridge, and run out across the mantle cavity, but free from the mantle and from each other, to terminate upon the right side. The osphradium, if present, must be sought upon the left of the gill ridge.

In this situation, examination reveals the presence of a structure not hitherto described, but which is, no doubt, the osphradium or 'olfactory organ' of *Crepidula fornicata*. To the naked eye it is a row of small knobs, distinctly perceptible when the attention is called to them, and readily seen under a low magnification. It stands upon the left side of the gill ridge in a sort of groove made there by the ridge. It is parallel with the branchial ridge, but much shorter than it, being confined entirely to the anterior part of the mantle cavity, chiefly to the basal portion of the triangular roof.

This organ, the osphradium, is not, at first sight, much like the osphradium typical of the Ctenobranchs. It bears no resemblance, whatever, to a gill, and would not be likely to receive the name of rudimentary gill from its appearance solely. It consists of a central axis, which is a low ridge not forming any conspicuous portion of the organ until study is made by sections. Upon the central axis is carried a series of papillæ, each one independent of the rest, and arising from the central axis. The papillæ represent the leaves of the ordinary form of osphradium, while the central axis is the same structure in each. The papillæ are of variable number, but about 180–220, and are situated a trifle farther apart than the gill blades; have no direct relation in their arrangement to that of the gill blades. Each papilla consists of two portions—a narrow, short stalk, and a longer, much enlarged oval tip, the

* Studies Bio. Lab. Johns Hopk. Univ., vol. iii.

whole structure having somewhat the appearance of a short club. They are whitish in color, and each bears on the side turned toward the gill a large black pigment spot.

Examination by means of sections shows plainly the central axis in which may be seen the cross section of the olfactory nerve lying beneath the outer layer and surrounded by the mesoderm. In this respect it is like the structure of the osphradium of *Fulgur carica*.* This trunk is seen to be made up of a central portion consisting wholly of fibres which run longitudinally,

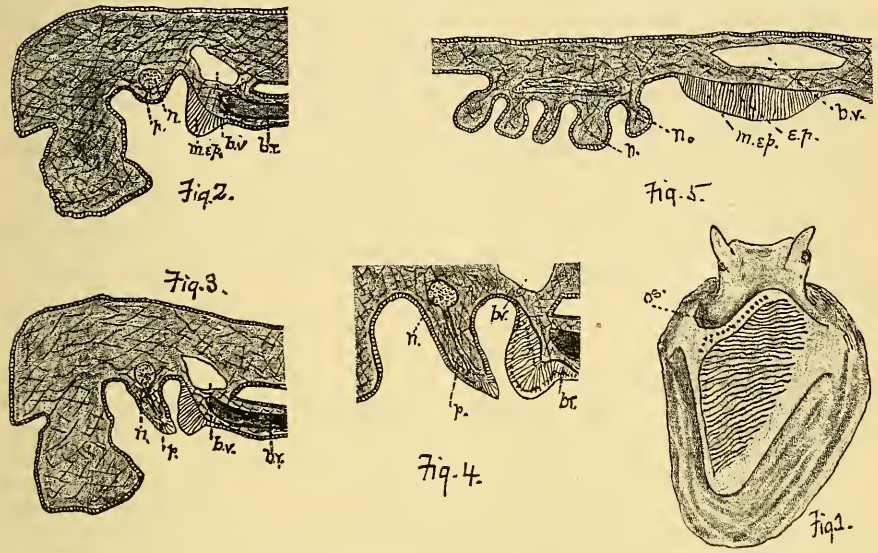

PLATE 2.—Osphradium of Crepidula.

br. Gill supporting rod; bv. Branchial vein; ep. Epithelium of the general surface; m. ep. The modified epithelium at the back of the gill ridge; n. The osphradial nerve; p. The osphradial papilla.

Fig. 1.—View of dorsal aspect of *Crepidula fornicata*, the mantle cavity diagrammatic, to show position of gill and osphradium.

Fig. 2.—Section across the mantle roof between two papillæ.

Fig. 3.—Section across the mantle roof passing through one papilla.

Fig. 4.—Section of one papilla.

Fig. 5.—Oblique section across the roof, showing parts of several papillæ and the area of modified epithelium.

invested peripherally by a mass of ganglion cells, whose nuclei are usually plainly seen when stained by the action of borax carmine. The whole is bound in by an extremely delicate layer of conn. tissue—its proper sheath. At each papilla a branch is sent off from the main trunk; this runs up into the papilla through the centre of the peduncle, and appears to spread out and become lost in the expanded terminal portion. The papilla consists of a core mesoderm and the nerve branch covered in with a layer of ectoderm. The ectoderm cells upon the peduncle and lower portion of the tip are shut off from the mesoderm by a well-defined basement membrane, and are columnar non-ciliated cells. Those upon the side toward the gill further contain masses of black pigment. This pigment is so much like that found variously scattered through the mantle that it is not probable that its presence is connected with the operation of the papilla as a sense organ. Upon the outer end of the papilla the cells are very tall and their outlines very ill-defined. The basement membrane, which is very evident over the sides of the papilla and over the mantle generally, becomes undistinguishable at this point,

* See Studies from Biol. Lab. J. H. U., vol. iii.

which I interpret as meaning that the basal end of the cells here are very irregular. Very likely many of them are continuous with fibres from the olfactory nerve, though this is merely conjectural. The sections show further an appearance in many cells, which, if my material had been perfectly preserved, I should unhesitatingly interpret as due to the presence of cilia, and I have but little doubt that the cells at the tips of the papillæ are many of them ciliated cells.

The precise shape of the cells from the papillæ and their connection with the fibres, if they have one, as seems probable, could be shown upon teased preparations. I had hoped to be able to investigate the matter in that way before this time, but have been unable to do so.

I wish, in this connection, to make mention of a tract of very peculiar epithelium encountered in studying the gills of Crepidula, and further, in studying the osphradium, though I do not feel prepared to assert that it is sensory in function. It is situated upon the branchial ridge upon the part turned toward the groove which lodges the osphradium, and is composed of tall granular cells. These, in cross-sections, look like a sort of cup or pocket, but longitudinally they are seen to be a long row or ridge which runs along the back of the gill-ridge throughout its entire extent. They are entirely unlike any cells seen anywhere else in the ectoderm, and are possibly glandular in their function.

PURDUE UNIVERSITY, *Dec.* 21, 1886.

A key to the Rotifera.*

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The following key is intended to facilitate the use of Hudson and Gosse's monograph on the Rotifera, and includes only the genera and species described in that work. In the analytical table of genera, the numbers appended to each name direct to that genus in this list, where a synopsis of the species will be found.

GENERA.

¶ Permanently adherent, not in social colonies, but sometimes in family groups (§).
¶ Permanently adherent in social clusters (§§).
¶ Free-swimming in clusters; tubes cohering, gelatinous, *Conochilus*, 12.
¶ Free-swimming, solitary (§§§).
§ Corona subcircular or broadly oval (*).
§ Corona cup-like or produced into lobes (**).
§§ Clusters fixed; tubes cohering, gelatinous, corona cordate. *Lacinularia*, 9.
§§ Clusters fixed, without tubes; corona reniform . *Megalotrocha*, 10.
§§§ Free-swimming and skipping by 6 limbs . . . . . *Pedalion*, 65.
§§§ Free-swimming only; cilia equatorial; body spherical, *Trochosphæra*, 11.
§§§ Free-swimming or floating; corona a membranous cup; foot none, *Apsilus*, 3.
§§§ Free-swimming, but in gelatinous tube; lobes 2, setigerous, *Floscularia*, 1.
§§§ Free-swimming and creeping like a leech; foot wholly telescopic (¶¶).
§§§ Free-swimming and sometimes creeping by the toes (*c*).

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* From the Journal of the Trenton Natural History Society, January, 1887.

* With 2 hooks enclosing the dorsal antennæ . . *Cephalosiphon*, 7.
* Without dorsal hooks; in a tube or not . . . . . *Œcistes*, 8.
** Lobes 2, not setigerous; tube membranous . . . . *Limnias*, 6.
** Lobes 2–7, short, setigerous; setæ long, radiating . *Floscularia*, 1.
** Lobes 4, not setigerous; inhabiting a tube . . . . . *Melicerta*, 5.
** Lobes 5, long, slender, erect, convergent . . . *Stephanoceros*, 4.
** Lobe single, frontal, arched; setæ none; foot truncate . *Acyclus*, 2.
¶¶ Corona 2, circular, transverse lobes (*a*).
¶¶ Corona a flat, ventral, ciliated surface (*b*).
a. Eyes 2, cervical . . . . . *Philodina*, 13.
a. Eyes 2, within the frontal column . . . . . *Rotifer*, 14.
a. Eyes 2, frontal; body excessively long and slender . *Actinurus*, 15.
a. Eyes absent; body slender, pointed, corrugated . . *Callidina*, 16.
b. Eyes absent; body longitudinally corrugated . . . . *Adineta*, 17.
c. Il-loricate; foot, when present, not transversely wrinkled (*d*).
c. Loricate wholly or partially; foot various (*r*).
d. Body with skipping appendages (*e*).
d. Body without skipping appendages (*f*).
e. Spines in clusters on the shoulders . . . . . *Polyarthra*, 22.
e. Spines single, 2 lateral, 1 ventral . . . . . *Triarthra*, 24.
e. Spines (styles) 2, on the breast. . . . . *Pedetes*, 25.
f. Corona with styligerous prominences (*g*.)
f. Corona without styligerous prominences (*i*).
g. Front with 2 ciliated auricles; mastax large, pyriform, *Synchæta*, 21.
g. Front without ciliated auricles; corona truncate (*h*).
h. Corona with a dorsal proboscis; eyes 2, on the proboscis, *Rhinops*, 27.
h. Corona without proboscis; body conical; eyes none . *Hydatina*, 26.
h. Corona without proboscis; body not conical; foot retractile; eye 1, *Notops*, 28.
i. Corona oblique, transverse, flat, circular; foot stylate, *Microcodon*, 18.
i. Corona oblique, transverse; foot furcate (*k*).
i. Corona subconical, with 2 apices . . . . . *Asplanchna*, 19.
i. Corona subconical, with 1 apex . . . . . *Sacculus*, 20.
k. Body vermiform, lengthened, foot small, toe 1. Endoparasitic, *Albertia*, 29.
k. Body more or less cylindrical (*l*).
l. Annulose; toes 2; cilia very limited or none . . *Taphrocampa*, 30.
l. Not annulose; often soft and versatile (*m*).
m. With sense-organs in the lumbar region . . . . . *Copeus*, 33.
m. Without sense organs in the lumbar region (*n*).
n. Foot with telescopic joints; eyes 3 . . . . . *Eosphora*, 36.
n. Foot without telescopic joints (*o*).
o. Brain conspicuous, usually opaque; eyes present . *Notommata*, 32.
o. Brain conspicuous, eyes absent; mallei 1-toothed, *Pleurotrocha*, 31.
o. Brain conspicuous, 3-lobed; eye single; tail a minute tubercle, *Copeus*, 33.
o. Brain not especially conspicuous, clear (*p*).
p. Body with a tendency to lumbar enlargement (*q*).
p. Body without tendency to lumbar enlargement; ciliated face more or less prone . . . . . *Proales*, 34.
q. Proboscis fleshy . . . . . *Distemma*, 38.
q. Proboscis often hooked; toes usually long, sharp . . . *Diglena*, 37.
q. Proboscis not hooked; toes usually long, conspicuous, *Furcularia*, 35.
r. Foot wanting, lorica bottle-like, smooth . . . . . *Pompholyx*, 59.
r. Foot wanting; lorica beset with pinnate styles . . *Pterœssa*, 23.

r. Foot wanting; lorica with spines or elastic setæ (*s*).
r. Foot not transversely wrinkled, not wholly retractile (*t*).
r. Foot transversely wrinkled, and wholly retractile (*c c*).
s. Frontal edge always, the anal sometimes, spinous . . *Anuræa*, 62.
s. Frontal edge six-spined; often produced behind . . *Notholca*, 63.
s. Lorica without spines, but with long, rigid styles . . *Eretmia*, 64.
t. Lorica without an arched frontal plate (*u*).
t. Lorica with an arched frontal plate (*v*).
u. Lorica entire, open at each end, cylindric (*w*).
u. Lorica entire, hemispheric or three-sided . . . . *Cochleare*, 57.
u. Lorica entire, formed of 2 plates, a dorsal and a ventral (*y*).
u. Lorica entire on the back, front open, gaping behind . *Mytilia*, 56.
u. Lorica split down the back, each end open (*a a*).
v. Lorica pyriform, vasiform or cylindric, entire; frontal plate subcircular or hook-like (*b b*).
v. Lorica subspherical or pear-shaped; ventral aspect slit; frontal plate a hook . . . . . *Colurus*, 53.
v. Lorica compressed; toe single . . . . . *Monura*, 55.
v. Lorica depressed, entire; toes 2 . . . . . *Metopidia*, 54.
w. Body fusiform, or irregularly thick, not curved; toe single, with accessory basal stylets . . . . . *Mastigocerca*, 39.
w. Body cylindrical, curved (*x*).
x. Toes 2, symmetrical, side by side . . . . . *Rattulus*, 40.
x. Toes 2, hollow, unequal, triangular superposed plates . *Cœlopus*, 41.
y. Lorica plates dissimilar, forming 2 unequal body cavities, *Euchlanis*, 49.
y. Lorica with deep lateral longitudinal sinus covered by flexible membrane (*z*).
z. Lorica subcylindrical in outline; toes 2 . . . . . *Cathypna*, 50.
z. Lorica subcylindrical in outline; toe single . . . . *Monostyla*, 52.
z. Lorica a long ellipse, closed behind; toes 2. . . . . *Distyla*, 51.
aa. Lorica oblong; spinous; eye single . . . . . *Salpina*, 47.
aa. Lorica not spinous; eye wanting . . . . . *Diplax*, 46.
aa. Lorica dorsal only, ventral surface naked . . . . *Diaschiza*, 45.
aa. Lorica of 2 plates, ventral flat, dorsal arched . . . . *Diploïs*, 48.
bb. Lorica dense, shagreened, facetted, with projecting plates or dorsal spines, *Dinocharis*, 42.
bb. Lorica, thin, smooth, without spines or plates; frontal plate hook-like, *Scaridium*, 43.
bb. Lorica sometimes posteriorly spinous, smooth; frontal plate subcircular, *Stephanops*, 44.
cc. Foot ending in a ciliated cup (*dd*).
cc. Foot ending in 2 toes (*ee*).
dd. Lorica subcircular, entire, flattened . . . . . *Pterodina*, 58.
ee. Lorica without elevated ridges; toes very small . . *Brachionus*, 60.
ee. Lorica facetted and covered with points . . . . . *Noteus*, 61.

Species.

1. Floscularia.

a. Lobes none . . . . . *edentata*.
a. Lobes 2, short; setæ very short, not vibratile . . . . . *calva*.
a. Lobes 3, well-developed; setæ short but vibratile . . . *mutabilis*.
a. Lobes 3, the dorsal processes 2, large, flexible . . . . *Hoodii*.
a. Lobes 3, body $\frac{1}{18}$ to $\frac{1}{15}$ inch; coronal depressions deep, rounded, *trilobata*.
a. Lobes 3, body $\frac{1}{65}$ inch; corona symmetrically dotted . . . *algicola*.

a. Lobes 3, body $\frac{1}{30}$ to $\frac{1}{40}$ inch; corona not dotted . . . . *ambigua*.
a. Lobes 5, knobbed (*b*).
a. Lobes 5, not knobbed (*c*).
a. Lobes 7, knobbed . . . . . *regalis*.
b. Lobes linear; setæ not vibratile . . . . . *coronetta*.
b. Lobes linear; setæ very long, in constant motion . . . . . *mira*.
b. Lobes triangular; no dorsal process . . . . . *ornata*.
b. Lobes triangular; with a dorsal process . . . . . *cornuta*.
b. Lobes very short, knobs almost sessile . . . . . *cyclops*.
c. Lobes pointed; peduncle very long . . . . . *longicaudata*.
c. Lobes broad; peduncle short . . . . . *campanulata*.

2. Acyclus *inquietus*.
3. Apsilus.

a. Frontal margin crenate or wrinkled . . . . . *lentiformis*.
a. Frontal margin smooth . . . . . *bipera*.

4. Stephanoceros *Eichhornii*.
5. Melicerta.

a. Pellets subspherical; lobes wider than the tube . . . . *ringens*.
b. Pellets pointed, cylindric; lobes as wide as the tube . . . *conifera*.
c. Pellets ovoid, large; upper lobes deeply separated . . . . *Janus*.
d. Pellets none, tube gelatinous; lobes thrice the body width . *tubicolaria*.

6. Limnias.

a. Tube membranous, transversely ridged . . . . . *annulatus*.
a. Tube membranous, not rigid . . . . . *ceratophylli*.

7. Cephalosiphon.

a. Tube membranous, tapering to the base . . . . . *limnias*.
a. Tube gelatinous, irregular, semi-transparent . . . . . *candidus*.

[*To be continued.*]

Trichina spiralis.

By Dr. R. REYBURN,

of Washington, D. C.

No animal has, at any time, attracted so much attention as the little nematode worm which lives rolled up in muscle. Let us imagine an extremely slender pin, such as entomologists employ to fasten the smallest insects, rolled upon itself in a spiral form so as to lodge in a cavity hollowed out in the midst of the muscles, in a space not larger than a grain of millet, but large enough to be discerned by the naked eye.

Before entering upon a particular description, we may notice the circumstances which led to their attracting so much attention. It was in 1832 that a demonstrator of anatomy at Guy's Hospital, in London, Mr. J. Hilton, found in the flesh of a man sixty-six years of age, who died of a cancer, a great number of little white bodies. These he took for vesicular worms. The scalpel, during the dissection of the muscles, met with granulations which blunted its edge. Astonished at finding these hard bodies, he removed some of them

and examined them attentively; but, not being sufficiently acquainted with helminthology to understand their true nature, he referred them to Professor Richard Owen, the celebrated naturalist of the British Museum. Professor Owen recognized them as new nematode worms, and gave them the name *Trichina*, from their hair-like form; he added the specific name *spiralis* on account of the manner in which they were rolled up in their cyst, and *Trichina spiralis* stands as the scientific name of this animal.

The trichinæ, which are now known in the minutest details of their organization and manner of life, have a distinct mouth and a complete digestive tube with an orifice at each end of the body. Besides this nutritive apparatus, trichinæ, like nematodes in general, have the sexes separate, so that there are males and females, which can be easily distinguished from each other by the size and form of the body.

Trichinæ are found in the flesh of almost all the mammals. If we eat this trichinous flesh, the worms are set free in the stomach as digestion goes on, and develop with extreme rapidity. Each female lays a prodigious number of eggs; from each of these comes a microscopic worm, which bores through the walls of the stomach or the intestines, and thousands of trichinæ lodge themselves in the flesh, where they hide till they are again introduced into another stomach. When the number is great, their presence may cause disorders, or even death.

Leuckart's experiments on animals aroused the attention of physicians, and then it was found that patients who had shown exceptional symptoms had fallen victims to the invasion of these parasites. Leuckart estimated 700,000 trichinæ in a pound of human flesh, and Zenker speaks of even five millions found in a similar quantity of human flesh.

The *Trichina spiralis* produces about a hundred young worms at the end of a week (viviparous); and a pig which had swallowed a pound of flesh (5,000,000 trichinæ) might contain, after some days, 250 millions, reckoning that only half the worms hatched were females, which is not the case, for the females outnumber males. It appears that trichinæ can become sexually mature in all warm-blooded animals; but the number in which they can become encysted is not so great. It appears that they are not encysted in birds.

In the month of December, 1863, R. Leuckart wrote from Giessen:—'The trichinæ are playing a great part at present in Germany (with the exception of Schleswig-Holstein). Two epidemics have made their appearance within a few months, and have produced a veritable panic, so that no person will any longer eat pork. The authorities everywhere are obliged to subject the flesh of these animals to microscopic examination.'

We owe to Leuckart (1856 and 1857) and to Virchow (1858) our knowledge of the principal facts of the history of these worms. Virchow ascertained by experiment that they become sexually mature in the alimentary canal at the end of three days; and these two naturalists discovered, after many researches, that trichinæ are neither Strongylus nor Trichocephalus, but a different kind of nematode, which is hatched in the stomach of those whom it infests, and that their embryos, instead of migrating, establish themselves in the host himself. The embryos of parasites do not usually remain in the animal which gives them lodging; they are evacuated, as well as the eggs, and are conveyed to another animal. The trichinæ, however, are developed to sexual maturity in the same animal in which they have been engendered.

Eggs of parasitic worms are not usually developed in the body of the host of their parent, but are evacuated with the feces. The trichinæ are an exception. These agamous worms, when introduced into the stomach, rapidly pass through their embryonic history, mature, and lay eggs. The young

which are produced pierce the tissues and become encysted in the muscles or other closed organs. It appears that the *Ollulanus tricuspis*, a nematode of the cat, presents the same phenomena. This is an ally of trichina, which lives first in the muscles of the mouse, which serves it as a vehicle, then in the stomach of the cat, where it becomes sexual and complete.

Infected muscle in the early state is hardly distinguishable from healthy muscle by naked-eye observation, but in the advanced stages of the disease the capsules are invaded with calcareous deposits which render them visible as white or grayish specks scattered through the muscle.

Dr. Leidy says that children seem to suffer less from trichinosis than adults, and the explanation given is that from the ready production of diarrhœa in children the ova are expelled from the intestine before having time to perforate its walls.

The muscles nearest the intestinal lining, as the diaphragm and the abdominal walls, are most infected by the parasite.

The symptoms produced are at first of a dyspeptic character, followed by violent symptoms of gastro-intestinal irritation, often resembling those of Asiatic cholera. The muscles become hard and swollen and highly painful in movement; breathing may be performed only with difficulty, owing to invasion of the diaphragm. Fever is usually absent in mild cases, but exists in severe cases and of every grade, resembling typhus fever.

The prognosis is very bad in severe cases, as no antidote to the parasite is known.

In mild cases the best treatment is frequent purging by castor oil and turpentine and keeping up the powers of the system by diet.

Dr. Leidy states that it was in a piece of boiled ham, from which he had partly made his dinner, that he first discovered *trichina* in the hog.

Notes on diatom study.—II.

By WM. A. TERRY.

I have succeeded fairly well in cleaning diatoms by any of the published processes when the quantity operated upon was small; but, in attempting to clean a half pint of material or more at one operation, have frequently met with notable loss, sometimes amounting to the entire destruction of certain varieties. This I conclude to be partly due to the organic acids formed, as in certain experiments made for that purpose I have found that oxalic acid, and other compounds, formed by the action of mineral acids upon organic matter, were capable of dissolving the diatoms at a high temperature. The great volume of acid fumes given off in these processes is also very troublesome. My process, detailed below, I consider an improvement, as it gives off no fumes of any consequence, requires no artificial heat, and is accomplished in a few minutes, and, in many comparative trials, I have found a much larger proportion of the diatoms uninjured. On account of the variable nature and amount of the organic refuse of different gatherings, accurate weights and measures cannot be given; but I will endeavor to make the general principles so plain that common ingenuity will suggest the necessary modifications. Suppose, then, that we have a recent fresh-water gathering that has not been dried. After washing out the coarser sand and straining out the coarse refuse, allow the material to settle in the vessel in which the operation is to be performed; then pour off the water rather closely, so that the amount remaining shall be about equal in weight to the weight of the material dry. Then add finely pulverized bichromate potash in amount equal

to the estimated amount of organic matter in the material, exclusive of the sand; stir until mixed. A slip of glass one-half inch wide and of convenient length, with rounded corners and smoothed edges, is more effective to stir with than a glass rod. Now take strong commercial sulphuric acid in a bottle convenient for pouring, and drop in at first slowly and afterward more rapidly, with constant stirring, until brisk effervescence sets in with copious disengagement of carbon dioxide. Continue the operation until the further addition of sulphuric acid produces no effect. Then, after waiting a few minutes for the completion of the reaction, pour the whole material into a suitable vessel containing the requisite quantity of cold-water. Rinse the operating vessel and add, and stir the whole briskly for some minutes; then leave at rest to settle thoroughly. The diatoms should now be nearly clean, requiring only the usual alkaline treatment and thorough washing. After the addition of the bichromate see that the temperature of the material, and of the acid to be used also, is not lower than 70 degrees Fahr. If the acid is not added fast enough, or too much water is present, the action may not be energetic enough to dissolve refractory material, and if too fast, or too much at a time, the diatoms may be injured. If there is very little organic matter present and too much bichromate is used, the addition of sulphuric acid may cause a deep red precipitate, in which case very little action will take place. If mistakes have been made and the diatoms are not sufficiently cleaned, the operation may be repeated with less bichromate, or nitric acid can now be used without fuming much or much danger of injury. If the material has been dried, it will be better to soak or boil it in water for some time before using acid. Marine muds should be washed in fresh water to remove the salt, otherwise acid fumes would be generated. They are apt to contain more refractory material than fresh-water gatherings, and the action should be proportionately energetic. Fossil marine earths would require a considerable modification of above process, as the organic matter they contain is so changed and compacted with silicates as not to be readily acted upon by acids. They should be thoroughly softened by long soaking and boiling before being acted on by acids, as otherwise the gases disengaged would tear and fracture very many of the forms. I would advise against boiling in alkalies in all cases where it can be avoided. Recent fresh-water gatherings do not generally require it; vigorous shaking or stirring in a weak solution of sodium carbonate is generally sufficient with thorough washing. If any one wishes to see the action of alkalies on diatoms let him place a drop of potash solution on a slip, and on it a cover prepared with *Pinnularia*, *Stauroneis*, and *Cymbella* and watch it a short time under the microscope. The shells will soon be softened and distorted and very soon dissolved more or less entirely, and this in a cold and comparatively weak solution, or even in potash soap. It is common to find preparations containing, say, *Coscinodiscus*, in which one layer of the shell is more or less completely removed, causing a very different appearance from its normal condition. I have been surprised to find that, among fresh-water varieties, some of the heavier and more glossy shells were the first attacked; the larger Pinnularias, Stauroneis, Acuta, and a variety of *Navicula elliptica* being destroyed by the chemicals, while many smaller and more delicate varieties were apparently uninjured. The marine varieties generally will bear rougher treatment than the fresh water. Inexperienced operators should be reminded that the first washing from both acid and alkaline treatment settles very slowly, and should be given plenty of time; if poured off too quickly the lighter and more delicate varieties would be lost. I have used the above-described process exclusively for a considerable time, and generally succeed in getting the diatoms beautifully white and clean at the first operation; if not, it is easily repeated or supplemented, and

it is a great satisfaction to get rid of the terrible acid fumes when operating upon large quantities. I do not consider the process perfect, however, and hope to improve upon it hereafter.

BRISTOL, CONN., *Mar.* 22, 1887.

MICROSCOPICAL TECHNIQUE.

Improved settling tube for urinary deposits.

BY F. VANDERPOEL,

OF NEWARK, NEW JERSEY.

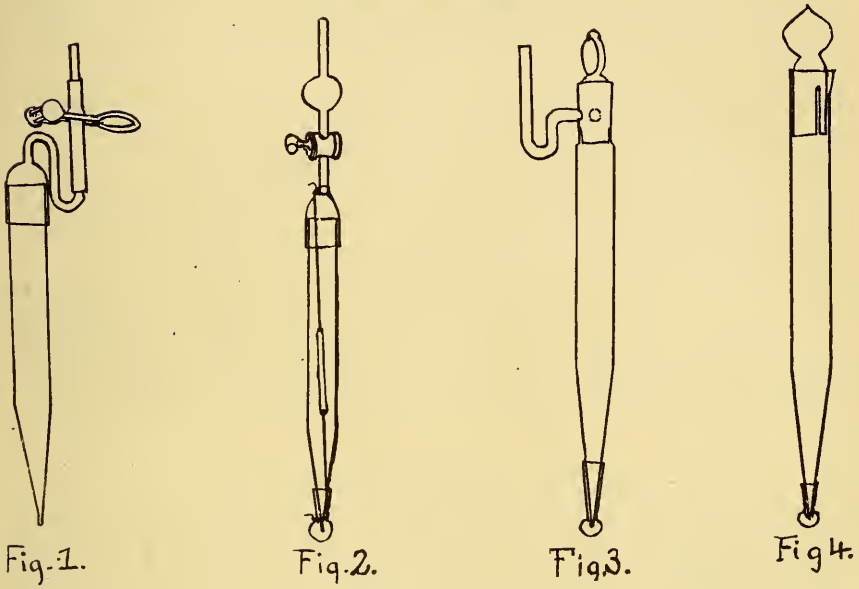

PLATE 3.—Vanderpoel's settling tubes.

In the February number of this *Journal* the writer described a new settling tube for urinary deposits which possessed several advantages over the old method with conical test-glass and pipette. For several reasons, however, the article was not illustrated, and it is for the purpose of elucidation, by means of illustration, as well as to bring before the readers of the *Journal* two new and improved forms of the tube, that space in these columns is again sought. The first two of the figures, 1 and 2, represent the tube as originally devised; 1 denoting the tube with movable cap secured to it by means of a rubber band, and 2 the tube with a ground-glass cap and stop-cock. The first departure from these forms is shown at 3, and consists of a conical tube, as before, but provided with a perforated stopper, the side opening in which communicates with a side tube. The perforation in the stopper, which is easily made by a glass-blower, thus allows the overflow, when the stopper is inserted into the full tube, to pass into the side tube. The stopper is then turned so as to cut off the urine in the latter from that in the large tube, and the latter is thus made tight. After allowing it to remain at rest long enough to permit subsidence of all that will settle, the stopper is gently turned

and a drop taken off the lower end upon a slide, to be examined at leisure with the microscope. The cap, ground and fitted upon the lower end, is put there as a precautionary measure, as will be seen farther on.

The tube shown at 4 is, we think, an improvement upon all of the foregoing, for, upon it there is no side tube to break off, and everything is comprised in a small space. As will be seen by referring to the figure, there is a slight enlargement in the ground portion of the stopper-end of the tube, this protuberance coming down about one-half the length of the stopper, which is solid and ground to fit perfectly. The lower half, however, is provided with a small longitudinal slit or groove, the lower end of which communicates with the interior of the tube, whilst the upper end just reaches the enlargement in the side of the latter. Thus, in one position of the stopper, there is a communication between the tube and the outer air, whilst in all other positions the tube is quite shut. In all these tubes care must be taken to fill them *completely* with the urine, and to allow no bubbles of air to remain therein.

The first of these settling tubes was made without the ground cap on the lower end, the latter being inserted into a small test-tube for safety. At the suggestion of Mr. J. L. Smith the test-tube was made a part of the apparatus by fitting it (by grinding) upon the conical end, and in its present form it serves to protect the latter from dust and to prevent evaporation of the urine (or other liquid) and consequent deposition of salts, if, for any reason, the user should allow the tube to remain suspended for several days.

These tubes will be found very useful for collecting and concentrating into a small bulk the sediment contained in any liquid, whether it be composed of urinary deposits, diatoms in process of being cleaned, or anything of like nature; and, as the parts are all of glass, the strongest acids may be used, excepting, of course, hydro-fluoric acid, without harm to the tubes.

March 11, 1887.

The Zeiss Workshops at Jena.

Mr. J. Mayall, Jr., of the Royal Microscopical Society, detailed at the January meeting of the Society an account of his recent visit to the 'Mecca of Microscopists.' He received every attention from Professor Abbe, and could follow, in the fortnight of his stay, all the technical processes employed. It would hardly be possible to overrate the skill exhibited in the organization of the manufactory. Three hundred are employed, and the shops are so arranged that those departments where the most delicate work is done are quite isolated from the jarring of those where steam-power is in use, the casting and rough brass-work being all done on the premises. Only a small portion of the optical work is done by the aid of steam-power. The plank surfaces of eye-piece lenses were worked together in large sets. The glass slitting-machine, a rapidly-revolving iron disk, charged on the edges with diamond dust, was used in the preparation of prisms of different samples of glass to determine the refractive and dispersive indices. The slitters were used to cut out plates of optical glass of various required thickness; these were then cut into squares and snipped to approximately a disc-shape by the grinders. These then cemented them upon a suitable block and ground and polished the surfaces upon metal tools attached to foot-lathes. The accuracy of the finished surfaces was tested by Fraunhofer's method, which consisted in providing for each curvature required a pair of highly-finished standard convex and concave surfaces worked in rock-crystal, of which the radii had been accurately determined by means of a spherometer of great precision, the per-

fection of the curvature being shown by the symmetrical formation of Newton's rings when the surfaces were pressed in contact. It was an interesting fact that these methods of precision were in constant use in the shops, thus securing admirable training for the difficult work. Mr. Mayall witnessed the whole process of manufacture of a front lens for an apochromatic one-eighth homogeneous immersion, from the grinding to the complete mounting in its cell, centering, etc.

Mounting opaque objects.

Mr. J. Frank Brown (86 State street, Boston) sends us a very neat and convenient device for mounting opaque objects which, though not entirely novel, deserves mention. It consists in the use of 3 x 1 inch strips of heavy cardboard, with a hole punched through the centre of $\frac{3}{8}$ inch in diameter. The object to be mounted is placed over the hole of one strip, and then a second strip is placed over the first and secured to it, thus firmly holding the object between them. Mr. Brown, in his letter, says:—'I send you enclosed, a microscopic slide of bolting-cloth or silk, used for straining of paint and many other purposes. As it is one of my first attempts at this sort of mounting, it is not quite as neat as I hope that practice will enable me to do. I send it as a sample of quick and inexpensive mounting for many common objects, which are instructive and handsome when seen on both sides. This slide is a fine opaque one, and shows finely why the cloth is so strong and hard to tear. I had wanted a method of mounting leaves of Deutzia, and like leaves, with stellate hairs on its two sides, and finding that wooden slides (2 cents apiece) could not be found in Boston, or perhaps short of Philadelphia, had this idea of paper slides enter my head, and my stationer did the work for me. I pay eighty cents for five hundred of these slips, and have them in various colors—green, salmon, yellow, &c. Should my slide grow dirty from handling, or its edges rough up, it is easy to make another.' Mr. Brown sends, also, slide of *Deutzia gracilis* leaf and *Solanum mammosum* from Florida. Objects which it is desired to view upon both sides, as opaque objects, and without careful histological treatment, are in this manner very conveniently and cheaply mounted. The method is, of course, not applicable to a careful morphological examination of the hairs as modified epidermal structures, but such a slide could not be prepared as an opaque object. For pleasing and popular objects, and also for many educational objects, as, for example, a variety of textile fabrics, which could remain uncovered without serious detriment, and which are to be examined upon both sides, this method could be followed with economy and real utility.

New method of fixing sections to the slide.

By H. E. SUMMERS,

CORNELL UNIVERSITY.

The following method has been tested with paraffine and celloidin sections. For either kind of sections the slides are first coated with collodion, either by flowing from a bottle or by a brush, and allowed to dry. The celloidin used for embedding, thinned with alcohol and ether, answers admirably. The coated slides may be kept indefinitely before using.

Paraffine sections are arranged upon the slide and a small amount of a mixture of equal parts of alcohol and ether is then dropped upon the slide. The

liquid will be immediately drawn under the sections. Bubbles of air will rarely remain beneath the sections, but if they do, they may easily be displaced by gently touching the section with a soft brush. The liquid is allowed to evaporate spontaneously. When quite dry, which will take but a few minutes, the paraffine may be dissolved and the sections will be found firmly fixed.

Celloidin sections are placed for a few minutes in ninety-five per cent. alcohol, and then arranged on the coated slide. They are drained as free of alcohol as possible, and as soon as their surface is nearly dry, as is shown by its assuming a dull appearance, the mixture of alcohol and ether is dropped upon them rather freely. When this has evaporated until the surface of the sections again assumes a dull appearance, the slide is placed in eighty per cent. or weaker alcohol, and may then be treated by any of the reagents applicable to paraffine sections fixed with collodion.

The advantages claimed for this method are three: the use of heat is dispensed with, and thus one source of inconvenience and injury to the sections is avoided; the paraffine is not removed (or melted) until the sections are fixed, and thus in sections consisting of disconnected parts, the position of these parts is preserved; labor and work-table space are saved by having a single method which is applicable to both paraffine and celloidin sections. In a later note Prof. Summers adds:—'The following simpler method is found to work as well. Place the sections in 95 per cent. alcohol for a minute or two, arrange on the slide, drain off the superfluous alcohol by tipping the slide, then pour over the sections sulphuric ether vapor from bottle of liquid ether. The celloidin will immediately soften. Place the slide in 80, then 95 alcohol. The sections will be found firmly fixed, and may be stained, cleared,' etc.—*The Microscope.*

Chloride of gold for staining animal tissues.

Mr. A. Underwood immerses the section first in carbonate of sodium for one hour, then for an equal time in neutral solution of gold chloride excluded from the light. After a few minutes in soda bath it is kept for 1½ hours in warm 1% solution of formic acid and then mounted in glycerin jelly.—*National Druggist.*

The preservative fluid of Prof. Wickersheim, of the Anatomical Museum at Berlin, is made as follows:—Caustic potash 60 pts., arsenious acid 10 pts.; dissolve with heat in 500 pts. water; add water enough to make 3000 pts. To this add 100 pts. alum, 25 pts. salt, 12 pts. saltpetre. After cooling filter the solution. To 10 litres of this neutral, colorless, and odorless fluid add 4 litres glycerin and 1 litre methyl alcohol. The body to be preserved is injected with this fluid and then immersed in it. It is said to prevent decomposition, so that the color, form, and flexibility of dead animal bodies and all their tissues are preserved completely for years.—Dr. H. Speier in *Pharmaceutical Record.*

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A chick section, cut by the method of Dr. Reeves, of Wheeling, W. Va., described in our January number (see p. 12), has been sent us by Mr. Jay L. Smith, of New York, who reports himself as very well pleased with the method as a rapid one, and of value for sections for diagnostic purposes. The section he has sent us of a chick of eight days' incubation shows plainly that the process of imbedding is a good one and much more rapid than the longer one. The section sent us is not perfect, but, then, a histologist understands very well

that perfect sections are the exception; the section shows that the method of imbedding would be of great value for rapid use. We regret that we have not had an opportunity of testing the method as contrasted with the other more laborious one we have hitherto employed, but shall find time to do so before long.

EDITORIAL.

Summer schools for biological study.—We begin to hear thus early of the summer schools for biological study at the sea-side, and have learned of the plans of three. The Chesapeake Zoological Laboratory, which has so successfully studied the waters of the southern United States Atlantic coast, was located last year at Nassau, N. P., Bahama Islands, and very interesting results were obtained from the study there. Dr. Brooks, the director, has already gone there for the season of 1887 and begun work, and from his early start many results of the highest interest may be anticipated. Several other members of the station will go down to Nassau later and join Dr. Brooks.

Prof. J. S. Kingsley, of Malden, Mass., announces that he will conduct a small laboratory during the summer at Salem, Mass., with accommodations for a limited number of advanced students. The usual outfit of tables, nets, aquaria, and reagents, a small morphological library, boats, etc., will be provided; but microscope and material, dissecting instruments, slides and covers, and alcohol must be furnished by the student. The laboratory will be open from July 1st till September 1st. The vicinity of Salem furnishes fine collecting grounds, and any who are so fortunate as to be able to attend the laboratory will find abundant opportunities for work.

A 'summer school' is also announced by Dr. H. W. Conn, of Wesleyan University, to be held at Martha's Vineyard. We are not fully informed with respect to this, but understand it to be more elementary in character than the other two, which are only open to independent workers. Information with regard to it can be obtained by writing to the director at Middletown, Conn.

In regard to summer schools, we would say as strong a word as possible to urge all students of zoology and some of the botanists to by all means, if possible, visit the sea-shore and stay there just as long as they can. To one who lives very far from the sea-coast this does not seem an easy thing to do, but, with the present facilities of travel, it is not the difficult task it once must have been. No teacher who has zoology to deal with can afford to pass a summer vacation in resting and jaunting if he can in any way reach the ocean. Six or eight weeks there will build him up physically and intellectually in a way beyond the imagination of any one who has not tried it. Instead of the few sparsely-attended summer schools along the coast there should be two dozen, where work is well done, for those who cannot attend a good laboratory course in the winter. Whole classes of animals abundant in the ocean are never seen away from it, and long life-histories with most interesting larval metamorphoses are abbreviated by the fresh-water or land forms. Thus the precocious cray-fish has relatives in the salt water who pass through long and most interesting stages of babyhood and youth before they assume the adult form. The salt-water crustacea are also so manifold in form, etc., that one who has known only the fresh-water or land forms does not truly know the group at all. Insects and vertebrates may be studied inland, but all the rest of the animal kingdom must be sought out in marine haunts.

Schools for both beginners and older workers are growing in number and favor, and we are glad to see this another sign of progress in this line. Not

the least advantage in all grades of summer sea-side laboratories is the contact with other workers and the new acquaintances formed; influences are there generated which go into the next year's work and make it lighter and pleasanter for the teacher and far more valuable to his pupils.

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Obituary.—We have learned with very great regret of the death of Wm. T. Bruce, Ph.D., of Johns Hopkins University, at Cairo, Egypt, Feb. 11, 1887. Dr. Bruce graduated three or four years ago at Princeton College. After graduation he was elected to a fellowship in biology at Johns Hopkins University, and was one of the most active morphological workers of the laboratory under the efficient guidance of Dr. W. K. Brooks. Last year he was made Lecturer upon Mammalian Anatomy at that institution, and was actively engaged in the duties of his lectureship when his health failed from overwork, and he went abroad for rest and change. He was on his way to Japan at the time of his death.

Dr. Bruce has contributed several important original embryological papers to science upon Limulus and also upon the Lepidoptera, and he gave promise of a very active career in scientific study. The ranks of zoology can ill afford to lose a man so well prepared and so full of enthusiasm for the cause.

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The St. Louis Medical and Surgical Journal, in its department of Microscopy, under the editorship of Dr. Frank L. James, contains, in the February number, the first of a series of articles upon Chemical Microscopical Technology. The article referred to is introductory; directions for arranging the work-room or work-table, with specifications; many details, such as arrangement of light, the table, apparatus, and reagents. From the series of articles just finished by Dr. James we feel very confident in expecting a most valuable treatment of this subject from him.

NOTES.

The Radula of Cephalophorous mollusks was the title of a paper by B. B. Woodward at the January meeting of the Western Microscopical Society of Great Britain. He said in effect that the organ consists of muscular masses working upon cartilages, over which is stretched a horny membrane bearing on its upper surface numerous teeth disposed in rows. The teeth are hook-shaped, and the points curve backward. As those in front are worn away they are replaced by fresh ones developed at the posterior end of the organ. The organ is so distinctive of mollusks that its occurrence in Neomania and Chætoderma furnishes one strong reason for regarding these worm-like creatures as of Molluscan affinity. The radula attains its greatest length, 3 inches, in the limpets. In the edible snail (*Helix pomatia*) its length is less than its breadth, about ¼ inch. In this case, however, it contains 21,000 teeth, and in *Limax maximus* 27,000. Only a partial classification of the Mollusca on the 'radula' is possible.

Sanitation is engaging a very great deal of attention in the State of Michigan and is likely to be made even more of. At a meeting of the State Board of Health, on January 11th, Dr. Vaughan remarked upon the necessity of establishing a laboratory for the scientific investigation of sanitary problems, also to be an educational centre in hygienic subjects. He refers to what has been done for public health by intelligent study in this direction, cites the case of Munich, where, after the establishment of such a laboratory, the typhoid fever death rate fell from 24.2 in 10,000 to only 1.4 per 10,000. Typhoid fever is only one preventable disease; diphtheria, scarlet fever, and cholera also are preventable by attention to sanitary precautions. The municipal laboratory at Paris, for a small fee, tests any sample of food or drink for adulterations. Without this all legislation against adulteration is more or less helpless.

MICROSCOPICAL SOCIETIES.

Washington, D. C.

Discussion of Dr. Reyburn's paper (read at 57th regular meeting of Washington Microscopical Society) and other items.

The paper was fully illustrated by specimens. Dr. Balloch said:—Dr. Reyburn has not said anything as to methods of examination and mounting this parasite. The best method of examining a portion of suspected material is to tease it with needles and examine in glycerin. The calcareous cyst may be dissolved by application of dilute hydrochloric acid and the worm fully exposed. Permanent mounts may be made in glycerin or balsam.

Dr. Schaeffer said:—In my experience balsam has proved too transparent a medium for mounting trichinæ. In the Army Medical Museum are specimens mounted in 1866 in glycerin, and in glycerin and gum, which are still good. I should mount in glycerin. As to frequency, I have counted seventeen cysts in a transverse section of the tongue of a mouse, but the largest number I have seen was in the diaphragm of a man. In Dr. Glazier's report on trichinæ, published by the Marine Hospital Service, he has endeavored to show that the American hog is free from this worm. This is not true. This parasite has caused immense loss to America by the prohibition of American pork in Europe. Some years ago an appropriation of two thousand dollars was asked for, I believe by the State Department, for examination of American pork, but was refused. Had this aid been granted we should have been prepared for this question when it was sprung on us by Germany. Referring to the use of glycerin as a remedy, I have known trichinæ to live two hours and forty minutes in glycerin. Prof. Virchow refers to minute filiaria found in serous membranes, which he believes to be larval trichinæ. The fact that trichinæ are found in frogs suggests the idea that the original habitat of this nematode may be pools of stagnant water. In 1868 I found filiaria in large quantities in the blood of a frog from a stagnant pool, and have seen trichinæ in the lungs of frogs; have never found trichinæ in blood-vessels or in their coats.

Dr. Blackburn said:—The specimens shown you to-night are from the body of a German, aged about sixty, who died in St. Elizabeth's Hospital of some other disease. I have found trichinæ twice in one hundred and seventy autopsies. I have found them in all the voluntary muscles, but never in the heart, and I think I have seen it stated that they are never found in that organ.

Dr. Caldwell suggested that the fact that the heart is inclosed in a serous membrane and is in constant motion might account for this, if it were so. Prof. Seaman said:—Is trichina a native of this country, or an importation? In my opinion it is not so common in this country as in Europe. If this is so, it is due to two causes:—either it is not a native of this country, or the conditions here are not favorable to its existence. We are now as competent to examine this question as are European observers, and careful investigation ought to be made.

Dr. Schaeffer asked if any of the Society had seen Fasoldt's rulings on glass.

Prof. Seaman said Fasoldt had done some fine work, but the finest was that done by Prof. Rogers, who had not only done the best work, but had indicated the methods of doing it and the errors to be avoided. He was a severe critic of his own work, and in contradistinction to Nobert, Fasoldt, and others, had nothing to conceal, but was continually striving after the highest excellence, and was willing and anxious that all the world should know his methods and improve them, if it could be done.

E. A. Balloch, *Rec. Secr.*

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San Francisco, Cal.

The regular semi-monthly meeting of the San Francisco Microscopical Society was held on the evening of Mar. 9, at its rooms, President Wickson in the chair.

Chas. C. Riedy of this city was elected a resident member.

The subject appointed for discussion, viz., '*Bacillus tuberculosis* in Fowls,' was introduced by Dr. Stallard, who said that the close analogy existing between certain diseases found in many domestic animals and in the human race had long been known, as was also the communicability of such diseases. Rabies was a case in point, and, in a lesser degree, the disease known as anthrax or charbon. It is a known fact that typhoid fever has been transmitted from animals to man by means of infected milk. In connection with this subject he desired to call attention to the following occurrence:—While

convalescing from sickness recently, he had ordered a broiled chicken. While preparing it for cooking his wife noticed peculiar spots on the liver and spleen and showed them to him. As they were apparently tubercular, he placed them in preservative fluid until his recovery, when, upon chemical treatment and microscopical examination, the material was found to be crowded with true tubercular *bacilli*. The liver and spleen were especially infected, but bacilli were also plentifully found in the mesenteric glands, the lungs and other parts. He had thereupon made inquiries among the cooks of several large hotels and boarding-houses, and was by them supplied with material for further investigation. In the short time that he had been studying the matter he had already found six chickens, all very badly infested with the bacillus in question, and he believed that probably 5 per cent. of all the fowls offered for sale in this city were similarly affected. It was true that most of the organs thus affected were not used for food, yet, this was not always the case. Danger to the human race of infection from this source was greatly reduced, from the fact that the thermal death-point of the *Bacillus tuberculosis* was about 150° Fahrenheit, so that in the process of cooking thoroughly they would be destroyed. A much higher temperature, however, is required to kill the *spores* of these bacilli, and, as there could scarcely be a doubt of the existence of spore-bearing bacilli in the chicken, it could not be said that danger from this source did not exist. While, therefore, by no means wishing to assume the role of alarmist, the speaker wished to commend the subject to microscopists and the medical fraternity, for its interest as well as its importance. Specimens of infected organs of chickens were shown, and mounted slides, showing the tuberculous matter and the *bacilli* themselves, all stained by chemical reagents, were shown under a number of microscopes. A set of slides illustrative of the subject was donated to the society by Doctor Stallard, and a vote of thanks was thereupon tendered him for his donation and his interesting address.

Two interesting slides of native wire copper from Lake Superior were handed in by Dr. Selfridge.

As an instance of the brilliance with which many animal integuments are displayed by the use of polarized light, the secretary exhibited a carbolic-acid mount of the human flea, and also a slide of a rare marine crustacean from the Channel Islands.

A. H. Breckenfeld, *Rec. Secr.*

NOTICES OF BOOKS.

Microscopy for Beginners, or Common Objects from the Ponds and Ditches. By A. C. Stokes, M. D. Harper Brothers, New York City. 1887. (pp. 308).

Though it might at first thought seem that the literature of elementary microscopy is crowded, such is by no means the case with respect to good books. If the beginner with the microscope were to ask for a work which to take as a *vade mecum* to stand at his elbow and answer his question, 'what is this?' as he looks through a drop of water from his roof gutter, or the pool where he collected a bit of 'scum,' he will find that work nowhere but in the little volume which Dr. Stokes has just produced. After a brief chapter upon the ways of examining pond life, the microscope, both simple and compound, and how to use it, the author takes up consecutively Desmids, Diatoms, Fresh-water Algæ, Rhizopods, Infusoria, Hydra, Aquatic Worms, Crustacea and Insect Larvæ, Rotifers, Fresh-water Polyzoa, and thus runs through the groups which contain the animals likely to be met by the searcher. This plan is highly commendable. There is some interest for the amateur in merely looking through the microscope, but far more if he is guided by a competent teacher or hand-book. This work makes it possible for him to find out readily for himself the relationships of almost anything he is likely to meet in his collections, and gives him considerable information about it. This is done in a very clear manner by the help of artificial diagnostic keys based upon the most conspicuous character, irrespective of morphological significance, and by very frequent figures. There are in all 179 figures of objects, besides the six figures which relate to apparatus. The book contains also a good glossary and a very complete index.

We have not meant to speak of Dr. Stokes' book as if it were suited only to the needs of beginners. It does not claim to be a monograph of aquatic life, and yet we are assured that it will do good service upon the work-table of many who have become more than beginners or amateurs in the study. Keys to the genera of the various groups will be found a great convenience by very many who have formed the acquain-

tance of many aquatic forms, and passed by many others with little notion of what they were.

In estimating the value of the book, we may say that its literary workmanship is most excellent. The author writes clearly, and by an intelligent use of his figures, keys, and descriptions any one may very soon train himself to become an observer of microscopic forms of life, and, more than a mere curiosity seeker, a student of nature. The plan of the book, as well as the author's motive in its production, is most admirable. It is intended for the popular reader, and is the first work of its kind published which relates directly to our American forms of life. Its faithful user will soon rise above the low level of butterfly-scale and leaf-hair collectors to a higher plane occupied by students who are studying the forms of living creatures, their habits, and the manner of their life processes. Thus, in the description of *Utricularia* (page 54), the plant is not merely named, but the interesting devices for capturing animal food are pointed out and described. We are well pleased with this feature. Valuable work is only accomplished by one who gets beneath the mere superficialities by closer observation, and here he finds a guide which will promote this spirit in its users. We have to thank the firm of Harper Brothers for presenting in such agreeable shape so valuable a book, and we trust that it may fall into the hands of a great many persons who would walk in the way if they only knew it, and help them to find the way, and stimulate many who are now in the way to a better form and quality of work than they have hitherto known how to do.

The Principles of Pharmacognosy. By F. A. Flückiger and A. Tschirch. Translated from the second German edition by Frederick B. Power.

This book gives to American students not only a valuable aid for the recognition of the various crude drugs of the vegetable kingdom, but also a hand-book of plant histology which will be highly appreciated. A most welcome feature is the large number of fine illustrations which have not before appeared in American books. Numerous diagrams make clear points that students often find difficult of apprehension, and the acquisition of the technical terms is much facilitated by the frequent etymologies. The physiological classification of the tissues which is here employed has not received that attention in this country which by its helpfulness it surely merits, and we believe that the present translation in the hands of our students will do much to illuminate their histological study. F. L. S.

Notes on Microscopical Methods. By S. H. Gage. Ithaca, N. Y. Andrus & Church. 1886–7. (pp. 32).

This work is primarily intended for the instruction of the classes of Cornell University, and is an amplification and improvement of a similar work prepared by the same author in 1881. It takes up the main facts which are required to be known to one who would be a successful histologist, presenting the following topics, viz:—

1. The microscope, its parts, care, and use.
2. Interpretation of appearances under the microscope.
3. Magnification—ocular micrometer ratios.
4. Micrometry and drawing.
5. Adjustible and immersion objectives, etc.
6. Appendix—imbedding in celloidin, cutting, fixing, and clearing celloidin sections, counting white blood corpuscles, cleaning large cover glasses.

The book is well illustrated with diagrams and drawings, which fully explain the author's meaning, and make his book a very convenient hand-book for any who would learn the use of the instrument, and, by means of the bibliographical notices and references liberally scattered through, would be useful to many persons who are already skilled in the use of the instrument. There is a line somewhere between ignorance of most of the details of microscope construction and management, and the entire engrossment of the mind by those details to the exclusion of the use of the instrument for its legitimate purpose which must be carefully drawn. Works which treat solely of technique sometimes give rise to the impression that mere technique is the end, and not real study the end to which the technique is merely a subservient means. Microscopical studies are peculiarly liable to fall into such a mistake, and become disgraced thereby. The work before us does not tend to foster such a spirit, but awards to the instrument a due amount of attention to secure its most efficient use, without making the user a student of the tool as the end of study.

Twelfth Annual Report of the American Postal Microscopical Club. Samuel Lockwood, president. Troy, N. Y. 1887. (pp. 16).

This report shows that for the past twelve years the Club has given to its members opportunities, not otherwise attainable, for comparing notes on, and products of work, for the pleasures of companionship to those far apart, and the stimulus of sociability and practical advantages of comparison of one's own work with that of others. 'These advantages, which are only of incidental importance to those favored members who are situated at the scientific centres, in the midst of the libraries, laboratories, and strong local societies, become of vital importance * * * to isolated workers, supplying them with a means of contact with the experience of those whose expertness can set them a standard of excellence, and whose suggestions can greatly aid them to approach that standard.' The club is doing good work and has a flourishing membership.

Bulletin of the Washburn Laboratory of Natural History, Vol. I, Nos. 1, 2, 3, 4, 5, 6, and 7. By F. W. Cragin. Topeka, Kansas. 1884–1886. (pp. 212, pls. 7).

These several bulletins, seven in number, the last one dated December, 1886, contain the collected results of natural history studies by the students in Washburn College and others. They are made up of papers descriptive of various zoological and botanical collections, made for the most part as part of the work of the Biological Survey of Kansas. The papers are entirely systematic in character, and are lists of species, or descriptions of new species, both botanical and zoological. The papers show a great amount of activity upon the part of the editor, Prof. Cragin, who has contributed numerous papers upon a variety of topics. Papers by Eugene Rau, Francis Wolle, Chas. H. Gilbert, W. A. Kellerman, and other well-known writers upon collections of the Survey, add to the value of the *Bulletin*. Mr. R. E. Call has contributed a large number of valuable papers upon the Land Mollusca of Kansas, many of which are well illustrated by plates and cuts inserted in the text. The *Bulletin* bears the evident mark of careful work upon the part of its contributors.

We desire to acknowledge, with thanks, the receipt of the following articles from the authors:—

1. *Note sur quelques points de la morphologie des Orchesties, suivie d'une liste succinte des Amphipodes du Boulonnais.* Par Th. Barrois, Lille, France. 2. *Note sur le* PALAEMONETES VARIANS *Leach, suivie de quelques considerations sur la distribution géographique de ce Crüstace.* Par Th. Barrois, Lille, France. 3. *On the Trap and Sandstone at Tarrifville, Conn.* By Wm. North Price, Ph.D., Middletown, Conn. 4. *Revision of the North American species of* FISSIDENS. By C. R. Barnes, Lafayette, Ind.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology. HENRY L. OSBORN, Lafayette, Ind.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired. M. A. BOOTH, Longmeadow, Mass.

Wanted, exchange of slides, and correspondence on unusual urinary products.
J. M. ADAMS, Watertown, N. Y.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one.
K. M. CUNNINGHAM,
Land Office M. & O. R R. Co., Mobile, Ala.

Pathological and Histological Slides (very fine) in exchange for other good slides.
F. M. HOYT, 160 Washington Park, Brooklyn, N. Y.

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Elementary histological studies of the Cray-fish.—I.

BY HENRY L. OSBORN.

INTRODUCTION.

It is the purpose to prepare a series of studies upon the histological structure of the cray-fish, presenting an introduction to the science of histology for the use of those beginners who require a guide of an elementary character. In setting forth the subject I shall attempt to omit no detail of instruction, in regard to both the method of manipulation required, and, more particularly, the proper way to study histology; how to see, and what to see; how to interpret one's observations; and, last, but not least, how to record the observations, both by drawings and by written descriptions.

The study of histology may be desultory or scientific. The worker may collect section after section, give it a hasty glance, and store it in his cabinet—too often he does only this—or he may thoroughly examine his section, and from it go to its place in the organ of which it forms a part, to build up for himself a competent idea of the construction of the organ. This should always be his purpose, and it is to teach such a method of working in histology that this series of studies in the histology of the cray-fish is laid before our readers. If they prove helpful to biological teachers as well, it will be an added gain, for there is a need of some work to be used as an elementary guide in animal histology, to accompany the many elementary works on zoology from which this chapter is omitted. My reasons for selecting the cray-fish as the creature upon which to make these studies are several:—the great abundance of cray-fish in all parts of the country is one consideration, the general use of the cray-fish in anatomical studies is another; but the chief reason is that the greater simplicity of structure in the case of many of the organs makes them more favorable for a beginner to study than would be a vertebrate, while, at the same time, in the cray-fish the tissues are more varied than in lower forms, so that they illustrate well many of the facts and principles of animal histology.

CHAPTER I.—THE GREEN GLAND.

1. **Gross anatomy.**—It should be the invariable rule of the histologist to examine the part to be studied first with his naked eye, and also to familiarize himself with so much of it as can be seen with a simple microscope, for very often such precaution will save him a large amount of useless speculation regarding appearances which he finds presented in his section. Such an examination in the case of the green gland should be made as follows:—Place

the cray-fish in a pint of water, to which five cc. of chloroform or ether have been added; in a few minutes he will die. Removing him from the fluid,* cut off the anterior part of the carapace, and, carefully lifting the fore-end of the stomach, cut around the shell on the ventral side close in front of the mandibles, and remove the whole front end of the cephalothorax. The two green glands can now be seen lying next to the shell on the ventral side; they are of a brownish color, and the whitish sack lying over them will be conspicuous. Place these in strong alcohol (95%) for several hours, and they will be changed from soft bodies, which tear too readily to permit dissection, to tough and firmer ones, and can be dissected in a watch-glass, under alcohol, with a simple dissecting microscope, and the gross structure demonstrated clearly. Examination will show that the apparatus of one side is entirely independent of the other, and that each is composed of two parts:—First, a very thin-walled and delicate sack which lies above, the second, a compact body of a very flattened spheroidal shape, the glandular portion.

I. *The sack* may be seen to be hollow; in fact, unless very great caution has been observed, the roof of the sack will have been broken into, displaying its cavity. The cavity of the sack may be followed forward, the sack narrowing into a tube, which runs over the front of the more solid part of the apparatus, and beneath it, to open by a hole through the shelly basal joint of the antenna. The portion of the sack which is applied to the upper surface of the glandular portion of the apparatus will be found loosely adherent, except at one place where it appears to run into the substance of the glandular portion, and in several places where narrow threads may be seen to run across from it to the glandular part.

II. *The glandular portion* is flat or slightly concave above, where it lies against the sack, and convex below, where it lies against the shell of the ventral side of the head region of the body. Close examination of this under simple microscope (15 diameters) will show what appears to be a compact body coarsely granular. If, with a scalpel, a few slices are cut across it, it will be seen to be of a spongy texture, partitions running through it in all directions and cutting it up into irregular cavities. It will be seen that there is no trace of an opening to the gland upon its under surface, but close examination of the upper surface will show that the hollow of the sack communicates with the interior of the glandular portion.†

2. **Preparation of the sections.**—There are many modes of treatment to produce the same final result in cutting the sections. In all these the purpose is to preserve the cells in the most natural manner, to harden them so that the thinnest sections can be cut, to stain so as to make most easily seen the naturally very transparent protoplasmic parts, to mount the section so as to preserve the natural relations of all the parts, and, finally, to permanently protect the section in a medium which will prevent any change after the mounting has been completed. A full discussion of all the various processes for accomplishing all these purposes would be very interesting; but not sufficiently elementary for the purpose in hand. I intend rather to give an exact account of the actual processes employed in the preparation of the sections to be afterwards described, with such remarks upon them as will, I trust, enable any one to put a similar structure through a similar course of treatment and arrive at as satisfactory results. The following is a copy from my laboratory notes upon the history of the sections from which plate IV was drawn:—

* The chloroform or ether will not mix with the water, and may be collected and saved for a future occasion.

† A good figure to illustrate the general relation of the parts of the green gland to each other and to the rest of the body is shown in Huxley's The Cray-fish, p. 83, fig. 18.

No. 278.—Green gland of cray-fish—killed in atmosphere of chloroform. March 15, 1887.

	Mo.	*Day.*	*Hour.*
Corrosive sublimate, saturated aqueous sol., temp. 18° cent.	3	15	2.00 P. M.
H_2O (dist.)	3	15	2.45 "
50 per cent. alcohol	3	15	4.00 "
70 per cent. "	3	15	4 30 "
Borax carmine	4	10	8.48 A. M.
Washed and transferred to 100 per cent. alcohol	4	11	10.25 A. M.
Chloroform	4	11	12.20 P. M.
" and paraffine	4	11	4.00 "
Pure paraffine at 55° cent	4	11	9.30 "
Imbedded	4	11	10.20 "
Mounted in chloroform balsam,	4	12	11.00 A. M.

Cut with Jung microtome. Ribbons cemented with collodion. Cleared with turpentine.

The following notes will be found helpful to any one who follows the foregoing course :—

1. The saturated corrosive sublimate solution is made by heating water to boiling, and adding as much of the salt as will dissolve, then allowing the solution to cool, whereupon the excess of the salt will be crystalized out of the strong solution.

2. The work of the corrosive solution is to coagulate the protoplasm of the cells. Since it acts rapidly, it soon hardens the peripheral parts of the piece, and then the ready attack upon the central cells is prevented. One should, therefore, never harden large pieces with corrosive sublimate, as cells separated from the fluid by more than $\frac{1}{5}$ of an inch of intervening tissue will not be readily reached by the reagent, and so not well preserved. If it is desired to hurry the action, one may add a few drops of glacial acetic acid to the corrosive sublimate, and then leave the tissue in the fluid only ten to twenty minutes.

3. After coagulation of the protoplasm by corrosive sublimate, the salt must be entirely removed from the tissue, and since warm water would tend to destroy the cells a steady stream of cold water flowing over the specimen is employed. This must continue long enough to entirely remove the corrosive, viz., from one-half hour to one hour, or even more. If the water is cold it will not hurt the specimen.

4. As soon as all the corrosive sublimate has been removed, the specimen must be gotten as soon as possible into strong alcohol. It must not, however, be transferred directly from the water to 95 per cent. alcohol, but carried up through weaker alcohols, 30, 50, and 70 per cent. are a good series, and since a change in protoplasm will not go on in 70 per cent. alcohol the specimen may remain in it till it is desired to stain, precaution being taken to keep the alcohol at 70 per cent.

5. Borax-carmine solution is made by dissolving 4 grs. borax and 4 grs. carmine in 100 cc. distilled water with heat, adding 100 cc. of 70 per cent. alcohol, and after 36 hours using filtered solution. The solution keeps without change, indefinitely, and may be used over and over again. In using the borax-carmine, one immerses the whole piece (called staining "*in toto*," or "in bulk," or "in piece"). In this case the time was twenty-four hours, or thereabouts; a longer time will do no harm. After removal from the borax-carmine, the piece will have a deep maroon color; this is to be changed to a bright red by washing a few moments in 70 per cent. alcohol, to which two parts of strong hydrochloric acid have been added. During this wash much of the staining fluid will be at first removed, but gradually less and less. It should be continued with perhaps a change of the solution until no more color is removed.

6. The alcohol which is used to remove the last trace of water before the transfer of the piece to chloroform, the solvent of paraffin used in the present instance, need not be strictly 100 per cent., though where one is working with small quantities it is wiser to buy the absolute and be on the safe side; but an alcohol of 97 per cent., or even 96 + per cent., will answer equally well if procurable. Druggists do not often dispense an alcohol of higher

proof than 95 per cent., *which cannot be used as a substitute for 100 per cent. alcohol in this process of imbedding.*

7. The time during which the piece must remain in the chloroform will depend upon the size of the specimen. The worker can, however, tell when to make the next transfer by these indications :—(*i*) At first currents may be seen in the chloroform, as the alcohol leaves the piece and the chloroform replaces it; these will cease, even after shaking, at the end of the process. (*ii*) The specimen, at first opaque, will gradually become very translucent, and close watching will tell when there is no further change in this direction. (*iii*) The specimen when first placed in the chloroform will float at its surface, but as saturation with chloroform goes on it becomes heavier, and finally gravitates to the bottom of the vessel. It is very essential that all traces of alcohol be removed before the next process is initiated.

8. A saturated solution of the pure paraffine in chloroform provides a step between the pure chloroform and the pure paraffine, by which a part of the chloroform is gotten rid of before the piece is subjected to a temperature higher than that of the atmosphere of the room.

9. The paraffine used for imbedding must be chosen in accordance with the temperature of the room where the sections are to be cut. If too soft a paraffine be used the sections will be crushed by the razor; if too hard, then the thin slice will roll up, and cause great vexation, and make the 'ribbon' a failure. It is only after experience with various grades that one can select the best to use upon a particular occasion. Paraffines of various grades, soft, medium, and hard, can be bought of the chemists, who can also usually supply the other reagents in pure state. In immersion in melted paraffine care must be taken to prevent the temperature of the steam or water surrounding the cup holding the paraffine from rising far beyond the melting point of the paraffine. This is ordinarily about 55° C. The temperature must never be allowed to rise to or beyond 60° C.*

10. The precise steps in the imbedding process are these :—A small paper box is made, by folding, from a piece of writing-paper, or two L-shaped pieces of lead are used upon a glass slide, and thus an oblong mould is formed, into which the melted paraffine is poured. Its outer surfaces begin at once to cool, but the centre remains liquid for some time. The piece, carefully lifted from beneath upon a 'section-lifter' (which may be made by hammering flat the end of a piece of copper wire four inches long), is now deposited in the melted paraffine in the mould, and, with a warm needle, adjusted so that sections cut across the block will pass through it in the desired plane; the section is now held thus a second or two, till the paraffine has hardened sufficiently to prevent its displacement, and then the mass is allowed to cool. There is no hurry about cutting the sections after imbedding; it may be done whenever convenient, for the piece will now undergo no change.

11. In cutting sections after this method of imbedding has been employed, the razor should be pushed straight ahead without any lateral movement. To do this the razor at the part used must be perfectly free from any breaks in its edge, however slight; it should look entire, even to microscopic examination, and be very sharp indeed. Before cutting the sections the paraffine block, with the imbedded piece, must be fixed in the microtome, care being exercised that the surface presented to the knife be the one prepared for in adjusting the piece in melted paraffine. After the block is mounted in the microtome in position, the paraffine should be pared down by four vertical cuts around the piece at right angles to each other, thus enclosing the piece in a four-sided prism of paraffine. The edge of the prism which the knife

* On water-bath apparatus consult this *Journal*, vol. vii, p. 203, 1886.

first meets must be precisely parallel to the edge opposite. If these conditions have been observed, if the knife is sharp, and the paraffine is of the proper grade, slice after slice may be cut off the top of the prism, and the edges of successive slices will adhere together, so that a long narrow ribbon is formed, made up of the successive slices, all the slices lying in exactly similar position. A number of these slices can be mounted at the same time as easily as one slice. This makes it possible to preserve a long series of consecutive slices, and thus to trace any part through from section to section, and learn its shape and relations.

12. In mounting it will be well to place a large number of sections on the same slide, and for the purpose, oblong covers, 2 inches long by $\frac{1}{8}$ inch wide, may be bought of the opticians, or large sheets of cover-glass may be bought, and covers of any desired size cut with a writing diamond. If the series are cemented to the slide or cover before clearing off the turpentine, as many as 50 or 75 of a small object (say $\frac{1}{8}$ in. square) can be mounted under a single cover. To fix the objects to the slide, spread over the slide a thin film of a mixture of 2 parts collodion and 1 part oil of cloves. Lay the sections in rows as close together as you please upon this film, and lightly press them with a small camel's-hair brush. Place them on a metallic surface warmed to 50° cent. for 15 minutes, then immerse the whole slide in pure spirits of turpentine; the paraffine will be quickly dissolved. The turpentine must now be drained off as quickly as possible, and when the sections are almost at the point where, in another moment, they would become dry, a few drops of benzole or chloroform balsam dropped on the sections, and the cover-glass carefully applied.

3. **Examination of the sections.**—1. *Low power.* As in the study of the organ, we are recommended first to become familiar with its most obvious features, so, in the study of sections, it is always wise to begin with a low power, and, after seeing all it will reveal, pick out certain parts from it for more detailed study. Figure 1 is a camera-lucida drawing taken from one of the sections, the one which passes through the place where the sack dips down into the glandular portion.

a. **The sack** is shown below and to the left in figure 1, and the reference letter S is placed in its cavity. Only a small portion of the sack was preserved and cut, the remainder being like it in structure. It is found to present an inner lining, the *epithelium*, which immediately surrounds *the cavity*, and may be seen to be of noticeable thickness, and with dark spots at definite intervals along it. The cavity is seen to extend some distance into the substance of the gland, and the lining also to continue up into the space in the gland. This passage from the gland is called the *duct*. If the entire sack had been preserved, together with the tube leading out to the opening upon the basal joint of the antenna, it would be seen that the epithelium, which forms the lining of the sack, is continuous and without any break from the duct of the gland to the opening on the antenna, thus placing the cavity of the sack in direct communication with the outside water which bathes the body, and at the same time preventing water from entering at the opening and wandering about at large through the body within. A second layer may be seen to surround the epithelium, lining the sack; it is a protective and supporting covering for the epithelium. If this covering be followed to the gland, as was the epithelium, it will be seen that just where it reaches the gland surface it departs from the epithelium and runs around upon the surface of the gland, thus entirely enveloping both the sack and the glandular portion of the apparatus.

b. **The glandular portion** is shown in figure 1 slightly simplified from the original section for the sake of clearness. The cavity of the duct is

seen running into the centre of the gland, and a change in the epithelium is seen. The whole body of the gland is, furthermore, found to be made up of cavities bordered with a very clearly-shown lining, which looks more or less like the lining of the duct. A somewhat close inspection of these cavities will show that they are all closed, that is to say, if you begin at any one point, and follow the border around, you will come back at last to the very point from which you started. This may be demonstrated more clearly upon the figure than in all parts of the section, unless the section is very thin and perfect, but it can be shown clearly in so many parts of the section, and is so clearly indicated in others, that the observer can assure himself of its truth for all parts. In making such an excursion around the wall of some of the cavities (thus, for example, the one in which the letter E is placed), it will be seen that the wall is very complicated, and in some places double, while in other places it is single. A little reflection will show that we may regard the double places in the wall as inward folds from the single-rowed outer partition. Such folds in the walls of organs are very often met with in animal structures, and they give a greater exposure of surface in a given area than simple walls without the folds would do. In E, as well as in another large cavity with the infolded walls, I have traced around a very dark boundary line, which will aid in following the folds. By following this line closely, spaces of greater or less extent will be found, and these, in many cases, will be seen to open out into a general space, which surrounds the whole cavity, and many other cavities. The cavity is known as the lumen of one of the gland sacks, and the cavity outside the wall is in direct communication with the general cavity of the body, the space inside the shell and

PLATE IV.—Green gland of *Cambarus immunis*.

outer skin, in which all the organs lie, but there is no communication through the wall of the gland sack.

A glance through the section will show that the whole gland is constructed upon the same principle as here set forth, with some variation in detail. These are, namely, first, in the size of the cavities from very small ones to very great ones, and second, in the character of their lining or epithelium. Dismissing for the present the former, let us consider the latter.

[*To be continued.*]

Notes from Japan.—II.

By ROMYN HITCHCOCK, F. R. M. S.,
OSAKA, JAPAN.

It is now comparatively seldom that we take pen in hand to write upon a microscopical subject. Despite the great advances in education and in other ways that have been made in Japan during the last decade, there is a vast difference between the knowledge and culture of Osaka and Washington. We are here almost as isolated from persons of attainment in science and from those who are generally informed about the world's progress as one could be in the wilds of our far western country. The few scientific periodicals that come to us bring news that is already a month old to the world at large; and we scarcely dare venture to send forward notes upon their contents lest they be regarded as quite out of date by the time they reach the public eye. As for new observations of interest to the microscopist, we are not yet able to proclaim any great, or even notable, discoveries. It is true we have done some collecting in the ponds and rice-fields, but thus far we have not found much of particular interest. This is partly due, no doubt, to the season, but mainly, we think, to the character of the country. The rice-fields must be supplied with abundant water, and to ensure an adequate supply the water is stored in deep reservoirs on the hill-sides, which are fed by springs or mountain streams. These reservoirs are now being emptied, and the bottom mud is taken out for manure. The consequence is that the algæ do not seem to grow in great variety in these artificial and much-disturbed reservoirs. Perhaps later in the season we may have a different story to tell. At present only the more common forms of filamentous algæ and a few diatoms attached are found. The rice-fields are not just now good collecting grounds. It is said that in the warm weather the algæ become so prolific that the farmers are obliged to rake them off.

Speaking of diatoms reminds us that on page 37 Mr. W. A. Terry has a letter in which he infers, from the rather ambiguous language we used on page 6, that we had never found the *Bacillaria paradoxa* in America. That is not just what we intended to say, although the language used fully justifies such an interpretation. We have frequently found the diatoms at home, but we believe never when making a search especially for them. Mr. Terry's observations are of much interest, as indicating the varied conditions under which the species thrives.

We have received many applications for specimens of Japanese diatoms which will certainly be responded to as soon as good collections are made. At present we have only enough for two or three papers, and not enough to send home. We have made the discovery that material shrinks wonderfully in drying, and that to supply home demands we must collect in large quantities.

One correspondent wishes to know if diatoms could not be sent home so as to be received still living. Well, we are disposed to think not. It might

be possible to carry them across the water, but the absence of light for six weeks would probably be more than they could stand, to say nothing of other unfavorable conditions in the mail bags. However, we propose to try the experiment some time, and hope for a favorable result.

In the course of our photographic work here we have made numerous careful observations upon the practical efficiency of pyrogallol and ferrous oxalate developers, and a few notes upon this subject may be of interest. Ferrous oxalate has always been a favorite with us for its cleanliness, and the freedom of the negatives from objectionable color. Many operators contend, however, that it does not give sufficient latitude of exposure, and that an under-exposed plate cannot be made to give the same detail with the oxalate as with the pyro developer. We do not propose to enter into this question further than to say that, so far as our experience enables us to judge, the one developer will do as much as the other. Those who have condemned oxalate have usually given formulas for preparing it which seem to us not calculated to give the best results.

Nevertheless, we have come to regard the alkaline developer with greater favor than oxalate, for the following reasons:—

1. It gives softer negatives with short exposures. With ferrous oxalate, even when used very weak, a plate slightly under-exposed will give very strong and dense high lights before the shadows are well brought up, especially if there are strong contrasts in the subject. The only means of controlling this action is by making the developer weak in iron. Development then goes on very slowly, and is a tedious operation. With pyro, on the other hand, the details in the shadows may be quickly brought out by adding alkali, while keeping the developer weak in pyro prevents undue increase in the density of the high lights.

2. It is a more rapid developer.

3. It is decidedly more convenient to carry about when one is travelling.

Pyro stains are quite unnecessary, except when the development has to be prolonged with a strong developer. Alum solution, acidified with oxalic or other suitable acid, removes any ordinary stain, and with a properly exposed plate the resulting color leaves nothing to be desired. Probably the best agent to remove stains, after the negative is fixed and thoroughly washed, is a saturated solution of alum, acidified with oxalic acid, in which a quantity of ferrous sulphate is then dissolved.

We prefer to use the pyro in the dry state, dissolving only what is required for each development, at the time it is wanted. The compressed tablets are doubtless very good for this purpose, but we use the ordinary dry pyro with perfect satisfaction. The common sodium sulphite is not to be compared in efficiency with a solution made by saturating a concentrated solution of sodium carbonate with sulphurous acid.

History and biology of Pear-blight.

By J. C. ARTHUR.*

1. *Historical summary.*

Pear-blight, or fire-blight, is a malady which frequently destroys trees in fullest apparent vigor in a few hours, turning the leaves suddenly brown, as if withered by fire. It happens all through the warm season, most frequently in hot and moist weather.† The disease extends from Canada to Louisiana,

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* Abridged from original paper in Proc. Acad. Nat. Sci., Phila., 1886, p. 322.
† Cox—Cultivation of fruit-trees, Phila., 1817, p. 174.

and from the Rocky Mountains to the Atlantic Ocean, but is usually rare upon the sea-coast. The disease is not recorded in Europe, and it is only within a year that European authorities have become acquainted with it. In the years of 1826 and '32 the blight became a wide-spread epidemic, and in 1844 few orchards escaped without some loss, and many were entirely destroyed. Early conjectures regarding the cause of the disease were not satisfactory. One, that of Cox, supposed it due 'to the hot rays of the sun acting through a misty atmosphere deranging the vital activities of the plant.' Another assigned it to the work of insects, founded on the discovery of a small brown beetle, *Xyleborus pyri*, still known as the blight-beetle, which penetrated the branch and caused the part beyond it to die. Another theory is called the frozen-sap theory; it held that the freezing of unripe wood generated a poison, which was distributed the next spring and summer, causing death. This was first published by the late Rev. Henry Ward Beecher, in *Hovey's Magazine*, in 1844. In 1863, Dr. J. H. Salisbury figured a fungus which he decided was the specific cause of the blight. The last hypothesis of importance is that of Prof. T. J. Burrill, who, in 1878, stated his belief that the disease was bacterial, and the presence of which in affected parts he observed in great numbers. He made a series of experiments by inoculation, and presented the results of his investigations at the Boston meeting of the American Association, and extended and confirmed his result in 1884.

The question of the cause of pear-blight was finally removed from the domain of speculation, in 1885, by the writer by a series of crucial experiments. These consisted in showing that the bacteria, when removed from the tree and passed through a series of artificial cultures, would generate the disease when again introduced into the tree, but the juices accompanying blight will not produce the disease if inoculated after the bacteria have been removed by filtration.

2. *Life history.*

Prof. Burrill first recognized the bacteria of blight in 1877; in 1882 he characterized the organism as *Micrococcus amylovorus*. Its form under varying conditions is very constant. Single cells are from oval to roundish-ovoid, and only vary by slight changes in the ratio between their length and breadth. Length 1 to $1\frac{1}{4}\mu$, breadth $\frac{1}{2}$ to $\frac{3}{4}\mu$; quite colorless. They exist usually as single independent cells, but often are in pairs, especially when multiplying, or even in series of 4 or 5, but never extend into chains.

During rapid growth in rich media they exhibit rapid swarming movements, never moving in a straight line for any great distance. These movements become slower as the rate of growth decreases.

The most characteristic feature in the life-history of *M. amylovorus* is the formation of the zooglœa, which occurs with regularity in the fluid cultures, though it has never been observed in the tree or upon solid culture-media. They are produced through the fluid, but are most abundant in the thin pellicle which forms on the surface within about 48 hours from the beginning of the culture. The substance of the pellicle is a colorless matrix filled with motionless bacteria, and against this the zooglœa are sharply defined. They are brought out even more distinctly by the surrounding colorless layer free from bacteria, which is doubtless an extension of the ground substance of the zooglœa mass.

The masses are far more dense than the pellicle, and compactly filled with bacteria, which have become highly refractive. They are oblong or globular in form, and may be single or united into chains of two or more placed end to end. When the length of the mass reaches 20μ, the mass, from a smooth surface, acquires a wrinkled, folded surface eventually, something like the external

aspect of the brain, but at first better described as mulberry-like. Whatever variation may take place, this peculiar cerebric surface is an unfailing character, and not known to occur in the case of any other bacteria.

The range of fluid culture-media is very great. An infusion of almost any vegetable substance containing a fair amount of soluble carbo-hydrate is likely to furnish sufficient nourishment for growth. The potato has proved most satisfactory. The infusion is prepared by slicing in 3 or 4 times its bulk of water, warmed to 70° C. and kept so for a couple of hours with occasional stirring, then filtered, and placed in culture vessels for sterilizing and use. The resulting liquid is clear and watery; iodine gives a blue coloration, proving the presence of starch; corn-meal similarly treated gives an almost equally good culture fluid. Media which are not well suited for the culture of the bacteria interfere with the growth of the pellicle, which may not form. The presence of ½ per cent. of malic acid prevented the growth of zoogloœa and the pellicle, but gave a sediment formed of groups of blight bacteria of the brilliantly refractive kind found normally on the borders of the pellicle. Two per cent. malic acid gave similar results with less abundant sediment.

In test tube gelatin cultures the most characteristic results have been obtained by adding bacteria to liquid gelatin, then thoroughly shaking the tube. In from 2 to 4 days the gelatin contains numerous small white dots, which, on examination, prove to be masses of bacteria. The dots are globular or oval, and increase to about .5 mm. No further growth takes place, and they remain for weeks without liquefying the gelatin. When sown on the surface of gelatin the growth is feeble and does not amount to more than a slight shining appearance. No success was obtained by the use of agar-agar. The most successful opaque solid cultures have been upon freshly-gathered unripe pears. Slices of these placed under a moist bell-jar and infected by touching with a needle which had been dipped into some substance containing the bacteria. In 2 or 3 days fine milky drops like beads of dew appear scattered over the surface for 5 mm. or more about the infected spot. In slices of baked or boiled potato the bacteria do not grow readily. The opaque solid cultures prove very distinctly that *M. amylovorus* requires a large supply of water for its best development, a fact which has an economic bearing.

The most successful stainings have been made with a watery solution of Bismarck-brown in cover-glass preparations, but no staining has been discovered by which to distinguish this bacteria from other micrococci.

The chemical changes brought about by the agency of the bacteria are not entirely understood. The most obvious product is carbon dioxide, which often passes off so freely as to produce slow effervescence. Butyric acid and alcohol are formed in very small quantities, if at all. Glucose does not seem to be formed, and there is a diminution in the amount of sugar. Tests made to detect the presence of a poisonous ptomaine, the early assumed cause of the disease, gave negative results in every instance.

3. *Action on the living plant.*

The bacteria have the power of growth and multiplication in the presence of the living cells of the pear, and in this one important respect differ essentially from other species of bacteria, as has been proven by experiment. It is upon this that the rapid progress of the disease depends—the blight bacterium extending far out among the living cells gradually kills them, and then other forms begin their work and escape destruction. One property which enables this species to so successfully penetrate the pear tree is its indifference to acids which prevent most other forms from making any growth; the juices of the pear give a strong acid reaction with test-paper. The chemical changes brought about in the plant by its activity cannot be definitely stated, further than to say that a mucilage or gum, which is soluble in water, is produced in

abundance, and the contents of the cells which have not been liquefied or changed into stony tissue pass over into this viscous product.

It was observed by early cultivators that any process of cultivation which prevents succulency is a check upon the disease. To determine, however, the relation between the hydration of the tissues and the progress of the disease will require further experiment. Experiments thus far made seem to give some support to the view that there is a direct relation between succulency and the strength of the disease.

The adoral cilia of the Hypotricha.

By DR. ALFRED C. STOKES,
OF TRENTON, NEW JERSEY.

The large and powerful cilia extending about the frontal border and down the left-hand margin of the peristome field to the oval aperture in the infusoria, forming the above-mentioned group, have been the subject of careful study, but until recently their true structure has not been elucidated. When in action, as they always are during the infusorian's life, they appear like large, thick, and tapering filaments which the celebrated German investigator, the late Count Fr. von Stein, thought to be simple ciliary threads lying in grooves, while other observers have described them as skin plates. In the February number of the Journal of the Royal Microscopical Society, however, it is stated that Professor K. Moebius, of the University of Kiel, has recently shown these cilia to be composed of numerous fine threads, whose connected basal portions form the transverse ridges of the ciliated organ. This is a correct description of the structure of these appendages. I am much pleased to be able to confirm the statement of the German professor. A year ago it became my good fortune to demonstrate that this structure is the true one, and for that length of time the matter has been in manuscript awaiting a convenient season for the preparation and publication of a paper on certain members of the Hypotricha. As yet I have not had access to Professor Moebius' original article. I know it, therefore, only in the abstract contained in the Journal of the Royal Microscopical Society, but this is sufficient for the present purpose.

To see these fimbriated cilia when the infusorian is well and ordinarily active is difficult, yet I have frequently thus observed them during a momentary pause in their vibratory action. But when the animalcule is dying from the effects of iodine poisoning, these appendages move more and more sluggishly, and then often appear like the partially unravelled ends of microscopic skeins, the largest and more anterior especially presenting this aspect. When seen for the first time, I supposed the appearance to be due to changes taking place as precursors of death and disintegration, but the repeated observation of the same fimbriated or comb-like condition in the living and healthy infusoria rather forced upon me an understanding of the correct interpretation. While the creature is undergoing transverse reproductive fission its movements often become languid, and it may for some time remain almost quiet in the field of view, and this ciliary structure may then be seen without much difficulty.

Observations on multiplication in Amœbæ.

Miss Lillie E. Holman, on July 4th, '86, while studying the forms in a life slide which had been filled for some hours remarked a great scarcity of amœbæ, though other infusorians were abundant. At length one was found of elongated, triangular outline and rather torpid. While examining it, a second of twice its size glided on the scene, moved up close to the other, and

appeared as if trying to swallow it. After about a half hour the larger one had entirely surrounded the smaller one, which did not, however, lose its vitality, but did not seem to try to escape. The larger one now moved about with the smaller one engulphed and quiet. Finally the larger amœba expelled the smaller one, after which it began to expel refuse matter, or had anchored itself near some other refuse matter, and looked as if using it as a sort of grapple to rid itself of the smaller amœba. It was successful, and moved away, leaving the latter looking like an encysted amœba lying near the little group of refuse. The smaller one, now disk-shaped, commenced a contractile movement, throwing out particles or granules as if it were laying eggs—the particles had no regularity of shape though of approximately the same size. After a time this ceased, and the amœba, putting out pseudopadia, moved in the field, leaving behind a group of the particles. This amœba soon lost animation, became transparent, and seemed to fade into a mere shell of its formerly active form.

This observation occupied several hours, and the author suspected it of being a clear case of conjugation, in spite of the fact that the process had never been reported before as taking place in amœba.

In confirmation of this suspicion it is further stated that two nights thereafter the slide, which had been laid away carefully for future examination, was found to be full of young amœbæ. They literally swarmed, and it was estimated that between one and two hundred were in the slide which had held but two. The worn out disk was recognized and what seemed to be the remains of the larger amœba.—*Proc. Acad. Nat. Sci., Phila.*, 1886, p. 346.

MICROSCOPICAL TECHNIQUE.

Mounting opaque objects.

By C. M. VORCE,
CLEVELAND, OHIO.

At page 73, of the April number of the *Journal*, is an article under the above title, which, since it embraces a method of which I have had a pretty full experience, I think demands a word of warning. *Pasteboard or cardboard is not a good material for microscope slides.* I make this assertion broadly, without wishing to disparage the results that some may have obtained by its use, but from the experience and observation of a quarter of a century of microscopical study and recreation.

The objections I have found to it are, first, its lack of rigidity; second, its lack of durability in use; and third, its lack of resistance to the effects of heat and moisture. About twenty years ago I was taken with a spasm of economy in the matter of slide materials, all of which cost then from three to four times what they do now, and invented the precise method described by Mr. Brown, which was even then not novel I found. At first the saving of cover glass was a great satisfaction to me. I tried all sorts of cardboard, strawboard, tarboard, both light and heavy, and wooden slips. I found the method so simple and speedy that I soon accumulated several hundred slides mounted in that manner. By that time trouble began to appear, and thereafter was never absent until a lucky accident relieved me of the whole collection. First, the effects of dust upon the uncovered objects became apparent, and applying a cover *then* would not help the case. Soon the binding paper and edges of the slides became worn, torn, and rough, looking unsightly and giving no end of trouble in use. To exclude dust the slides

were kept in packs with a solid piece at top and bottom, and a rubber band to hold them. It soon became common to open one of the packs for a particular slide and find it, with many others, destroyed by insects. To prevent the growth of mould, etc., the slides were kept in a box in a dry, warm closet; this caused the paste, gum, or glue to crack, and often to peel off the binding paper and labels, until I learned to add glycerin to the gum or glue; then it never became entirely dry.

My tribulations continued in this fashion until one spring, when house-cleaning invaded the premises, during which operation, unknown to me, some water was spilled upon my box of pasteboard slides. When the house was 'settled' again I found them a reeking mass of blue mould and all irretrievably ruined, those that were covered as well as those that were not. I have never mounted a slide on pasteboard since.

Pasteboard slides, even of heavy tarboard, bend so easily as to crack or loosen covers very easily, and unless well saturated with some resinous varnish are liable to mould on the slightest provocation, or to take up moisture from the air and deposit it under the cover. The material is so soft as to wear rough speedily in use, and covering with paper helps it but little to stand wear. Wooden slips are vastly better and can be cheaply made by boring a hole centrally edgewise through a piece of wood one inch thick and three inches long, of any width, and slitting it up on a saw table. If too thick they are clumsy, and if too thin are flimsy.

For the class of objects named, for which low powers will ordinarily be sufficient, glass is the best material, and admits of examining both sides of the object. For objects that *must* be viewed uncovered and on both sides, no other mount will equal two of Pierce's capped cells mounted back to back with the object between, and fixed in a wooden slip, either temporarily or permanently, or on a metal plate.

I venture the prediction that whoever uses cardboard for slides to any great extent will regret it.

Gums and pastes for labels.—It is usually found that the addition of acetic or nitric acid to gums, glues, or pastes will make an efficient adhesive for almost any purpose. But, the following notes by Mr. L. Eliel, read before the American Pharmaceutical Association, may be useful:—

1. Gum tragacanth, 1 oz.; gum arabic, 4 oz.; dissolve in water, 1 pt.; strain and add thymol, 14 grains, suspended in glycerin, 4 oz.; finally add water to make 2 pints. This makes a thin paste, suitable for labeling bottles or wooden or tin boxes, or any other purpose for which paste is liable to be required. It will keep sweet indefinitely, the thymol preventing fermentation, and though it separates on standing, a single shake will mix it sufficiently for use.

2. Rye flour, 4 oz.; powdered acacia, ½ oz.; rub to a smooth paste with 8 oz. of cold water; strain through a cheese-cloth and pour into one pint of cold water; heat until thickened to suit. When cold add glycerin, 1 oz.; oil of cloves, 20 drops. This is suitable for adhesion on tin, wood, or glass, and keeps sweet a long time.

3. Rye flour, 4 oz.; water, 1 pt.; nitric acid, 1 drm.; carbolic acid, 10 min.; oil of cloves, 10 min.; glycerin, 1 oz. Mix the flour with the water, strain through a cheese cloth, and add nitric acid. Heat till thickened to suit, and add other ingredients when cooling.

4. Dextrine, 8 parts; acetic acid, 2 parts; alcohol, 2 parts; water, 10 parts; mix dextrine, water, and acetic acid to a smooth paste, then add the alcohol. It makes a thin paste suitable for wood or glass, but will not adhere to tin.—*English Mechanic*, Feb. 18, 1887.

A new photomicrographic apparatus.

By A. G. FIELD, M. D.,
OF DES MOINES, IOWA.

The apparatus is explained by means of the following references to the engraving (plate V):

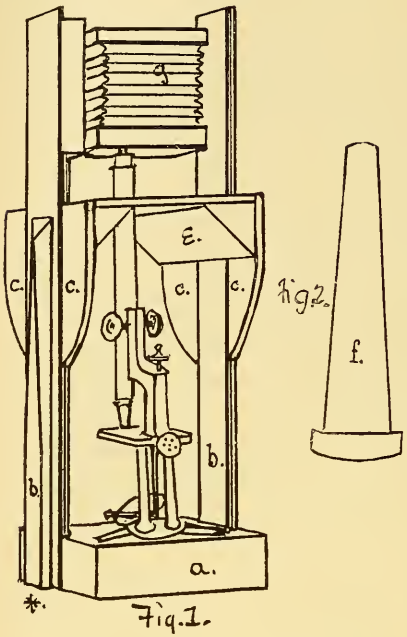

PLATE V.—Photomicrographic Apparatus.

a is the base, 14 × 14 × 5 inches; *b b* the uprights, 5 × 1 inches, 7 feet high. The uprights are grooved on their edges to receive the tongues on the arms, *cccc*, of the secondary base and of the camera carrier. The uprights are made firmer by additional pieces extending up 30 inches from the base. *E* is the secondary base, 14 × 14 inches, adjustable as to height and perforated for tube of microscope when arranged for high amplification. In low amplification the microscope may be placed upon it. *f* is the pasteboard cone, with camera front, used in copying and in very high amplification. The camera, *g*, is attached to the uprights by a sliding-box carrier, tongued for grooves in uprights. The stand is used upright in microphotography, for horizontal stage in work with fluids and unmounted objects, and horizontal in copying. The uprights are precisely perpendicular to the bases, which are centred by diagonal and parallel lines to facilitate arranging the instruments in line and centre.

Bank-note cement.—Soften 1 lb. of the best glue in water, boil to dissolve, and strain it very clear; boil also 4 oz. of isinglass, previously softened by steeping in water; put the two together in a double glue-pot with ½ lb. of brown sugar, and boil the mixture until it is quite thick; then pour into plates or moulds. When cold, cut and allow to dry, when the pieces are ready for use. They can be carried in the vest pocket. The cement is very useful for joining pieces of paper containing drawings, torn greenbacks, etc., as it immediately softens when applied to the tongue.—*Chem. and Druggist.*

EDITORIAL.

Elementary histology.—We have, during the progress of the current year of the *Journal* work, received numerous letters from subscribers, some of which were kind and encouraging; for them we would desire to thank the writers, whose sympathy we are glad to have; others, while commendatory, mentioned features which the writers would desire to see introduced. To some of these requests for articles of particular character, we have been glad to respond where it has been within our power, and we shall continue the practice so far as practicable. It is, in part, in answer to such a request

that we have projected a series of articles, elementary in character, which shall set forth the facts and principles of animal histology as a branch in the science of zoology.

We are led to present this series of articles by a second consideration, as well; namely, by the want, on the part of many teachers, of a text which can be used by beginning students. We are aware of the many good guides to vegetable histology, but have not, in our own experience, found the book to put into the zoological laboratory as an introduction to this branch of the subject. As many of the readers of these pages are teachers, we feel assured that they will find at least suggestions toward a plan of work, if not the detailed plan which will be useful to them. We, perhaps, will seem to stretch the meaning of elementary by introducing so many details to the reader, but wish to say that they cannot be avoided if one desires to present a sufficient account of animal histology as it exists at the present time.

We think there is a confusion of ideas abroad in the land regarding the meanings of the elementary and superficial. These words are by no means synonymous, though often used interchangeably. Now, a merely superficial idea is one of no value to its possessor; it gives him nothing which he can use. By its possession he can listen, perhaps, and look wise when the subject is up for conversation, but when cornered with a question he quickly pleads an insufficient knowledge, which is no better than ignorance. Such is not 'elementary,' which work is more allied in significance to 'essential.' An elementary course is, or should be, understood to be one which presents the outline of the subject stripped of the most of its details, but with enough clinging to the outline to enable one to supply the rest. Thus of anatomy:—elementary anatomy of muscle tells of the bone, and joint, and tendon, and muscle structure, but after mentioning the biceps and gastrocnemius, and a few other examples, leaves the others untold as repetitions merely.

'Elementary' does not mean 'easy;' in fact it is more difficult than would be the study of mere fact after fact, for it includes, besides the comparatively easy pursuit of facts, the discrimination of those essential to an outline merely, and not more than that by reason of the too numerous details. All true students of nature, whether as professionals or as amateurs, following science as a relaxation, are equally in search of this outline or skeleton, and this gives a higher purpose to their study than mere accumulation could alone furnish. We are not to be misunderstood to mean that we need not bother with detail. Any one who possesses our elementary course will doubtless find detail enough to suit him; but we mean that in the pursuit of the detail he must not be distracted from the whole, of which the detail forms only a part, and by his study exaggerate to grotesqueness what should be a symmetrical whole of information.

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Japan sends us occasional very interesting notes through the former editor of the *Journal*. We understand, of course, the isolation of one so far removed from the working centres, and value anything from such an one the more. Our readers will all be interested in the occasional contributions from Prof. Hitchcock, and trust that he will, as the year progresses, find much of interest to tell us and the time to write often.

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Marine diatomaceæ of the southern waters of eastern United States are receiving attention from Dr. Geo. N. Taylor, of Mobile, extracts from whose letters may be found in our department of correspondence. Dr. Taylor has sent us one of his phials for examination, and it contained a large number of very beautifully cleaned forms. These we distributed to a few friends,

from whom we trust to have some particulars which will interest our readers. Dr. Taylor wishes to distribute his collections to those especially interested in diatom study, and all such who wish to obtain some of this fine material will do well to communicate with him. The collections will be distributed free, except a slight charge to recover the cost of obtaining the raw material. No attempt will be made to market the material, and Dr. Taylor expressly states that only one phial can be had by any one individual. This systematic study of these waters will no doubt furnish the basis for a very thorough survey of the diatom flora of our southern marine waters.

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The American Association for the Advancement of Science will hold its 36th meeting in New York city, beginning on Aug. 10th, 1887. The meetings will be held at Columbia College, Prof. S. P. Langley presiding. Prof. E. S. Morse, of Salem, who is the retiring president, gives the address.

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The American Society of Microscopists will hold their annual meeting at Pittsburg, Penna. The date of the meeting has been fixed at Aug. 30, to last probably 4 days. There is promise of good work this year. Plans are not yet complete, but they include the following: Much attention will be given to practical demonstrations. Prof. S. H. Gage will demonstrate methods of preparing areolar tissue. Dr. Reeves will demonstrate his method of section cutting. Prof. Smith will continue his papers upon Development of Diatomaceæ. A fuller account of the plans for the meeting has not yet reached us, but we hope to be able to place it before our readers in our next number.

CORRESPONDENCE.

To the Editor:—I send you a phial of diatoms from a new find (Tampa Bay, Fla.) The cleaning is not finished, so you must allow for that in examining it. I will have about twenty phials to dispose of to your subscribers. The rest of the cleaning, some eighty phials, will be sent out to my friends, through Queen & Co., of Philadelphia. This is the last work I shall do on the Gulf coast. I am about to extend my investigations along the Atlantic coast, and shall confine myself to the bays and sounds. The entire result of this work will be sent out through Queen & Co. free to all who apply for it.

The cost of the raw material is beyond my means, and I take this method of disposing of diatoms to help pay for *muds* from the Atlantic coast. I will send the *cleaned* diatoms to any one who will furnish me their name and address, and allow them to place their own value upon it.

I hope that those who really take an interest in diatoms will at least help me to pay for the raw material, in order that they may obtain the cleaned. I have sent out forms from the Gulf for some years without exchange, and have distributed free to all, through Queen and Co., of Philadelphia, *water-washed* diatoms from Mobile Bay, Bon Secour Bay, Pensacola Bay, and St. Andrew's Bay, the entire result of two years' hard work, and enough forms to make at least four hundred phials, each phial of which should have contained enough material to make one hundred slides. I am now about to extend my researches to the sounds and bays of the Atlantic coast. My first point will be Albemarle Sound, N. C. I shall endeavor to work up the salt-water deposits to the best of my ability, but lack of means will be my greatest drawback. I worked for years on the Gulf deposits until I became skilful as a cleaner. I have a few phials of cleaned forms, on which I spent one month to each phial, and used three gallons of mud and four hundred gallons of water to produce the desired result. I thank you for your kind letter, and will cheerfully give any information in my power to any who may require it through the columns of your *Journal.*

Geo. H. Taylor.

Mobile, Ala.

MICROSCOPICAL SOCIETIES.

Resolutions of the Cleveland Microscopical Society in regard to the death of Allen Y. Moore, M. D.:

Whereas for the second time in the history of this Society the visitation of Providence has removed from our midst by death one of our most valued members and personal friends in the person of Dr. Allen Y. Moore, who died April 16th, 1887, after a brief illness;

And whereas we, the members of the Cleveland Microscopical Society, desire to express our heartfelt sorrow at the decease of our esteemed fellow-member and our sympathy with the bereavement of his relatives and friends: therefore

Resolved, That in the death of our lamented friend and member, Allen Y. Moore, M. D., this Society has suffered the loss of one of its most earnest and valued members, whose labors and studies in microscopical science and whose unwearied interest and efforts in the work of this Society has contributed largely to its success and greatly sustained and encouraged the interest of his fellow-members, and the science of microscopy has lost an earnest devotee and an energetic and original investigator, whose researches have advanced in no small degree the store of knowledge upon which the useful and reliable use of the microscope depends.

Resolved, That in the death of our deceased member we feel the loss of a genial friend, endeared to us personally by his many estimable qualities of mind and heart.

Resolved, That our warmest sympathies are extended to his bereaved family and relatives, whose loss so far overshadows ours, who are called upon to mourn not only their beloved one but his removal from his field of usefulness at a time when his marked abilities gave promise of distinction and increased usefulness to science and his profession.

Resolved, That a copy of these resolutions be forwarded to his family and to the American Society of Microscopists, and furnished to the press and microscopical journals for publication.

Resolved, That a suitable memorial be prepared and spread upon the record of the Society.

Brooklyn Microscopical Society.

This Society, organized in 1880, has grown to be one of the most flourishing associations in the State. Its object has been comparison of work and methods by informal methods, at bi-monthly meetings, rather than the discussion of set topics and papers. It numbers about seventy-five members, and includes all the prominent scientists, physicians, and amateurs in Brooklyn. On Tuesday evening, April 19, a reception was given at the hall of the Adelphi Academy, and a throng of ladies and gentlemen accepted the invitations. Sixty-eight microscopes were arranged on tables in the spacious hall of the Academy. The instruments were numbered and the catalogue informed the observer of the object and exhibitor. The exhibits bore testimony to the care of preparation, as well as the skill in instrumental manipulation and illumination by the members, and the selection of slides by the committee in charge does them credit.

Space forbids a detailed description of the objects shown, but a few deserve special mention. Dr. J. H. Hunt exhibited two fine injected specimens, transverse and horizontal, of the scalp, showing hair follicles surrounded by arteries. Mr. H. S. Woodman showed the reflection of the second-hand of a watch in each facet of the beetle's eye. The definition of this display was particularly fine. Mr. Joseph Ketchum exhibited four stands: asparagin by polarized light, double-stained and injected section of cat's intestine, showing arteries in villi; bacteria of cholera; and a superb slide of arranged polycestina. The illumination of this table was by means of a portable oxy-calcium lamp recently devised by Mr. Ketchum, and which, when packed, occupied a case only thirteen inches long by six inches square. The oxygen cylinder was 3 x 12 inches long and contained four hours' supply; the illumination was very fine. Mr. H. E. Fincke exhibited four of the instruments made by the Bausch & Lomb Optical Company, and which were greatly admired. Mr. H. E. Chapman presented plant hairs (*Shepherdia canadensis*) with polarized light, which elicited an 'Oh! my!' from every lady inspector.

Prof. W. C. Peckham had a table to himself, on which were four splendidly-equipped

instruments. He exhibited carniverous plant hairs (*Drosera filifolia*) with paraboloid illumination, green felspar with polarized light, raphides in garlic (*Allium sativum*), and a drop of the city water. The latter created quite a stir among the ladies, many expecting to see all kinds of fierce beasts, and were agreeably disappointed when they found it clear. Mr. G. M. Hopkins exhibited the path of the electric spark on smoked glass, salacin disks rotating in opposite directions, and Newton's rings. W. S. Brevoort, Esq., had a section of the flowering dogwood, with the polarizer rotated by an ingeniously-contrived clock-work train. Geo. E. Ashby, Esq., exhibited insect in fossil gum-copal from Zanzibar; Mr. G. M. Mather, globules of mercury sublimed; Mr. J. Lee Smith, one of his sixty-five-hour chicks; Dr. C. N. Hoagland, *Bacterium termo* with a $\frac{1}{18}$ Zeiss oil-immersion objective; Mr. G. D. Hiscox, head of diamond beetle and a slide of arranged diatoms; and Mr. John Green, *Amphipleura pellucida* under a $\frac{1}{18}$ objective, recently completed by himself after Tolle's formula, and others which space forbids our mentioning.

At nine-thirty the lights were extinguished, and Prof. Peckham and Mr. G. M. Hopkins projected about one hundred slides upon the screen with the superb lantern belonging to the Academy. Altogether, it was a most successful and interesting affair. The committee having the matter in charge deserve credit for the way in which it was managed. They were G. D. Hiscox, W. C. Peckham, Joseph Ketchum, Geo. E. Ashby, and E. C. Chapman.

SIT LUX.

—o—

SAN FRANCISCO, CAL.

A well-attended meeting of the San Francisco Microscopical Society was held on the evening of March 23.

The committee to which was referred the subject of tuberculous milk asked to be discharged, as from the great difficulty of finding suitable material it was almost impossible to proceed further in the matter at present. In the specimen of cow's lung which had been submitted as containing *bacilli*, none had been detected. On motion the committee's request was granted.

A valuable addition to the society's already extensive library was made by the receipt of over thirty volumes of publications of the Smithsonian Institution, including all those bearing upon Microscopy. A special vote of thanks was tendered Congressman Morrow for his good offices in procuring this donation.

A very beautiful specimen of crystallized sulphate of baryta, from Derbyshire, England, was received from Thos. Clark, of the Birmingham Natural Historical Society. It bore a most remarkable resemblance to a transverse section of a vegetable stem.

Mr. Howard showed specimens of *Noctiluca miliaris*, the interesting little organisms to which is mainly due the well-known 'phosphorescence' of the ocean. The gathering (which was a very plentiful one) also contained numerous specimens of the rare *Leptodiscus medusoides* (Hertwig) an organism allied to *Noctiluca*, but distinguished from the latter principally by the entire absence of any transversely-striated tentacle, and by the very regular reticulate appearance of the contained protoplasm.

A block of diatomaceous earth, sent by R. E. Wood of St. Helena, for examination, was referred to Mr. Howard.

On motion, the Chair appointed a committee to consider the matter of printing annual reports, and also of making the exhibiting of attractive slides a regular feature of each meeting, after the disposal of the routine business.

A slide of arborescent silver crystal was handed in by Dr. E. S. Clark. A slide of native gold crystals from quartz, also mounted by him, was of unusual beauty.

Reference was made to the newly discovered deposit of fossil diatoms at Omaru, New Zealand, which is attracting much attention at present in microscopical societies by reason of its great richness and the large number of forms entirely new to science found therein. A slide of this beautiful deposit was examined with great interest.

After ordering some new accessories for the society's Nachet microscope the meeting adjourned to the 13th prox.

A. H. BRECKENFELD, *Rec. Secr.*

—o—

WASHINGTON, D. C.

At the 58th regular meeting of the Society, Dr. C. T. Caldwell made a few remarks on a new cement, which he had first used at the suggestion of Dr. Taylor. It is simply the article sold at the paint and oil stores under the name of "hard oil finish." He

did not know its exact composition, but had been told that it contained shellac, copal, linseed oil, and turpentine. It runs freely, makes smooth rings, dries readily and quickly, and is extremely adhesive. It is cleanly. Slides made with it had not changed in six months. It can be used also as a mounting medium. It does not affect polarization. Water and glycerin mounts are very easily made. A cell can be made, a mount made, and cover-glass put on inside of ten minutes. Wet slides can be ringed by simply wiping off the superfluous moisture and running a ring around. This makes it easy to preserve urinary deposits which otherwise would be lost. Several slides were shown, some of which, mounted only about four hours before the meeting of the Society, were quite hard enough to bear ordinary handling. Dr. Taylor said:—I think this varnish contains oxidized linseed oil, which will account for its polish and rapid drying. I have used it with success, and think it almost as good as James' and much cheaper. Almost any color can be mixed with it.

Dr. Schaeffer said:—I think the cement contains asphalt. In my experience some balsam preparation answers better for a cement than anything else. Time is the only test for a cement.

Dr. Reyburn said:—Some years ago I used as a varnish a fine article of copal with success. The principal objection to it was its slowness in drying.

Prof. Seaman said:—I think the cement a valuable addition to our armamentarium. I do not think there is much oxidized oil, because it is so cheap, and the oxidized oil is costly. The cheapest gums in the market are kauri and damar. I think the cement contains kauri and the silicates of soda and potash combined with turpentine and benzine. Nearly all cements have been failures because of their lack of adhesiveness to glass.

The annual soirée of this Society will be held on April 26th.

E. A. Balloch, *Rec. Secr.*

——o——

Washington, D. C.

At the 59th regular meeting, April 12th, 1887, Mr. F. T. Chapman said:—

Artificially prepared silver crystals make fine opaque objects for the microscope, either as permanent mounts, or for observing the process of crystallization, and they may be readily prepared, although some care is necessary in order to obtain the best results, especially if the preparation is designed to be permanent.

The deposition of silver from a solution of silver nitrate by means of copper, preferably a copper-wire ring placed in a sufficiently deep cement cell, gives very good results if the wire ring and the thicker mass of crystals at the edge be removed, and the specimen then thoroughly dried and protected by a cover-glass in the usual way.

Much better results, however, can be obtained with a brass cell provided with a removable cover or cap (known as the 'Pierce cell'), and cemented to a glass slip, the cell being backed by dark-colored wax.

When filled with the solution, the deposition of silver crystals on the inner surface of the cell will immediately commence and proceed slowly toward, but should not be permitted to reach, the centre. When the crystals have approached so near the centre as to leave a clear space of about one-eighth of an inch in diameter, the solution should be removed by means of a small piece of blotting paper placed on top of the cell and allowed to remain for a moment.

The strength of the solution is not important, but should not be very weak, as the feathery masses of cyrstals that add greatly to the beauty and 'depth' of the mount do not then appper.

If the crystals, when forming, appear white and brilliant, or darken slightly, or appear to be very fine or small at the sides of the cell, while those at the bottom are spray-like and quite large, the result will usually be successful, although the best conditions are when the bottom of the cell is occupied by several large feathery sprays of crystals, and the sides by shorter sprays or spine-like crystals, the whole being white and brilliant.

Sometimes, after the solution has been removed, a deposition of copper on the silver will be found, or crystals of copper salts will intermingle with the silver, and mar its appearance, in which case it is necessary to reprepare the mount.

If the silver be permitted to reach the centre, a black precipitate will form and spoil the preparation as a permanent mount, but as the fluid is then filled with a mass of minute, sparkling crystals in constant motion, the effect is both interesting and beautiful when viewed with a power of about twenty-five or fifty diameters.

The time usually occupied in preparing a silver mount is about five minutes, the

preparation being completed when the solution is removed from the cell by the blotting paper.

If the crystallization of the silver be unsatisfactory, the cell may be readily cleaned and another layer of wax applied. In order to apply the wax to the cell, a sheet is placed on the cell, pressed slightly with the finger, and a disk of the wax forced into the said cell by means of a cork that will snugly fit it, sufficient pressure being applied to cause the wax to adhere to the glass slide or to the wax already in the cell.

There seems to be no rule by which the deposition of the crystals can be regulated, as under apparently the same conditions one preparation will be successful and the next one will be a failure.

It would seem that a small quantity of gum in the solution would cause the crystals to adhere, and prevent them from breaking or shaking loose when the slide is handled roughly. Gum arabic has been tried without success, as it causes the crystals to turn black.

However, the crystals usually adhere firmly enough to the cell and to each other to stand all ordinary usage.

A greater mass of crystals may be obtained by repeating the deposition in the same cell, and allowing one mass of crystals to form on top of the other.

When forming in the solution, the crystals seem to almost completely fill the cell, standing out laterally, but when the fluid is removed they fall to the bottom and appear to the eye to form a thin layer, but under the microscope they stand out in bold relief.

Dr. Caldwell showed a 'bolus,' one of about a peck, recently removed from the colon of a horse that died of peritonitis. The mass was about two inches in diameter, of a brownish color, and showed facets where it had been impacted against neighboring masses. The mass was yielding to the touch, and was of a soft feeling like felt. Microscopical examination showed it to be composed principally of hairs, with traces of calcareous matter. Upon examination of the specimen, Dr. Taylor thought the whole thing was composed of 'vegetable hairs,' and thought it had resulted from eating some kind of feed containing the hairs. He thought it would be interesting to examine some of the feed to which the horse had been accustomed.

Dr. Schaeffer showed several masses about the size of a filbert which had been submitted to him for examination by a physician who stated that they were from a patient of his who told him that she coughed them up, and also passed them from her bladder and rectum. Microscopical examination showed the masses to be composed entirely of lung tissue.

E. A. BALLOCH, *Rec. Secr.*

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology.
HENRY L. OSBORN, Lafayette, Ind.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired.
M. A. BOOTH, Longmeadow, Mass.

Wanted, exchange of slides, and correspondence on unusual urinary products.
J. M. ADAMS, Watertown, N. Y.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one.
K. M. CUNNINGHAM,
Land Office M. & O. R.R. Co., Mobile, Ala.

Pathological and Histological Slides (very fine) in exchange for other good slides.
F. M. HOYT, 160 Washington Park, Brooklyn, N. Y.

Correspondence with animal histologists with regard to exchanges solicited.
HENRY L. OSBORN, Lafayette, Ind.

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Elementary histological studies of the Cray-fish.—II.

BY HENRY L. OSBORN.

(*Continued from page* 87.)

In the further study of the green gland a power of 350 diameters or thereabouts must be employed. The purpose of the study is to trace out more definitely the various elements which, placed together, form the organ whose position and shape have already been observed with the naked eye and with the low power. It is convenient to restrict the meaning of the word histology and apply it to the study of these various elements, their various shapes, and the way in which they are combined. The elements themselves are called the cells.

Examination with the low power has already shown that all the substance of the gland inside the outer sheathing sack (J) is made up by cavities bounded by a wall and that the wall itself presents everywhere much the same look. Select the cavity in which the reference letter E is placed and examine the wall: the result is shown in figure 3. Here are to be seen, *a*, the blood space, b. c.;—*b*, blood corpuscles, bl. c., lying in the blood space;—*c*, a sharp line which borders the body cavity, the basement membrane, b.m.;—*d*, a faint line running approximately parallel with the basement membrane, the outer cell wall;—*e*, fainter lines running from the outer cell wall to the basement membrane, c. w., the side walls of the cells;—*f*, finely granular matter in a dark zone near the basement membrane, the protoplasm;—*g*, a circular sharp line in the protoplasm bounding more colored matter, the nucleus, n. The skilled histologist looks for all these different parts at once; notes which are prominent, which are indistinct, and makes many instantaneous inferences as to what must be the fact where the fact cannot be observed. And he finds it difficult to understand the beginner in his perplexity. Since some of the seven parts mentioned above are always easy to see and others are often to be known only by inference from indications of them rather than by observation of themselves, I shall take up each one in course and discuss its appearance or how to see it.

a. **The blood space.**—Spread all through the gland are spaces which are in no case completely circumscribed. These spaces form a complete network of intercommunicating avenues, which traverse the entire structure. They are of very various shapes. They may be narrow passages between the cellular walls of the gland alveoli, where usually a few oval blood corpuscles may be seen; sometimes so narrow that they are seen only as a faint line, or even obliterated for a short distance. In other cases they are broad open areas, usually containing much larger numbers of corpuscles. The blood spaces seem to be a place of resort for the corpuscles; in fact, they are the only portion of the gland in which they are ever found. The blood

spaces also always lead from the centre toward the outside of the gland, and they lead by openings through the sack, J, which envelopes the gland, to the body space, in which the gland itself lies. The blood space is shown in fig. 2, and at g. m. the gland sack and the position of the blood space (b.c.) are shown.

b. **The blood corpuscles.**—Scattered through the blood spaces in all parts of the gland (*e.g.*, fig. 3) one may see small globular bodies, the blood corpuscles. The presence of these may be taken as demonstrating the continuity of the blood cavity, even into the places where the walls of the gland cavities are in immediate contact, and justifying the inference that these walls are only temporarily pressed against each other. The corpuscles are all alike in appearance, except some slight variations as to size. Each one exhibits an outer thin coat, which is hardly distinguishable from the very deeply-staining substance making up the mass of the corpuscle. Each corpuscle is regarded as a cell. The substance of the cell is not homogeneous, that is, of even texture throughout, but is made up of portions mixed together very closely, but some of them staining much more deeply than others. About six of the corpuscles, laid side by side, would measure one one-thousandth of an inch; the corpuscle is, therefore, about $\frac{1}{6000}$ of an inch in diameter. The corpuscles always seem circular or oval in all parts of all sections. What are we to say as to their real shape? In studying sections the student must keep constantly in mind that in sections he is not dealing with objects as he deals with objects of natural vision. In microscopical study there is very little or no perspective; a cylinder or a sphere may look the same in section, and this fact must be constantly kept in mind in interpreting one's observations. Bearing this in mind, shall we think the corpuscles to be globules or the cut ends of cylinders? The question may be settled, of course, by study of the blood of the cray-fish from a fresh specimen in a film, after the usual manner. This would be final, and, at the same time, an easy method. A second method would be to cut sections in various planes. This method must be applied to the study of some tissues. It would show the corpuscles of the same shape in every plane, and hence spheroidal bodies, the only rounded bodies which can have the same shape in any section.

The name for the substance of the corpuscle is protoplasm. What it is, chemically, does not concern us at present, but microscopically, protoplasm presents certain characteristics which are met with here, as in all living cells, some of which we must note. Protoplasm in animal or vegetable cells, so long as it is alive, does not stain readily. But as soon as it is killed, we cannot say before it has undergone any change, but we believe before it has changed greatly, a great variety of reagents affect it in ways which the histologist uses to help him in his studies upon it. For one thing it is very deeply colored by various dyes, as logwood or carmine or the anilines. When so colored it never has a clear, transparent look, but an opaque, or, at least, translucent, look, and may be coarsely granular, with some granules densely, and others faintly, stained, or it may be very coarsely granular. The substance of the corpuscle has the appearance of a densely granular protoplasm deeply and very thoroughly stained. While speaking of protoplasm as staining thus, we must notice that many other substances which will dye with the proper dyes do not look like this cell substance. Thus fat, starch, and horn may be mentioned as three which, if present in the free state in the green gland in any quantity, could be told from the protoplasm merely by their different reactions toward staining fluids. I mention these matters to enforce the importance of noting well the appearance of the substance within the corpuscle. We shall later meet with cells which contain something besides protoplasm.

It is very doubtful if there be any envelope differing essentially from the protoplasmic substance of the corpuscle which envelopes the substance. On the other hand it seems most probable that the substance is naked, that it is not covered by any envelope or cell-wall. If one examine the living blood corpuscle under certain favorable conditions it will be seen to undergo changes of shape, and from the globular assume stellar forms, 'amœboid forms,' and this indicates that a wall of any great density could not be present. Moreover, in examination of the corpuscle no wall can be seen separate from the protoplasm as may be seen in many other cells.

We must note before leaving the blood corpuscle how the microscope alone is unable to furnish all the facts which the biologist must possess. The corpuscles are a part of the blood, but the other part, the fluid which carries the corpuscles, is not seen though, we doubt not, present in the blood space (b. c.) and to be studied in other ways. As a study of the blood itself would form a topic for a special chapter, I must leave it for the present.

c. **The basement membrane.**—The blood space (b. c.) is bounded, except upon the outer borders of the gland, by the walls of the cavities of the glands called the '*alveoli*.' The alveolus of the gland is the active portion of the apparatus in vertebrate language, and we may use the same term here, though here duct and alveolus are less different in structure than in the salivary gland of the cat, for instance. The wall is composed of cells packed closely together and they are supported by a very thin and delicate structure which also bounds the blood space, the 'basement membrane.' This membrane is not always to be seen in all parts of the section, and, in fact, more often it cannot be seen. Looking at the borders of the blood space, one most often finds the end of the cell apparently in direct connection with the space, but in numerous places a very sharp though very thin line may be discovered between the cells of the alveolus wall and the blood space.

Other investigations show with regard to the basement membrane that it is itself cellular, though sections across it ordinarily show no trace of a cellular structure. It is composed (in mammals) of very broad and flat cells, spread out to form a surface on which the cells of the alveolus wall are carried. A basement membrane thus carrying cells is, together with the cells carried, called an epithelium, and the green gland of the cray-fish gives us an introduction to an epithelium in its simplest form. One point in regard to the position of the basement membrane requires especial emphasis, for, while characteristic of epithelium in all animal histology, it is seen here illustrated in the simplest manner. It is that the basement membrane always stands between the blood spaces (or blood vessels in the higher animals) and the epithelium cells, and forms an impassable barrier to all substances except those especially provided for, which would pass to or from the blood through it.

Since the basement membrane is very important for the working of animal bodies, its presence as part of every epithelium surface should be demonstrated if possible. But it is often so difficult to see that a prolonged search may be necessary along the walls of the alveoli before a place is found where it can be distinctly demonstrated. Such a search will usually be rewarded, and its presence, clearly in a few places and faintly in others, is evidence of its general presence, despite the difficulty of seeing it elsewhere. The basement membrane bounds what is known as the inner ends of the epithelium cells.

d. **The outer cell-wall** will be seen approximately parallel with the basement membrane. In the part we are now particularly describing (fig. 3) it is a very faint line intervening between the lumen of the alveolus (L u) and the substance of the cell. It is one-thousandth of an inch, or more often less, from the basement membrane, and is the limiting membrane or wall

of the part of the cell which directly faces the cavity. The substance within the cell may be traced to the outer cell-wall, but never beyond it. The part of the cell which lies next this wall we will call the outer end of the cell, as the part next the basement membrane is the inner end of the cell. The distance between the inner and outer cell-walls is the height of the cells here, $\frac{1}{1000}$ of an inch in a few cases.

e. **The side walls** of the cell are often very hard to see, hence the exact contour of the cell is very often almost impossible to determine. It is easy to see why this is so. The animal cell wall is so extremely thin that we scarcely ever see it when it lies in contact with the contents of the cell, especially if this substance is placed on both sides of it by the contact of two cells. Now the end walls stand between very unlike substances, and their position, if not the actual walls, is easily determined, while the side walls, wedged between two very similar masses of protoplasm, are often almost or quite invisible. They can, however, be seen in various places if one is patient, and often careful focussing will bring them to view. When they can be seen they give us, of course, the exact boundary of the cell as it was left by the various preservative reagents. They can never be seen in every part of a section as plainly as it is the custom to represent them in illustrations, and in the figures (plate iv, fig. 2) illustrating this paper they are drawn too plain, for the purpose of making it possible to trace their outline. The strip on the extreme right of that figure is, however, faithful to the section represented. In tracing the outline of the cell the observer meets very great difficulty from this faintness of the cell-wall, and it is, perhaps, the most dissatisfying experience at first in the attempt to determine the boundaries of cells such as these.

f. **The protoplasm.**—While the boundary of the cell is thus very obscure, the protoplasmic substance within the cell, by reason of its affinity for the staining fluid, is always brought into prominence. This is differently distributed in different kinds of cells, or even different similar cells of a single organ. In the part at present under consideration (see fig. 3) there is a very marked difference between the inner and outer ends of the cells. The outer ends are very transparent, and faintly stained, with only here and there an indication of granular matter. Somewhat deeper the tint becomes deeper and the granules more numerous, and in the deepest portion of the cells the protoplasm becomes deeply stained, the granules very thick, as if, perhaps, the protoplasm were especially aggregated in the deep portion of the cell.

The protoplasm of these epithelium cells is by no means so intensely colored as that of the blood corpuscles. This may indicate some difference in its constitution; it might also indicate that the protoplasmic substance is less compact than in the blood-corpuscle. Very possibly both are true. We must note also here the even character of the protoplasm of the cells, that is, the absence of any non-protoplasmic matter from them, the presence of which would be at once revealed by the different behaviour of the staining fluid toward it.

g. **The nucleus.**—Between the basement membrane and the outer wall of the cell will be seen a row of circular bodies. These are the nuclei of the epithelium cells. If the section be a very thin one the nuclei will be found separated by a narrow space and surrounded with protoplasm. For the present it is enough to say that there is but one nucleus in any single cell under all ordinary circumstances. In studying the nucleus carefully the observer will note its size, somewhat larger than the blood-corpuscle ($\frac{3}{1000}$ inch in diameter); its circular outline in the cells in question (its shape varies much in various tissues); its very sharp bounding wall; its contents, made up of two sorts of substances, one which stains very deeply, and another which stains little or none.

I have thus far attempted, with as little digression as possible, to point out all the features of the section in the field when the microscope is pointed at the wall of the alveolus marked *E* (fig. 3). With so many details, each one of which must be noted and weighed carefully before any judgment can be formed, what wonder that the beginner in histology fails to see the point eloquently enlarged upon in a diagrammatic sketch! But any one who will carefully follow some such mode of study a few times will soon begin to acquire the power of almost instantaneously seeing and interpreting all these appearances, to form a conception of the actual structure of the sections under observation. Having thus noted the points to be observed, and what is actually seen, let us take the further higher step of the histologist. the careful judgment from the appearances to the facts of structure, or, in the biologist's parlance, the 'interpretation of the section.' We have already anticipated this step to some extent. In the actual study of a skilled histologist the two processes are practically simultaneous, not successive, as here necessarily set forth.

Resolution of pearls of Amphipleura.

By ROMYN HITCHCOCK.

Dr. Van Heurck has sent some very good and interesting photographs to the writer, showing the excellence of his method of work and the extremely fine results it has afforded him. Among these the most striking, as well as the most difficult test, is the resolution of the *Amphipleura pellucida* into beads or pearls, which, in the photograph, are distinct, and far more satisfactorily shown than in another print received a year ago.

The method employed was first described in full in these columns,* and need not, therefore, receive further attention at this time. The photographs received are the following:—

1. *Pleurasigma angulatum*, W. Sm. The specimen was mounted in the yellow medium. The photograph shows very clearly that the valve is made up of several layers—certainly of two, which are distinctly seen. Near the raphe the upper or superior layer is broken and portions of it have been removed, showing the inferior layer with its alveoles corresponding to the markings of the upper layer.

Valves in this condition are not uncommon, and these observations can be readily verified.

2. *Surirella gemma*, Ehr. Photographed from a mount in the yellow medium with an initial magnification of 600 diameters and enlarged to 3000. An excellent demonstration of the fine definition of the Zeiss 3 mm. lens. We have always regarded this diatom a very trying test.

3. *Amphipleura pellucida*. Resolution of the transverse striæ.

4. The same. Resolution of the longitudinal striæ.

5. The same. Resolution of the pearls.

The last three are from the same valve, taken with a direct magnification of 1100 diameters, using a Zeiss objective of 3 mm., combined with a correcting ocular of 25 mm., by the same maker. The Wenham reflex illuminator was used and monochromatic sunlight. The longitudinal lines have never before been photographed, and the pearly or beaded structure has never before been seen by transmitted light.

A careful examination of the prints will convince any skeptic that there is no illusion about the resolutions. Dr. Van Heurck informs us that Profes-

* February, 1885.

sor Abbe fully concurs in this view. The fineness of the longitudinal lines, their peculiar undulating character, and their direction parallel with the raphe, seem to preclude any possible error in this regard, as Dr. Van Heurck has already pointed out.

6. Nobert's 18th and 19th bands. This photograph was made with the 3 mm. Zeiss lens and the 25 mm. ocular. The illumination was monochromatic sunlight with a Powell & Lealand oil-condenser.

As Dr. Pigott has so well said, there is no trace of diffraction lines about these photographs, and the lines stand out clear and perfectly sharp. Dr. Pigott* says, regarding diffraction spectra, that 'after all, these diffractions are not real and inherently uncontrollable. Nor do they require any elaborate theory to account for what now have, fortunately, here ceased to exist in these splendid pictures; due to the elaborate perfections of the compensations.'

Key to the Rotifera.—*Continued.*

8. Œcistes.

a. Tube short or none; foot thrice the body length . . . *serpentinus.*
a. Tube short or none; foot not exceeding body length . . . *velatus.*
b. Tube floccose, irregular; body length $\frac{1}{70}$ inch . . . . *longicornis.*
b. Tube floccose, irregular; body length $\frac{1}{18}$ inch . . . . . *umbella.*
b. Tube floccose, irregular; body length $\frac{1}{50}$ inch . . . *crystallinus.*
c. Tube gelatinous; corona two-lobed . . . . . *brachiatus.*
c. Tube gelatinous; corona circular . . . . . *stygis.*
d. Tube of pellets; antennæ long . . . . . *pilula.*
e. Tube membranous . . . . . *intermedius.*

9. Lacinularia *socialis.*
10. Megalotrocha *alboflavicans.*
11. Trochosphæra *æquatorialis.* Marine.
12. Conochilus.

a. Tubes coherent, gelatinous; individuals many . . . . . *volvox.*
a. Tubes distinct; colony 1 adult and few young . . . . *dossuarius.*

13. Philodina.

a. Body colorless; corona very wide, sulcus small . . *megalotrocha.*
a. Body colorless; corona ample, sulcus broad, shallow, *erythrophthalma.*
b. Body dark brown, beset with spines . . . . . *aculeata.*
b. Body dark brown, beset with rough tubercles . . . *tuberculata.*
c. Body yellow, neck constricted, foot slender . . . . . *citrina.*
d. Body ruddy, translucent, not constricted; foot stout . . . *roseola.*

14. Rotifer.

a. Body white, smooth, tapering to the foot . . . . . *vulgaris.*
a. Body white, ends hyaline, suddenly attenuate to the long foot, *macrurus.*
b. Body dull brown, viscous, strongly plicate . . . . . *tardus.*
b. Body clear brown, not viscous, not strongly plicate . . . *hapticus.*
c. Body hyaline, with longitudinal folds . . . . . *macroceros.*

15. Actinurus *neptunius.*
16. Callidina.

a. Frontal column with 2 curved hooks . . . . . *bihamata.*
a. Frontal column without hooks (*b*).

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* English Mechanic.

b. Parasitic on Crustacea; teeth 2 . . . . . *parasitica*.
b. Not parasitic, fusiform, strongly fluted; teeth none . . . *elegans*.
b. Not parasitic; closely corrugated; teeth 2 . . . . . *bidens*.

17. Adineta *vaga*.
18. Microcodon *clavus*.
19. Asplanchna.

Female with 4 humps; eye single . . . . . *Ebbesbornii*.
Female without humps; eye single . . . . . *Brightwelli*.
Female without humps; eyes 3 . . . . . *priodonta*.

20. Sacculus *viridis*.
21. Synchæta.

a. Marine, luminous; cylindric, conical behind . . . . . *Baltica*.
a. Fresh-water (*b*).
b. Body length $\frac{1}{70}$ inch; auricles long, pointed . . . . . *pectinata*.
b. Body length $\frac{1}{110}$ inch; auricles scarcely protuberant . . . *tremula*.
b. Body pyriform or ovate; auricles wide, rounded . . . . *oblonga*.

22. Polyarthra.

Spines, 12, broad, serrated . . . . . *platyptera*.

23. Pterœssa.

Pinnæ 24, in 6 longitudinal rows; horny yellow. . . . . *ardas*.

24. Triarthra.

Spines more than twice the body length . . . . . *longiseta*.
Spines less than twice the body length . . . . . *mystacina*.
Spines less than one-fourth the body length . . . . . *breviseta*.

25. Pedetes.

Leaping styles twice the body length . . . . . *saltator*.

26. Hydatina *senta*.
27. Rhinops *vitrea*.
28. Notops.

Foot $\frac{1}{3}$ total length, not wholly retractile . . . . . *brachionus*.
Foot $\frac{1}{9}$ total length, wholly retractile . . . . . *clavulatus*.
Foot $\frac{1}{5}$ total length, wholly retractile; body partially loricate . *hyptopus*.

29. Albertia.

Body $\frac{1}{100}$ inch, straight, unconstricted . . . . . *intrusor*.
Body $\frac{1}{270}$ inch, slightly constricted behind . . . . . *naïdis*.

30. Taphrocampa.

Cylindric, short, thick, articulate; brain opaque . . . . . *annulosa*.
Fusiform, annulate; brain clear . . . . . *Saundersiæ*.

31. Pleurotrocha.

Length $\frac{1}{325}$ to $\frac{1}{216}$ inch . . . . . *gibba*.
Length $\frac{1}{150}$ inch . . . . . *leptura*.
Length $\frac{1}{144}$ inch . . . . . *constricta*.

32. Notommata.

§ Brain more or less opaque (*a*).
§ Brain clear (*b*).
a. Body subcylindric, ventricose; auricles large, evertile . . . *aurita*.
a. Body subcylindrical, auricles small, evertile . . . . . *collaris*.
a. Body subcylindrical, auricles not visible . . . . . *cyrtopus*.

a. Body saccate, long, front large, tapering behind . . . . *forcipata*.
a. Body saccate, slender, ends obtusely pointed; face prone, long, *saccigera*.
a. Body rhomboid in outline; auricles great, globose . . . *pilarius*.
a. Body thick, dorsally arched; auricles small, slender . . . . *tripus*.
b. Body subcylindric; toes long . . . . . *ansata*.
b. Body fusiform; foot invisible, toes minute . . . . . *brachyota*.
b. Body fusiform; foot long, toes short, pointed . . . . . *naias*.
b. Body trumpet-shaped; toes conical, minute . . . . . *tuba*.
b. Body somewhat vasiform; toes long; mastax very large . *lacinulata*.

33. Copeus.

Lumbar organs a stout seta on each side . . . . . *labiatus*.
Lumbar organs tubules setigerous at the summits . . . . . *spicatus*.
Lumbar organs tubules not setigerous . . . . . *pachyurus*.
Lumbar organs a single tentacle; antenna single . . . . . *caudatus*.
Lumbar organs wholly wanting . . . . . *cerberus*.

34. Proales.

Foot and toes none. Parasitic in Volvox . . . . . *parasita*.
Foot undeveloped; toes minute; body slender, vermiform . . *decipiens*.
Foot stout; toes slender, pointed; proboscis large, fleshy . . . . *felis*
Foot stout; toes slender, pointed; back much arched; . proboscis small, *gibba*.
Foot stout, long, toes minute; body ovate . . . . . *petromyzon*.
Foot very broad, toes minute; body subcylindric, head broad . *sordida*.
Foot and toes long, in profile sigmoid; body cylindric or fusiform, *tigridia*.

35. Furcularia.

a. Toes twice the body length, unequal . . . . . *longiseta*.
a. Toes twice the body length, equal . . . . . *æqualis*.
b. Toes nearly one-half the body length, stylate, acute, straight . *gibba*.
b. Toes about one-half the foot length, conical; body fusiform . *Boltoni*.
c. Toes blade-shaped, acute, decurved, notched with 2 teeth . *forficula*.
c. Toes blade-shaped, acute, decurved, not notched; marine . . *marina*.
c. Toes blade-shaped, wider vertically than laterally, not notched, *ensifera*.
d. Toes slender, straight, acute, front rounded, face oblique . . *gracilis*.
d. Toes slender, slightly curved, obtuse; neck strongly constricted, *cæca*.
e. Toes minute, conical, foot inconspicuous; no eye . . . *micropus*.

36. Eosphora.

Head separated by a neck; auricles protrusible . . . . . *aurita*.

37. Diglena.

a. Toes straight, parallel-edged, abruptly pointed; proboscis frontal, *grandis*.
a. Toes straight, slender; body necked, slender . . . . . *giraffa*.
a. Toes straight, long; foot short, very thick; eyes 2, colorless, *caudata*.
a. Toes straight, acute; foot long, thick; body very soft . . *permollis*.
a. Toes straight, long, rod-like; body oblong . . . . . *biraphis*.
a. Toe straight, short, projecting ventrally at right angles to the body, *catellina*.
b. Toes decurved, long; body in a leathery sheath, hunchbacked . *gibber*.
b. Toes decurved, body not sheathed, long, cylindric, slender . *clastopis*.
c. Toes incurved, slender; proboscis acute . . . . . *circinator*.
d. Toes scythe-shaped; body cylindric, each end obtuse . . *forcipata*.

38. Distemma.

a. Body long, gibbous behind, changeable; marine . . . . . *raptor*.
b. Body cylindric, long; toes one-third the entire length . . . *Collinsii*.
c. Body gibbous, long, slender; foot long, toes minute . . . *labiatum*.

MIROSCOPICAL TECHNIQUE.

Lighton's Analyzing Diaphragm for Polariscope.

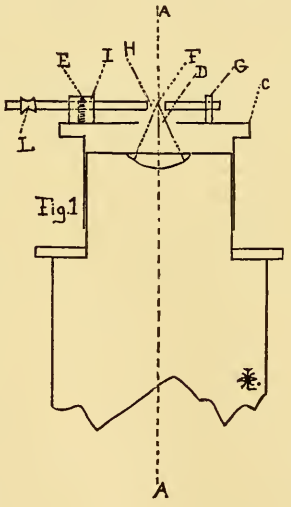
By WILLIAM LIGHTON.
LEAVENWORTH, KANSAS.

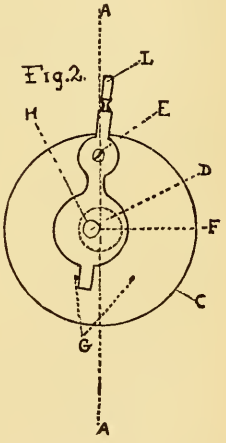
The following described piece of apparatus has been found by me to be of great help in the study of crystallography, and I have thought that a description of it to working microscopists through your *Journal* would help along the good cause of microscopy.

We will suppose that the polariscope as ordinarily used has been placed in position, the polarizing prism below the stage and the analyzing prism above the objective.

The apparatus consists simply of a cap with movable diaphragm placed over the eye-piece, as illustrated in figures 1 and 2. Fig. 1 is a sectional view and Fig. 2 a top view of cap of eye-piece.

The letters in both drawings refer, as will be seen, to the same parts.





Let A indicate the axis of tube; B, Fig. 1, the eye-piece; C, the cap of eye-piece. The apparatus consists merely in a diaphragm plate, D, swinging from right to left on the pivot I, Fig. 1. This motion is given by placing the finger at the knob L. The amount of motion is controlled by the two small studs G. The diaphragm is pierced by a small hole H, one eighth of an inch in diameter. E is a screw in top of post I, Fig. 1, holding diaphragm in place. F is apex of cone of light formed by the image of source of light passing through the eye-piece.

Now if the diaphragm be so adjusted by sliding the cap upon the eye-piece that it will be on a level with this point of light a very interesting series of optical effects will be observed.

The small studs, G, should be so placed that when the diaphragm is swung to the right or left the sides of hole, H, will just cut the axis of eye-lens (apex of cone of light).

I will mention a few of the sights seen by its use as described above. In no case were the prisms of polariscope revolved.

A crystal of chlorate of potash was selected which, upon simply revolv-

ing the stage, passed merely from an orange-purple to a dull gray. On introducing the cap and passing diaphragm from right to left a beautiful series of the most brilliant tints was seen—a fine navy blue changing to purple, orange, and then to lemon yellow, and lastly pale straw color.

A section of fortification agate was taken which showed a small crystal of pure quartz in one portion. With the diaphragm used as before from right to left the color of the crystal was merged from bright green to magenta and then to a velvety brown-red. With the usual revolution of the stage the colors exhibited were green fading to a dull black.

With this apparatus there is not only a more varied and brilliant series of colors, but also a marked intensification of points of structure. In the two above mentioned slides delicate lines of crystallization were shown which were invisible under ordinary circumstances.

One of the small, curiously branched bones of the Red-horse, a fish common in this region, was examined and showed the bone cells in a remarkably distinct way, they being quite indistinct without the diaphragm.

Ryder's Automatic Microtome.*—This new instrument has been devised by Professor John A. Ryder, of the University of Pennsylvania, in order to facilitate the preparation of sections for large classes, and also for the rapid preparation of series of sections in ribbons in embryological work, in which the element of time becomes a serious consideration. The device is small and compact, and is also automatic—that is, the same movement which cuts the section also brings the block into position for cutting the next successive section, and so on continuously, of any desired uniform thickness; the cutting takes place as fast as it is possible to move a vibrating lever up and down through a distance of three inches with the right hand.

The working parts are an oscillating lever, which is provided with a clamp at one end, into which the paraffine-holders are adjusted, and at the other with a simple handle. This lever rests upon trunnions on either side, and these in turn rest in triangular notches at the top of the two pillars between which the lever oscillates. At the cutting end of the lever a spring pulls the lever down and effects the sectioning and also the adjustment for the next section. The lever is pushed over and adjusted for the successive sections by a hollow screw, through which passes the trunnion on the side away from the knife. This screw is fixed to a toothed wheel, three inches in diameter, which revolves close by the side of the oscillating lever. The toothed wheel and screw is actuated by a pawl fixed to the side of the lever near the handle. The number of teeth which this pawl can pass in a single vibration downward is controlled by a fixed stop screwed into the under side of the oscillating lever near the handle; the end of this stop striking on the top of the bed-plate thus brings the lever to rest at a constant point in its downward excursion. An adjustable sector by the side of the toothed wheel throws the pawl out of gear after a given radius of the wheel has been turned through an arc embracing the desired number of teeth. This adjustment is also effected before the block containing the object to be cut reaches the edge of the knife. The adjustment for the next section is therefore effected while the surface of the block is not in contact with the under side of the knife, so that no flattening or scraping effect is produced on the surface of the block in its upward passage past the knife.

The movement of the vibrating lever being arrested at each down stroke

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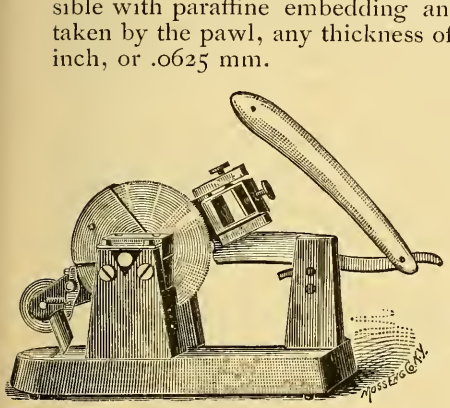
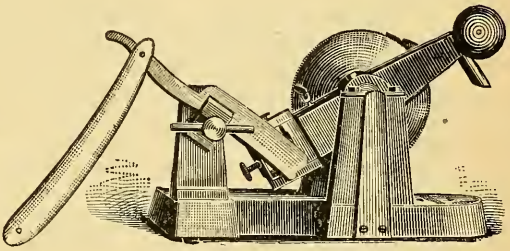
* From the *American Naturalist*, March, 1887. We are indebted to Mr. Joseph Zentmayer for the illustrations of the instrument.

at one point, and the pawl which catches into the notches in the toothed wheel being released at any desired point by the action of the adjustable sector, it is possible to adjust the apparatus with great accuracy for cutting sections of any desired thickness. If a given radius of the wheel is moved through the arc embraced by a single tooth, sections are cut having a thickness of only $\frac{1}{10000}$ of an inch, or .0025 mm.,—a thickness which is only practically possible with paraffine embedding and a very keen razor. If more teeth are taken by the pawl, any thickness of section is possible up to about $\frac{1}{400}$ of an inch, or .0625 mm.





A freezing attachment, which has lately been appended to the apparatus, shows that frozen sections can be made with as great rapidity and success as those cut from objects embedded in the paraffine block, and very nearly, if not quite, as thin. The freezing attachment is as simple and efficient as the self-adjusting and cutting devices of the instrument. Other auxiliary apparatus makes it possible to cut celloidin sections. This is effected by means of alcohol conducted by a tube from a reservoir to the knife, over which the fluid will run and drain into a tray below in such a way as not to come in contact with any other parts of the machine. This tray fits into a recess in the side of the bed-plate of the instrument just below the knife, and into this tray the celloidin sections may be allowed to drop as fast as cut.

The paraffine-holders are square and seven-eighths of an inch in diameter, so that a block of that size may very readily be sectioned. For the botanist, one of these holders is provided with a movable side and screw for clamping objects, so that rather tough stems may be firmly held between blocks of cork, while the more delicate vegetable tissues, or such as must be imbedded in fresh carrot, soaked in gum and hardened in alcohol, may also be firmly held for sectioning by the same device, provided the pieces of carrot are first trimmed into the right shape. The same style of holder is equally applicable for holding the corks—if properly trimmed—upon which tissues are embedded in celloidin or in gum. This style of holder also enables one to embed very long objects entire in paraffine,—such as earth-worms,—and to cut them as a single piece, provided the surrounding paraffine is carefully trimmed so as to have two opposite sides parallel. An object six inches long and three-fourths of an inch in diameter embedded in this way may be cut into an absolutely continuous series of sections without losing any essential portions. This is accomplished by slipping the block through the quadrangular clamp for the distance of half an inch every time a half-inch of the object has been cut off in the form of sections. One-half inch is the length of block which can be cut at one time without readjusting the feed-screw which moves the block and vibrating lever over towards the knife, the whole being kept firmly in place against the face of the hollow screw by a strong spring

which presses against the end of the trunnion on the outside of the iron pillar on that side of the instrument where the knife is fastened, so that all the sections are of exactly the same thickness from first to last. Cutting up large objects in the manner above described is not possible with any other form of microtome yet constructed.

Almost any section-knife—wide, or narrow-bladed—will fit into and be firmly held by the knife-clamp, which is, however, intended more especially to hold an ordinary razor. The best razors for cutting sections have been found to be those of the best make only, such as Wade & Butcher, or Joseph Rodgers & Sons, of Sheffield. Only such razors as hold an edge well should be used.

For ribbon-cutting by the paraffine method, the block containing the object, after it is trimmed and soldered to the paraffine with which the holder is filled, by means of a heated wire, is covered with a thin coat of soft paraffine. This enables one to cut ribbons of any desired length, since the softer paraffine at the edges of the successive sections sticks them together by their margins as fast as they are cut.

The ribbons may be allowed to fall upon a slip of paper, which may be drawn out, as fast as the sections are cut, from under the bed-plate of the instrument, beneath which there is a space left for this purpose, between the three toes or tripod upon which the whole apparatus rests. The edge of the knife also remains in the same plane, no matter at what angle the cutting edge is placed with reference to the direction in which the block to be cut is moved, just as in the best forms of the sledge microtome.

The advantages which this new instrument offers are, briefly, comparatively small cost, great efficiency, rapidity, and accuracy. One hundred sections per minute may very readily be cut with it. Its simplicity of construction, with few wearing parts, and slight liability to get out of order in the hands of inexperienced persons, will also commend it to the teacher and investigator. Experience has already shown that those once using it can scarcely ever be again induced to use the most efficient sledge or automatic microtomes of different design if they can have access to this instrument. This device is made by Mr. Zentmayer, whose name is a sufficient guarantee of the workmanship employed in its construction.

Simple life slides is the title of a paper by Dr. A. C. Stokes in the May number of *The Microscope*. In it he describes and figures a number of devices which he finds useful in studying living objects. He prefers squares of glass to circles for covers, for the greater facility of irrigation with new supply of water. He also recommends a shallow shellac cell, made by turning a circle and, after drying, removing two opposite quadrants, one above and one below. To make another form of cell he cements in the centre a thin circle $\frac{3}{16}$ in. in diameter. Then, taking a glass or zinc ring of $\frac{1}{4}$ in. aperture, he breaks a piece out of one side and cements it around the circle. From another ring, $\frac{3}{8}$ in. aperture, he breaks out a bit and cements it to the slide concentrically with the other and the circle and with the breaks of the rings opposite each other. A thin, square cover finishes the slide. In using this slide a drop of water for study is placed on the inner circle and the cover applied. Then a drop of water is placed at the break in the outer ring; it runs in and keeps the air in the contrivance moist without reaching to the circle, which thus is both isolated and prevented from evaporation.

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Sections of injected lung may be made, according to a writer in *The College and Clinical Record*, by injecting the lung with gelatin-carmine

mass through the right ventricle, and, when full, ligaturing the pulmonary arteries and veins. The lungs then removed, they are distended through the trachea by injecting alcohol (90 per cent.), and then sunk under 90 per cent. alcohol and hardened twenty-four hours. After several changes, every five days, both of the alcohol in the air-cells and about the lung (it takes about a month to complete the process), the lung may then be imbedded and sliced as usual, and the cavities will not collapse.

EDITORIAL.

Creation vs. evolution.—The *Popular Science Monthly* for May contains a valuable review by Professor Le Sueur of a recent work by Mr. Geo. T. Curtis, entitled 'Creation or Evolution,' in which the author declares himself in favor of special creation. The key-note of the work is struck when he says, 'All correct reasoning on the subject of man's descent as an animal begins, I presume, with the postulate of an infinite Creator, having under His power all the elements and forms of matter, organized and unorganized, animate and inanimate.' Here the author starts out with a method the contrary of the scientific, and the one which, by its adoption, has the blame for so many human errors—the *a priori* method. Starting, not from the facts but from certain conceptions of a Creator, he would reason out the method of man's descent. The reviewer imputes to such a course more of arrogance and irreverence than to that of the much condemned scientist, who attempts, from the facts, to find out how God has worked, not to decide how He must have worked on premises which are assumed and not proven. With such a predetermined bias, what wonder the author pays little heed to facts! The facts of Darwin, Huxley, and Spencer, brought forward in their works, are attempted to be explained away, or they are spoken of as the mysterious and inexplicable by a finite mind, because the work of an Infinite Creator. Such writing, such speculation on matters which deserve more rational consideration, are the amusement of the great jurist's leisure moments. They are natural in a mind so apt to be swayed by 'decisions' as his, but they are not the science of to-day but of five centuries ago. The question is not what we think the Creator would have done, but what the facts indicate has been done. We once heard this absurd sentence from the lips of a scholar very eminent in all biblical matters: 'If the scientist cares to consider himself descended from a monkey he may do so; I don't care to acknowledge any such ancestry.' This, well enough as a mere æsthetic sentiment, would hardly pass as a sufficient argument against man's descent from lower forms.

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The Nineteenth Century has for several months contained interesting articles upon not this same topic but the general principle of which this is but a special case. The articles form a controversy between Professor Huxley and the Duke of Argyle upon the old question of nominalism and realism, the existence of universals. In this controversy, which is carried on with great ability, Professor Huxley advocates principles which are recognized as the true principles of experimental science, and which, if they could gain universal sway in all thinking minds, would make many controversies impossible. Law has not in itself an existence separate from its operations. The habitual prepossession, to the contrary, makes men seek to grasp the law without the laborious road to it through the facts, unmindful that it has no existence except as they reach it through the facts; and they are following an *ignis fatuus* which they can never grasp.

Professor Dallinger presents a far more commendable course, as shown in his laborious and conscientious work described in his presidential address before the Royal Microscopical Society. 'Instead of predetermining that an organism cannot adjust itself to changed environment, because it might follow that species could be evolved from each other, a conclusion at variance with our narrow notion of the way in which an Infinite Creator would proceed in peopling a world with animals and plants, he goes about a series of most delicate experiments, lasting through seven years without a break, to learn if it is a fact that environing conditions may be greatly changed and yet the organism adjust itself to the change. No one can read his account without admiration for such painstaking and intelligent experimentation and for the determination, after the break in the series, to go over the ground again. Such work done by the leaders inspire the rank and file of workers, and it is such work as this which has given us scientific discoveries and their benefits.

Speculation on the probable origin of the universe may furnish amusement for idle hours, which is as permissible as guessing at any conundrums; but it should not be forced upon the world as science. History is studied from the documents and other records; the origin of a nation is learned by study of all the facts; and the historian would murmur if he were confronted with the assertion that all correct reasoning begins with a postulate.

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An enthusiastic microscopist.—Not long since it was our good fortune to pass a very pleasant evening with Mr. E. H. Griffith, the genial microscopist, who is perhaps as widely known personally as any worker in this country. He is one of the most untiring and enthusiastic of workers and full of interesting and helpful suggestions. We found him prepared to spend an evening at the microscope after a day of business and before a long rail-ride on the day to follow. He was mounting diatoms which he had collected a few days previously in Puget's Sound. His club microscope was on the table, and we looked over its contrivances—truly a most ingenious piece of work and most compact and portable. Mr. Griffith showed us how he is in the habit, during long journeys, of using his instrument to help make the time pass pleasantly; also to amuse and instruct those about him. Surely much can be done by one who will contrive the means to overcome hindrances and the instrument made not only a most fascinating and restful pastime, but also a means of very great instruction in the mysteries of creation. We shall be always glad to welcome Mr. Griffith or any others who come within our reach.

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Change of Address.—It will save some delay if all correspondents will note the change of the Editor's address for the summer to No. 3 East Forty-seventh street, New York city. This will continue till Sept. first, and further notice may be expected in the August number.

NOTES.

Desiccated sewage.—The question of how to get rid of the sewage waste from large cities is an important sanitary problem which has not up to the present time found an entirely satisfactory solution. In the *London Times* is contained a description of the apparatus in use by Mr. Astrop in the environs of London. By it the sewage is chemically treated and then pumped into a tank of 400 gallons capacity. From this the 'sewage sludge' is fed into a vat into which perforated heated cylinders are placed,

surrounded by the sludge, capable of revolution through the contents of the vat. Within the cylinders pumps create a partial vacuum and thus moisture is drawn out of the sludge to the amount of about 60% of its total. From the vat the half-dried sludge is drawn out on an endless traveling-web of very fine wire gauze 8 feet wide, supported by two rollers and passing over exhausters which remove 10% more of the moisture. The sludge now passes between 5 pairs of rollers and then into a hopper, whence it is fed into a cage on a lower floor and dried by a blast of hot air. It finally contains but 5 per cent. of moisture, is powdered and placed in bags for sale, as the product has a high manurial value.

Dr. Frankland, to whose work in determining the numbers of bacteria in drinking water we have already referred, has exposed suitable sterilized cultivating media to air, at various places and dates, with a view to determining the conditions affecting the distribution of micro-organisms in the atmosphere. He found, in 10 litres of air from Primrose Hill, 9 organisms, and in the same quantity of air from the bottom of the hill (100 ft.) 24. From the spire of Norwich Cathedral (300 ft.) 7, from the ground 18. From air near the golden gallery of St. Paul's 11, while in the churchyard 70. He determined that in air in a chemical laboratory 15 fell on a square foot in one minute, and 1,662 in a natural history museum. While in a railway 3d class carriage near London, window closed, no fewer than 3,120. In a barn during thrashing, as many as upwards of 8,000 organisms were determined as falling on one square foot in one minute. Of the micro-organisms there were many different kinds; moulds, bacilli, micrococci, and various forms of yeast.

Clinical microscopical technology is a series of articles by Dr. F. L. James, at present running in the *St. Louis Medical and Surgical Journal.* They are in the same general vein as those upon more elementary topics, and will prove to be of great value. We need some simple and elementary work on the subject of clinical microscopical studies. Dr. James gives the methods to be followed. We trust he will follow them by an enumeration of the various objects found in urine, and their diagnostic significance, together with description of those for which they may be readily mistaken.

Microscope in dentistry, by Thos. L. Gilmer, M. D., D.D. S. In *The Dental Review* for May we find a brief article aiming to stimulate a wider use of the instrument among dentists.

The journal of the Franklin Institute for March, 1887, contained an article of interest to those who are interested in the microscopic structure of rocks, upon the structure of iron and steel. The article is well illustrated by photomicrographs. The article gives an account of the tools needed in such study, and follows it with a description of the appearance of both iron and steel.

Water, heat, and cold, in their physiological action, forms the subject of a paper by G. F. Lydston, M. D., of Chicago. In it he considers the substance protoplasm as the 'basic substance of tissues,' and tries to trace back physiological processes to it where they belong. 'The rôle of protoplasm * * * appears to me a most important one, and too little thought of in our own studies of nutrition and the action of remedies.' Thus, fevers show hypermetabolic activity of protoplasm, high temperature in consequence of the rapid metabolism, rapid loss of water in consequence of high temperature. By use of water in large quantities, dilute products of oxydation inhibit protoplasmic activity, and thus diminish heat, producing restoration of fluid to the tissues.

CORRESPONDENCE.

To the Editor:—Since writing you, some weeks ago, I have made a slight modification of the settling tube for urinary deposits, etc., said modification consisting in substituting, for the enlargement on the side of the tube, a small hole at the same point (*i.e.*, about half-way up the side of the stopper—but, of course, not *in* the stopper, but in the tube). The stopper is provided with a slot, as before; and, in taking a drop from the lower end of the tube, it is a good plan to cover the small hole near the top with the thumb of one hand, turn the stopper with the other hand until the slot

comes opposite the hole in the side, when the small amount of air contained in the latter will be found sufficient to enable a small drop to be taken upon a slide. This is probably the simplest and best method proposed.

191, Roseville Avenue, Newark, N. J. FRANK VANDERPOEL.

MICROSCOPICAL SOCIETIES.

PITTSBURG, PENN.

The Iron City Microscopical Society held a soireé on March 11th in the chapel of the First Presbyterian Church. The exhibition was very successful, there being in all fifty exhibits, each of which had three changes during the evening. A glance through the programme shows much the usual array of objects exhibited. Among them, of perhaps greatest interest, may be mentioned :—1. Section of human scalp, showing hair *in situ*. 2. Eggs of fish, showing embryo. 3. Section of fœtal foot. 4. Cerebellum of man. 5. Human bone, transverse section. 6. Section of human tooth, showing nerve *in situ*. 7. Head of *Tænia solium*, from dog. 8. Lung of steel-worker in health and disease. 9. Living sugar mites. 10. Living cheese mites. 11. Living animalcules from hay infusion. 12. Wing of humble bee, showing hooklets. The array of microscopes reported is very considerable, and must have been an interesting sight to one who is interested in comparing the various stands of various makers. The Society contains seventy members.

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WASHINGTON, D. C.

The 60th regular meeting was given up to an exhibition of slides, principally a lot recently imported from Möller by various members of the Society. Two type-plates, one of one hundred and one of four hundred diatoms, were shown, with other slides of different kinds.

A noticeable feature was an ingenious adaptation of clock-work to a polariscope, by Prof. W. H. Seaman, by means of which the necessity of rotating by hand was done away with.

One of J. Harbord Lewis' desmid slides, containing some fifty species, was also shown. E. A. BALLOCH, *Rec. Secr.*

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SAN FRANCISCO, CAL.

A regular meeting of the Society was held upon April 13th. Upon the recommendation of the committee appointed to report on the matter, it was decided that the Chair should hereafter, at each meeting, appoint two members whose duty it would be to provide and display a number of interesting and attractive microscopic objects at the meeting next ensuing.

As an instance of how a grain of truth may sometimes be transformed into a mountain of error, the Secretary read an item which has been going the rounds of the interior press, and which announced the discovery of a new glass in Sweden, composed principally of boron and phosphorus, of such extraordinary refractive power that lenses made of it would reveal the 'one-two-hundred-and-four-million-seven-hundred-thousandth part of an inch!' The basis of this extraordinary paragraph was probably the recent introduction of the new optical glass made at Jena, containing small proportions of borates and phosphates. By the use of this glass it has been made possible to construct lenses with less chromatic aberration than heretofore, but as the refractive index is practically that of ordinary glass, the magnifyng power for any given curvature is, of course, also about the same.

The exhibition of the new 'Doty Balsam-mounting Bottle' brought out a discussion of various late methods in balsam mounting, and of the relative advantages of different mounting media.

Dr. Mouser gave a brief description of the laboratory he has just fitted up for prosecuting the study of the micro-organisms of disease. He concluded by extending a cordial invitation to the Society to examine the various appliances, and, on motion, the invitation was unanimously accepted, it being decided to hold the meeting of the 27th inst. at the laboratory, 707 Bush Street.

It was stated by Prof. Hanks that while visiting Verdi, Nev., recently, he had come across a fossil diatomaceous earth of a peculiar bright salmon color, and there was every reason to believe that this deposit was the source of a sample of such earth which had been sent to the Society anonymously more than twelve years ago, and which had attracted considerable attention at the time by reason of its richness.

Among the objects exhibited were slides of diatoms and of quartz from Alameda beach, mounted by Dr. Riehl, and nine well-stained slides mounted by Dr. Stallard in further illustration of the subject of tuberculosis in fowls.

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San Francisco, Cal.

By invitation of Dr. S. M. Mouser, the regular fortnightly meeting of the San Francisco Microscopical Society was held in his extensive laboratory last evening, April 26th., President Wickson occupying the chair.

It was decided to hold the Society's annual reception on the evening of May 28th next, and the President was authorized to appoint a committee to make the necessary arrangements.

The death of Dr. Allen Y. Moore, a corresponding member of the Society, was announced, and remarks eulogistic of the deceased were made by various members.

Dr. Henry L. Wagner, who has recently completed an extensive course of study in the leading biological laboratories of Europe, drew attention to a new organism lately found by him, closely allied to the *Micrococcus tetragonus* which Koch has observed in connection with his investigations on the tubercle bacillus. The cells of the new organism occur in characteristic groups of four, and its growth in gelatin is very destructive in the appearance of the colonies formed. Dr. Wagner also described and gave the formula for a new culture medium devised by him, more particularly for use in the study of such organisms as found their natural pabulum upon mucous surfaces. Its principal characteristic was the substitution of an alkaline solution of mucin, for the peptone usually employed. Dr. Wagner received the thanks of the meeting for his interesting address.

The members then proceeded to inspect the methods adopted by Dr. Mouser in the study of bacteria and allied organisms. The various steam-filters, sterilizers (both hot-air and steam), incubators, etc., ranged along the sides of the laboratory, were duly shown and their operation described. The method of procedure is briefly as follows:—Small portions of the material infected by the organism to be studied are placed with a needle-point, previously sterilized by heating, either upon the freshly cut surface of a boiled potato, which is then covered by a bell-glass, or into a test tube partly filled with fluid gelatin which is first shaken thoroughly so as to distribute the introduced germs as much as possible, and is then poured upon a glass plate where it hardens, and is also covered by a bell-glass. In either case the introduced organisms, rapidly multiplying by self division, form small colonies, each original germ being the starting point of one. Up to this point, the admixture of foreign and undesired germs floating in the atmosphere, is unavoidable. It, is, however, an interesting and very valuable fact that the colonies respectively formed by different genera, and even species of bacteria and their allies, present marked differences of appearance even to the naked eye, so that there is little liability to error from this source. After the colonies have grown sufficiently to enable them to be identified, a test tube partially filled with a solidified preparation of sterilized gelatin, agar-agar, or similar substance, is quickly inoculated by introducing with a needle-point a minute quantity of material from what has been ascertained to be the desired colony on the potato or glass plate. The test tube is then closed by a wad of sterilized cotton or glass wool and is placed in the incubator at the temperature best suited to the contained organisms. The growth of the latter is rapid and also distinctly peculiar in the different species, so that an experienced investigator, by holding to the light a tube containing a pure culture of such organisms, can determine the species merely by the appearance of the colony, which sometimes spreads over the top of the gelatin in the tube, sometimes grows only in the path made by the needle, and in other cases takes the form of a spiral, a nail, a bunch of grapes, etc. Throughout the entire process the very utmost care is taken to prevent the introduction of germs other than the one to be studied. Every portion of the apparatus and the culture-media used are sterilized with the greatest precaution, and even the hands of the investigator are bathed in germicide solutions at all the important steps of the procedure. When a perfectly pure culture of some germ has been thus obtained, the further study of its characteristics, both in the colony and under the

microscope, becomes comparatively easy, and valuable experiments of inoculation upon living animals, etc., are made possible. The immensely valuable results already obtained by Pasteur, Koch and many others, are a guarantee of what may be reasonably hoped for in the near future by the study of a subject, the immense importance of which can hardly be over-estimated.

A most cordial vote of thanks was unanimously tendered Dr. Mouser for his very interesting and instructive exhibition. A. H. BRECKENFELD, *Rec. Secr.*

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SAN FRANCISCO, CAL.

A meeting of the San Francisco Microscopical Society was held on May 11th, President Wickson occupying the chair.

The Secretary announced the receipt, from Dr. Thomas Taylor, Microscopist of the Department of Agriculture, Washington, D. C., of the last annual report of that department, accompanied by a number of colored plates, photo-engravings and photomicrographs, illustrating the crystallography of butter and of other animal fats. A great deal of work is now being done by Dr. Taylor, in regard to this important subject, and his investigations, thus far, show that the fats of different animals differ in their crystallization. For example, if small quantities of butter and of lard and of beef-fat be separately boiled and slowly cooled, for, say twenty-four hours, the resulting crystals will show very marked differences under the microscope. The normal butter-crystal is large and globular, polarizes brilliantly and shows a well-marked St. Andrew's cross. That of lard shows a stellar form, while that of beef-fat has a foliated appearance. In course of time, as the butter loses its freshness, the globular crystals degenerate and gradually merge into peculiar rosette-like forms. These different stages of crystallization could be plainly seen in the photographs sent. Specimens of butter-crystals had been prepared by the Secretary and were shown as resplendent objects under polarized light. Favorable comments were made on the excellent work done by this branch of the Government, in breaking up the traffic in unwholesome and fraudulent 'butter compounds.'

Specimens of the interesting little alga *Chlamydococcus pluvialis* were sent in by Dr. H. W. Harkness. The bright-red globose cells bear a strong resemblance to those of *C. nivalis*—the microscopic plant producing the phenomenon known as 'red-snow.' A slide of the latter, gathered in the Sierra Nevada Mountains, near Donner Lake, was also exhibited to show the close similarity between the two plants. In fact, the later authorities are inclined to regard them as not specifically distinct, but differing only in habitat. *C. pluvialis* being the plant as found in rain water, and *C. nivalis* as found in snow. The cells possess the remarkable property of retaining vitality after being kept dry for years, for as soon as moisture is supplied, vegetation again commences.

Communications were read, requesting exchanges of diatomaceæ, and of native gold crystals.

A committee, consisting of Prof. Hanks, Mr. Hyde and Col. Kinne, was appointed for the purpose of compiling and perpetuating the early history of the society.

Chas. C. Reidy exhibited a slide of Foraminifera under dark-field illumination, the latter being obtained in remarkable perfection by means of the Bausch and Lomb form of Abbe condenser.

A committee was appointed for the purpose of arranging details for the annual reception, to be held on the 28th inst., and the society adjourned for two weeks.

A. H. BRECKENFELD, *Rec. Secr.*

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ESSEX COUNTY, N. J.

The Essex Co. Microscopical Society met at the residence of Jay L. Smith, Thursday evening, May 5th, subject, microscopical technique.

After the regular business was transacted, Mr. Smith gave a practical demonstration of his modification of Dr. Reeves' method of cutting sections. The only part of the operation that was omitted was the clarification of the object in turpentine. As this takes some two or three hours, he placed the object in turpentine some hours before the meeting. An account of the method will be found in the February number of this *Journal.*

Dr. Geo S. Allen showed some seventy slides illustrating the histology of a developing pig's tooth, each slide contained from ten to twenty sections cut by the ribbon

method and stained in borax carmine. The sections were most beautifully cut, but many were so thin that, as the secretary pointed out, they would not hold the stain. Dr. Allen described the method which he had seen at Cambridge, and which is so familiar, it is not worth while describing.

'The eye' was chosen as the subject for the next meeting on the 19th of May.

JAY L. SMITH, *Secr.*

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ESSEX COUNTY, N. J.

The regular semi-monthly meeting was held at the residence of Dr. Morgan W. Ayres, Upper Montclair, on May 19th, eight members present.

The subject chosen for discussion 'The eye' was described by Dr. F. R. Chambers, who illustrated his remarks with a model.

He called attention to the different tissues, and in a few well chosen words described their functions. Mr. Vanderpoel had a number of diagrams illustrating binocular vision, and by the aid of a pin hole in a card showed that the image was received on the retina in an inverted position.

There was a lively discussion on the retina as some of the members could not understand the position of the retina, having been misled by confusing diagrams in some ofthe text books.

Dr. Allen showed a fine section of the lens, cornea, retina, and the pigment layer of the retina. Smith showed rods and cones, meibomian glands, healed corneal ulcer with serrated cells, infiltration of lens with morgagnian fluid. Cornea with granulation tissue in wound made by needle, in the operation for glaucoma, with incarceration of the iris, section of posterior half of the eye with optic nerve entrance, and spreading of the retina. Mr. Woolman exhibited a number of sections. It was resolved to continue the subject to next meeting on the 3d proximo.

JAY L. SMITH, *Secr.*

NOTICES OF BOOKS.

Bulletin of the Iowa Agricultural College, from the Botanical Department. By Byron D. Halsted. (pp. 66). Cedar Rapids. Nov., 1886.

This bulletin is a good-sized pamphlet, in which the writer has given an outline of work carried on by college classes during the year of 1886. It gives a full account of the college curriculum in botany, which we will pass over, and contains the record of the results of observations by the classes. Among these we may mention various experiments upon germination and growth, plant movement, flesh eating in case of plants with perfoliate leaves suggested, variations in forms of leaves, observation on useless plants, calendar of trees and shrubs, and a large variety of other allied topics. While in the bulletin many interesting observations are recorded, we regard its chief though by no means sole value, to lie in the interest evidenced by it of study on the part of the students who contributed to it, and the stimulus to such study they have in the knowledge that their work goes on record. We should be glad to know if the system proves valuable, year after year, from an educational standpoint as well as for the facts contributed regarding plants.

Elementary Microscopical Technology. Part I. By Frank L. James. (pp. 187). St. Louis. 1887.

We have noticed, from time to time, the excellent articles from Prof. James upon microscopical technique. These have been appearing, from time to time, in the *St. Louis Medical and Surgical Journal.* They are now collected to form the first portion of a work. In the part before us the author deals with 'the technical history of a slide from the crude materials to the finished mount.' The number of books which claim to be manuals of microscopical treatment are very numerous. We should be afraid to guess how many. Some of them leave very little to be desired in their particular line, but most of them are written with the understanding that the user will have had some experience to start upon. Professor James has assumed, to start with, that his reader has no knowledge of this technique, even the simplest, and works out his volume for the benefit of such readers. We confess ourselves unable to decide upon its merits from this standpoint. We do not see how any one could fail, using it carefully, to become a good histologist, even without a practised one to imitate at first, and yet mankind are sometimes very obtuse. We should like to see the experiment tried.

But even if the work should fail to do what is really, practically, almost impossible, viz., teaching what one could learn by imitation very rapidly, still the work is a valuable and convenient one for the general worker for the numbers of formulæ it contains for making and using cement stains, preservatives, cells, etc. We regret that the formulæ are all given in the ancient system of weights and measures. For purposes of dilution, etc., the metric system is far more convenient. Thus, 1 gramme of chromic acid and 99 c.c. of water give us a 1% solution of chromic acid and the same for osmic acid. We, however, are willing to concede much to habit in this matter, but we do not see how, by the non-decimal systems, these various percentage solutions can be easily made up. Since the work is not complete, we may hope that future volumes will take up other processes, for instance, tensing and cell isolation, injecting, etc., and the study of fresh tissues. We note the omission of some favorite fluids, thus, acetic acid, corrosive sublimate (except in the modified Goadby's fluid) But we remember that the work is 'elementary,' and that the writer is writing not for the purpose of teaching a beginner all things of the art, but how to mount a slide. We can safely recommend the book as one as well calculated to do this as any work we know of.

Proceedings of the American Society of Microscopists. (pp. 243). Buffalo. 1886.

The proceedings of the 9th annual meeting of this excellent society were received some weeks ago, and form an interesting and valuable volume. It contains papers by Burrill on Bacteria and Disease, Smith on Life History of Diatomaceæ, Weber and Taylor on Butter and its Adulterations, and a great variety of others of less general interest. The volume evidences good work done on the part of the society, and the good list of names of members shows that the society flourishes. We trust the meeting of the coming summer may be even more interesting than ever, and it gives every promise of being so.

We desire to acknowledge, with thanks, the receipt of the following:—

1. *Eyes of Mollusks and Arthropods.* By Wm. Patten. (Abstract from *American Naturalist*). 2. *Ryder's Automatic Microtome. Am. Naturalist.* 1887. 3. *More about the Sea-Horse.* By Samuel Lockwood. 4. *Raising Diatoms in the Laboratory.* By Samuel Lockwood. 5. *Captain Glazier and his Lake.* By A. D. Harrower. Ivison Blakeman & Company. 1887. 6. *On Bacteria in Ice, with special Reference to the Ice Supply of New York City.* By T. M. Prudden. 1887. 7. *On the Action of certain Salts upon the Arteries.* By F. S. Lee. Baltimore, Md. 1887. 8. *The Conchologist's Exchange, Vol. I, Nos. 6 and 7.* By W. D. Averell. Philadelphia, Penn. 1886–7. 9. *Innervation of the Heart of the Slider-Terrapin.* 10. *The Action of certain Drugs and Poisons on the Heart of a Fish.* 11. *The Causation of the Heart-Beat.* By T. Wesley Mills. Montreal. 1887.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology.
HENRY L. OSBORN, Lafayette, Ind.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired.
M. A. BOOTH, Longmeadow, Mass.

Wanted, exchange of slides, and correspondence on unusual urinary products.
J. M. ADAMS, Watertown. N. Y.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one.
K. M. CUNNINGHAM,
Land Office M. & O. R.R. Co., Mobile, Ala.

Pathological and Histological Slides (very fine) in exchange for other good slides.
F. M. HOYT, 160 Washington Park, Brooklyn, N. Y.

Correspondence with animal histologists with regard to exchanges solicited.
HENRY L. OSBORN, Lafayette, Ind.

Publisher's Notices.—All communications, exchanges, etc., should be addressed to Henry Leslie Osborn, Lafayette, Indiana, Purdue University.

Subscriptions, and all matters of business, should be addressed to the Business Manager, P. O. Box 630, Washington, D. C. The address of Mr. R. Hitchcock is Osaka, Japan.

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The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the following prices which are net:—Vol. II (1881) complete, $1.50; Vol. III (1882), out of print; Vol. IV (1883) complete, $1.50; Vol. V (1884) complete, $1.50; Vol. V (1884), Nos. 2–12, $1.00; Vol. VI (1885), $1.50; Vol. VII (1886), $1.00.

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Elementary histological studies of the Cray-fish.—III.

BY HENRY L. OSBORN.

(*Continued from page* 105.)

4. **Interpretation of the sections.**—The problem for the histologist is to determine the natural size and shape of every kind of cell in the subject of his study and the way they are all put together, and, further, to determine, if possible, the internal structure of the cell, its parts, their constitution and arrangement. He has not reached the end of his study until he has answered all questions relative to the construction of this minute body only $\frac{1}{1000}$ of an inch across. The difficulties which beset him arise from four general sources, viz :—Uncertainty as to the perfect operation of his preservative methods ; the fact that his view is of a surface, not of a solid body, so that he can look at the cell from only one single standpoint ; the fact that the cells are so delicately walled that their outlines are often invisible, and usually almost so ; and the constant possibility of meeting diseased cells, cells in which pathological changes have taken place, or places where some abnormal or irregular occurrence has been hit upon. In the solution of his problem he must keep all these drawbacks in mind ; test his observation by them before he reaches a conclusion.

Let us now set before ourselves the task of determining the facts regarding the cells of the walls of the alveoli. In attempting this I would urge upon the student the need of recognizing the vast gap between what he sees and what he may assure himself to be the case by inference. In the order of study, what one sees comes first, but to what one has seen in any one place is to be added what he sees in every other place, and from these observations a completed notion must be derived. Unless he sees the necessity of thus looking from point to point in his section to form a composite photograph, so to speak, he will never get beyond the most primary part of his study. Most students are at the outset met by this difficulty. They pursue the study of the section with deepest interest, but they fail entirely to transfer their study from the section to the organ to which it belongs, and to interpret from the sections the structure of the organ. Such a course robs the study of its proper fruit, and the harder work is all done, and the worker leaves his task before he has reaped its legitimate reward.

I shall not attempt here to show what reasons there are for accepting the appearances of the cells as natural. If the cell has such a delicate wall the natural supposition would be that, treating it with absolute alcohol and chloroform and hot paraffine would distort the frail structures into unnatural shapes. The reasons for believing, in any case, that it is not injured are numerous, but, as they depend upon considerable prior information, they cannot with value be discussed at present, and the observer must accept at the start the

statement that the careful treatment, as planned above, will not, to any sensible extent, damage the cells. But as the learner becomes a skilled and original student, whenever he attempts any new departure he must guard himself very carefully against difficulties from this source. Accepting, then, that appearances have not been made unnatural by the processes of preservation, imbedding, and so forth, let us go on to the reconstruction, in imagination, of the green gland from them.

a. **Shape of the cells of the alveolus.**—Study of these cells will soon convince one that seen in section they are squarish. To this conclusion he will be led by two considerations; in the first place he will here and there find one side wall or perhaps both very distinctly visible, and where he can find this the squarish outline of the cell will be plain enough. Then, secondly, wherever he finds the wall and the nucleus, which he judges to belong to the same cell, he will find them a certain distance apart. This will help to guide him where to look for the wall of the other side, and direct him to search there even more carefully, and perhaps detect it. In this way, by careful observation, and at the same time with comparison of the results of the same methods applied to the study of the alveolar wall in a score or two of places, the observer soon satisfies himself that a cross-section of the cells is truthfully represented in figure 3 or figure 2, though the actual appearance at first sight is shown in another part of figure 2. A figure which thus represents the facts as they are believed to be, not on a foundation of mere guesswork, but after diligent study, is usually called a diagrammatic representation, and a diagrammatic representation, when conscientiously made, is evidence that the observer has both seen, and compared, and judged. Such figures are common in our text-books; they do not often look like our sections, for they are somewhat more ideal than any particular section is ever likely to be, but they are all the more helpful on that account.

Having thus decided the shape of the cell in cross-section, we must go still further, and determine its shape as a solid figure. To accomplish this the most natural thing would be to turn it up and look at its side. This, however, we cannot do with the cells whose cross-section we have already inspected. We can, however, cut part of the gland in one plane, and the rest in the plane at right-angles to the first, which would give the desired section, and find other alveolar cells cut in the other direction. This is the true way to do, and one should make a practice of slicing all tissues in two planes, so that he shall cut lengthwise and crosswise of all cells. In the case of the green gland the cells would look the same in any section which was vertical to the basement membrane, and, as the cubical form only could give squares in any section, the inference is necessary that the green-gland cells are cuboidal bodies. This conception of their form will be corroborated by the study of the nucleus, the cells being so small that section is about the thickness of each one. They can be cut much thinner, so that cells will be seen without the nucleus. Such would be more frequent if the cells were a prism, and the nucleus globular and in the centre. Therefore, though one cannot by this mode of study see all of any one cell, he can find enough appearances to put together to assure himself of the rightness of his conclusion that the cells are cubes.*

The inspection of the section will reveal the fact that there is more than one kind of alveolar lining cells, and while the form just described and shown in figure 2 is to be found lining some of the cavities, in other places a

* Before leaving this part of the subject I will say that there is a method of cell-study which proceeds upon an entirely different plan from the one we are at present following, namely, by isolating the cells by the dissolving of the substance which cements them together, thus setting them free, when they may be studied in their entirety. This method should supplement the method by section, and will be described at a future time.

very different kind is the rule. In sections cut in most parts of the gland there are to be seen three kinds of epithelium cells; these three are represented in figures 2, 3, and 4. Some are very low, and their side walls can not be seen, but their position may be located roughly by the distances apart of the nuclei—a method of determining the shapes of cells which is lacking in exactness, but may be used if used rationally. These cells, we infer from what we can see in their section, are low and broad, very unlike those described and figured in figure 2. They are to be seen at D in fig. 1 and in other places, and cells very like them are to be seen lining the sack—figure 1, *Ep*. At *Du* the transition from one to the other kind may be seen where the sack enters the substance of the gland.

A third form of cell, of different outline from those mentioned, is also detected in linings of other cavities of the gland. These are shown in figure 3. They are taller than broad, and hence in sections vertical to the base-membrane they appear to be columnar in outline instead of squarish or broad and flat. We have thus determined that there are three forms in which the cells lining the cavities of the gland may appear.

b. **Size of the cell.**—In addition to determining the shape of the cell, one should determine its dimensions. This may be done in a variety of ways. One way, which is convenient and accurate, is the following; after it is learned others may be followed if any one desires. The way which is, perhaps, most desirable is the one followed in making plate iv. The drawing, let us say, of figure 2, was first sketched in outline with a camera lucida. In making this drawing with the camera such details received most careful attention as the outer wall and basement membrane, shape and position of nuclei, and distance of nuclei from each other, and indications anywhere of side walls, while the protoplasmic content was drawn in free hand. As soon as the sketch of the section was completed the instrument was kept in its position and a stage micrometer substituted for the slide and its lines drawn on the paper. These, of course, had the same enlargement as the section before it, and its actual size is known. It may, therefore, be directly compared with the drawing of the cell. Thus in fig. 2 the scale accompanies the drawing of the cells on the left, and the cells are directly measured, $\frac{1}{1000}$ in. high by $\frac{6}{1000}$ in. across, in a few cases, to $\frac{8}{1000}$ in. high by $\frac{4}{1000}$ in. across, in other instances, and an average of $\frac{5}{1000}$ in. $\times$ $\frac{4}{1000}$ in.

By consulting the other figures the reader will find accompanying them the scale. Since these scales are of unequal length in the figures, the inference is that the various sections are not equally magnified, which is true, the three figures having been drawn at different times and without any attempt at equal enlargement. We learn, by applying them to the measurement of the cells, that the columnar cells are, some of them, $\frac{1 \cdot 3}{1000}$ inch high by $\frac{1}{1000}$ inch broad; the flat cells are $\frac{2}{1000}$ inch high and presumably about $\frac{2}{1000}$ broad. It is a very good plan to always draw the scale with every drawing of the object. Very many good histologists have very inexact ideas of the size in connection with the cells they study.

c. **Contents of the cells.**—Within the boundary of all the cells of the alveolus one will see colored matter, which is not homogeneous and transparent but very finely granular. This is called the 'cell contents,' or 'cell substance.' It is in the cells under consideration composed entirely of 'protoplasm.' It requires training and the study of many different kinds of cells to be able to recognize protoplasm by its appearance, after staining, and this matter will come up again as we examine other cells, some of which will be found to contain non-protoplasmic material. But, in the cells of the healthy green gland, protoplasm only is to be detected after such treatment as has been described.

As the three kinds of cells were found to vary in shape and size, so one can see a difference between the three in the character of their contents. In all of them the 'cell substance,' so far as we can see, is protoplasmic. 1. In the cubical cells the protoplasm is evenly distributed through the cell, excepting under the outer wall, where it shows a deeper color, as if it were a trifle denser there than through the rest of the cell. 2. In the columnar cells there is a very marked difference, the protoplasm here is heaped up in the inner end of the cell and is very thin in the outer end; thus the wall made up of these cells exhibits a sort of double band of inner deep color and outer faint color. 3. In the flat cells the cell substance is very much less granular. It has a very deep color and a semi-translucent appearance with bright transmitted illumination. This is not well shown in the figure, but is very conspicuous in the section, making it possible to pick out this sort of lining at once with a very low power.

In addition to the protoplasmic contents spread through the cell a protoplasmic body remains to be described—

The nucleus.—This is plainly seen in many places, more plainly often than the outline of the cell to which it belongs. In studying it it is important to observe its shape, size, and position in the cell also, so much of its finer structure can be determined.

In the alveolar cells the nucleus presents an outer sharply-defined boundary wall, which runs around it as a thin, sharp line. Within this line a faintly granular mass is spread about, and here and there in this mass several very dark spots are to be seen. One of these is usually central in position, while the others lie close to the boundary wall. The nuclei in the cubical and columnar cells lie in the centre, or rather nearer the inner end of the cell, and surrounded by the protoplasm.

d. **Arrangement of the cells.**—Having traced the course to be pursued to prepare and study the green gland, and to study its histological or cell structure, so far as relates to certain of the cells which are found in it, we have further to see how these cells are combined, and, if possible, to determine how the entire organ is built. It is time now to bring forward the name 'tissue' for these aggregates of similar cells, like figure 2, for example; and in their case a very simple example of a tissue is presented. As in the case of a single cell, we have only one slice and one view, so in the case of the whole organ, to which we now return, we have but a single slice. Figure 1 is a somewhat simplified representation of such a slice. Our task is to learn, if possible, how the individual cells go together to form the whole structure.

A study of the section will show that the 'outer ends' of the epithelium cells always face toward the cavity of which they help to form the wall. The inner end of the cell, on the other hand, is always farthest from the cavity or lumen, and beyond it still is the basement membrane. Thus, *e.g.*, fig 3: *Lu* stands in the cavity of such a place as *E* in fig. 1. This is true in every instance, as the observer can verify upon his sections, though not on figure 1, where the difference between the inner and the outer ends of the cells is not shown. It is not only true of the cells of the outer wall, which bounds the whole cavity, but it is true of certain islands of tissue, which (in the sections) have no connection with the outer boundary wall. Its cells, upon examination, present an outer end and an inner end, with a basement membrane farthest from the lumen of the alveolus. Sometimes blood corpuscles are to be seen surrounded by these islands of tissue; but it is to be noted that in every case the basement membrane intervenes between the blood corpuscles and the cells. Wherever the epithelium comes out upon the outer edge of the gland, as at H, for instance, it is the inner ends of the cells which are nearest the surface of the glands, while the outer ends of the cells are turned toward the lumen of the

gland, as usual. The gland, then, is made up of bags or alveoli, closely packed together. These alveoli are thin walls, one cell thick, covering in considerable spaces. The walls are, further, not simple, but thrown into numbers of folds, which run into the cavity of the alveoli, thus increasing the wall space or giving place for a greater number of cells. Sometimes these ingrowing processes are sharp-pointed, and when cut in sections they show no sign of their connection with the wall, this showing in sections at some other level. The blood space is the space around the alveoli, which do not open into the blood space, as is evidenced by the entire absence of blood corpuscles from their lumen. The foldings of the walls are separated and the blood space continues into them, as shown by the presence of blood corpuscles; and the same is true of the centres of the 'islands.' The alveoli are of three kinds, as shown by the character of the cells which form their walls. The manner in which these are connected with each other is not shown by the section, and would require a completer study of the structure of the organ than is at present desirable. The fact that they do open into each other may be demonstrated in various places. Thus, in figure 1, is shown the communication between the collecting sack and a cubical cell-lined alveolus, which is undoubtedly the main outlet from the various alveoli throughout the gland. In a section not far from the one figured the upper end of the duct opens into the large alveolus just above it in figure 1.

The green gland, then, is made up of a sack lined with flat-celled epithelium opening into the gland proper, and the gland made up of alveoli or lesser sacks of three kinds, which communicate with each other and are surrounded by blood spaces, through which blood corpuscles wander at large. This, with the particular account of the cells, is the interpretation of the appearances seen in a study of the section; it is by no means all which would be likely to be thought of by the most thoughtful and practised students, but it is the least which should be thought of by any one who would place himself in the attitude of a student of histology. It implies more than merely the cutting of a pretty section. It supplements the merely mechanical operation with the proper biological one; the studying out of the section and the reproduction from it of the facts as to the actual structure of the organ under consideration. It is a wonderful result to be able to preserve these delicate and perishable bodies—cubes of $\frac{1}{1000}$ in. in diameter—to slice them up and mount them permanently, so that a hundred years hence any one might accurately measure and draw their shape and get a result which the careful use of the technical methods at present in use makes possible and even easy.*

Key to the Rotifera.—III.

By L. C. STEVENS.

(Continued from page 109.)

39. Mastigocerca.

(*Toe usually with accessory basal stylets.*)

a. Stylets none; toe two-thirds body-and-head length; base bulbous, *bicornis*.

a. Stylets none; toe less than one-half body-and-head length, simple, *stylata*.

b. Stylets very minute; toe equal to body-and-head length, straight, *carinata*.

* If the above account, full as it is, leaves some points unsettled, *e. g.*, the membrane which envelopes the gland and sack, the communications of the blood-space with the body cavity, and others, it is not because they are not important, but only because they must be omitted for the present.

b. Stylets very minute; toe longer than body and head . . . . *rattus*.
c. Stylets $\frac{1}{2}\frac{1}{0}$ toe length; toe as long as lorica . . . . . *elongata*.
c. Stylets $\frac{1}{3}$ toe length; toe $\frac{2}{3}$ body length . . . . . *lophoessa*.
c. Stylets $\frac{1}{4}$ toe length; toe $\frac{1}{2}$ body length (*d*).
d. Lorica front with 3 spines . . . . . *scipio*.
d. Lorica front smooth-edged . . . . . *macera*.

40. Rattulus.

a. Brain clear; face with pendent fleshy lobes; marine . . . *calyptus*.
a. Brain clear; toes with 2 pairs very short basal stylets . . . *tigris*.
a. Brain clear; toes without basal stylets . . . . . *helminthodes*.
b. Brain semi-opaque; toes equal, decurved, set wide apart . *sejunctipes*.
c. Brain opaque; toes short, blade-like, decurved . . . . . *cimolius*.

41. Cœlopus.

§ Lorica ridged; head with 2 spines . . . . . *porcellus*.
§ Lorica not ridged (*a*).
a. Head with 2 or 3 points; toe with 2 stylets . . . . . *tenuior*.
a. Head not spinous (*b*).
b. Body cylindric, short, plump, decurved . . . . . *brachyurus*.
b. Body subglobose, elevated, protruding behind the foot . . . *cavia*.
b. Body rotund, $\frac{1}{5}\frac{1}{0}\frac{1}{0}$ inch long; eyes 2, wide apart . . . . *minutus*.

42. Dinocharis.

Lorica subquadrangular, edges serrated, dorsal spines 8 . . . *Collinsii*.
Lorica vasiform, subcylindrical, a short spine between the toes . *pocillum*.
Lorica vasiform, narrowing behind, no spine between the toes . *tetractis*.

43. Scaridium.

Toes equal to the body length; lorica pyriform . . . . *eudactylotum*.
Toes, foot and elongate body about co-equal . . . . . *longicaudum*.

44. Stephanops.

Lorica pyriform, posterior spines 3; foot with toe-like spine . *lamellaris*.
Lorica cylindrical, neck thick, constricted; no spine on foot . . *muticus*.
Lorica cylindrical, not constricted, 3 points behind; toe single . *chlæna*.
Lorica ovate, dorsal spine, long, straight; toes 2 . . . . . *unisetatus*.

45. Diaschiza.

§ Dorsal cleft narrow, the edges parallel (*a*).
§ Dorsal cleft closed in front, gaping behind (*b*).
§ Dorsal cleft wide throughout (*c*).
a. Body gibbous and widest behind; toes decurved . . . . . *Hoodii*.
a. Body gibbous and widest behind; toes thick conical . . . . *exigua*.
a. Body widest in front; toes decurved, two-thirds body length . *valga*.
b. Toes long, slender, recurved . . . . . *semiaperta*.
b. Toes blade-like; recurved . . . . . *pæta*.
c. Toes thick, nearly straight, obtuse . . . . . *tenuior*.

46. Diplax.

Lorica lateral outline a parallelogram . . . . . *compressa*.
Lorica lateral outline ovate; in section triangular . . . . . *trigona*.

47. Salpina.

a. Lumbar spine short; frontal spines 2, procurved . . . *mucronata*.
a. Lumbar spine short; frontal spines none . . . . . *brevispina*.
b. Lumbar spine long, acute; frontal spines 2 . . . . . *spinigera*.

b. Lumbar spine long; frontal spines none . . . . . *macracantha*.
c. Lumbar spine short, conical, arched; frontal none . . . . *eustala*.
d. Lumbar spine short, its base widened; frontal spines 2 . . *sulcata*.

48. Diploïs.

Dorsal cleft wide before, closed behind; posterior ventral spines 3, *propatula*.
Dorsal cleft open throughout, narrow; ventral spines none . . *Daviesiæ*.

49. Euchlanis.

§ Lorica oval, long, narrow; hind dorsal edge not notched . . . *lyra*.
§ Lorica ovate or broadly oval; not constricted (*a*).
§ Lorica centrally constricted; toes rod-shaped . . . . *pyriformis*.
a. Dorsal front edge with a broad gap; uncus 5-toothed . . . *dilatata*.
a. Dorsal front edge with a broad gap; uncas 7-toothed . . . *macrura*.
a. Dorsal front edge notched; ventral plate concave . . . . *triquetra*.
a. Dorsal front edge notched; ventral plate membranous . . . *deflexa*.

50. Cathypna.

Lorica surface fluted, front edge straight . . . . . *sulcata*.
Lorica surface coarsely tesselated, front opening narrow . . . *rusticula*.
Lorica surface smooth, front edge crescentic . . . . . *luna*.

51. Dystyla.

Lorica flexible, plicate, nearly parallel-sided . . . . . *flexilis*.
Lorica rigid, round behind, front truncate . . . . . *Gissensis*.

52. Monostyla.

Front deeply cleft, with 2 curved horn-like spines . . . *quadridentata*.
Front deeply excavate between 2 triangular flat points . . . . *lunaris*.
Front shallow concave; no distinct shoulder to claw . . . . *cornuta*.
Front with deep, narrow sinus between 2 obtuse points . . . . *bulla*.
Front excavation forming 3 sides of a square; lorica tesselated. . *Lordii*.

53. Colurus.

§ Marine (*a*).
§ Fresh water (*b*).
a. Toe single, long, with a median depression . . . . . *amblytelus*.
a. Toe double, formed of 2 narrow, superposed plates . . . *cœlopinus*.
a. Toes 2, large, thick, curved . . . . . *dactylotus*.
a. Toes 2, minute, straight . . . . . *pedatus*.
b. Hind end with 2 acute spines, sinus deep, wide . . . . . *deflexus*.
b. Hind end with 2 blunt, short spines; front truncate . . . *uncinatus*.
b. Hind end with two very short points; lorica pyriform . . *caudatus*.
b. Hind end excavate, not cleft . . . . . *bicuspidatus*.
b. Hind end rounded, without points . . . . . *obtusus*.

54. Metopidia.

a. Lorica subcircular, with 1 dorsal 2 lateral wings . . . . *triptera*.
a. Lorica subcircular, without wings . . . . . *solidus*.
b. Lorica oval, with 2 small postero-dorsal projections . . . *bractea*.
b. Lorica oval, without posterior projections . . . . . *lepadella*.
c. Lorica ovate, tesselated, with a dorsal longitudinal ridge . *oxysternum*.
c. Lorica ovate, not tesselated, acutely pointed behind, front 2-pointed, *acuminata*.
d. Lorica rhombic-ovate, obtusely pointed behind . . . . *rhomboides*.

55. Monura.

Lorica ovate. Marine . . . . . *colurus.*

56. Mytilia.

Eyes 2, frontal, wide apart. Marine . . . . . *tavina.*

57. Cochleare.

Lorica hemispheric . . . . . *staphylinus.*
Lorica three-sided . . . . . *turbo.*

58. Pterodina.

a. Lorica subcircular, the sides movable, valve-like . . . . *valvata.*
a. Lorica subcircular, inflexible, front acutely pointed . . *mucronata.*
a. Lorica subcircular, inflexible, front rounded . . . . . *patina.*
b. Lorica elliptical, both ends truncate . . . . . *clypeata.*
c. Lorica ovate, front only truncate . . . . . *truncata.*

59. Pompholyx.

Lorica with 4 longitudinal furrows . . . . . *sulcata.*
Lorica not furrowed, front obtusely pointed . . . . . *complanata.*

60. Brachionus.

a. Frontal spines 6; posterior spines 2 . . . . . *Bakeri.*
a. Frontal spines 6; posterior 2, papilla-like . . . . . *urceolaris.*
b. Frontal spines 4, the central 2 curved . . . . . *dorcas.*
b. Frontal spines 4, straight, long, sharp . . . . . *pala.*
c. Frontal spines reduced to unequal saw-teeth sloping inward . *rubens.*
c. Frontal spines reduced to low teeth, their outer edges sinuate. Marine, *Mülleri.*
c. Frontal spines reduced to slight undulations; hind end with 2 blunt processes . . . . . *angularis.*

61. Noteus.

Lorica facetted, stippled; front with 2 curved strips; hind end with 2 long spines . . . . . *quadricornis.*

62. Anuræa.

Lorica with 6 frontal spines (*a*).
Lorica without spines . . . . . *hypelasma.*
a. Posterior spines none; 5 median facets only perfect . . . *curvicornis.*
a. Posterior spines none; dorsal ridge present; facets large . . . *tecta.*
a. Posterior spines 2, on the angles; surface tesselated . . . *aculeata.*
a. Posterior spines 2, often obsolete; lorica *very* rough, tesselated, *serrulata.*
a. Posterior spine 1, central; back ridged, tesselated . . . *cochlearis.*

63. Notholca.

Posterior point long, truncate . . . . . *acuminata.*
Posterior point a very long curved spine . . . . . *longispina.*
Posterior margin truncate. Marine . . . . . *thalassia.*
Posterior margin rounded. Marine . . . . . *scapha.*

64. Eretmia.

Setæ 6; 1 dorsal, 1 ventral, diverging; 4 straight, terminal . . *cubeutes.*
Setæ 5; 1 dorsal, 2 from each side . . . . . *pentathrix.*
Setæ 4; 3 frontal, 1 postero-terminal; lorica obconic . . . *tetrathrix.*

65. Pedalion.

Limbs 1 ventral, large; 1 dorsal; 2 unequal lateral pairs . . . *mirum.*

Quantitative variations in the germ life of Potomac water during the year 1886.*

By THEOBALD SMITH, M. D.,
OF WASHINGTON, D. C.

The value of the so-called biological analysis of drinking water—the quantitative and qualitative determination of bacteria present—is still very unsettled. Recent investigations certainly have not contributed toward a clearer understanding of the problem, but have made it more complex. Meanwhile statistical determinations cannot be amiss in aiding investigators in interpreting their own results. It is from this point of view that the following statistics are published, without any attempt at estimating the quality of the water therefrom.

The water was drawn from a faucet in the basement of the Agricultural Department building, which was constantly in use, so that there could have been no stagnation of water in the smaller pipes. It was immediately examined according to the method of Koch—two gelatin plates being always made from the same sample of water. This was measured with flamed glass pipettes without being diluted. The pipettes† were graduated by determining accurately how many drops of distilled water were required to make 1 cc. If 51 drops were necessary, and only 8 added to the gelatin, $\frac{8}{51}$ cc. was considered taken. This method is far simpler than the one which insists upon dilution, unless the number of bacteria be very large.

From 0.1 to 0.5 cc. of water was added, according to the probable number of bacteria present. The culture medium was the well-known beef infusion peptone gelatin, containing 10 per cent. gelatin. There was always a close agreement between the two parallel plate cultures made from the same sample.

As to the results of the year's observation, we first observe from a glance at the table that the number is highest in winter, in spite of the fact that heat greatly favors, and cold checks, multiplication.

Table giving the Monthly Average Number of Bacteria found in one Cubic Centimeter of Potomac Drinking Water during 1886.

1886.	Number of observations.	Average.	Rainfall (inches).
January	2	3774	3.46
February	4	2536	2.79
March	5	1210	4.16
April	4	1521	4.21
May	3	1069	7.77
June	2	348	4.98
July	2	255	8.42
August	1	254	1.03
September	2	178	1.04
October	3	75	2.31
November	1	116	3.69
December	2	967	3.07
1887.			
January	3	882	2.19

This anomalous condition is not so difficult of explanation. In the winter the water as it reaches the city is more or less turbid, and, when shaken, clouds, composed of very minute particles, are seen. These will pass through ordinary filter paper, and when gathered together, as in distilling water, the residue is made up of reddish earth. This turbidity, most pronounced in winter, gradually disappears toward summer, when the water becomes very clear and limpid. The number of bacteria varied with the change in turbidity, being highest when the suspended matter was most abundant.

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* Reprinted from *Medical News*, April 9, '87.

† The pipettes are easily made by drawing out, in the flame, the middle point of a piece of glass tubing about 15 cm. long and 6–7 mm. in diameter, until a narrow tube is formed $\frac{3}{4}$ to 1 mm. in diameter and about 30 cm. long. This is broken in the middle to make two pipettes. If the capillary tube be drawn out to the above size, each drop will equal from $\frac{1}{40}$ to $\frac{1}{60}$ of a cc., the exact size being determined for each pipette. Into the other end a plug, preferably of glass wool, 2 to 3 cm. long, is introduced, and the bulb of a medicine dropper drawn over the tube to give the necessary aspirating force. Immediately before use the pipette is thoroughly flamed, beginning with the glass-wool plug while it is held with the bulb between the fingers. Care must be taken lest the heat be too great, and change the form and size of the orifice. If any doubt exists as to this point, it is best to graduate the pipette again *after* use, and with the sample of water to be examined if the latter should vary much in its specific gravity from distilled water.

This fact impressed me so strongly after a number of observations that it became possible to anticipate quite accurately the number of bacteria present by looking at the water in the tube with transmitted light.

It seemed reasonable to conclude that whatever agency brought the suspended earth also brought the bacteria, and that the earth contained the bacteria. Throughout the winter of 1886 I noticed that after heavy rains the turbidity increased quite suddenly, this fluctuation, of course, producing a corresponding rise and fall in the number of bacteria. The rain, washing down the soil from the surface drained by the tributaries of the river, was thus the cause of the turbidity. But was there any relation between rainfall and the number of bacteria? Through the kindness of the Signal Office I obtained the data given in the third column of the table. Comparing the second and third columns, the relation is certainly not on the surface. The heaviest rains occurred in July, but the number of bacteria did not rise perceptibly, and no turbidity appears. The only explanation which suggests itself is that which must be sought in the changed condition of the surface of the soil in winter and summer as regards vegetation. The precipitated water is caught by the foliage of trees, by the grass and herbage, which clothes the soil everywhere. The soil itself is at the same time more firmly bound together by the vegetation itself. In winter all this is changed. The absence of vegetation leaves the loose soil ready to be washed into streams by rain and melting snow, carrying with it the bacterial vegetation.

The majority of bacteria carried into the river are, no doubt, harmless, but what is to prevent the infectious micro-organisms of typhoid and other diseases from being washed down and carried into our houses with the suspended matter? The danger is thus not constant, but only occasional. The number of bacteria may have no direct significance, but it is certainly an index of the possible danger. It is safe to assume that Potomac water, free from suspended matters, contains from 50 to 200 bacteria in 1 cc. This will, no doubt, be found a low average for unfiltered river water when more statistics have been collected of other streams whose water is used to supply towns and larger cities.

No qualitative examination of the different kinds of bacteria was made for want of time. Liquefying bacteria were constantly present; when the bacteria were few in number, as in summer, as many as 50 per cent were liquefying, so that counting was somewhat difficult, and many plates were lost by the confluence of the large colonies and the total liquefaction of the gelatin layer. When the number was very high, as in winter, the liquefying forms did not increase in the same proportion, but formed only 5 to 10 per cent. of the whole. These observations led to the inference that they are constant inhabitants of the water, and that attention must be directed to them, first of all, if individual forms are to be more closely examined.

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Chinese fish lines.—A communication from Miss Adele M. Fielde states that near Swatow, China, the silk-glands are taken from the larvæ of several species of large lepidopterous insects just before they enter the pupa stage and are made into fishing lines. At this period in the life-history of the insect the glands are full of the viscid white substance from which the cocoon is to be spun. The silk-glands of a species of *Atlas* were found to be one yard long, a tenth of an inch in diameter at the free posterior end and a hundredth of an inch in diameter at its anterior end. The two glands extend nearly the whole length of the body cavity on either side of the alimentary canal, lying in loops of varying length and uniting in a single duct under the mouth, as in the silkworm, *Bombyx mori*. The Chinese make a transverse cut across the back of

the caterpillar, take hold of one of the loops of the silk-gland, draw it out entire, drop it in vinegar to take off its external coat, then stretch it to double or treble its original length and dry it. A durable filament is thus formed strong as cat-gut, and much cheaper. The tenacity of the filament is constantly restored by soaking it for a few minutes in warm rice water; that is, in the water in which rice has been boiled for food. The fishermen say that when thus prepared a line will hold the largest fish taken on the coast. It was found, however, that a single filament would not sustain a weight of more than $4\frac{1}{2}$ pounds. Dr. Caustand, in charge of the hospital at Swatow, had successfully used these filaments to replace ligature silk.—*Proc. Acad. Nat. Sci., Philada.*, 1886, p. 298.

MICROSCOPICAL TECHNIQUE.

An electrical constant-temperature apparatus.

By W. C. BORDEN, M. D., U. S. A.,
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In many of the details of histological technique, an apparatus for maintaining a constant temperature is a great convenience, and in some it is a necessity.

This apparatus should be one that will not easily get out of order, and that can be depended upon to maintain the temperature desired. For the use of those who, like myself, have no gas at command, but have to use either petroleum, or alcohol, as a source of heat, the apparatus described in this article will be found efficient and reliable. It can be left for hours with the certainty that, when again examined, the heat will not have gone above a certain point, or have dropped, at any time, more than one-half, or possibly one, degree below it. The general form of the entire apparatus is diagramed in figure 2 and the regulating thermometer in figure 1. The battery used is the ordinary gravity battery used in telegraphy, and which can be purchased, copper and zinc included, for 85 cents a cell. I have used three cells. This form of battery gives a current of nearly constant quantity, and requires but little attention, needing to be cleaned but about once in two or three months, when the zincs and coppers should be taken out and scraped. The loss of water by evaporation should be made up from time to time, and if the clear solution of sulphate of zinc, which forms at the top of the jar, attains a specific gravity of 1030°, or more, some of it should be taken out and fresh water added. The blue saturated solution of sulphate of copper should always cover the copper, and if it goes too low, add more crystals of the salt. With these few attentions there will be no danger of the battery breaking down, while in use, and so spoiling the work. The regulating thermometer (fig. 1) is made by taking a small glass vial, filling the lower part with mercury, and the upper with 95% alcohol, corking it tightly, and passing a small glass tube through the cork, to the bottom. The cork must fit very closely, and should be made impervious to water by soaking in melted paraffine for several hours.

The top of the tube is to be loosely corked, and two wires passed down into it through the cork, without touching each other—one well down into the mercury and the other free above it. This regulating thermometer is now hung in the water bath, supported by the cork C, and when the temperature of the bath, as shown by a standard thermometer, has reached the highest point desired, the wire above the mercury (B, fig. 1) is pushed down so as just to touch the surface of the latter.

It is obvious, that if the bath be filled with water below the temperature desired, the mercury will not rise and touch the wire B, thus making connection with the other wire, until the bath reaches that temperature, and that, as soon as the temperature falls below this point, the mercury will fall with it, and away from the wire B; also that by raising, or lowering, this wire the connection can be made to take place at any desired higher or lower temperature. This regulating thermometer will be found to be sufficiently delicate to keep the temperature to within two degrees. It can be made, by simply blowing a bulb on a glass tube and filling the bulb and tube with mercury alone.

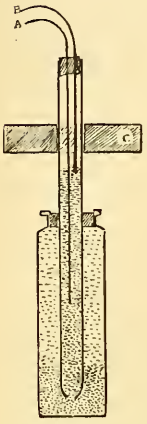

Fig. 1.

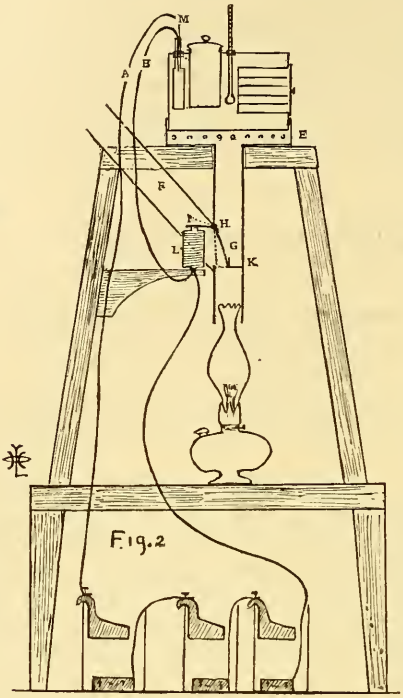

Fig. 2

Fitting over the top of the lamp chimney is a chimney (D, fig. 2), eleven inches long and $2\frac{3}{4}$ inches square, having at its top a hot-air chamber E, into which the water bath fits. This chamber has holes around the sides, near the bottom, for the escape of hot air. The chimney D has at one side a branch chimney F, twelve inches long, opening into it at an angle of 45°. In the opening between the chimneys is hung a valve G, turning on a hinge H, and moved by a lever I, on the outside. This valve should be very light and must turn easily on the hinge which is made by hanging the valve, fastened on a wire passed through holes on the sides of the chimney; to this wire is attached on the outside the lever, which is to be weighted on the end with a small bullet so as nearly to balance the valve, which must just fall of its own weight.

At K is a shelf, $2\frac{1}{4}$ inches wide, extending into the chimney D. This shelf leaves an opening in the chimney $\frac{1}{2}$ inch wide, which is sufficient for the passage upward of the hot air, and which can be readily closed, or opened by the valve, without too far swinging. At L is an electro-magnet, which is connected with one pole of the battery, and with the regulating thermometer by means of the wire B. The magnet used by me is a small one, wound to 20 ohms resistance, and costing 80 cents. Also the regulating thermometer is connected with the other pole of the battery by means of the wire A. Both these wires are of course insulated, and can be purchased covered, together with the battery and magnet, of any electrical supply house.

The action of the apparatus is sufficiently plain. The lamp being lighted the temperature, of the water bath, will rise, and the mercury, in the regulating thermometer M, with it, until it touches the wire B, thus closing the circuit, and magnetizing the electro-magnet, which will attract the lever I, pulling it down, and raising the valve G, so closing the opening in the chim-

ney K, when the heat will escape, by the branch chimney F. The temperature of the bath will now fall slightly, and the mercury with it away from B, thus breaking the circuit, and demagnetizing the electro-magnet, which will cease to attract the lever, and so allow the valve to fall, of its own weight, closing the opening into the branch chimney, and allowing the hot air to again ascend through K, and reheat the water bath.

This regulating action will continue as long as any oil remains in the lamp, which should therefore have a large reservoir, and the flame be turned only high enough to keep the bath slightly above the temperature desired. The water bath which I have is 7 inches long, 6 inches wide, and 5 inches deep, and has openings for two imbedding dishes, the regulating, and standard thermometer. Into it at one end is built an oven, with six shelves, which will take 24 slides for drying. The whole, including chimneys and hot-air chamber, is of copper, and was made by a tinsmith, after my directions, at a cost of but five dollars. With this apparatus many processes, such as Weigert's hæmatoxylin staining of the nervous system, which without a constant temperature, of long continued duration, are impossible of performance, are made easy, and any one, who has had the bother of watching a bath, while imbedding in paraffine, will appreciate the gain arising from an apparatus which will run all night, and have the tissues in good condition for imbedding in the morning, to say nothing of the many other uses besides staining and imbedding, to which it can be put.

April 30, 1887.

EDITORIAL.

Summer work.—Those who are interested in biological studies may find the summer time, when they are tempted to relax a little, the very best time for work in the whole year. Histological studies on hardened material may, to be sure, be carried on as well in the winter or, perhaps, even better; but after all histological studies on hardened material should always be made after structures or whole animals have been studied alive; and perhaps the most important and interesting studies in all the range of biological works are those which can be pursued only in the summer time. Without desiring to draw any invidious comparisons, or to pronounce against any one pet form of work as inferior to any other, we must all recognize that some lines of study are more important than others from the biologist's standpoint. Since the chief interest of the biologist centres around the origin and mode of growth of living organisms as problems to be more fully worked out, studies upon the life history of all forms engross the chief attention. We cannot infer, from close similarity in adult anatomy, a close resemblance in embryonic history; for, in many cases closely similar adults come through very dissimilar and devious roads, as the cray-fish and his salt-water cousin, the lobster, and their cousin, the shrimp (*Peneus*). So the story for each species needs to be fully studied.

There is, then, a whole field of study closed to the biologist who studies only in the winter time and folds his hands during the summer season—a field which will furnish him some of his most interesting subjects of study. Who lives on or near the salt water has, in this matter, an immense advantage. A few minutes' use of the dip-net at high tide will give him an immense assortment of adult and embryonic forms from which to select those he wishes. He can find larvæ of crustacea and, isolating them in little aquaria—where he must be careful to make frequent changes of water, for

these little fellows require a great deal of ventilation—he can watch and register their daily changes as they grow toward their adult form. Thus the barnacle, common as it is, will furnish abundant material for a summer study. The eggs may be obtained and their segmentation watched; the young nauplius may be studied, and the grafting upon it later of the more complex cypris stage, the final changes in this, and the attachment of the hitherto free creature, and the assumption of a sedentary habit. Or he may obtain egg-cases of some of the numerous snails and watch the growth of a snail from the egg through its larval veliger stage; or catch in his net the free-swimming embryos of various worms and watch them grow a tail by budding; or readily fertilize for himself the eggs of echinoderms, and see every change from the unfertilized ovum through the very interesting larva form to the adult shape.

All these and many other lines of study are open to the interested student who lives near the sea-shore; and there are many books which will help him to pursue them to advantage. Many of them require no expensive outfit, and they open the way to the most interesting and attractive paths of study of the whole field of zoology, as well as to many interesting lines of work in botany.

But the student who lives inland, beyond reach of the shore, is not, by any means, shut out from such lines of research; though, in his case, fewer are accessible. Whole groups of animals are, indeed, exclusively marine. Thus the echinoderms, and some life-histories of widest interest, are to be studied only in marine forms. But there is, for all that, enough among fresh-water forms to occupy any one many years, and to interest and instruct all. Thus the little gelatinous masses so common on submerged twigs of any quiet pond are bunches of the eggs of snails. These are easily obtainable in all stages of development. They are, by reason of their great transparency, very favorable for study. They also furnish the student an opportunity to reach, perhaps, valuable original results; for the authorities are disagreed upon the main facts in the development of the pond snails. Very interesting objects of study are too numerous to mention:—The polyzoa and their habits; *Hydra* in the living state; living plants, such as conjugating filamentous algæ, moving diatoms, etc. Some of these may be kept indefinitely in aquaria and used for winter study; others may be preserved and studied by section or otherwise. One who in the summer stops his studies makes a great mistake; it should be his time of greatest activity.

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Microscopical demonstrations.—Mr. Arthur J. Doherty, of 19 Blossom avenue, Manchester, Eng., desires us to state that he will be at liberty to give the under-mentioned series of demonstrations in practical microscopical work before societies in this country:—

Animal and plant section cutting.
Single and double staining.
Anatomical injecting.
Selecting and arranging foraminifera.
Mounting in balsam and other media with and without pressure.
The mechanical and optical construction of the lantern microscope, including an exhibit of a number of beautiful objects by means of the instrument.

Mr. Doherty leaves England for Australia upon the 23d July, and any communication to him should be addressed to the general post-office, Sydney, New South Wales. If he can make a sufficient number of engagements to pay expenses he will make the trip to the United States across the Pacific.

We are glad to commend this project to our readers as one which will be

likely to result in substantial benefit to them, provided it can be executed. Of the value of such demonstration there can be no doubt, especially in the case of those who do not have the opportunities for work in the great laboratories. The similar project of demonstrations before the American Society of Microscopists will be very profitable to those who can be present at the meeting. Of the ability of Mr. Doherty to conduct such demonstrations we are fully assured from the character of the work we have seen from his hands. The expense of such a project would not be excessive if distributed among a number of societies.

NOTES.

Mr. G. S. Woolman invited us to visit him at his place of business, No. 116 Fulton street, New York. We passed two or three hours in his establishment a few days ago very enjoyably. Mr. Woolman shows a larger stock of physical and mathematical instruments than microscopical, but he has a very great deal to interest one in the latter department. We looked through objectives, examined the new Ryder microtome, looked at cabinets and slides. Among his slides were a large number of finely-mounted objects, prepared by the late Dr. Allen Y. Moore. He had, too, some historic slides, among them one of Beck's original test slides of Rodura scales given him by the elder Mr. Beck in 1870. We saw also a case which Mr. Woolman is devising for packing his own microscope to carry around to club meetings, etc., which is very handsome and will be very useful. While there the enthusiastic Mr. Jay L. Smith, of Orange, New Jersey, dropped in, and we talked over the earthworm. Our visit at 116 Fulton was a very pleasant one, and we have every inclination to repeat it. Mr. Woolman is a good friend of the microscope and its users.

Origin of scarlet fever.—It is estimated by the London *Times* that in the thirty years from 1850 to 1880 the number of deaths caused by scarlet fever in the United Kingdom was 543,000, and that the same disease causes more than 200,000 cases of illness in that country every year. The very successful experiments by which Mr. Power and Dr. Klein, of London, have shown how the disease is communicated to human beings from cows by the milk supply are of interest.

The scarlet fever epidemic which was the subject of Mr. Power's careful inquiry occurred in the north of London last winter, and the disease was confined exclusively (aside from cases of subsequent infection) to those who used milk supplied from one dairy farm in Hendon. It was clearly shown that the milk had not absorbed the contagion directly from human beings, and had not been contaminated by unsanitary surroundings. The cows suffered from a disease very closely resembling scarlet fever, though milder in form, and it was this disease which had been communicated to those who drank the milk. In human beings it was scarlet fever, without a doubt.

The manifestations of this disease in the cows were visceral lesions, sores on the skin, loss of hair in patches, and ulcers on the udder. These sores contained micrococci or microbes, and after calves had been inoculated with a cultivation of these microbes the same disease appeared in them at the end of an incubation period.

The evidence was almost complete, but it was necessary to prove that scarlet fever in man was due to the presence and multiplication in the blood and tissues of the same microbe, and that the microbe obtained from human scarlet fever would cause in a cow the disease produced in healthy cows by the microbe taken from the cows at the Hendon farm. In a lecture recently delivered before the Royal Institution in London Dr. Klein showed that the needed proof had been procured. In the blood and tissues of persons affected with scarlet fever a microbe identical in microscopical and in cultural character with that obtained from the Hendon cows has been found. By repeated experiments it has been shown that the action of this microbe upon cows and other animals is exactly the same as that of the microbe taken from the cows at Hendon. Calves and other animals were inoculated with cultivations of each microbe (that taken from the human being and that obtained from the Hendon cows), and in each case there was developed the same cutaneous and

visceral disease, similar to scarlet fever in man. Moreover, from the blood and tissues of these animals infected with one microbe or the other, the same microbe was recovered. 'I think I may after this say,' remarked Dr. Klein, 'that this microbe—*Micrococcus scarlatinæ*—is the cause of human scarlet fever; further, that it produces in bovine animals a disease identical with the Hendon disease and human scarlet fever, and that, consequently, while the cow is susceptible to infection with human scarlet fever, it can in its turn be the source of contagion for the human species, as was no doubt the case in that milk epidemic from the Hendon farm.' It should be said that the herd at Hendon appeared to have been infected by several cows that had recently been brought to the farm from Derbyshire. It may be that in Derbyshire the disease was communicated to them from human beings.

In corroboration of all this an interesting bit of evidence was submitted by Dr. Klein. It was suspected that a certain brand of condensed milk had caused scarlet fever in persons who used it. Several cans of this milk, which is a cheap preparation, were examined by the doctor. From one-third of those inspected he obtained by cultivation a microbe which in every respect, morphologically and in cultures, was the same as the microbe procured from the Hendon cows and from human scarlet fever. Tested upon calves and other animals, it caused the identical disease which had been produced by the microbes taken from those sources. Other proof was obtained from Wimbledon, where a severe epidemic of scarlet fever occurred three or four months ago. This epidemic was traced to a dairy farm. In one of the houses where the disease prevailed, a pet monkey that had consumed a considerable quantity of the milk became ill and died. Dr. Klein made a post-mortem examination of the body and discovered that the monkey had without doubt died of scarlet fever. From the blood of the monkey he obtained by cultivation a micrococcus, or microbe, identical with those procured from the Hendon cows, from human subjects, and from the condensed milk. By inoculation with this microbe the same effect was produced.

The writer further suggests that tuberculosis may be communicated in the same way.—*N. Y. Times, June* 28, 1887.

Diatom deposits.—A description of some diatomaceous deposits from the peat of Aberdeenshire was read before the British Association in 1875, and published in the *Chem. News* of that year. The author is Prof. W. J. Macadam. The species of diatoms found are not given, but numerous analyses of the deposits to determine their commercial value. The deposits mentioned are known as Kinnord, Black Moss, Ordie Moss, Auchnerran, Logie Moss, and Milton.—H.

MICROSCOPICAL SOCIETIES.

San Francisco, Cal.

The annual reception of the San Francisco Microscopical Society was held at Pioneer Hall on Saturday evening, May, 27, 1887. The audience comprised many of the most prominent names in the social, scientific and educational circles of this city, and the entertainment was evidently thoroughly enjoyed by all present. Never before has such a display of microscopes been seen on the Pacific Coast. Arranged along seven long rows of tables were no less than sixty-four instruments. The list of objects shown was a most attractive one, and, as the best of lenses were used in their display, and careful attention was given to obtaining the best effects of illumination, the results were eminently satisfactory. It may incidentally be remarked as a fact most gratifying to all interested in the progress of microscopical investigation on this coast, that, although the local microscopical society is one of the oldest in the country, being now in its fifteenth year—it has lost none of its vitality, but has, on the contrary, at present a larger membership, a larger and finer library and cabinet, a larger average attendance at meetings and in every way better prospects for useful work in the future than at any previous time in its history.

Among objects shown may be mentioned that of Dr. C. P. Bates, the ever-beautiful circulation of the blood in the gills of *Menobranchus*. By means of an ingeniously

constructed 'life slide' the animal was supplied with a current of fresh water and was thus kept in full vigor during the entire evening.

The seed of the common California wild flower, *Orthocarpus purpurescens*, by A. S. Brackett. Each seed is inclosed by a delicate transparent latticed receptacle, thus presenting a charming appearance when well illuminated.

The exhibit of A. H. Breckenfeld comprised double stained sections of the human scalp, both vertical and horizontal, thus giving an excellent idea of its structure.

J. E. Davis exhibited a beautiful specimen of the 'glass-rope sponge' (*Euplectella*) under a bell-glass, and also its network of silicious spicules under the microscope. He also showed a fine slide of the interesting diatoms and polycistina dredged from the ocean's bed at a depth of 1,750 fathoms.

Dr. S. W. Dennis exhibited slides of the optic nerve under amplifications of 30 and 750 diameters respectively, from which a good general understanding of its structure could be obtained. He also showed a very fine injected section of cat's jaw with teeth *in situ*.

A fine section through the entire human eye was shown under a lower power by Dr. Henry Ferrer, who also exhibited excellent preparations of the human retina, and of the embryonic eye of the calf. The elegant Zeiss stand and apochromatic objectives belonging to this gentleman received much admiring attention from the experts present.

Dr. Thomas Morffew's exhibit illustrated very finely the structure of human teeth. Longitudinal sections of an incisor, a cuspid and a molar were shown and their characteristics duly explained.

Dr. S. M. Mouser, with a very fine array of instruments, exhibited an interesting slide of *Trichina spiralis*, and also a series of pathogenic micro-organisms grown in his biological laboratory, and shown under high-power objectives giving exquisite definition.

The lingual ribbon or tongue of *Haliotis*, exhibited by W. F. Myers, strikingly illustrated the characteristics of this peculiar organ of the Molluscæ. The beautiful iridescent shell of this animal was also shown, both microscopically and in its entirety.

The resplendent scales of the diamond beetle were shown by Charles C. Riedy under a microscope; interesting from its having been in use for half a century. He also exhibited the well-known test diatom *Pleurosigma angulatum* under an amplification of 2,000 diameters. The most attractive objects in his exhibits, however, were the beautiful shells of Foraminifera shown with dark-ground illumination obtained by the Bausch & Lomb Abbe condenser.

Sand from Alameda beach formed an attractive object as shown by Dr. Riehl, who also exhibited living diatoms in active motion, collected in San Francisco Bay.

Dr. J. M. Selfridge presented an attractive exhibit, comprising a very fine mount showing the villi in duodenum of rabbit, another of the beautiful crystals of cinnabar, and last, but by no means least, the circulation of the blood in the mesentery of the frog.

Dr. J. H. Stallard's exhibit was the largest in the hall, he having no less than thirteen microscopes under his charge. The entire series was devoted to illustrating the structure of both normal and diseased human lungs. The slides shown were all masterly preparations, and the opinion was universally expressed that the entire exhibit formed the finest presentation of the subject ever seen here.

The subject chosen by the President of the Society, E. J. Wickson, was that of insect fruit pests. Living individuals of the Cottony Cushion Scale and the San José Scale were shown, and also specimens of the egg deposit of the *Lecanium* Scale, and of the larval form of *Chilocorus bivulneris*. Colored engravings, showing the appearance and ravages of some of these little destroyers were also exhibited. Mr. Wickson's table was the last on the programme, and its inspection brought to a close an entertainment which must be pronounced an unqualified success.

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A well attended regular meeting of the Society was held on June 7th. J. A. Sladky, of Berkeley, was proposed for resident membership.

An ingenious device, called the 'Quimby Mounting Cabinet,' was received for inspection from the Society's indefatigable corresponding member, E. H. Griffith. Its purpose is to facilitate the illumination of objects by transmitted light, during the process of mounting.

Dr. Selfridge brought a sample of the Oakland water supply, which upon exami-

nation was found to contain large numbers of the interesting infusorian *Ceratium longicorne*. Some four years ago the water supply of this city contained enormous numbers of the same little organisms.

Mr. Wickson exhibited some eggs and insects found upon an apple tree by Dr. Edward Gray, of Benicia, and sent by him to the society for determination. Mr. Wickson remarked that it would be difficult to identify a species by the egg and newly-hatched larvæ alone, unless one is very familiar with the forms. He said, however, that the insect was of the *heteroptera*, a sub-order or division of the *hemiptera*, in which one pair of wings is thin and membranous and the other partly thickened and leathery. The *heteroptera* are divided into twelve families and the specimen sent probably belongs to the *scutelleridæ*, a family characterized in part by the size of the shield it bears upon its back. The larvæ shown had neither wings nor shield ; these parts appear later in the progress of the insect. The eggs shown were strikingly beautiful. They were oval in shape, attached to the bark by one end, while the upper end was either open—if the insect had hatched out—or still closed with its cap-like cover, if the larvæ had not appeared. The eggs are of pearly-hue and had the appearance of frosted glassware. In the mouths of the eggs from which the larvæ had hatched there was to be seen the following peculiar arrangement, described by Kirby and Spence : ' The egg of a *Pentatoma* is furnished not only with a convex lid, but with a lever of a horny texture, and in the form of a cross-bow, for opening it, the handle being fixed to the lower part of the egg by a membrane and the bow part to the lid. When the larva is ready to emerge the cap flies off the egg-case. In the specimen shown under the microscope some of the covers were shown as they had fallen off and were lodged on the bark. The eggs, etc., had been mounted by Mr. Wickson in a deep cell, which, although very simple, answered the purpose admirably. It consisted of the neck and top flange of a homœopathic vial, the lower edge having been ground flat and cemented to the slide.

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Washington, D. C.

At the sixty-first regular meeting of the Society Dr. J. W. Blackburn presented a paper on methods of preparing tissues for microscopical study and brains for anatomical demonstrations.* Dr. Taylor said the ordinary freezing microtomes have too much brass work about them. The one shown does not seem to be liable to that objection. He then described the freezing microtome devised by himself, in which the refrigerating agent is a mixture of salt and ice, and which is very economical in its workings.

Prof. Seaman said that, in his opinion, the green wax shown was the true myrtle or bay-berry wax, the yellow not. He was not certain as to composition of the latter, but would report at the next meeting.

At the sixty-second regular meeting, June 14, 1887, Prof. Seaman made the following report upon the waxes shown at the last meeting. The green wax is myrtle wax and is described by G. E. Moore in *Silliman's Journal*, 1862, p. 313, It is known also as candle-berry wax and bay-berry tallow. It is the product of *Myrica cerifera*, and has a sp. gr. of 1.004–1.006. Fusion point 47–49 C. Soluble in 100 parts boiling alcohol to the extent of 5 per cent., boiling ether 25 per cent., oil of turpentine 6 per cent. Saponifies readily with caustic potash, and consists of palmitin and palmitic acid with a trace of lamic acid.

The yellow wax is Japan wax, the product of *Rhus succedanea*, a tree from eight to nine metres high, with a stone fruit the size of a pea, yellowish and with a fibrous pericarp containing the wax between its fibres. One tree yields as much as sixty pounds of fruit containing twenty-five per cent. of wax. It melts at from 53.5 to 54.5 C., and solidifies at from 40.5 to 41.5 C., the temperature rising thereby to 45.5 or 46.5 C. Becomes transparent at from ten to twelve degrees under its melting point, and on cooling melts afterward at 42 C. Various melting points have been assigned to it. Consists of C_{70}, $H_{12.07}$, $O_{17.93}$, with .08 ash. Thirteen hundred tons of this wax were exported from Japan in 1874.

The rest of the evening was given up to an exhibition of bacilli, a large number of slides being shown by Dr. White, covering nearly the whole list of known bacilli.

E. A. Balloch, *Rec. Secr.*

* This paper will be published in our August number.—Ed.

NOTICES OF BOOKS.

Elements of Botany. By Edson L. Bastin, A. M., F. R. M. S. (pp. 282, figs. 459). Chicago. 1887.

We hardly know what to say in reviewing a college text-book. Standards are so multifarious that we cannot make sure that our words will convey the ideas to others which they mean to ourself. Upon the whole our opinion of the book is favorable. Our chief objection is that the matter is so condensed that the book can hardly be successfully used as a text-book for any but educated readers. It contains the *elements*, that is, the *essentials*, of a botanical education, and one who has already read science in other lines, and studied not botany, but other sciences, could, by faithfully using this work, very satisfactorily inform himself upon all but the most special points in the science of botany. Having thus pointed out this limitation, as it seems to us, in the use of the book to the needs of only students of some attainment, we can most heartily commend the treatise to teachers or general readers. The arrangement is admirable, taking up first phanerogamous plants after the lead of Gray's structural botany, following this with a part on vegetable histology, then vegetable physiology, and finally vegetable taxonomy, a survey of the leading forms of Protophytes, Zygophytes, Oophytes, Carpophytes, mosses, and ferns, and finally flowering plants.

There is much to be said in favor of this plan in spite of the course pursued very widely at the present day in teaching the science of botany. The plan is, in its first step, that of Dr. Asa Gray, and is well exemplified in his 'First Lessons,' or 'Structural Botany.' A student should not stop at Gray's 'First Lessons' or the analysis of a few plants; he will gain thereby some knowledge of the principles of the science. While microscopic study of histology, both of vascular and the lower plants, is necessary to a competent knowledge of botany to-day and must not be passed over, we doubt the advisability of introducing the beginners in the science to that instrument with its intricacies, and believe that an interest in plant study should be aroused by study first of the more easily apprehended facts, followed by a completer study of the same, and later a complete study along comparative lines.

Mr. Bastin's work follows such a course as this, and deserves commendation for its execution of the plan. It is so condensed and concise that it would be very 'hard' as a text-book. It is, however, an excellent guide to a course in botany if supplemented by other fuller works, or in the hands of a teacher, supplemented by well-chosen subjects for practical study and explanatory remarks. The illustrations are very numerous and are all from drawings by the author, some of them original and others copied from several well-known sources. These are not in all cases as fine as those which come from the hands of professional draughtsmen, but in most cases are very satisfactory indeed. They are drawn for a purpose and illustrate well the point. They will serve as admirable models to suggest to students the proper way to illustrate his work.

New Treatment of the Affections of the Respiratory Organs and of Blood-poison. By Dr. V. Morel. Translated from the French by L. E. Holman. (pp. 21). Philadelphia, '87.

Messrs. J. W. Queen & Co., of Philadelphia, have gotten out this translation of the papers of Dr. Morel to better inform the public upon the theory and practical application of the gaseous treatment for tuberculosis and other pulmonary troubles now coming into common use in this country. We have space for only a brief account of this interesting pamphlet. It is to be regretted that the discovery of the microbe of tuberculosis has for a long time remained sterile, so far as the development of a cure for tuberculosis based on a knowledge of the microbe is concerned. M. Debove, in '83, says that the cure for phthisis is in the discovery of a germicide unfortunately not yet successful. Having settled that phthisis is due to a parasitic organism, Dr. Bergeon sought a means of destroying the microbe without injury to the system of the human host. He thought of two ways—administration of doses through the respiration process; introduction of dose through digestive tube. The former is open to greater difficulties than the latter process. Thus sulphuretted hydrogen will kill quickly if inhaled, but may be injected into the veins directly or into the rectum without fatal results. Upon this principle, and to avoid the unpleasant taste if taken into the alimentary canal, Dr. Bergeon devised his treatment of phthisis by rectal injections of carbonic acid and hydrogen sulphide gas. The pamphlet before us is a clear and readable ac-

count of the discovery, its principles, and mode of application. No physician who is informed upon the advances made in his profession can afford to pass this treatment unnoticed. We are not prepared to assert that it is a success, but it is worth a fair trial before it is cast aside.

On the Use of the Microscope in Determining the Sanitary Value of Potable Waters. (pp. 25). Rochester, N. Y. 1887.

How to Study the Biology of a Water Supply. (pp. 19). By Geo. W. Raftor. Rochester, N. Y. 1887.

In these two papers the writer considers the methods of studying water supplies biologically. He declares himself in favor of comparatively simple apparatus. 'Very wide-angled immersion lenses * * * add to the amount of time required for an examination.' After repeated trials, he prefers, as a life slide, 'a plain slide with a ring of cement and a cover-glass.' Other cells are mentioned; some of them described, and their merits brought out. A good sub-stage condenser is an indispensable apparatus for collecting aquatic forms, both animal and plant. Modes of cleaning and mounting are described. The forms found contaminating drinking-water are briefly and summarily enumerated. An outline is presented in the form of a series of suggestive questions, and the writer urges that 'a year's study of the water supply' would furnish a 'fascinating and prolific field of study.' The papers are two papers read by a professional civil engineer before the Rochester Academy of Science. They are interesting and profitable reading, with references enough to fuller accounts to make them a valuable guide for any one who should care to commence upon study in that very interesting direction.

Some New and Rare Diatoms. By Walker & Chase. (12 pp., 3 pls.) Flint, Mich., 1887.

Under the above title comes a fascicle of plates, three in number, with twelve pages of descriptive text. The figures are photographs from rare or new diatoms and are very highly commendable. In all forty-one forms are represented. Many are very fine as photomicrographs. Some have apparently been touched up with the pen-point, but many are evidently unchanged from the photograph, and are almost as clear as the original object must have been. The text is a series of brief notes (dated January, 1887) upon the forms represented. These give references to original descriptions when the forms are not new, also the habitat notes on specific characters.

The fascicle forms series two and three of a more extended work. We can recommend it to diatom workers. Who may apply can doubtless find out price and extent of the proposed work by writing to H. H. Chase, M. D., Linden, Michigan, or W. C. Walker, Utica, New York.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology.
HENRY L. OSBORN, Lafayette, Ind.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired.
M. A. BOOTH, Longmeadow, Mass.

Wanted, exchange of slides, and correspondence on unusual urinary products.
J. M. ADAMS, Watertown, N. Y.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one.
K. M. CUNNINGHAM,
Land Office M. & O. R.R. Co., Mobile, Ala.

Pathological and Histological Slides (very fine) in exchange for other good slides.
F. M. HOYT, 160 Washington Park, Brooklyn, N. Y.

Correspondence with animal histologists with regard to exchanges solicited.
HENRY L. OSBORN, Lafayette, Ind.

Publisher's Notices.—All communications, exchanges, etc., should be addressed to Henry Leslie Osborn, Lafayette, Indiana, Purdue University.

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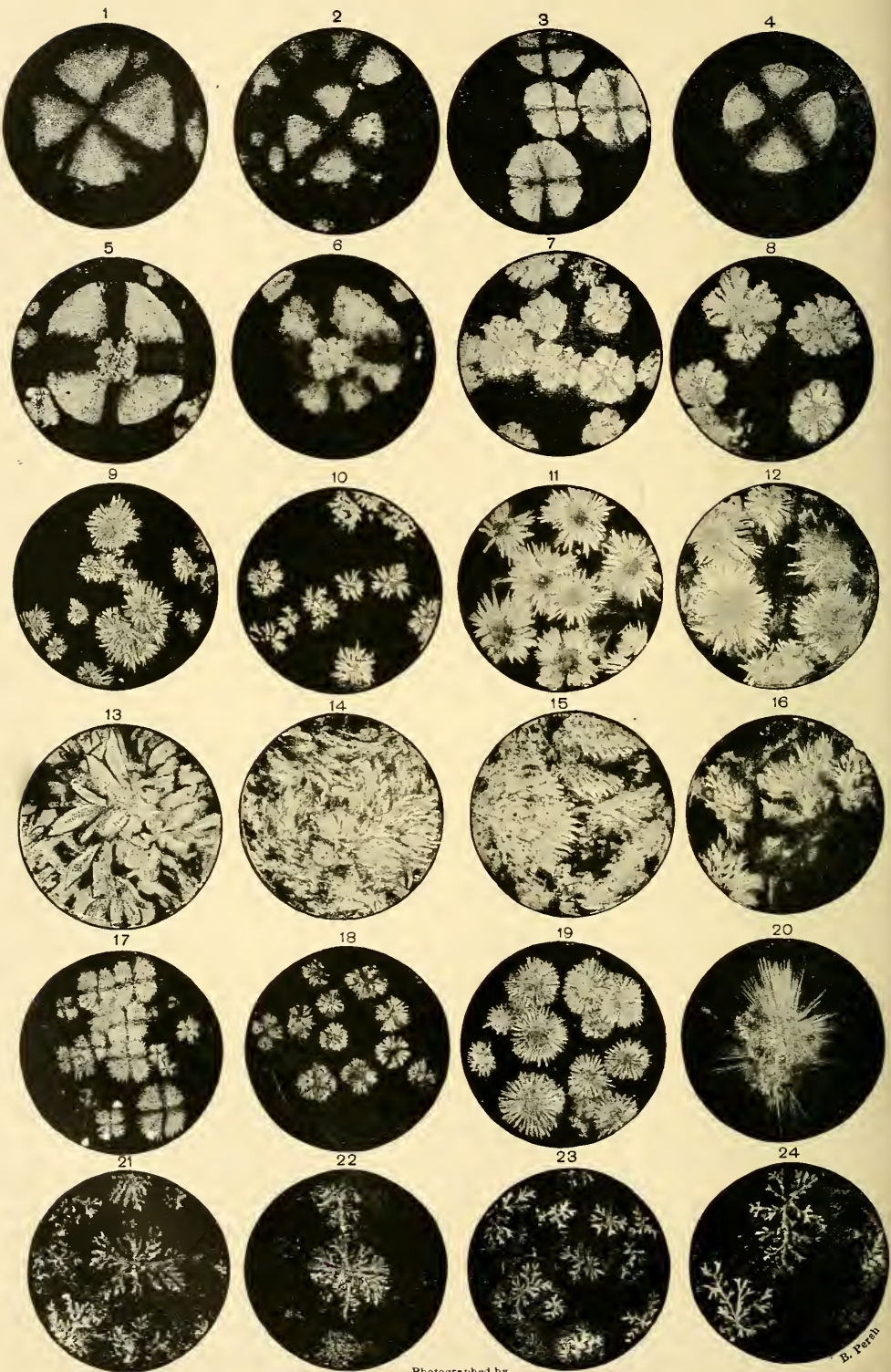
PLATE I.

CRYSTALLINE FORMATIONS OF BUTTER AND FATS.



MOSS ENG. CO., N. Y.

Photographed by
Persh and Gascoyne.

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Notices of new fresh-water infusoria.—VI.

BY DR. ALFRED C. STOKES,
TRENTON, N. J.

Anthophysa stagnatilis, sp. nov. (Figs. 1 and 2).

Bodies subpyriform, slightly compressed, about three times as long as broad, one lateral border convex, the opposite concave, the animalcule thus apparently curved toward one side; the anterior border truncate or slightly excavate, the posterior body-half tapering to the point of attachment; nucleus posteriorly located near the convex border; contractile vesicle apparently single, placed near the centre of the same region; endoplasm granular. Colonies social, elongate, subcylindrical, from two to four times as long as broad, composed of fifty or more zooids; pedicle brown, soft, very flexuose, finely and somewhat irregularly striate, rarely branched, but forming extensive, inextricably-tangled, decumbent aggregations. Length of the bodies $\frac{1}{2250}$ inch; height of a fully developed colony about $\frac{1}{450}$ inch. Hab.—Stagnant water, with decaying vegetation.

This interesting colonial organism differs from *A. socialis* (From.) S. K. in the form of the zooids, the number of individuals in the clusters, there being but eight in *A. socialis*, and in the lax, flexuose, and tangled condition of the pedicles. From *A. vegetans* it is separated by the absence of the rosette-like colonies characteristic of the former, the absence of the distinctly branching pedicle, and by the position of both the nucleus and the contractile vesicle. The last-named organs have assumed a position in *A. stagnatilis* exactly the reverse of that which obtains in *A. vegetans*, the nucleus of the latter being subcentrally placed, with two or more posteriorly located contractile vesicles, while, in addition, the pulsating vacuole of the present species is apparently single.

The colonies, as with other forms, often leave their pedicles and swim freely by a rotatory motion. In this free swimming state the subcylindrical form frequently almost entirely disappears, the clusters becoming subspherical. This, however, is not always the case, as in some instances they become even more elongated than when attached to the foot-stalk.

Hexamita gyrans, sp. nov. (Fig. 3).

Body soft and changeable in shape, broadly ovate or subspherical, somewhat depressed, less than twice as long as broad; flagella exceeding the body in length, the two trailing appendages originating from the posterior extremity at some distance apart, the four anterior vibratile arising at some distance from the frontal border, and arranged in two groups of two flagella each, the two of each group arising opposite one another with the thickness of the body between them, the free ends often curved; contractile vesicle small, anteriorly situated. Length of body $\frac{1}{3000}$ inch. Hab.—Standing

pond water. Movements extremely rapid and rotatory on the longitudinal axis, the anterior flagella then rigidly extended at right angles to the body, their distal extremities alone vibrating.

The endoplasm seems to be semi-fluid; it is remarkably soft, rapidly circulating within the flexible but firmer ectoplasm, carrying in its course the enclosed granules, and also apparently the contractile vesicle. In reference to the latter it is difficult to determine, as the infusorian's quiescent periods are neither long nor frequent, but the contractile vesicle certainly seems to expand when near the posterior extremity, pass with the current to a certain point on the anterolateral border, and there to contract and disappear.

Chloromonas pulcherrima, sp. nov. (Fig. 4).

Body subfusiform, less than six times as long as broad, the posterior region narrowed and produced as a colorless, somewhat flexible, tail-like prolongation forming about one-sixth of the entire length of the body, and sometimes slightly curved, its extremity truncate, often somewhat dilated, and usually bearing several short, fine setæ; the anterior border obtusely pointed, surrounded by three or four rows of divergent, acuminate, colorless spines, forwardly directed; the entire cuticular surface ornamented by rhombus-shaped depressions transversely placed, largest centrally, diminishing both anteriorly and posteriorly; lateral color bands distinct greenish-yellow, extending through the entire length of the body, except the tail-like prolongation; flagellum shorter than the body; contractile vesicles two, situated on opposite sides of the lateral borders of the posterior body region; eye-spot not observed. Length of body $\frac{1}{320}$ inch. Hab.—Shallow ponds in early spring. Movements somewhat irregular and vacillating, not rapid.

Balanitizoon gyrans, sp. nov. (Fig. 5).

Body ovate, about twice as long as broad, widest near the centre, thence tapering anteriorly, the borders rounded, the postero-lateral margins flattened, nearly straight, the body slightly narrowed at the truncate posterior extremity; oval aperture central, projecting: cilia clothing the anterior two-thirds of the body; posterior seta single, sub-equal to the body in length; pharyngeal passage usually conspicuous; contractile vesicle single placed at one end of the posterior extremity; cuticular surface apparently transversely striate. Length of body $\frac{1}{2000}$ to $\frac{1}{1500}$ inch. Hab.—Standing pond water. Movements by rapid revolutions on the longitudinal axis, with sudden lateral leaps. Reproduction by both transverse and longitudinal fission.

Gerda vernalis, sp. nov. (Fig. 6).

Body soft, elongated, six to seven times as long as the widest part, the anterior two-thirds subcylindrical, the posterior one-third somewhat inflated, about twice as wide as the anterior region, the posterior extremity abruptly tapering and obtusely pointed; peristome border revolute, ciliary disc obliquely elevated, ciliary circles two, the anterior wreath a spiral; cuticular surface finely striate transversely; nucleus long, narrow, hand-like, perpendicularly placed near one lateral border; contractile vesicle spherical, situated in the inflated posterior region. Length when fully extended somewhat less than $\frac{1}{100}$ inch. Habitat.—Shallow pools in early spring.

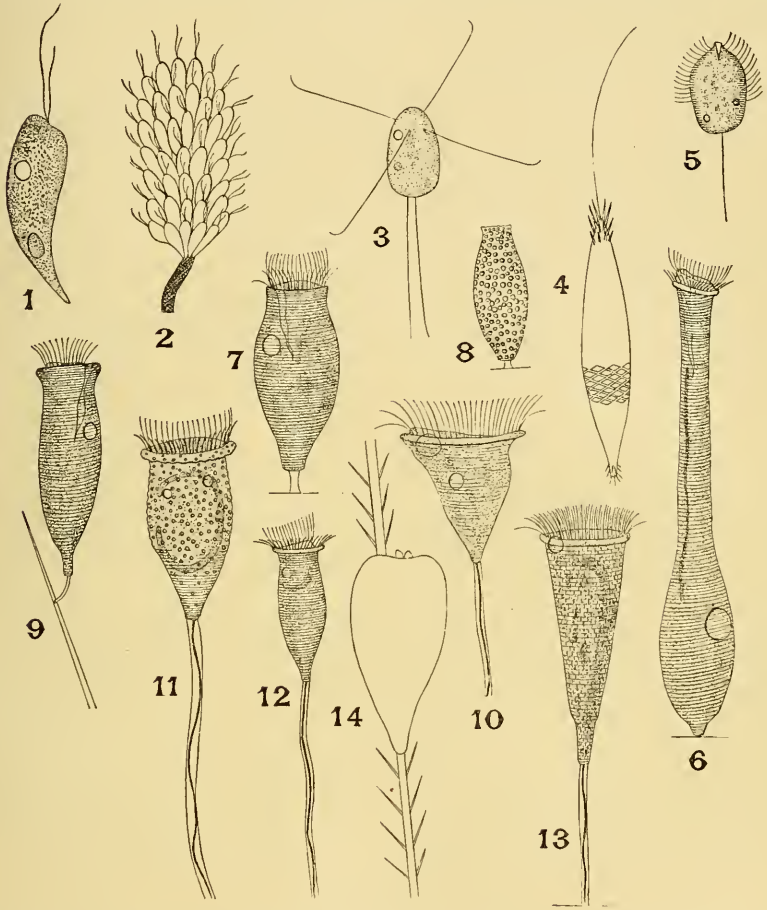
Thus far I have observed but a single individual of this species, taking it on the first day of March from beneath ice a quarter of an inch thick. The little wayside pool was not more than three inches in depth, but it harbored very many infusoria, entomostræa, and rotifers. The cold water made my fingers painfully ache after a short immersion, yet these minute animals seemed as lively as in the warmth of summer.

The body of *G. vernalis* is rather longer in proportion to its width than is *G. fixa* of D'Udekem, but the two closely resemble each other in form. The differences however are conspicuous. The cuticular surface of *G. fixa*

is smooth, and the contractile vesicle is situated far forward. The body of *G. vernalis* is quite soft and flexible, and the endoplasm colorless and finely granular.

Rhabdostyla vernalis, sp. nov. (Figs. 7 and 8).

Body urceolate, often somewhat gibbous, rather more than twice as long as broad, widest centrally, constricted beneath the peristome border; cuticular surface finely striate transversely; pedicle short, about one-eighth as long



* Plate VIII.—Fresh Water Infusoria.

as the body; ciliary disc elevated, convex, occasionally developing a central and conspicuous nipple-like projection; ciliary circles two; peristome border slightly everted, not revolute; vestibulum extending to near the body centre, the vestibular cilia prominent; contractile vesicle near the centre of the anterior body-half; nucleus hand-like, curved, located posteriorly; endoplasm

* Explanation of the figures.—Plate VIII.

Fig. 1. Anthophysa stagnatilis.
Fig. 2 A colony. Diagram.
Fig. 3. Hexamita gyrans.
Fig. 4. Chloromonas pulcherrima. Cuticular ornamentation only partially delineated.
Fig. 5. Balanitzoon gyrans.
Fig 6. Gerda vernalis.
Fig. 7. Rhabdostyla vernalis.
Fig. 8. Reproductive cyst of the same.
Fig. 9. Rhabdostyla chæticola.
Fig. 10. Vorticella similis.
Fig. 11. Vorticella vernalis.
Fig. 12. Vorticella parasita.
Fig. 13. Vorticella conica.
Fig. 14. Lagenophrys obovata.

granular; contracted zooid obovate, often nodding, the pedicle invaginate within the posterior body region. Length $\frac{1}{530}$ inch. Hab.—Attached to *Cypris* and *Cyclops* in the pools of early spring.

This form closely resembles *Rhabdostyla invaginata* Stokes in contour, in the invagination of the pedicle by the contracted body, and in its habitat, but differing conspicuously in the much shorter pedicle, the more posterior position of the pulsating vesicle, and particularly in the form of the ciliary disc, this region in *Rh. invaginata* being markedly conical, while in *Rh. vernalis* it is usually evenly convex. The two species also differ widely in size.

Reproduction of the present form takes place by longitudinal fission, and by encystment. The former method was observed by De Fromentil in an infusorian now regulated to the genus Rhabdostyla, but, so far as I know, has not been seen with any other species. Here, however, it takes place rapidly. The body widens until the breadth is nearly equal to the length, and then divides into two longitudinal parts, the moiety which will finally develop an independent pedicle remaining attached to the original foot-stalk by the tip of its posterior extremity until the production of a ciliary girdle, by means of which it becomes temporarily free-swimming. This ciliary ring is developed within a constriction formed around the body at about one-third its length from the posterior extremity, the free-swimming zooid being a short pyriform creature with rapid movements. Its free phase, however, is of limited duration, and its subsequent history is essentially that of the natatory zooid of Vorticella.

When reproduction by encystment is about to be accomplished, the body surrounds itself by an ovate, apparently chitinous, cyst, which remains attached to the pedicle. The walls are thick, and the surface is minutely tuberculate, the anterior extremity being centrally pierced by a circular orifice and surrounded by a short, neck-like projection (Fig. 8). The cyst is colorless when first formed, but soon becomes brown. The enclosed body gradually shrinks from the walls and becomes ovid, but the subsequent processes are not known. Although I have obtained these infusoria in abundance, indeed, in the greatest profusion, and have repeatedly witnessed their assumption of the encysted phase, yet I have never observed subdivision, spore formation, nor any other reproductive method. The encysted animalcules, so far as my observations extend, remain quiescent and unchanged for an indefinite and unknown time. Attempts to preserve them in a life-cell have proved fruitless. Even in this condition of quiescence they appear to need the influence of moving water obtained by the active motions of the Cypris, Cyclops, or Canthocamptus bearing them. The infusorians were obtained from shallow pools as early in the year as the middle of February.

Rhabdostyla chæticola, sp. nov. (Fig. 9.)

Body elongate-ovate, somewhat changeable in shape, slightly gibbous, about four times as long as broad, widest centrally, constricted anteriorly beneath the peristome border, the posterior extremity narrowed to produce a subcylindrical prolongation about one-eighth the length of the entire body; peristome everted, not revolute; its width slightly exceeding that of the body; ciliary disc scarcely exserted: cuticular surface finely striate transversely; pedicle short, about one-eighth as long as the body, invaginate within the posterior extremity of the contracted body. Length of the zooid $\frac{1}{560}$ inch. Hab.—Pond water; attached to the dorso-lateral setæ of *Nais*.

Vorticella similis, sp. nov. (Fig. 10.)

Body broadly campanulate, only slightly longer than wide, very finely striate transversely, soft and somewhat changeable in shape, constricted beneath the peristome border, thence widening and tapering in almost straight

lines to the pedicle; peristome width equalling or exceeding the body length, the border revolute; ciliary disc slightly and obliquely elevated; pedicle slender, six to seven times as long as the body; contracted zooid broadly obovate or subspherical; endoplasm granular. Length of body $\frac{1}{600}$ to $\frac{1}{475}$ inch. Hab.—Pond water. Locial, attached to *Ceratophyllum*.

The cuticular striæ are so fine and delicate that they are usually visible only when the animalcule is examined by oblique light. The body when in certain positions quite closely resembles that of *V. pattellina* Müll, differing from the latter, however, aside from the fresh-water habitat, in the striated surface, the revolute peristome edge, the comparative length of pedicle, and in size. the present form being much the smaller of the two species.

Vorticella vernalis, sp. nov. (Fig. 11.)

Body elongate campanulate, less than twice as long as broad, soft and somewhat changeable in shape, widest centrally, thence tapering conically to the pedicle; anterior two-thirds of the cuticular surface, densely and irregularly supplied with minute, rounded, solid elevations, the posterior one-third exhibiting distinct transverse striations, with few and very minute cuticular elevations; peristome exceeding the body centre in width, revolute, its margin and surface minutely monilated; ciliary disc elevated, convex; contractile vesicles *two*, small, usually pulsating alternately; nucleus very long, narrow, band-like; pedicle six to seven times as long as the body; contracted body subspherical. Length of body $\frac{1}{500}$ inch. Hab.—Pond water in early spring.

This form seems readily distinguishable from all other Vorticellæ whose surface is ornamented by cuticular monilations, by the combination of rounded prominences and transverse striations, the latter being chiefly confined to the posterior region. From *V. monilata* Tatem it is easily separated by its conical form and the minuteness of the surface beads; from *V. Lockwoodii* Stokes by its shape and the absence of nuclear nodules within the superficial monilations.

Vorticella parasita, sp. nov. (Fig. 12.)

Body elongate, between two and three times as long as broad, widest centrally, tapering posteriorly to the pedicle; peristome slightly wider than the body centre, the border thickened, revolute; ciliary disc obliquely elevated, the lowermost or outer series of cilia extending, when in action, almost horizontally; cuticular surface finely striate transversely; pedicle three to four times as long as the body; nucleus short, curved, band-like, in the anterior body-half, usually transversely placed; contracted zooid obovate, the posterior extremity sheathing the pedicle with one or two annulations. Length of the body $\frac{1}{640}$ inch. Hab.—Pond water; attached singly at intervals, or few together, to the body of an aquatic worm.

Vorticella conica, sp. nov. (Fig. 13.)

Body elongate conical, exceeding the pedicle in length, about three times as long as broad, widest beneath the peristome, tapering thence to near the posterior one-fourth, where it is interrupted by a slight angular elevation, below which it is somewhat narrowed, tapering thence regularly to the pedicle; cuticular surface finely striate transversely, and roughened by minute elevations, so that, under insufficient amplification, the superficies appears to be also longitudinally striate; peristome exceeding the body-centre in width; ciliary disc convex; pedicle stout, shorter than the body; nucleus, band-like, long, extending for almost the entire length of one lateral border, and anteriorly curved across the frontal region; contracted body obovate, posteriorly invaginate in two annular folds. Length of body $\frac{1}{260}$ to $\frac{1}{225}$ inch. Hab.—Standing pond water; attached to *Cyclops*.

The body of this much elongated creature resembles in its contour that of

V. quadrangularis S. K., and *V. spectabilis* S. K., but is readily distinguishable from both. In its contracted state it is easily separable from *V. spectabilis*, the latter then being subspherical, and without the posterior annulations of *V. conica*. From *V. quadrangularis* it is separated by the absence of the subcylindrical body, and the anterior and posterior projecting angles of the latter, the small angular elevation encircling the rear part of *V. conica* being unrepresented in the frontal region.

The form here referred to seems much less timid than the majority of Vorticellæ, seldom contracting the body or throwing the pedicle into the usual spiral coils, as the cover-glass may be repeatedly and somewhat violently disturbed without in any way altering the expanded animalcule. This might be anticipated by reason of the supporting host's activity, the Cyclops leaping through the water by rapid and often long-continued movements, necessarily dragging the Vorticella with it. In addition to the six or eight individuals of *V. conica* attached to one particular Cyclops, the Entomostracan was also loaded with a profusion of *Podophyra fixa* (Müll), S. K., actively producing and extruding their free-swimming embryos.

Epistylis tincta, sp. nov.

Bodies conical campanulate, less than twice as long as broad, soft and flexible, widest anteriorly, the posterior extremity tapering to the pedicle; surface transversely striate; peristome border revolute; ciliary disc not elevated, ciliary circles six or more, the cilia comparatively short; zooids yellowish in color; pedicle profusely and dichotomously branched; the ultimate divisions nearly three times as long as the bodies; contracted zooids subpyriform; nucleus hand-like, curved, transversely placed in the anterior body-half. Length of body $\frac{1}{166}$ inch; expanded colonies often $\frac{1}{10}$ inch in height by $\frac{1}{4}$ in diameter. Primary pedicle variable in length. Hab.—Pond water in early spring. Attached to various submerged objects.

This resembles *F. flavicans* somewhat closely in the form of the zooids, in their color, and in the profusely and dichotomously branching pedicle, but it differs widely in the shape of the contracted bodies, and in the length of the ultimate branches of the foot-stalk. The contracted zooids of *E. flavicans* are subspherical, in *E. tincta* they are pyriform, and in the latter the ultimate divisions of the pedicle are more than twice as long as the expanded bodies, while in *E. flavicans* the bodies are more than twice as long as the final divisions of the foot-stalk. In the present form the pedicle is stout, thick-walled, and hollow. In the numerous colonies examined the length of the primary portion has never exceeded twice that of the expanded zooid.

Near the posterior extremity of a majority of the animalcules is a closely-packed cluster or layer of problematical bodies, small in size, measuring only about $\frac{1}{500}$ inch in length by about one-half that in greatest width and more or less obovate in form. They are refractive and apparently crystalline. The cluster is composed of usually but one layer of these closely approximated little objects, each layer being formed of many of these closely contiguous and apparently crystalline nodules, the entire collection seeming to be concavo-convex, the convexity being directed posteriorly. The layer is located at about one-fifth the entire length of the extended zooid from the posterior extremity, extending almost completely across this part of the body, acting apparently as a partition-wall between the two regions, the endoplasm in advance being ordinarily crowded with granular, subspherical food-masses, while posteriorly the body substance is, as a rule, clear, semi-transparent and tinged only by the pale, diffused color of the animalcule. These crystalline bodies, however, are not invariably present. They often occur in young colonies composed of but two zooids, while in other and older zoodendria formed of many animalcules, they may be absent. They may also

be apparent in some members of a large colony and invisible in others of the same group.

Lagenophrys obovata, sp. nov. (Fig. 14.)

Lorica obovate, somewhat gibbous, about twice as long as broad, widest centrally, tapering posteriorly, the anterior extremity truncate or slightly concave; aperture valvular, the two lips separating and closing at the extension and retraction of the ensheathed animalcule. Length of lorica $\frac{1}{315}$ inch. Hab.—Pond water; attached to *Canthocamptus minutas*.

In form and size this most nearly resembles *Lagenophrys vaginicola*, Stein, but differs from it in the less cordate aspect of the lorica and in the narrower anterior region, the subcentral portion being the widest part of the sheath. The lorica becomes chestnut brown with age.

The biological examination of water.—I.

By ROMYN HITCHCOCK,

OSAKA, JAPAN.

The importance of what is now very often designated as the biological examination of water is conceded by all microscopists, but comparatively few of them are prepared to undertake the work. Many are deterred by the array of apparatus that is described in recent books treating of bacteria and the methods of cultivating them. Not long ago the writer was called upon to make some examinations to determine the number of germs in water. Probably there is not a laboratory in Japan fitted up for such work, and it would be months before the approved forms of apparatus could be imported. It was, therefore, necessary to adapt to the purpose such articles as could be found; and one object of this article is to suggest expedients to those who desire to conduct such observations without spending money on costly apparatus.

Before proceeding with a description of the apparatus and methods, a few words may be said relative to the purposes and practical benefits of such investigations. To what extent, for example, are the results trustworthy? Is it possible to say that a given specimen of water is dangerous to health because it contains a microbe of a specific disease—typhoid fever or cholera, for example? The answer is, that it is not necessary to identify the specific microbes of a disease, although it is quite possible to do so; but when a water is found to contain a large number of bacterial spores or living forms it is certainly not safe for household use. The mere fact that it contains an abundance of life shows that it may readily become a carrier of pathogenic forms.

The importance of micro-organisms in the purification of water is not to be disregarded. It is by no means true that a water is dangerous to health because it shows many centres of growth on a gelatin plate. Many centres of growth do, indeed, indicate the presence in the water of matters which sustain an abundance of microscopic life, and it is the function of the organisms to destroy that organic matter and thus to purify the water. At the same time, as already stated, such water may at any time become a carrier of pathogenic germs, and it is presumable that such germs might multiply very rapidly in a water that is so rich in nutriment for other forms.

The distinction between the innocuous and the dangerous bacteria can only be made by carefully conducted experiments with pure cultures. However, it is generally assumed that the forms that liquefy gelatin are derived from decomposing animal matter, and they point to contamination of a very objectionable kind.

As regards the purifying effect of these organisms, F. Emich* has shown

* Biederm. Centr. Bl. für Agr. Chemie xiv, pt. 5.

that by agitating sterilized water with air no purification resulted, but if the same water be mixed with ordinary water containing microbes it became purified by contact with air. He concludes that self-purification of water is impossible without microbes, and that direct oxidation is not possible.

The reader is already acquainted with this subject through the valuable article published last year in these columns, written by Dr. T. Smith.*

In looking over the literature at hand we have found several valuable contributions in *The Chemical News* of the year 1885. The methods of observation are practically the same everywhere. Dr. Koch's method of plate culture on sterilized gelatin being universally adopted, sometimes supplemented by potato cultures and growths on other media. Among the most important contributions is that of Percy F. Frankland, Ph.D., F. C. S., etc., entitled The Removal of Micro-organisms from Water.† In this article the effect of several methods of purification by filtration, subsidence, and precipitation, is shown by plate cultures.

The substances selected for filters were green sand, silver sand, powdered glass, brick dust, coke, animal charcoal, and spongy iron, all being passed through a sieve of forty meshes to the inch. The filters were tubes of glass, one inch in diameter, drawn out at the bottom to a small aperture. A small piece of asbestos was first placed in the tube and above it the filtering material to a depth of six inches.

The results of the experiments are of interest, but they can only be briefly summarized here. Green sand at first completely removed the organisms from stale urine water. After thirteen days, during which 7.1 litres had passed through, the filtered water contained 1,071 centres of growth, the unfiltered 8,193, thus showing some efficiency, and even after an entire month it continued to remove a large proportion of the organisms.

Animal charcoal removed all the organisms from a very bad water after twelve days of continuous action, 4.2 litres having passed through. At the end of one month 14.6 litres had passed, but not only had the filter lost its efficiency, but it was found to contaminate the water and greatly increase the number of organisms in it. The unfiltered water contained 1,281 and the filtered water 6,958 centres of growth per cubic centimetre.

Spongy iron removed the organisms entirely for twelve days (3.6 litres), and after one month, when 9 litres had been filtered, only two centres of growth were observed in the filtrate, against 1,280 in the original water.

Brick dust is not efficient, even when fresh.

Coke is next to spongy iron in efficiency, and a more rapid filter. After five weeks 86 centres of growth were observed in the filtrate against 5,932 in the unfiltered water.

Sand, freed from iron by washing with hydrochloric acid, filtered very rapidly; but it does not, even at first, remove all the organisms. It diminishes their number, however, 11,232 being reduced to 1,012 per cubic centimetre.

Powdered glass acts very much like sand.

Another series of experiments showed that by merely shaking up the water with the filtering materials above mentioned, and allowing them to subside, a decided reduction in the number of organisms will sometimes be effected. Thus, with spongy iron, 609 centres were reduced to 28; with chalk, 8,325 to 274; animal charcoal, 8,325 to 60; while coke reduced them from a number too great to be counted to none at all. Clay and brick dust have no noticeable effect.

It has been presumed that subsidence would lead to the separation of living

* Notes on the Biological Examination of Drinking Water, with a few Statistics of Potomac Drinking Water. This *Journal*, vii (1886), 61.

† *Chem. News*. Lii (1885), 27, 40.

organisms, but upon very insufficient grounds, and actual experiment shows that under favorable conditions of growth their numbers actually increase. The results observed are as follows:

Hours of subsidence.	*Number of centres per cc.*
0	1,073
6	6,028
24	7,262
48	48,100

By the addition of lime, as in Clark's process to make hard waters soft, the precipitated carbonate carries down with it the greater number of living organisms. This process may be advantageously applied on a large scale.

Pasteur's filter, a cylinder of biscuit porcelain through which the water is forced, when new, appears to separate all the organisms in the water, but it soon becomes clogged.

Prof. C. J. H. Warden, Surg. H. M. Bengal Army, has described the methods in use at the Reich's Gesundheits Amt, Berlin, with illustrations.* The subject is well treated, and the concluding article has an elaborate table showing the results of numerous chemical and bacteriological examinations of waters, from various sources, which will be valuable to anyone engaged in such work.

Dr. T. Leone† has described some investigations to determine the rapidity of increase of the micro-organisms in samples collected and kept for a time. These results are of practical interest and importance, since they clearly show the necessity of immediate examination. At first thought it might be supposed that the increase would depend upon the nutrient quality of each kind of water, and that very pure water would show very little increase of life. The results indicate, however, that even very pure water may support a considerable number of living organisms. For example, the Mangfall water, supplied to the city of Munich, leaves a residue of only 284 millegrammes per litre, and contains not a trace of nitrates, nitrites or ammoniacal salts, and scarcely any organic matter.‡ This water, when drawn from a cock, showed five microbes in a cubic centimetre; after twenty-four hours, at 14°–18° C., it showed more than one hundred; in two days, 10,500; in three days, 67,000; in four days, 315,000; in five days, more than half a million. A similar increase was observed when the water was kept inmotion. These results fully confirm those already quoted from Frankland's experiments.

It should be remembered that this increase will not continue indefinitely, but after a certain point the number of organisms will decrease.

As regards carbonic waters, it was found that the microbia decrease in number and are always less than in the original water. This was found to be due to the carbonic acid, as the same effect was observed when water was charged with the gas, without pressure. The presence of oxygen seems not to be necessary for the increase of microbia in water, as was proved by replacing the oxygen by hydrogen.

(*To be continued*).

Elementary histological studies of the Cray-fish.—IV.

By HENRY L. OSBORN.

CHAPTER I.—THE GREEN GLAND.—(*Continued from page* 125.)

5. **Record of the observations.**—The biologist has, by no means, finished his work when he has prepared and examined his section; he has

Chem. News. Lii (1885), 52, 66, 73. 89, 101.
† On the Micro-organisms of Potable Waters: Their life in Carbonic Waters. *Chem. News.* Lii (1885), 275.
‡ Requiring only 0.99 mgr. of oxygen to oxidize it.

then done the preliminary labor and obtained his results, but he must now record these results so as to make them available for future use. For while the collector of a handsome cabinet may not be interested in the completest study of his acquisitions, the successful student must not only thoroughly understand his sections and be able to build from them the organ under examination, but he must also have and keep the results at his finger ends for later use. To do this he cannot rely entirely upon his memory; indeed, I might almost say that the average student should not rely in any degree upon his memory. But the registration of a proper record will furnish the materials for memory to work upon in their most easily remembered shape, and thus really aid it. A record of the proper shape will mean an analysis of the facts presented and a clear one, and hence in the shape easiest to recall.

It seems, perhaps, superfluous to dwell upon this matter, and yet for the student it is, perhaps, the most important one in this chapter, as may be evident as we proceed. It requires the digesting of the more crude material furnished by the observation and study of the section. For the purpose of this record two processes are requisite:—*a*, drawing, and *b*, written description.

a. **Drawing.**—It is not at all hazardous to assert that it is at drawing that five out of every six students, who halt at any part of biological work, rebel. They can't 'draw,' and they are so fully prepossessed by the idea that it amounts to a monomania on the subject, and actually inhibits the exercise of what little real power in that direction they may have. It is absurd for anyone who can see and who can hold a pen to say he 'can't draw,' not 'can't draw well,' but 'can't draw.' If one can see a straight line on a piece of paper he can draw a second beside it of the same length as a tolerably faithful copy of the first; so of a crooked line, so of a collection of lines, provided he can draw the lines one by one and not confuse himself by a vast maze of lines. If he can do so free hand, much more can he do it with the aid of reflectors, whereby he virtually traces a copy of the first line or lines. If he can do it of lines he can do it of a picture, or can make a picture of any object in which he can extricate from the confusion which first strikes the eye the leading features, and copy them, and then fill in the lesser portions and complete his copy.

Now, I do not say that all students can do this equally well, or even well, at first, in any proper sense of the word, but all can learn to attain some proficiency in the art if only they go about it in the right way. There are two elements which contribute toward the success of a histological drawing:—first, skill in drawing lines, or technical skill; second, and more important, skill in seeing the 'points' which are to show through the picture as the very essential points of structure, and enforcing them without making a mere diagram instead of a picture.

In drawings which are made for the purpose of photographic reproduction much attention must be given to the manner of line drawn, as well to the tool, *e. g.*, pen or pencil or brush, and medium, as India-ink, crayon, etc., as to the character of line, whether broad or narrow, continuous or broken, even or ragged. But, setting this aside as not to be considered in drawings to be preserved merely as notes of work, there are but few points of technique which need to be attended to by the beginning student. He should select a good paper—a medium weight bristol-board or a heavy banker's linen being preferred by most—and it would be advisable to preserve all drawings and other notes upon uniform size pieces for convenience in filing for later reference. Many think that all drawings should be done with pen and India-ink. If this be the practice, a fine pen such as the lithographers use, or an Estabrook No. 170 is the best for regular use. It is for some reasons better to use the pencil for preserving notes of this kind both because a false line can be

erased readily, and because shading can be done so much more expeditiously, and by the unskilful with so much better effect. A judicious use of both the pen and pencil will secure results which improve upon the best work of either alone. Outlines can be brought out with decision, while broad tints are put in with a pencil with fine effect. Where pencil is employed, and enough of the graphite thrown on the paper to endanger blurring should the drawing be rubbed, it should be 'fixed' or varnished by a coat of white shellac dissolved in alcohol, sprayed on with an atomizer.

In making the drawing the camera obscura should be freely used both to obtain an accurate outline and to fill in as many of the details as possible. In choosing a camera one should be selected which can be used with the tube vertical, as it is often desirable to keep the stage horizontal especially in studying living animals. Either the Zeiss camera or the Abbe camera are used in this manner and are the most universally convenient, for they may be at once applied without change of the position of the instrument. If a camera is used which requires the tube to be horizontal, the camera should be a compound or erecting prism which furnishes an image on the paper in the same position as the one on the stage. The reason for this becomes at once apparent on finishing, free-hand, the drawing begun with the camera. In the absence of a camera a very good device for obtaining an accurate copy of the object in the field, is to draw on the paper a circle which is nearly or quite equal to the field of view and rule it with ink quadrants, and then draw on the real quadrants the contents of imaginary corresponding quadrants of the field. By training the left eye to the microscope, and the right eye to the paper, the student can, with practise, obtain great facility in this mode of drawing, using, of course, one eye at a time. He can improve on it by adding other lines to the first two at his own discretion. While the camera is on and the position of the instrument unchanged, a stage micrometer should replace the slide and a drawing of the scale to accompany the picture should be made.

In the first attempt to copy on paper what is before the eye in the microscope there is a vast confusion and disappointment. Apparently the task is beyond human powers, even with the simplest possible object, as a diatom, or hydroid cuticle, or thread-cell, and much greater with a section of animal tissue. And this confusion and despair will continue indefinitely unless the draughtsman set out to overcome it, and so long as it lasts will prevent success at histological drawing; and we may go further and say at any natural history drawing. Without entering into any of the disputes on standards of excellence from the art standpoint, we may say that there is only one first criterion of excellence in scientific drawing, and that is clearness. The drawing must represent clearly and unmistakably the structure of the object. Now, it will be seen that it is only after such a study of the object as we have outlined as necessary—a study which reveals the plan of structure—that the student can have a sufficiently clear knowledge of that plan of structure to make an intelligible drawing from his object. When he has such a knowledge it is not very difficult to make a drawing which shall be a visible description, so to speak, of the facts which would be embodied in a verbal description, and without such a knowledge a good drawing is impossible except from the simplest objects. Histological drawing, more than any other, requires the exercise of judgment and sagacity. I am aware that many instructors in this art tell the pupil to draw what he sees, but they should add to this that he must see with the eye of judgment as well as of mere sensation. Furthermore, there must be care exercised in selecting a view which best shows the 'points,' if the pupil is to draw only what he sees. The precept should be to select the best view, draw as much of the detail as skill permits, but

keep well in sight the chief relations and make them true—then let the others follow. This point, simple as it seems, is one of the most important. A clear drawing which illustrates the facts is the ideal, and, when realized, is evidence of satisfactory work preceding it.

Of the value of drawings of the objects of study made in this way everyone must be assured. It is a record of past work ready for immediate reference, while the best memory is but an imperfect record. It is, further, a guarantee of excellent work, for an honest student cannot make a good drawing unless he has a thorough knowledge; and it thus helps him to test and complete his work before he strays off to some other study. It prevents much of the evil of desultory work.

b. **Written description.**—I have already mentioned and described one written record in connection with this study, the histological record. In it we should have a record in black and white of the history of the section, together with any remarks upon the histological treatment with regard to its success, etc. But, besides this, the thorough student would find it to his advantage to jot down on a slip of paper, of uniform size with his drawings, anything he may think of in connection with his section, any note on its location in the organ and of the organ in the body, remarks on any living condition of the organ which could not be seen in the section or drawing, *e. g.*, color in the living state, any abnormality which might be observed, any memoranda on reading made in connection with the study of the section, references to literature consulted, etc. If the habit is early formed of gathering together the results of study at the time, and shaping them as if for future use, a mass of valuable material will begin to accumulate which will be found of frequent use in subsequent studies. While this practice of review, which fixes the results of study, is good for any independent student of natural history, it is indispensable in the training of students in college or similar classes. They should be required to state the results of their study, in the most accurate form they can devise, an exercise which, supplementing their drawing, would be a brief treatise upon the subject in hand.

This is a well-worn theme, and one which pedagogues review frequently. I feel, however, that the very common neglect among students of the principles of this section of my first chapter justifies its presence here. In treating of histological study, surely these words, on an important help in its pursuit, should find a place.

EXPLANATION OF PLATE IV. (See page 86).—*Reference letters to all the Figures.*

A. Epithelium of main collecting duct.
B. C. 'Islands' of Epithelium in lumen of gland alveolus.
b. c. Blood space.
bl. c. Blood corpuscle.
b. m. Basement membrane.
c. w Side wall of gland cells.
D. Flat-celled epithelium.
Du. Duct leading from alveolar portion of gland.
E. Lumen of gland alveolus.
Ep. Flat-celled epithelium of the collecting sack.
G. Lumen of gland alveolus.
g. m. Sheathing membrane, or capsule of gland.
H. Cubical-celled epithelium on the surface of the green gland.
J. Outer sheath of gland and sack.
K. Blood space.
Lu. Lumen or cavity of alveolus.
N. Cell nucleus.
S. Lumen of the collecting sack.
Fig. 1. Camera lucida drawing of section through gland and sack. Mag. 38 diam.
Fig. 2. Camera lucida drawing of cubical celled epithelium. Mag 330 diam.
Fig. 3. Camera lucida drawing of columnar epithelium. Mag. 370 diam.
Fig. 4. Camera lucida drawing of flat celled epithelium. Mag. 360 diam.

The crystallography of butter and other fats.

By Dr. THOMAS TAYLOR,

U. S. AGRICULTURAL DEPARTMENT, WASHINGTON, D. C.

EXPLANATION OF PLATE I.

Figs. 1, 2, 3, and 4 represent primary crystals of boiled butter, from milch cows of different breeds, under differing conditions of feed. × 80 to 110.

Figs. 5 and 6 represent secondary or rosette crystals forming within the primary or globose crystals.

Figs. 7 and 8 represent these secondary or rosette crystals having separated from the primary crystals. The secondaries generally break up into stellate forms in the process of decay. × 80 to 110.

Figs. 9, 10, and 11 represent tertiary crystals, or the third transition stage of the butter crystal, generally seen in boiled butter that has been kept several months. × 80 to 140.

Fig. 12 represents tertiary crystals resolving into the amorphous condition. × 140.

Figs. 13, 14, 15, and 16 represent oleomargarine which has no typical form or crystal. × 80 to 110.

Fig. 17 represents oleo as it generally appears when boiled and cooled. × 140.

Fig. 18 represents neutral lard under the same conditions. × 140.

Figs. 19 and 20 represent common lard when boiled and cooled. × 140 to 400.

Figs. 21, 22, 23, and 24 represent crystals of beef-fat from various tissues of the ox; the omentum, kidney, marrow of femur and round. × 65.

MICROSCOPICAL TECHNIQUE.

Laboratory Jottings.

By Dr. GEORGE A. PIERSOL.

At this time when our American workers are so rapidly appropriating, and indeed improving, the best methods of present histological technique—what a contrast to that of ten years ago—a few reflections suggested by personal observation, and endorsed by the usage of some of the most prominent of the Continental laboratories, may be pardoned. What follows makes no pretence to novelty; as the teaching of experience it may be of interest.

The fact is frequently forced home that in spite of all our successful subsequent manipulations sufficient care is not exercised in the preservation of material. Where simply relation and arrangement are to be determined, the precise condition of the histological elements is of secondary importance; when, however, it becomes a question of cell structure, genesis, or metamorphosis, the value of an entire investigation may depend upon the care and accuracy of the initial proceeding. The distinction between the mere hardening of a tissue and a true fixation of its elements cannot be too strongly insisted upon.

The formerly much valued method of preparing tissues by the successive action of 33, 60, 80 and 93 alcohol, while hardening admirably, is now admitted to be entirely unreliable for the preservation of fine structural detail. That we, as yet, have no reagent, which reliably 'fixes' form and leaves protoplasm in a perfectly normal condition examination of many kinds of cells will convince every careful observer.

Of the various 'fixing' reagents offered, upon which can the histologist rely for daily use as generally yielding preparations in which the elements are well preserved in form and structure? Our own experience endorses chromic acid as one of the most reliable and convenient reagents for fixing which we possess.

Its merits are general applicability, reliability, cheapness, ease of prepa-

tion and stability; its disadvantages bring coloration of the tissue, brittleness when used too long or too strong, and an almost absolute exclusion of the ordinary carmine and hæmatoxylin stainings. We have usually fixed the fresh tissue (in small pieces) in a comparative strong solution (1%) for 8 to 12 hours; washed in running water for several hours, and hardened in 50, 80 alcohol. The elements of tissues so treated will generally be found to be very satisfactorily preserved in form and structure.

Where an accurate and especial examination of the cells chiefly concerns the investigator, as in studying spermatogenesis, etc., the later solution of Flemming is the general favorite; this later mixture, it will be remembered, is much stronger than its predecessor, consisting of chromic acid (1%) 7 parts, osmic acid (2%) 2 parts, glacial acetic acid $\frac{1}{3}$ to 1 part. In this mixture the absolutely fresh tissue is allowed to remain at least 24 hours, in many cases with advantage for 2 or 3 times as long; thorough washing for 1–2 hours, and hardening in 70, 90, and 100 alcohol follow. Success with Flemming's solution requires two precautions:—freshly mixed solution, and sufficiently thin (2-3 mm.) pieces of tissue. Where pieces too thick are used, the centre will be found to have been effected by the chromic acid alone, as the action of the osmic acid is confined to a limited external zone. Let it be emphasized that fresh tissues are never to be subjected to the action of water before being fixed; and that for the investigation of delicate cells, the tissue must be taken from the *just* killed animal and *at once* transferred to the fixing reagent—that the tissue still warm (which in large organs may be the case after some considerable time) is no guarantee that the *cells* have not undergone change.

While the excellence of these chromic acid solutions is generally admitted, yet the great difficulty of obtaining good hæmatoxylin stainings, and the absolute impracticability of using carmine, deters many from generally employing these fixing fluids. Saffranin is very useful for displaying nuclear figures in tissues so treated, yet such preparations leave much to be desired where the remaining parts of the cells are to be studied. A decided advance, it seems to us, is offered with the hæmatoxylin of Delafield, by which admirable preparations may be obtained. Attention may be called, however, to Benda's modified copper-hæmatoxylin, of the excellence of which nearly a year's contant use has thoroughly convinced us. Admitting that the method is somewhat troublesome, the results amply repay where a careful study of cells under high powers is proposed.

Tissues treated with chromic acid or Flemming's solution stain readily, as well as do those hardened in alcohol or any other of the usual fluids. For careful examination staining after cutting is to be recommended. The sections on the slide or cover are placed for 8–12 hours in an almost saturated solution of cupric acetate (to which a few drops of acetic acid may be added) in the oven at 50° C; washed a few minutes in two changes of distilled water, and stained with 10% alcoholic solution of hæmatoxylin until very dark blue; transferred *directly* to hydrochloric acid solution (1:350), where they remain until bleached to a straw tint; after being rinsed in water, they are placed in *fresh* copper solution until again blue, care being taken to stop the reaction (by transferring to water) before the tissue becomes too dark, as the tint will be somewhat deeper after the final washing (which must be thorough) and dehydration. Should the sections be too dark, they may be again bleached in the acid, and passed through the copper solution as before; should they be too pale, they may be once more placed in the hæmatoxylin, and carried through the solutions as at first. The advantages of the method are certainty of good results after chromic acid, control of the intensity and ease of correcting faults of the stain, and, above all, the excel-

lent results. While the color is less brilliant than the usual alum-hœmatoxylin stainings, the crisp, sharply defined pictures furnished leave little to be desired, and to those seeking a precise and reliable stain after Flemming's solution this method is confidently recommended. Since the hæmatoxylin, with care and occasional filtering, may be repeatedly used, and as the copper solution is readily prepared and inexpensive, the method will be found economical and by no means as complicated in practice as on paper.

The reaction against paraffine in favor of celloidin for certain tissues seems to be well grounded; for entire sections of eyes and large nervous masses, paraffine may with advantage be replaced by celloidin; by some of the most skilful investigators of Berlin for eye, ear, brain, spinal cord, and skin celloidin is now always preferred.

Much has been written regarding the necessity of having paraffine of exactly the right consistence to insure success in cutting ribbon-sections, but the desirability of having it *homogeneous*—to which much attention is given in Kölliker's laboratory—has been but little emphasized. The selection of a pure paraffine, freedom from the turpentine or chloroform used in embedding, and a very *rapid cooling* after the tissue is arranged, appear to be the essential conditions for securing this desirable character to the embedding mass; with a homogeneous paraffine it is surprising to see within what wide latitudes as to melting point the chains of sections will come off.

The very usual clearing with clove or other oil is a step which can with advantage be omitted where the sections are thin, especially when numerous and fixed to the slide or cover. If the sections be thorougly dehydrated by being in very strong or absolute alcohol, they may be directly mounted in balsam. Cleaned covers, and a lighted spirit-lamp are first arranged; the slide with the dehydrated sections is removed from the absolute alcohol, hastily drained, a drop of pure balsam (most conveniently from an artist's tube) added, and the clean cover, which is for a moment held over the flame, is applied, when the slide is *gently warmed* over the lamp. If the sections be thin and well dehydrated, and the manipulations rapidly performed, the tissue clears up at once. There may be cloudiness at first towards the edges of the cover, but in a few minutes (with large sections somewhat longer) this all disappears; after a night in the oven at 40° C. these slides come out with covers so firmly fixed that oil immersions may be used and the covers cleaned with little fear of shifting. Hundreds of preparations have been so mounted, and clearing oils find no place at present on our work-table.

WÜRZBURG, GERMANY, *May*, 1887.

EDITORIAL.

Microscope in medicine.—The appearance of such a work as Ziegler's Pathology, recently completed and issued in the English translation, reminds one of the great debt owed to the microscope by medicine. When one looks through the medical literature of the days before the microscope and encounters the absurd tissue of speculation and guess-work in the absence of an instrument of precision by which to secure exact results, and then, by way of contrast, glances over the pages of a work like Prof. Ziegler's, it makes one thankful to live in this matter-of-fact age, even if it be more prosaic than the days of fables. It is no exaggeration to claim that the scalpel and microscope have revolutionized medicine, taking it from the realm of witchcraft

and placing it on a secure foundation. That they have not done more for medicine, which through them is now a science, is due largely to the fact that too many of its practitioners are not sufficiently scientific, and due also to the great difficulty which stands in the way of the investigation of many interesting cases growing out of the very natural prejudice against post-mortem study. The physicians are little to blame for their slight acquaintance in some cases with the microscope or the importance of its use, for in the schools largely the subject of the cell structure is very insufficiently studied. But a few medical schools in this country realize the importance of this matter, and we may hope for more and more thorough knowledge of disease and its exact effect on the human organism as our lesser schools elevate their standard in this regard. The importance of a knowledge of biology and of thorough training in histology for the student who expects to be a thorough master of his science can hardly be overestimated. Such principles which may be regarded as almost truisms now-a-days underlie the work of Ziegler, who is, besides a lecturer and writer, an active student of pathology and contributor to the science. His work is written in full harmony with the modern spirit of research, and no one can faithfully read it without catching some of the true spirit of the man, and finding the spirit grow in him as he reads and verifies.

We were shocked one day not a year ago to receive a visit from a practitioner in a certain city. He showed us a small tumor on his left hand and asked to have it viewed with a microscope to see if it were malignant. We expostulated against such defiance of the rules of procedure, but promised to examine it if it were removed and sent to our laboratory. It was accordingly removed and, after several days, fell into our hands wrapped like a piece of meat from the butcher's. This same gentleman told us he had but little faith in the diagnosis of disease by the aid of the microscope.

This rather extreme case represents a phase of objection which the users of the microscope have to meet—an objection from insufficient knowledge of the facts in the case. Pathological histology is a young science; it is full of unsettled problems, many so obscure that perhaps they cannot be solved; but who will give them up? Certainly the vast body of experts seem to have no intention of giving up the earnest struggle to give to the science of medicine a firmer basis than ever by tracing disease to the cell of the living body most interested, as the first step in finding out just how to cure as many as possible, perhaps, in time, all the trouble which the flesh inherits or encounters. Those who do not believe in the claims of the microscope to a large debt from the science of pathology ought to see to convince themselves by an examination of its claims, and then help the young science to grow by sympathy and support, not crush it because it is young. Fortunately there is, at present, but little opposition to the microscope in medicine and a growing recognition of its claims.

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American Society of Microscopists.—We have received the prospectus of the tenth annual meeting of this society and subjoin as much of it as space will permit for the benefit of our readers who are non-members.

'The meeting will be held in Pittsburgh, Penn., beginning August 30th, and lasting four days. The time is set for the week preceding the meeting of the International Medical Congress at Washington, and will therefore be convenient in both time and place for those who desire to attend both Conventions.

'Hotel headquarters will be at the Monongahela House, and the Sessions will be held in the chapel of the First Presbyterian Church. It has often been a matter for expressed regret at the close of the annual meetings that

so little opportunity had occurred for becoming acquainted with one another. This has led to the attempt to make the Pittsburgh meeting an *en masse* affair, so that it may be a social as well as a scientific success. The Monongahela House is well suited for this purpose. There are sufficient rooms for all, and convenient reception-rooms which will be at the disposal of members during the days of the meeting. The rate will be $2.50 per day.

'It is unnecessary to urge the claims of the "Working Session." The advantages of practical demonstrations of methods of work is conceded by all. It is hoped that this feature may prove as helpful in the future as it has in the past. The preparations for this Session are entrusted to a special committee, consisting of Hon. J. D. Cox, Prof. T. J. Burrill, and the Secretary, D. S. Kellicott. Those who are willing to assist in the demonstrations or who have suggestions regarding this work, are requested to communicate with the committee. During one evening of the week there will be a popular exhibition of objects and microscopes, and all members attending are urged to bring their microscopes and good objects for this occasion. The Local Committee will have full charge of this feature.

'Inquiries concerning local arrangements may be addressed to Jas. H. Logan, Room 804 Penn Building, Pittsburgh, Penn.'

We copy the following from a letter from C. M. Vorce, Esq., of Cleveland:

'A collecting excursion will form part of the programme, the expedition being divided into classes, each of which will search for a distinct class of organisms. One party will search for sponges, another for polyzoa, another for algæ, desmids, and diatoms, another for fungi, etc.

'There is talk also of an excursion to some of the large steel works, glass works, gas wells, etc., in lieu of the excursion for pleasure merely, which has often been made a feature of the meetings.

'The usual soiree to the public will be given, and will undoubtedly be a large affair, as the attendance at the meeting will be large and Pittsburgh is at present very full of interest in microscopy.'

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Elementary histological studies, by the editor, which have reached the fourth installment with the present number, are to be continued into the study of the most elementary points of various other structures, *e. g.*, 'liver,' intestines, ovary, muscle, eyes, ear, blood, perhaps some other parts. These studies are encouragingly spoken of by many, and we give this notice of the intention of continuing them in response to enquiries which have reached us from several quarters.

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Fat crystals.—We are glad to announce to our readers that, through the courtesy of the United States Department of Agriculture, and the kindness of Dr. Thomas Taylor, we shall be able to publish in the *Journal* five of the six plates which are to illustrate a monograph on the subject of butter and other fats. These plates are made, in part, from the beautiful photographs of the late Dr. Barnerd Persh, of Philadelphia, and serve both as a valuable series of figures of the subjects treated, and fine examples of the art by which they are reproduced.

NOTES.

The British Association met this year at Manchester on August 31st, Sir Henry Roscoe presiding.

Dr. E. M. Crookshanks has been elected Lecturer on Bacteriology at King's College, London. He has recently published two very elaborate works on this subject—a second edition of his 'Manual of Bacteriology' and 'Photography of Bacteria.'

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Dr. H. M. Fussell read a paper before the Philadelphia County Medical Society, giving a study sputa of 100 cases of lung disease. His results were as follows:—

(1). 79 cases—evident signs of phthisis; tubercle baccilli found.
(2). 5 cases—no physical signs of phthisis; bacilli found in sputa.
(3). 8 cases—no physical signs, and no bacilli found.
(4). 8 cases—no physical signs led to diagnosis of phthisis, but no bacilli found.

The practical value of examination is shown in such doubtful cases as 3 and 4, where the diagnosis was necessarily based on the sputa.

——o——

Tyrotoxicon in its relation to *cholera infantum* and similar diseases is the subject of a recent paper by Dr. V. C. Vaughan, of the Michigan State Board of Health. 'Experiments on animals seem to prove that the development of tyrotoxicon in milk is a frequent cause of *cholera infantum* and kindred affections. Among the poorer classes of cities where fresh milk is almost unknown the diseases are most frequent. The milk is often not obtained until it has began to sour, then is kept at high temperature and in foul atmosphere. It is then eaten by the little ones weakened by poverty, which means bad food, bad air, bad clothing. Then, too, often in the country sufficient care about the milking and care of milk is not exercised.' The author lays many summer diarrhœas to the account of tyrotoxicon, or allied poisons, and recommends during attacks an entire disuse of milk and substitution of chicken or mutton broth and others.

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— We notice in *Archiv. für Mikroskopische Anatomie*, 1887, p. 594, an article by Dr. Geo. A. Peirsol upon the histology of the harderian gland in Amphibia.

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Medical Jurisprudence, by M. D. Ewell, Chicago, Chapter I, from the advance sheets of a work on this subject, has reached us. We judge from its appearance that the work is to be a short compend on the subject, and from the character of the sample may properly expect a valuable work.

CORRESPONDENCE.

To the Editor:—I am pleased to be able to announce the organization of the Kansas Society of Natural History in Leavenworth, with the following officers for the coming year:—Dr. R. J. Brown, President; Dr. Chas. A. Carpenter, Vice-President; W. R. Lighton, Secretary and Treasurer.

The microscope will enter largely into the work of the society, which will be confined as much as possible to original research in such of the sciences as are of economic importance to the State of Kansas. At the next meeting, to be held on the 14th inst., a paper will be read by the vice-president, embodying the results of some investigations on the black rot of the grape. A paper will also be read by Dr. W. D. Bidwell on the structure of the eye, which will be illustrated by microscopical preparations. Prof. Wm. Lighton will give an outline of the history of the microscope, its early use and development. The president, Dr. Brown, will present a paper on some of the common plants of this region, and the secretary will bring before the society the results of some experiments on the circulation of sap in some common plants where the natural circulation is interfered with.

W. R. Lighton, *Sec.*

Leavenworth, Kansas, *July 6, 1887.*

MICROSCOPICAL SOCIETIES.

San Francisco, Cal.

The regular semi-monthly meeting, held on June 21, at its rooms, President Wickson occupying the chair.

Series 2 and 3 of Walker & Chase's 'New and Rare Diatoms,' consisting of photo-

engravings of interesting forms, with descriptive text, were donated by Dr. H. H. Chase.

A communication was received from A. J. Doherty, of Manchester, England, the well-known preparer of microscopic objects, announcing his intention of visiting this city in a few months. Arrangements have been made with him for a series of demonstrations of the most approved methods used in the preparing and mounting of objects for the microscope, and from the admitted ability of the gentleman in this line his discourses cannot fail to be interesting and instructive. A series of slides mounted by him, and comprising a wide range of subjects, were shown under a number of microscopes last evening by J. G. Clark, and the excellence of workmanship shown by these mounts elicited the warmest commendation.

J. A. Sladky, of Berkeley, was duly elected a resident member.

The useful little device known as 'Griffith's Focus Indicator,' was shown by Mr. Riedy. Its object is to enable an approximate focus to be obtained almost instantly, and to prevent the accidental crushing of a slide or cover-glass by the objective in focussing.

Mr. Norris announced that, through the kindness of Mrs. Ashburner, he had come into the possession of a number of exquisite slides, mounted by the late Prof. Ashburner, and comprising a number of preparations of the celebrated 'original Santa Monica' find. No better disposition could be made of these, Mr. Norris thought, than to distribute them among the members of the society, and this he proceeded to do. As appropriate mementoes of a departed friend, as evidences of his rare skill as a microscopist, and as the last remaining examples of mounts from the remarkable fragment whose history has been so closely connected with that of the society, these slides will be considered treasures by their fortunate possessors.

Specimens of rich diatomaceous earths from near San Pedro, and from near Santa Monica, collected by Mrs. Bush, of San José, were also handed in by Mr. Norris.

A. H. Breckenfeld, *Rec. Secr.*

NOTICES OF BOOKS.

A Text-book of Pathological Anatomy and Pathogenesis. By Ernst Ziegler, professor in Univ. Tübigen. Translated by Dr. MacAllister. Three parts complete in one volume. New York. Wm. Wood & Co. 1887. (pp. 1091; figures 289).

We are glad to notice the completion by Dr. MacAllister of his translation of this most thorough treatise on the subject of pathological anatomy, and its appearance as a complete single volume. For the benefit of any who are not familiar with the scope of the work through acquaintance with the earlier parts we will present an analytical review of its contents.

It falls into two parts—a general pathological anatomy, treated in seven sections, as follows:—1, Malformations; 2, Anomalies in the distribution of the blood and lymph; 3, Retrogressive disturbances of nutrition; 4, Progressive or formative disturbances of nutrition; 5, Inflamation and inflammatory growths; 6, Tumors; 7, Parasites; and special pathological anatomy, in twelve sections, as follows:—1, Blood and lymph; 2, Vascular mechanism; 3, Spleen and lymphatic glands; 4, Serous membranes; 5, Skin; 6, Mucous membranes; 7, Alimentary tract; 8, Liver and pancreas; 9, Urinary organs; 10, Respiratory organs; 11, Central nervous system; 12, Peripheral nervous system.

The introduction covering the first thirteen pages is a very remarkable essay upon the animal cell, its healthy life, and all the various forms of hindrance to healthy life to which it is subject. It is an admirable summary statement of case from the cell standpoint, and is in strict keeping with the thoroughly scientific character of the entire work. The author's recognition of the importance of cell pathology for the science of Pathology is well shown in the following quotation (p. 8):—'Morbid changes have their seat in the cells and in their derivatives, the intercellular substances. It is therefore indespensible to a right understanding of these changes to call in the help of the microscope, and with it follow out the cellular and intercellular processes.' 'As a fact, the microscope has in countless cases thrown an utterly unexpected light upon these processes, and the enormous advance of pathological anatomy in the last quarter of a century or so has been brought about simply by the exact attention bestowed upon

them. Virchow it was who inaugurated this new method and established it on a firm basis.' We may see in this the key-note to the treatment followed throughout the work. Preceding each section is a chapter of general considerations wherein a most convenient summary of the subject in hand is spread before the reader. This summary, with later explication of the subject in the remaining chapters of each section, is analytical throughout, and the book is thus made an analytical key wherein may be found in its proper place the consideration of any subject.

In treating each subject the author states the facts with discussion of mooted points, and cites numerous articles furnishing thus a valuable resumé of the literature on each topic. In the review and discussion of this literature the work is brought down to include very recent articles in many cases, even so late as 1886. This makes the work extremely valuable for students' use, both by reason of the review of the discussion, and the key to the original articles. The list of authors cited contains the names of about 1,400 writers; among them Virchow is referred to 117 times, Wagner, Weigōrt, Rindfleisch, Ranvier, Klein, Klebs, Koch, Eberth, Cohuheim, Cornil, and many others are often referred to frequently at considerable length.

As illustrating the character of treatment more clearly, let us select the section (vi) on tumors. In a chapter of general considerations, taking up the mode of tissue formation in a tumor growth, with a brief discussion of the use of the word 'tumor' and references; discussion of the various names for various kind of tumors, the clinical character of tumors. The following chapter on mesoblastic or connective tissue tumors, considers *a*, fibroma; *b*, myxoma; *c*, lipoma; *d*, glioma; *e*, chondroma; *f*, osteoma; *g*, angioma; *h*, myoma; *i*, neuroma; *j*, lymphoma; *k*, sarkoma; *l*, mixed tumors. The third chapter treats of epithelial tumors, glandular, and cancer of the various forms. The second and third chapters are well illustrated (37 figures), and there is an abundant reference to and discussion of unsettled matters. The fourth chapter of the section, the etiology of tumors, discusses pretty fully the views as to the nature of tumor and cancer, the origin of cancer, etc. The section covers 71 pages, and there is considerable scattered through the special pathology part of the book besides, making a very thorough though brief treatment of the topic.

The make up of the work is most commendable; the type is clear, and the introduction of heavy-faced type at the head, or in the middle of sentences whenever the chief word occurs, makes it easy to learn the subject matter of each paragraph at a glance. The index of subjects is very complete, occupying 26 pages, double columns. The illustrations are not what lithographs, or even the best photo-engraved plates, on plate paper can furnish; some are actually poor, but the vast majority of the figures are excellent. All the figures are made most available by the unusually complete and clear system of explanation by reference letters on the drawing and explanatory table immediately beneath. A brief epitome of the histological history of the section from which the drawing is made is also given in every instance.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology.
HENRY L. OSBORN, Lafayette, Ind.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired.
M. A. BOOTH, Longmeadow, Mass.

Wanted, exchange of slides, and correspondence on unusual urinary products.
J. M. ADAMS, Watertown. N. Y.

Ten selections of cleaned Marine Gulf Diatoms, and 100 lbs. Gulf Marine Diatom Muds. Correspondence invited from any one.
K. M. CUNNINGHAM,
Land Office M. & O. R.R. Co., Mobile, Ala.

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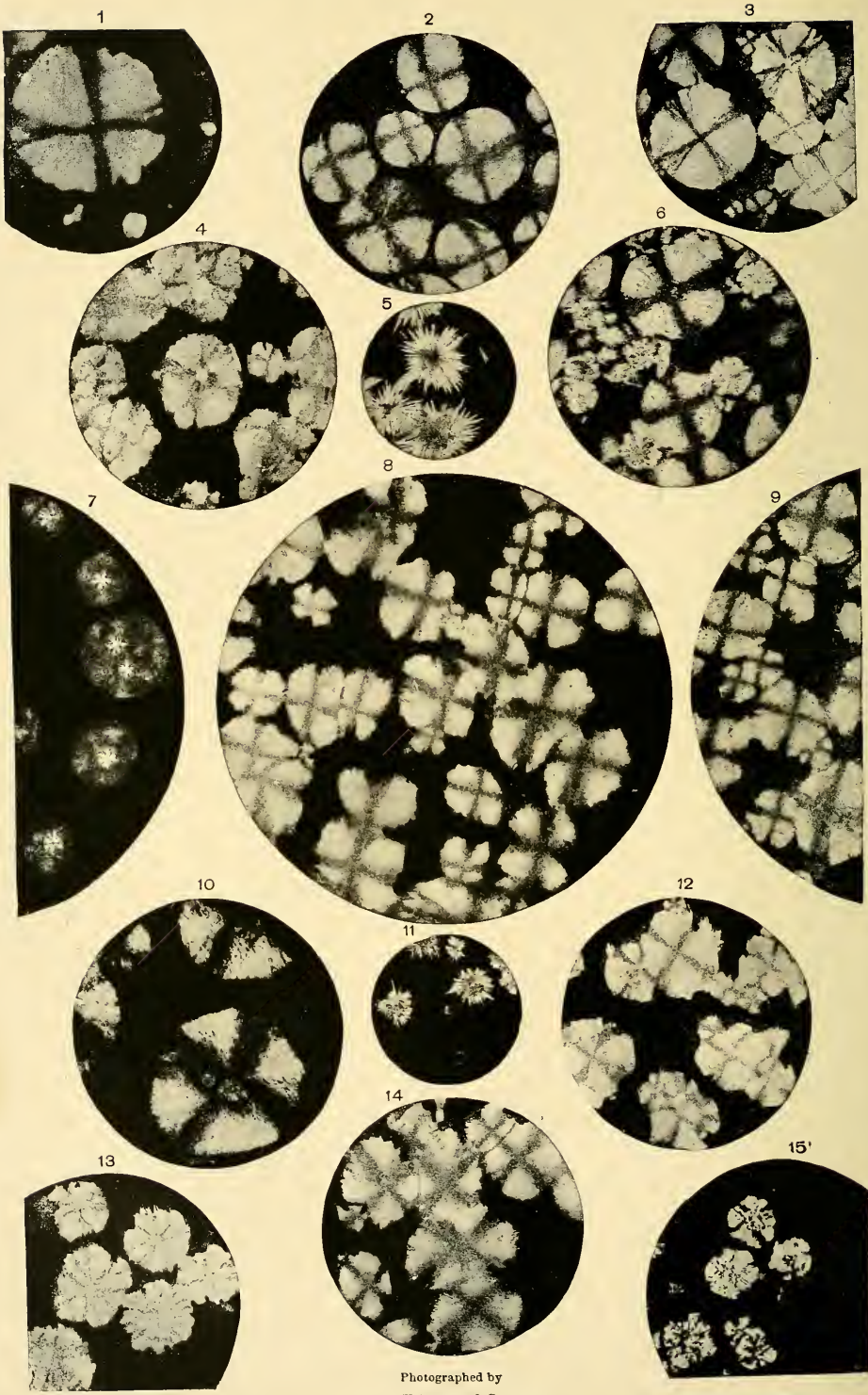
The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the following prices which are net:—Vol. II (1881) complete, $1.50; Vol. III (1882), out of print; Vol. IV (1883) complete, $1.50; Vol. V (1884) complete, $1.50; Vol. V (1884), Nos. 2–12, $1.00; Vol. VI (1885), $1.50; Vol. VII (1886), $1.00.

PLATE III.

CRYSTALLINE FORMATIONS OF BUTTER.



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VOL. VIII. SEPTEMBER, 1887. No. 9.

On methods of preparing tissues for microscopical study and brains for anatomical demonstration.*

BY J. W. BLACKBURN,
OF WASHINGTON, D. C.

FREEZING METHOD.

Undoubtedly freezing, if properly done, gives us the best method of demonstrating what we conceive to be the true condition of the tissues immediately after the cessation of life. The histological elements are fixed in their true shapes, sizes, and relative positions. It is, however, impossible to prepare tissues for the microscope without some manipulation, and the freezing and thawing and the subsequent staining, if the sections be stained before examination, may produce unsatisfactory results.

It is probable that with the ether-spray freezing apparatus the action of cold upon the tissues is more easily applied and controlled and less injury done to the tissues than by any other method of freezing; and if the sections cut by this method be examined in glycerin, unstained, or, if stained, using only the aqueous reagents, we believe we may claim a minimum of alteration for the freezing process.

The ether spray apparatus I exhibit is the one used with the Schanze microtome. It works very well, is simple, portable, inexpensive, and the rubber parts easily replaced if they become rotten, as they will in time. On the metal plate it is easy to freeze $\frac{1}{4}$ inch of tissue in a short time with the evaporation of a small amount of ether; and from this thickness of tissue a large number of thin sections may be cut.

The tissue should be frozen to about the consistence of hard cheese; if harder, the knife will *jump* or the edge will be spoiled.

It is advisable to use the best anæsthetic ether, as the commercial article will not spray well, and the difference in the expense is slight.

Tissues may be cut perfectly fresh or after partial hardening. If used fresh they are placed for a few minutes in a thick solution of gum arabic or gum and syrup; but even this is not necessary, and is only used to assist in freezing the piece to the metal plate.

If hardened first in any of the watery solutions the same method will answer, but if alcohol has been used the pieces must be placed in water for about 12 hours to remove the alcohol before placing in the gum. After hardening, however, the method can no longer be considered preferable to the interstitial imbedding processes to be described later.

The sections must be cut on some form of microtome, and the knife should be kept cold and dry and at nearly a right angle to the line of its motion.

* Read before the Washington Microscopical Society on May 24th, 1887.

The sections are cut into water, to which it is advisable to add one-third glycerin, and allowed to remain a short time to remove the gum; they are then stained in any of the aqueous stains and mounted in glycerin; or they may be preserved in the following:—

℞. Glycerin,
Aquæ dist., āā ℥ iv,
Acid carbolic, gtt. iii.
M. Boil and filter.

Beran Lewis treats brain sections cut by the freezing method with 0.25 per cent. solution of osmic acid, to prevent the injurious effects of water upon the sections. The sections are immersed for *one minute* in the osmic acid solution, which so 'fixes' the elements that they are not dissociated by subsequent washing, staining, etc. The osmic acid must be thoroughly removed by washing in pure water, or the staining will be unsatisfactory.

HARDENING AGENTS.

Alcohol is an unsuitable hardening agent for brain and nervous centres. The tissue is contracted and distorted, and the alcohol dissolves and extracts much of the fatty constituents of nerve tissue, thereby injuring the minute structures considerably. The substances extracted are precipitated in the crystalline form, and as an amorphous, granular material. On microscopical examination the precipitate is found to consist largely of cholesterin and leucin.

Spitzka has shown clearly that certain bodies found in the brains of the insane, and given such names as 'miliary sclerosis,' 'colloid spheres,' etc., are artificial productions due to the precipitation of these alcoholic extractives within the natural spaces of the tissue.

Spitzka says:—'It is not certain but that the surprising amount of such precipitates found in hydrophobia, tetanus, death from strychnine poisoning, and acute delirium, as contrasted with other cerebral conditions, may indicate a previous chemical predisposition to dissociation of the nerve elements.' If this be true, a certain value should be credited to alcohol as a chemical reagent, if not as a hardening agent.

The use of the solutions of chromic acid and its salts is to be preferred in the hardening of nervous tissue for microscopical purposes. Of these the most useful is Müller's fluid.* It is a slow hardening agent; but this is the only objection to it. Large pieces will harden in it, there is no appreciable shrinkage, and the sections stain well. The growth of fungi may be prevented by keeping the jars in a refrigerator or by keeping a piece of camphor in the fluid.

Four or five weeks are required to harden brain tissue. A whole or half brain will require longer; but hardening of large masses may be facilitated by making incisions into different parts, still keeping everything *in situ*. The membranes should *not* be removed.

A more rapid hardening agent is made by substituting sulphate of copper for the sulphate of soda in Müller's fluid. It is known as Erlitzky's (or Erlick's) fluid, and is made as follows:—

Potassium bichromate,	2½ parts.
Copper sulphate,	½ part.
Water,	100 parts.

This fluid will harden specimens in 8 or 10 days at the ordinary temperature without injury to the nerve tissues.

---

* Müller's Fluid.

℞. Potassium bichromate, 2 parts.
Sodium sulphate, 1 "
Distilled water, 100 "

After the specimens have hardened sufficiently they may be washed in water or placed at once in dilute alcohol; stronger alcohol is added gradually until ordinary commercial is used, in which the tissues may be preserved indefinitely.

The tissues may now be cut by the old or wet method; but usually a process of interstitial imbedding is used and the prepared tissue is cut dry.

INTERSTITIAL IMBEDDING.

The advantages of interstitial imbedding are that by it individual elements are supported during the cutting and the relations of the elements preserved, and at the same time it renders possible the cutting of sections of extreme thinness.

Paraffine has been used for some time as an interstitial imbedding mass.

A method of section cutting by the use of paraffine as an imbedding mass was described by Dr. Reeves, of Wheeling, W. Va., in an article in the *St. Louis Med. & Surg. Journal*, Dec., 1886, which was recapitulated in the *American Monthly Microscopical Journal*, Jan., 1887, with a just editorial criticism.

Dr. Reeves' method is essentially the same as had been used in the Army Med. Museum and in my own laboratory for some time.

Paraffine for this purpose should be bluish, transparent, and ring slightly when struck, and its melting point should be suitable to the temperature of the laboratory. I find 135° F. to be a suitable melting point for general use. By melting together the harder and softer kinds any desired melting point may be obtained.

Some solvent of paraffine is used to prepare the tissues for the bath of melted paraffine; those most used being turpentine and chloroform.

The specimens are first dehydrated in absolute alcohol, then placed in a bath of the solvent, and then in a solution of paraffine dissolved in the solvent, and finally in a bath of melted paraffine, and allowed to remain until thoroughly infiltrated. The process is the same, no matter what solvent is used, but turpentine is now more used than chloroform.

The time required for these different baths varies with different tissues, and cannot be definitely given.

The important point of difference between this method and that advised by Dr. Reeves is the use of an intermediate bath of paraffine dissolved in the solvent used, thereby preventing the great shrinkage which will occur if the specimens be transferred *directly* from the chloroform or turpentine into the pure paraffine.

The specimens are imbedded in *fresh* paraffine in paper trays, and after cooling may be cut, or kept in the blocks until wanted, in the dry state.

The sections are cut on a sliding microtome, with the knife nearly at a right angle. They are cut into turpentine, or, preferably, benzole, in which the paraffine is dissolved out, and are then washed in alcohol and stained.

Tissues may be stained *in bulk* before infiltrating, and may then be mounted from the benzole, in balsam. Much time is saved by this method.

Many of the common stains will do, but an alcoholic solution of borax carmine is the most useful. A little alcohol added to any of the common borax carmine solutions will answer every purpose. After staining 12 to 24 hours the pieces are placed in 70% alcohol, 100 c.c. and hydrochloric acid, 2 c.c.; in this mixture the color changes from a dark maroon to a bright red; they are then washed in common alcohol, dehydrated, and infiltrated as before described.

For success in the paraffine method it is essential that the following points be remembered:—

1. The tissues must be thoroughly *dehydrated*.
2. An intermediate bath of paraffine in the solvent must be used to prevent shrinkage.
3. The solvent must be *completely* replaced by pure paraffine.
4. Dry heat should be used in all the melting processes.
5. Paraffine with a proper melting point must be used, as it is not safe to heat to, or beyond, 60° C. (140° F.); nevertheless tissue will not be injured by any temperature which can be borne by the hand.
6. The section knife must be perfectly free from breaks in its edge, and *very* sharp.

MYRTLE WAX IMBEDDING PROCESS.

In an article in the *New York Medical Record*, April, 1885, Dr. Maurice N. Miller, of New York, called attention to a new imbedding material which he claims possesses some advantages over the paraffine and celloidin processes. The material is myrtle wax or bayberry tallow. Myrtle wax is a substance derived from *Myrica certifera*, a shrub from one to twelve feet high, growing in the United States, especially along the eastern coast.

The wax is found covering the fruit as a whitish coat, and is separated for use by boiling the berries in water; the wax separates and rises to the top, and is either skimmed off or allowed to concrete as the liquor cools, and is then removed. It is of a pale, grayish-green color, somewhat diaphanous, brittle, slightly unctious to the touch, and has a feeble aromatic odor and a slightly bitterish taste. Its sp. gr. is about that of water, and its melting point is about 46.6° C. to 48.8° C. (116° F. to 120° F.)

It is insoluble in water, scarcely soluble in cold alcohol, soluble except about 13 per cent. in twenty parts boiling alcohol, which deposits the greater part of it on cooling. It is also soluble in boiling ether, and slightly so in oil of turpentine.

In addition to the above solvents, usually given, I have found it to be very soluble in *chloroform*, *benzole*, and *xylol*.

The wax described above is no doubt the true product of *Myrica certifera*, but for the purposes of the microtomist it will *not* answer. A variety must be obtained which is *yellowish white* in color, tougher and softer. This variety, though *sold* as myrtle wax, is probably the product of *Rhus succedanea* Ln., and should be called 'Japan wax.'* With the above exceptions, the same description of physical characteristics will answer for both.

Dr. Miller based his method upon the following facts:—'Bayberry tallow is firm and solid at ordinary temperatures, and is soluble in warm alcohol.' He claims that specimens may be removed from the alcohol in which they have been preserved and placed at once in a bath of melted wax; but I think it is better to first dehydrate in absolute alcohol and then place in a preliminary bath of wax dissolved in *chloroform*.

Benzole and xylol will dissolve large quantities of the wax, but it is deposited in a *granular* form on their evaporation; but on evaporation of the chloroformic solution the wax is left in a solid form. Chloroform is, for this reason, preferred as a solvent for the preparatory bath, but for all other purposes the less expensive solvents may be used.

The chloroform may be used over and over again, and if occasionally a little fresh be added to it this bath may be kept always ready.

* Dr. Z. D. Gilman, of Washington, D. C., informs me that the wax in question is imported through a Japan trading company, and is said to be derived from *Rhus succedanea*, Ln. If this be its source, it is then one of the varieties of *Japan wax*.

Dr. Blackburn, in a private letter, desires to add his acknowledgment to Dr. Seaman (see this *Journal*, p. 138), who determined that the yellow wax, which is the one here referred to, was the product of *Rhus succ.* He says:—'In view of the present information upon the waxes, it is obviously wrong to continue applying the name "myrtle wax" to the yellow variety, which is the kind used, but as it is sold under that name, and the originator of the use of the wax so called it, I shall not alter the name used.'—[Ed.

The method of using myrtle wax is as follows :—The specimens are dehydrated in absolute alcohol and then placed in a solution of wax in chloroform, as a preliminary bath, or transferred directly to the melted wax. The pieces will be infiltrated in about the same time required by the paraffine method.

The pieces may be fastened on cork, by using the melted wax, or imbedded in blocks of wax or paraffine, to support the specimen in the clamp of the microtome.

The sections are cut dry, into benzole, washed in alcohol, stained and mounted as usual.

To completely remove the wax it is best to take the sections through a second bath of benzole, as any remaining wax will be precipitated by the alcohol used in the washing.

Warm absolute alcohol may be used to free the sections from wax, but the benzole is better and cheaper.

Ordinary alcohol warmed will not dissolve the wax perfectly ; warmed absolute alcohol will dissolve most of it, but will deposit it on cooling ; I, therefore, think that the above method is preferable to the immediate transferring from the preserving alcohol to the wax bath, as advised by Dr. Miller.

The method is more rapid than either the paraffine or celloidin process ; there is very little if any shrinkage ; it does not injure the most delicate tissues, and it is inexpensive.

The specimens I exhibit show the comparative shrinkage by this and by the Reeves Method.

If hardened in large masses there is a *slight* shrinkage and a tendency to crack ; this, I think, may be prevented by the addition of a small amount of paraffine with which it is miscible in all proportions.

I never have seen a section injured by cracking.

WAX METHOD APPLIED TO THE PREPARATION OF BRAINS FOR ANATOMICAL DEMONSTRATION.

The specimens of brains I exhibit were prepared by the use of myrtle wax as an infiltrating agent. The process is as follows :—

To prevent shrinkage the brain should be carefully hardened in a solution of one of the chromic acid salts, after which it should be gradually advanced through alcohols increasing in strength until absolute alcohol is reached.

It should be dehydrated and then either placed in an intermediate bath of wax dissolved in chloroform, or at once into the melted wax. About three days are required to infiltrate a hemisphere.

The dark olive color produced by the hardening fluid is the only objection to this method. By the use of other hardening agents a more pleasing color may be obtained, but the *shape* and *size* of the specimen are perfectly preserved by hardening in Miller's fluid and myrtle wax infiltration.

The light colored specimens were hardened in alcohol ; but the shrinking and distortion produced by this agent are objections to this.

A very fair degree of success may be attained by a direct transfer from the alcohol, used to preserve the brain, to the melted wax. In fact, some of the brains I exhibit were done in this way ; but the wax must be heated to a much higher degree than would be safe for microscopical preparations.

Dr. Dwight, in the *Boston Med. and Surgical Journal*, Mar. 10, 1887, describes Schwalbe's methods for making preparations of brain for demonstration, by the use of paraffine ; but he says it is ' apparently applicable to parts of brain rather than the whole organ.' I have tried the Schwalbe method, but with less satisfactory results than with the wax method, which, so far as I know, is a new process.

Notes from Japan.—III.

By ROMYN HITCHCOCK,
OSAKA, JAPAN.

(*Continued from page 88.*)

Our contributions to the *Journal* have not been regular or frequent since we have resided here, for the simple reason that there is no microscopical news to be obtained here. Such observations as it has been our good fortune to make with the microscope are not sufficiently far advanced to admit of publication. We are pleased to announce, however, that we have recently been able to secure specimens of harbor muds from four different ports in Japan, some of which will soon be distributed. But harbor mud is not satisfactory material to clean unless one has a large quantity. Therefore, only a few of those who have written for specimens will receive samples of these, which will mostly be sent to specialists who are sure to find them valuable. The other collections are growing slowly, but in due time every request will be complied with.

The editor of the *British Journal of Photography* comments upon a new specimen of microscopic writing recently executed by Mr. W. Webb, which, it is rather ambiguously stated, is 'so small as to require an eighth of an inch power on the microscope to see it.' The size of the letters is, perhaps, more clearly expressed in the statement that 'if a square inch were written over with letters of the same size the whole of the Bible and half a Bible more could be contained therein in quite legible form.' In other words, Mr. Webb can write legible letters so small that a square inch would afford space for five millions of them!!

In the same journal, of March 11, there is a communication from Mr. W. Leach describing a lantern microscope which we are quite ready to believe is an excellent arrangement, since it embodies in practical form precisely the ideas that the writer has long desired to apply, and which have been briefly set forth in these columns. The important feature of the device is the sub-stage condenser, which consists of a fitting with focussing adjustment, bearing a condenser that is changed to suit different objectives. For a two-inch objective the condenser is a plano-convex lens $1\frac{3}{8}$ inches in diameter and two inches focus. For powers from $1\frac{1}{2}$ to $\frac{4}{10}$ inch a similar lens of $1\frac{3}{4}$ inch focus serves very well. Back of these, in the cone of rays converging from the principal condenser, is placed a flint concave of about 6 inches focus and $1\frac{3}{4}$ inches in diameter. The purpose of the concave is to adapt the course of the rays from the principal condenser to the focus of the lenses in the sub-stage.

Mr. Leach seems to have fully understood the requirements of the lantern microscope, and has met them in what seems to be a most rational manner. As a result he states that *Volvox globator* projected on a sixteen-feet screen looked about as large as tennis balls; the cornea of *Dytiscus* may be well shown eight or ten feet, and echinus spines seven to twelve feet, in diameter.

The projecting microscope is undoubtedly capable of great improvement, and Mr. Leach has made a step forward which should be followed up. If the account we have referred to is not much exaggerated we may conclude that already the instrument may be advantageously used in class demonstrations, for it is there stated that with a $\frac{4}{10}$ inch objective 'images were shown upon the screen magnified eighty diameters, well defined, brilliantly and equally lighted,' the source of light being 'a small paraffine lamp with a single half-inch wick.'

There is one fact that should be borne in mind by those who purchase apparatus for this purpose, and that is this:—There is (at least so far as the writer is aware) not a sub-stage condenser in the market that is properly constructed for lantern projection. Indeed, it seems doubtful if any single com-

bination of lenses can be adapted to meet the requirements of different objectives, and to the various forms of lanterns. At least one firm of American opticians has lately introduced a form of condenser that is said to work well, but it does not commend itself to our mind. There is still opportunity for the application of the principles that have already been suggested, and the construction of a more efficient condenser than has yet been offered for sale.

We are indebted to Professor S. H. Gage for a copy of his really valuable 'Notes on Microscopical Methods,' which he has kindly sent to us in this far-away land. No doubt it has already received due notice in the *Journal*, so it is only left for us to acknowledge its arrival and return thanks for it. Along with it comes also a request from the author to examine the epithelium of the mouth of the large salamander that inhabits some of the lakes of Japan. This is the second letter we have received concerning the *Cryptobranchus* or *Megalobranchus*, which is said to attain a length of three feet; and so much interest seems to attach to it that we shall endeaver to capture one on the first opportunity, after which it will be time enough to consider the epithelium.

April 22, 1887.

Elementary histological studies of the Cray-fish.—V.

By HENRY L. OSBORN.

CHAPTER II.—THE 'LIVER.'—(*Continued from page 152.*)

1. **Preparation of the slide.**—For the study of the gross anatomy and histology of the 'liver' of the cray-fish one, if sufficiently expert, may use the same creature as has already served in the study of the green gland, but we should advise a beginner to take a fresh live creature for the purpose. This should be killed as before directed. (See pp. 81 and 82). To expose to view the organ called the liver the shell from the dorsal part of the body must be very carefully removed. To effect this raise the shell over the cephalo thorax at its hinder extremity; that is, where it meets the abdomen, and with a pair of fine scissors cut beneath it. Direct the scissors forward and toward the side and remove the shell from the entire back well forward toward the head. After the dorsal part of the carapace has been carefully removed, the same operation must be repeated upon the dorsal part of the anterior abdominal rings to remove the shell covering the two or three most forward of them. When the shell has been thus carefully removed, a number of organs will be exposed:—In the middle line in front a thin semi-transparent sack (1), the stomach; behind it, if the operation has been sufficiently careful, the heart still pulsating; on either side of (2) the heart, extending under it (3) the ovary or testis, according to the sex of the animal; on either side beyond the reproductive organ, and below it reaching forward to the stomach and backward to the first or second abdominal segment (4), the liver.

These organs may be carefully separated with dull teasing needles, not torn asunder or broken through, but gently pressed apart and submerged in strong alcohol for several hours preparatory to the study of the gross anatomy of the organ. The specimen for histological examination must be treated differently.

To prepare the material for sections the 'liver' of one side should be removed without any tearing or pulling of the organ. This can be accomplished if the other organs are sacrificed to some extent, if the sharp scissors are skilfully used and the tissue is manipulated with a section lifter and gentle

teasing to remove it from other parts. The whole of any desired part of the organ thus separated, several courses of treatment are presented for our choice. The specimen studied and figured for the present article was treated with the specimen last described, and hence received precisely similar handling. Whether it was best or not could only be determined by treating other portions of the same organ by other methods for comparison. This, if faithfully pursued, would furnish valuable results, but the topic will be discussed and we may leave it now. Since I have already described one method (see page 83), that of hardening with corrosive sublimate, I will here detail a way which might have been followed in the preparation of the sections with perhaps better results than the one pursued. I mean the picric acid method.

The picric acid series of reagents for hardening animal tissues contains four members which are in very common use. These are :—(1) Picric acid, or Kleinenberg's picric acid; (2) picric and nitric acid; (3) picric and sulphuric acid; (4) picric and hydrochloric acid. The first of these is simply a saturated aqueous solution of picric acid. The second, third, and fourth are made by adding 2 parts of strong acid to 98 parts of the Kleinenberg's solution, filtering to remove the heavy precipitate and reserving the clear filtrate for use. In use a dilute solution of the picro-nitric acid, etc., is desirable—one part to two of distilled water is commonly employed.

No unnecessary time should elapse after the killing of the animal before the tissue to be hardened is immersed in the hardening reagent, for death changes in the cell, and subsequent alterations, if operative for any considerable time before the structure is fixed by the hardening reagent, may produce false appearances in the sections. Cells to be well preserved should be in contact with the preservative reagent before they are themselves dead, to be killed by it. The amount of the fluid to be used varies with the size of the specimen. A good rule is to use about fifteen times as great an amount as the size of the specimen. Pieces should remain in the picric fluids from three to six hours according to their size. They should be transferred to 30% alcohol, to remain ten minutes, thence to 50% alcohol, to remain one-half hour, and thence to 70% alcohol, which should be removed every twenty-four hours until no yellow tint is imparted to the alcohol. This, for small pieces, will require about three or four changes.

If it is desired to harden a tissue which is contained in a calcareous envelope and cannot be removed from that envelope, the picric acid combined with nitric or, particularly, hydrochloric, presents especial advantage, for the hardening takes place simultaneously with the decalcification of the soft parts. This will appear when treating of the eye of the cray-fish.

The 'liver' will be hardened sufficiently, and cleared of the picric coloration after four days, when the other steps preparatory to sectioning may be taken. Kleinenberg's hæmatoxylin or borax carmine are most commonly employed as staining fluids where the piece is to be stained before sectioning. Borax carmine is to be preferred because of the readiness with which any over-stain may be removed. It is described, with notes on its use, on page 83. Hæmatoxylin, prepared after Kleinenberg's manner, is made as follows :—

Add crystallized calcium chloride in excess to 70% alcohol, draw off the saturated solution, add alum in excess, and let stand for one day; filter. To one volume of this filtrate add six-eight volumes of 70% alcohol. To this mixture add, drop by drop, a saturated solution of hæmatoxylin in absolute alcohol till a moderately dark purple results. The solution improves on standing. Tissues may be stained in piece in this fluid; for this purpose the fluid is diluted (with 70% alcohol) and the tissue remains in the fluid one or two days. Only a small piece of the fluid should be taken to secure even staining throughout the piece; any marks of the stain may be removed by

the use of dilute acetetic acid; for a general washing fluid to remove the diffused hæmatoxylin the piece may be treated as after the use of borax carmine. For the best sections, and particularly for the purpose of securing a series of sections of even thickness, the paraffine method already described is to be recommended (see pages 83, 84).

For the examination of such an organ as the 'liver' of the cray-fish the method is especially valuable because of the readiness with which the section may be secured to the slide; while all its (in the section) independent parts are held together by the paraffine. For the 'liver' consists of tubules free from each other except at their mouths, and the separate tubes when cut would, unless held in place on the slide by the cement, float away and their relations consequently be lost.

Sections should be cut in two or three directions, and they should also be cut from various portions of the 'liver' for the complete study of that organ. The section figured in connection with this particular study is a section across the long axis of the organ, which section illustrates more than a section in any other single plane could exhibit.

(*To be continued.*)

The biological examination of water.—II.

By ROMYN HITCHCOCK,

OSAKA, JAPAN.

(Continued from page 149.)

The apparatus for filtering the gelatin solution, which must be kept hot during filtration, was constructed as follows:—A tin fruit can was neatly cut off close to one end and a glass funnel selected that would just fit into it, leaving an annular space of about one-fourth of an inch between the edge of the funnel and the side of the can. A hole was then punched in the bottom of the can and a short tin tube soldered in to receive a cork. Through the cork a hole was made and the neck of the funnel pushed through it. The tin was then filled with hot water, which surrounded the funnel. The water was kept hot by conducting steam through a glass tube from a flask of boiling water. As a matter of fact, this makeshift apparatus served perfectly well, although it was all arranged in the course of an hour. A tinman fixed the can in a few minutes. Having no cork-borer, a small hole was first made through the cork with a Japanese boring tool and enlarged to fit the funnel by burning with a glass tube made red hot in the flame of a spirit-lamp. Then the tin, with its funnel in place, was set on a piece of cigar-box wood, with a hole in the middle, supported between two cigar boxes set on end. The flask for supplying the steam was set over an *hibachi*, a kind of charcoal furnace used by the Japanese for cooking and heating, and kept boiling briskly by piling on lighted charcoal from time to time. Another large *hibachi* stood near at hand, on which was a large tin sauce-pan nearly full of boiling water. The gelatin mixture was contained in a Mason fruit jar, which was sunk in the water, and heated for nearly an hour previous to filtration. The filter was carefully folded, and the filtration progressed in a perfectly satisfactory manner. Not having any test-tubes of suitable size, the filtrate was received in three sterilized flasks.

The sterilizing oven for apparatus was nothing more than the oven of a kitchen stove. The flasks, tubes, and other apparatus to be sterilized, were put into a tin dish and slipped into the oven, where they remained as long as convenient. Having no thermometer graduated above 120° F., the only guide as to temperature was the sense of feeling. However, to make sure that the

articles were heated enough, they were allowed to remain until the cotton in the necks of the bottles was discolored by the heat.

For sterilizing culture media, the tubes containing them were placed in boiling water, contained in large tin sauce-dishes. It was found that the tea-kettle was excellent for sterilizing nutritive gelatin in test-tubes. For this purpose the tubes are suspended from a glass rod by means of cord or copper wire. Half a dozen tubes may thus be lowered into a large tea-kettle and effectually heated. The thoroughness of the process is well shown by the fact that the tubes thus prepared, nearly a month ago, are still perfectly clear and free from life.

The only piece of apparatus that was not readily arranged was a culture oven which could be maintained at a constant temperature. This was dispensed with, but not without considerable disadvantage as well as inconvenience. However, it is not absolutely essential, except for special purposes, and the general work required in examinations of water progresses very well without one, in this climate at least.

The gelatin culture medium was prepared as follows: One hundred grammes of a French gelatin, that we found at a photographer's shop, was placed to soak overnight in 500 c.c. of water. Five hundred grammes of lean beef were chopped fine and also digested in 500 c.c. of water. On the following morning the meat extract was strained through a thin woollen cloth, mixed with the softened gelatin, and the whole gently warmed. Peptone is the proper material to be added at this stage, but at the time we could not obtain it, so, instead of that, 20 grammes of Dr. P. B. Rose's 'peptonized beef' were used, and 5 grammes of salt. The peptonized beef is an excellent preparation of beef, which can be boiled without precipitation of albumen, and it was thought that it would serve the purpose very well. Experience has fully sustained that presumption.

After carefully neutralizing the free acid with carbonate of soda, the beaten white of an egg was thoroughly mingled with the solution, which was then poured into a Mason jar and heated in boiling water over the kitchen fire. The addition of the white of an egg is not usually recommended, but it certainly expedites the filtration. The boiling must be continued for fully an hour, so that the albumen coagulum becomes very firm. The liquid may then be strained through a linen handkerchief, and it comes through remarkably clear. The next operation is to reheat the solution and filter it through paper in the apparatus already described. The filtrate must be perfectly clear and transparent. It is then poured into sterilized test-tubes, filling them to the depth of about an inch, and protected by plugs of cotton. The tubes are then heated in the tea-kettle of boiling water, as already described. The heating should be continued one hour, and repeated twice, at intervals of twenty-four hours. The medium will thus be perfectly sterilized. The sterilized gelatin used by Dr. T. Leone is composed as follows:—

Water,	100.0 parts.
Gelatin,	10.0 "
Peptone,	0.5 "
Extract of meat,	0.5 "
Sodium phosphate,	0.5 "

Sodium carbonate to faint alkaline reaction.

The water to be tested was obtained from some ice that had been condemned by the Japanese examiners as unfit for use, and the importers wished to know more about it. The water was collected in a sterilized flask, and immediately upon arriving home half a cubic centimetre of the water was mixed with the culture medium in one of the tubes and poured upon two prepared glass plates, each about four inches square. To cause the gelatin to set quickly a finger-

bowl was filled with ice and covered with a glass plate. This was levelled, and the plate to receive the gelatin was laid upon it. The gelatin was warmed by placing the test-tube in warm water and then poured upon the plates and evenly spread with a copper wire that had been heated in the flame of a spirit-lamp. The plates were successively cooled, each being protected from dust by a dish-cover, and in a few minutes the gelatin had set perfectly firm.

The culture chamber was a bell-jar inverted over blotting-paper on a glass plate. The whole was washed with a 0.1 per cent. solution of corrosive sublimate, and the blotting-paper was saturated with it. The plates to be examined were placed in the chamber, and after four days the points of growth were counted.

The result showed 200 centres of growth from one cubic centimetre of the water, of which about one-fourth liquified the gelatin. The number of germs is not excessive, and there was nothing whatever to justify the condemnation of the ice.

(*To be continued.*)

Enamel and Dentine. Some thoughts on the new theory concerning their structure.*

By GEORGE S. ALLEN,

NEW YORK CITY.

During the last eight or nine years articles from the pens of either Drs. Abbott, Bödecker, or Heitzmann have upheld the idea that these are living tissues, and that a living protoplasmic reticulum had been demonstrated continuous between the dentine and enamel and reaching into the protoplasm of the pulp cells.

Such views are novel and not to be accepted suddenly on dogmatic assertion, or without good and convincing reasons. Accordingly the new views provoked much criticism and study of proofs offered and repetition of experiments. We present here a brief review of the results. First, no other workers have been able to corroborate the statements of the original authors of the theory, notwithstanding the fact that the technical methods present no great obstacles. It is a weakness of their work that they used gold chloride or osmic acid, neither of which exhibit any special affinity for protoplasm.

Again, a protoplasmic reticulum must be of a soft, semi-fluid character, and could not exist in a dessicated tooth, and the process of preparation must destroy it even if present. Chemical analysis, too, ought to reveal the presence of as considerable an amount of animal matter more than is given for enamel. But reasoning should not do away with demonstrated fact, and the writers, in their beautiful plates, show a reticulum in all its details. The original sections were, however, examined and afforded most convincing proof of the non-existence of the reticulum. In a letter from Dr. R. R. Andrews, of Boston, who examined the section on which Dr. Abbott had based published statements, he says: 'In regard to the new theory of the structure of enamel, I have examined many slides of this enamel, some of which were examined by Prof. Heitzmann in his laboratory and pronounced by him to show the reticulum.' 'These specimens I have examined critically with a most excellent $\frac{1}{15}$ objective of Tolles, and am assured that nothing like the reticulum figured by him can be demonstrated in them. In regard to the recent study of Prof. Abbott's slides, which he so kindly loaned me for that purpose, I could find no appearance whatever of fibrils resembling the exquisite drawings made by Prof. Heitzmann, illustrating the article published in

* Abridged from *Dental Cosmos*, June, 1887

the April number of the *Dental Cosmos*.' The writer also made examination of specimens said to exhibit the reticulum, but could not make out the reticulum nor, in fact, anything resembling one. It is both easier and pleasanter to agree with one's friends and co-workers than to disagree, and it seems an ungracious task to criticise those who have shown you kindness and courtesy, but the cause of truth cannot allow these strange views, so dogmatically asserted, to remain longer unchallenged.

The crystallography of butter and other fats.—II.

By Dr. THOMAS TAYLOR,

U. S. AGRICULTURAL DEPARTMENT, WASHINGTON, D. C.

EXPLANATION OF PLATE III.

Figs. 1, 2, 3, 6, 8, 9, 12, and 14. Primary crystals of normal butter. × 80 to 110.

Figs. 4, 7, and 10. Primary crystals showing 'secondaries' forming.

Figs. 13 and 15. Secondary crystals of butter. × 80 to 140.

Figs. 5 and 11. Tertiary crystals of butter. × 80 to 140.

MICROSCOPICAL TECHNIQUE.

Making lantern slides.

By C. M. VORCE.

CLEVELAND, OHIO.

In the May, 1885, number of the *Journal* (vol. vi, p. 84), I published a carbon process for making lantern slides, which, by later experiments, I have learned is liable to mislead and which I wish now to amend, since the many letters and inquiries I have received on the subject is evidence that considerable interest in the subject exists.

It happened, entirely by chance, that in testing the process published as above I used negatives made from slides of injected tissues, in which negatives the vessels filled with carmine had left the plate almost entirely unimpressed, while the transparent tissue substance had given a dense field. Silver prints from such negatives show but little else than the injected vessels standing out boldly on an almost white ground. The result in making lantern slides from such negatives is, that the sensitive film of gelatin is strongly impressed with the image of the injected vessels and remains soluble in all other parts, and a strong transparency *of the vessels* is produced.

With negatives showing tints and half-tones, however, the above process will not succeed, for the reason that the whole field will print to some extent and thus prevent washing out the underlying soluble gelatin. It becomes necessary, therefore, with such negatives, and is the preferable plan in all cases, to modify the process by what is called the single transfer in carbon printing. For this purpose the gelatin film is prepared upon paper instead of glass and is sensitized after drying. The proportions of the ingredients admit of wide variation, as also does the strength of the bichromate sensitizing bath; but the best results in any case are obtained by a certain relation between the composition of the film, the strength of the bath, the drying of the film, the exposure, and the development, just as is the case in silver printing and photographic processes generally.

For lantern slides great density is not desirable, but clear lights are impera-

tive ; hence the composition of the film requires consideration and the proportion of coloring matter is important. An approved formula is as follows :— Gelatin, 150 grains ; white sugar, 20 grains ; white soap, 15 grains ; dry color, 6 grains ; water, 1 ounce.

The gelatin, sugar, and soap are dissolved in the water and rubbed smooth ; the dry color is moistened with water and ground on a paint slab until well mixed, then ground with a little of the gelatin mixture, and then added in portions to the melted gelatin mass and thoroughly stirred to incorporate all well together. The mass is then strained while hot through fine muslin and is ready for use.

The paper may be coated by drawing it over the surface of the melted gelatin mass, or by spreading the mass on the paper, or by coating a glass plate with the mixture and spreading the paper upon this. In any case, the paper must first be dampened with pure water. Spreading on glass gives the best gloss to the carbon surface, and is done as follows :—A *clean* glass plate is coated with wax or rubbed with ox-gall and leveled, the warm gelatin mass is poured on and quickly spread, as in making dry plates, air bubbles of course being avoided or removed. The gelatin soon sets and the damp paper is then carefully spread upon it, avoiding air-bubbles, and the plate is laid aside for half an hour. A knife-blade is then passed under the edges and the paper with the gelatin adhering is carefully lifted off, beginning at one corner. The paper is then hung up to dry, avoiding dust, and when dry will keep indefinitely. To sensitize it the paper is plunged into cold water, and as soon as it becomes limp and flat is immersed in a bath composed of bichromate of potassium 2 parts, water 80 parts, for from 3 to 5 minutes. This sensitizing may be done in dim daylight or by lamp-light, but the sensitized tissue must be dried in the dark, in a current of air if possible, and free from dust. When dry the tissue is printed by contact under the negative in the sunshine for about two-thirds the time required for a print on silver paper, as the carbon tissue is more sensitive than silver paper. A photometer is of advantage, but a little experience enables one to print the carbon tissue without it, the time for printing on silver from the same negative being known. The tissue is not examined during printing, as the image is not visible. In printing it is necessary to use a mat or mask which will protect the edge for $\frac{1}{4}$ inch all round from the light.

To develop the print it is taken from the printing frame and placed in cold water until soft and flexible, when it is placed under water, face downwards upon the cleaned glass on which it is to permanently remain, excluding air-bubbles, and on removal from the water is 'squeegeed' into close contact with the glass by means of a rubber squegee, and is set aside for about half an hour to drain. The glass with adhering print is now immersed in warm water at about 70° F. for a few minutes, then into water heated to about 100° F. and gently moved about until the black gelatin is seen oozing out around the edges of the paper, when the paper is lifted at one corner and carefully pulled off, under water.

The glass is now rinsed about in the hot water until the soluble gelatin is dissolved away, which is quickly done, or it may be held under a gentle stream of water at about 80° F., or suspended face downward, in a bath of warm water, and allowed to develop by itself. When developed sufficiently the prints are immersed in cool, then in cold, water for a minute or two, and then immersed for two or three minutes in a three to five per cent. solution of common alum, to which, if cloudy, one drop of sulphuric acid to the pint of solution is added. From the alum bath the plates are given a dip into clean cold water to rinse them, and are then dried, covered with clear glass or hard negative varnish, and mounted for use.

Any lettering or numbering of parts, or a written title, may be executed upon the dry gelatin film with india ink by means of a steel pen, before covering or varnishing.

The best coloring matter is carbon, and for black the best india ink is superior to any other substance. For tones bordering on black the following are good formulæ :—

Pure black.—Dry india ink, 1 part to each 30 parts gelatin.

Warm black.—India ink, 15 parts ; vandyke brown, 2 parts ; venetian red, 2 parts ; and of the mixture 1 part to 30 gelatin.

Deep black.—India ink, 20 parts ; indigo, 2 parts ; carmine lake, 1 part ; and of the mixture, 1 part to 35 gelatin.

Purple black.—India ink, 5 parts ; indian red, 5 parts ; burnt umber, 2 parts ; indigo, 1 part ; and use 1 part to 30 gelatin.

Pure levigated lamp-black alone may be used in many cases.

The printed tissue gains intensity after exposure, and hence must be developed soon after exposure. The following facts should be borne in mind, to guide the various steps of the process. The bichromate bath should be weaker in warm weather or temperature than in cold, and should ordinarily not be used at a temperature above 60° F. and 40° F. is better. The stronger the bath the softer the prints and more sensitive the tissue, but too strong a bath will ruin the tissue, or even dissolve it. The sensitized tissue should be dried quickly, as slowly dried tissue is not equally sensitive in all portions, but if too quickly dried the tissue may crack.

Although the above directions may seem voluminous, the actual processes are speedily and easily carried out, the control of the operator over the character of the picture, and the cheapness, certainty and permanence of the result, are not equalled by any other photographic process. In Europe the carbon process for portraiture, copying, enlargements, etc., is much more extensively followed than the silver process almost exclusively in vogue in America.

Sample prints on paper, and lantern slides, by the process above described are forwarded to the *Journal*, and may be seen by those interested in the subject.

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Warm stages.—The *Journal of the Royal Microscopical Society* in the April number contains an article which occupies 18 pages of that Journal upon warm and cold stages. It contains 35 illustrations, and is an exhaustive statement of the various mechanisms in use to control the temperature of an object under microscopic examination.

Four different principles of heating have been adopted, viz. :—(1) hot air ; (2) electricity ; (3) conduction through metal plates, and (4) warm water. Of these one form of (3) is perhaps most convenient for general use ; it may be made by bending a ring upon the end of a rod of copper wire four inches, and then hammering the ring very thin and flat. The ring has a central opening of $\frac{1}{2}$ inch diameter. The ring is placed between the stage and the side, and light passes through it upon the object. The end of the rod is placed in the flame of a spirit-lamp. The temperature may be conveniently regulated by a bit of paraffine of known melting point placed upon the slide. For warming slide to stimulate amœboid movements of corpuscles, or the movement of sluggish amœba, this device will be found entirely adequate. For exact studies such simple devices will not suffice, and for these the thermocaustic stage of Dr. Dallinger or Stricker's constant and varying temperature apparatus become necessary.

EDITORIAL.

Meeting of the American Association.—The thirty-sixth annual meeting of the American Association for the Advancement of Science was held at Columbia College, New York city. The meeting was one of the largest ever held, and a very large number of the best scientific men in this country were in attendance. Professor S. P. Langley, of the Smithsonian Institution, was the presiding officer, and Prof. E. S. Morse, of Salem, Mass., the retiring president. The address of Professor Morse was a *résumé* of the contributions of American investigators, more particularly in biological science, to the accumulated evidence in favor of Darwin's theory of the Evolution of Species from pre-existent forms. The address was an interesting one, showing that, during the past ten or twenty years, while students abroad have been so active, Americans have not been idle, but have contributed very many and important facts to the great sum of evidence in favor.

The usual interest was manifested by the members in the meetings in the various sections, but the meetings failed to attract as much attention from the citizens of New York as many members expected them to do. This is perhaps to be explained rather upon the ground of the absence from the city of many who would otherwise have attended rather than to any lack of cordialty on the part of the citizens, who were, in a sense, the hosts of the Association. Perhaps the most interesting paper brought before the Association was the lecture by Prof. G. N. Drummond, the African traveller, who gave an account of his expedition into the interior to the seat of the Livingstone mission. Excursions about New York harbor and to Long Branch and West Point and Bergen Hill, besides others by the Botanical and Entomological Clubs, were taken with great enjoyment. The meeting was one of the largest which has ever been held. It was voted to hold the next meeting at Cleveland, Ohio.

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Change of address.—We desire to call the attention of all those interested to the change of residence of the Editor from Lafayette, Indiana, to Hamline, Minnesota. All communications directed to the latter address will receive prompt attention.

CORRESPONDENCE.

A Correction.

To the Editor:—Owing to some mistake, the latter part of the description of the regulating thermometer, in my article 'An Electrical Constant-Temperature Apparatus,' which appeared in the July number of your Journal, was not clear. After describing the regulating thermometer, made from a glass tube and small vial, and filled with 95% alcohol and mercury, which will keep the temperature to within one-half a degree, it was intended to say that a simpler one, which will keep the temperature to within two degrees, can be made by simply blowing a bulb on a glass tube and filling the bulb and a portion of the tube with mercury alone.

W. C. Borden, M. D. U. S. A.

Fort Douglas, Utah, *August 8, 1887.*

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To the Editor:—A gentleman interested in microscopy lately called my attention to an item in the report of the Microscopical Society of Washington, D. C., in the April number of the *American Monthly Microscopical Journal*, page 77. 'Dr. Schaeffer asked if any of the society had seen Fasoldt's ruling on glass. Prof. Seaman said Fasoldt had done some fine work, but the finest was that done by Prof. Rogers,' &c.

I was not aware that I was recognized as an amateur in mechanics, and that I im-

posed on the world with inferior products; neither has a commission of any exhibition ever rendered such a verdict. Contrary to that, in World, International, and State Exhibitions I was always recognized as master of the masters, which is shown by the following first-class awards:—

Prize Medal of Honor and Diploma of Merit awarded at the Centennial Exposition of 1876. Also, First Prize Medal and Diploma, International Industrial Exhibition, Buffalo, N. Y.

Three First Prize Medals, Utica Mechanics' Association. First Premium Medal, Syracuse Mechanics' Association. Silver Medal and Certificate of Highest Merit of New York State.

Regarding the sentence that I do not publish my method of ruling, I do not want to dictate to other persons what methods to use to accomplish a certain work—in somewhat by showing and illustrating my machine—neither do I want to contradict those who attempt to illustrate how work is or should be done. I claim that everybody has the privilege to construct and make their own microscope, measuring, and illuminating apparatus, ruling machine, and machinery to make those and all other devices that anybody wishes to make for private or general public use, as I have done.

As it is proper for a man to uphold and prove what he has said, or either retract such quotation, I would ask Prof. Seaman to send the following rulings made by Prof. Rogers. All test plates should be ruled in bands, beginning with and running up every 10,000 to the denominations as given below:—

1 plate ruled up to 200,000, or 250,000 lines per inch.
1 " " " " " 120,000 " " "
1 " " " " " 6,000 " " mm.
3 stage mic. ruled 1, 10, 100, 1,000 lines per mm.
3 stage mic. ruled 100, 1,000, 5,000, 10,000 lines per inch.

When I will appoint a committee of four to measure and resolve them. And the Professor can appoint his committee and do likewise with my rulings.

We have numerous times resolved 200,000 and over. I have the facilities to do it with, and measuring likewise.

CHAS. FASOLDT.

ALBANY, N. Y., *July 5, 1887.*

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TO THE EDITOR:—You will take some interest in the fact that a Microscopical Society has at last been started in Calcutta. During the last 150 years we have made great progress here, and from having been a malarious rice-swamp at the commencement of that period, we have become a healthy and prosperous centre of trade and and commerce. We have had an University for over 30 years and have several societies, one of which, the Asiatic Society, is world-wide in its fame; but until the day before yesterday we had no Microscopical Society! It has not been for want of work, for our flora and fauna, and especially the microscopical portion of it, is unexplored. I only hope that interest in the new association will be maintained, and that its members will always work loyally in its interests and not put forth all their strength at the first go-off. I send by this mail a copy of a local paper containing a short notice of our first meeting, and as soon as they are ready will post you a copy of our Rules, etc. Dr. Simpson, our president, is health officer here, and a trained microscopist. I believe he has been in both Koch and Pasteur's laboratories. Our vice-president, Mr. I. Wood-Mason, is a celebrated zoologist out here, and specially strong in entomology and microscopy. We have an F. L. S., and one or two other doctors amongst us, and several members take a lively interest in local bacteriology and botany; so that on the whole I hope the society, which I may venture to call mine, will do good work. I am, dear sir,

Yours truly, W. I. SIMMONS.

CALCUTTA, *June 24,'87.*

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.

The usual fortnightly meeting was held on July 13, with President Wickson in the chair.

Dr. Mouser distributed some slides showing *Bacillus anthracis* in the lung of a guinea

pig. Several of these mounts showed very clearly the tendency of the rods to assume the *Leptothrix* form, especially in the smaller capillaries. The bacilli were exceedingly sharp and clear, the staining having been effectively done with gentian viole and Bismarck brown.

Mr. Wickson showed specimens of *Icerya purchasi* (the cottony cushion scale), and dwelt upon the importance of thoroughly studying out the life history of this insect, which is inflicting such terrible ravages among our citrus fruit trees. He also showed the beautiful eggs of a *Pentatoma* upon an apricot, while Dr. Bates exhibited the eggs, living larva, and perfect insect of a closely allied species of the same genus.

Another interesting specimen shown by Mr. Wickson consisted of a square block cut from the timbers used for bulkheading in the lower levels of the Comstock mines. In order to show by contrast the change wrought by the tremendous and long continued pressure upon these timbers, specimens of the wood used for them (white pine), in a normal state, were also shown. But the effect of the pressure was still more strikingly apparent in a slide which Mr. Wickson had prepared, showing both transverse and longitudinal sections of the compressed and uncompressed woods side by side. In the transverse sections the distortion was most apparent, the large, open sells of the parenchyma being squeezed out of all resemblance to their former appearance, while the effects of the steam and infiltration of hot, ore-bearing waters were seen in a complete change in the color of the wood. In the longitudinal sections it was an interesting fact that the glandular dots, characteristic of coniferous wood, which were finely shown in the uncompressed section, were completely obliterated in the other. Mr. Hanks stated that he had repeatedly made assays of such timbers, and had clearly shown the presence of both gold and silver, thus apparently showing that the deposition of these metals was a process still going on.

Mr. Clark handed in a slide which he had mounted from diatomaceous material collected at Tampa Bay, and cleaned by Dr. Taylor, of Mobile, Ala., who is making a specialty of working up the blue muds of the Gulf coast. The Tampa Bay gathering contains over twenty distinct forms, and is remarkably free from broken frustules.

In rather striking contrast to the above, a fossil diatomaceous deposit was shown by Mr. Hanks, obtained from Hearst's ranch, San Luis Obispo county, Cal. In this deposit nearly every diatom was broken. This was accounted for by the theory that, after the original deposit had been accumulated, it must have been broken up by water in a state of violent agitation, and then redeposited.

A paper on 'Errors likely to occur in Microscopical Observations' was read by Mr. Hanks. He dwelt upon the fact that the same object will sometimes make different impressions upon the eyes of different observers. For instance, the hemispherical 'bosses' upon certain diatoms are persistently seen by some as cup-shaped depressions or concavities. As an exemplification of this fact, he had chosen as his exhibit, at the late reception of the society, a nickel coin shown under a low amplification. A record was kept of a little over two hundred visitors who viewed this coin, and of this number some forty saw the elevated portions of the surface as depressions. After more prolonged examination, about one-half of these persons was enabled to see the coin in its true aspect, still leaving, however, some 10 per cent. of the original number who were unable to see in any way but as depressions the very evidently raised portions of the coin. The paper brought out an interesting discussion of the causes producing this peculiarity.

A. H. Breckenfeld, *Rec. Secr.*

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San Francisco, Cal.

The San Francisco Microscopical Society held its regular semi-monthly meeting on July 27th, at its rooms, 120 Sutter street, President Wickson in the chair.

A sample of a newly found deposit of diatomaceous earth was received from R. E. Wood, of St. Helena, Cal., and was referred for examination and report.

Copies of the memorial of William Ashburner, prepared by the Harvard Club of this city, were received and placed with the society's archives.

Dr. Riehl exhibited a slide under a 1-5-inch dry objective, showing numerous bacilli obtained from the sputum of a consumptive patient. In the preparation of the slide, the generally approved methods of staining had not been followed, but he claimed this had not unfavorably affected the result. In the discussion which followed, and which was generally participated in, Dr. Stallard described the staining methods now most widely used, and which had been found to yield the safest and most satisfactory results.

A slide of anthrax bacilli in the kidney of a guinea-pig was added to the cabinet by Dr. Mouser. He stated that the animal had been inoculated with these bacilli from a pure culture grown in his laboratory. Seventy hours after inoculation the animal died, and its lungs, kidney, and other organs were found crowded with the bacilli in question. In the kidney they were found in the capillaries, very plentifully in the Malpighian tufts, but not at all in the tubules.

President Wickson brought an interesting gathering of fresh-water algæ, in fruit, from Berkeley. It contained a species of *Spirogyra*, which was apparently new, and it was therefore referred to the Secretary for determination.

A specimen of the insect *Pentatoma*, the eggs of which had been shown at a previous meeting, was received from Dr. Gray, of Benicia.

Prof. F. L. Clarke, of Honolulu, was unanimously elected a corresponding member. The gentleman, being present as a visitor, was introduced to the meeting, and, after tendering his thanks for the honor conferred, gave an interesting account of microscopical matters in the Hawaiian Islands. After narrating the career of the microscopica society which once existed there, he stated that he had been commissioned by the King (who, it seems, takes more interest in scientific matters than is generally supposed) to perfect arrangements for the systematic exploration and study of the natural history of the Islands. With this end in view, Professor Clarke announced that he had already established connections with a number of specialists of this country and Europe, for the purpose of furnishing them with specimens of the fauna and flora of the Islands for study and determination. In further pursuance of this plan he said that the San Francisco Microscopical Society would be plentifully supplied with collections of objects suitable for microscopical investigation, and also that it had been selected as an agent for the distribution of such material to societies with similar aims in other parts of the world. The wonderful richness of the Hawaiian cryptogamic flora was alluded to, and the hope expressed that by the opening up of this comparatively unexplored field of study to the scientific workers of the world, results of the highest value would be obtained.

Copies of Gavarret's work on Optics and of Robins' 'Couris d'Histolgie' were donated by Charles C. Riedy. The same gentleman submitted very handsome designs of a monogram and slide label for the society's use. On motion the designs were approved, and Mr. Riedy's offer to prepare the cuts therefrom was accepted with thanks.

After receiving the report of ex-Treasurer Howard, the society adjourned to the 10th prox.

J. H. BRECKENFELD, *Rec. Secy.*

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The regular meeting of the San Francisco Microscopical Society was held in the society's rooms on August 10th, President Wickson and a large number of members being present. In the absence of Secretary Breckenfeld, Dr. C. P. Bates, of Berkeley, acted as Secretary.

Among donations to the cabinet were four slides of tubercular bacilli from Dr. Riehl, of Alameda, stained with different preparations. William Norris presented a recently issued part of Walker & Chase's series of 'New and Rare Diatoms.' Mr. Norris remarked the singular beauty of some of the newly-discovered diatoms. Those shown were from the Barbadoes deposits, a locality which has yielded many finds of foraminifera.

Professor Henry G. Hanks read an interesting paper, illustrated by diagrams, concerning a diamond found in this State. The first diamond, he said, was found by Mr. Lyman, of New England, who saw in 1850, in the new gold mines, a crystal about the size of a small pea. It was slightly straw-colored and had convex faces. From that time to the present these gems have been occasionally found in our State, but never in large numbers nor of unusual size. Professor Hanks said it has been long his opinion that if hydraulic mining had been allowed to continue a system of concentration would have been adopted which would result in a larger production of gold and platinum and in the finding of more diamonds. At the present time we know of the existence of diamonds in five counties in the State, as follows: Amador, Butte, El Dorado, Nevada, and Trinity. It is not unlikely that they may yet be found in California more plentifully than before.

A very beautiful and remarkable diamond has lately come into the possession of J Z. Davis, a member of the Microscopical Society, and this one Professor Hanks submitted for examination. It was found in 1882 at Volcano, Amador county, by A. Schmitz. It weighs 0.361 grammes, or 5.570 grains, equal to 1.571 carats. It is a modified octahedron about three-tenths of an inch in diameter, very nearly if not quite

colorless, perfectly transparent, but not without some trifling inclusions and faults. The form of the crystal is unusual. Professor Hanks has found such a one described or figured in books. The general form, as shown by examination, is that of a regular octahedron, but the faces seem convex. The whole crystal assumes a somewhat spherical form, and the edges of the pyramids are channels instead of planes, but on closer examination it will be seen that the channeled edges, the convex faces, and the solid angles are caused by an apparently secondary building up of the faces of a perfect octahedron, and for the same reason the girdle is not a perfect square, but has a somewhat circular form. These observations were well shown by drawings showing in enlarged form the outlines of the gem. The faces seem to be composed of thin plates overlying each other, and each slightly smaller than the last. These plates are triangular, but the lines forming the triangles are curved, and the edges of the plates themselves are beveled. Mr. Hanks remarked further that it could be seen by the enlarged crystal shown under the microscope and by drawings exhibited that each triangular plate was composed of three smaller triangles, and that all the lines were slightly curved. The building up of plate upon plate causes the channeled edges and the somewhat globular form of this exquisite crystal. The sketches shown were made from the diamond while in the field of the microscope by the aid of the camera-lucida, being enlarged about ten diameters.

A close examination of the crystal revealed tetrahedral impressions as if the corners of minute cubes had been imprinted on the surface of the crystal while in a plastic state. These are the result of the laws of crystallography, as were seen by the faint lines forming a lace-work of tiny triangles on the faces when the stone is placed in a proper light. Professor Hanks concluded with the remark that it would be an act of vandalism to cut the beautiful crystal which is a gem in two senses, and he protested against its ever being defiled by contact with the lapidary's wheel.

The diamond was placed under the microscope and arranged by Professor Hanks to demonstrate the points of his very accurate description. It was a beautiful object and was admired by all present.

Dr. Riehl, of Alameda, gave a demonstration of discovering tubercular bacilli in the sputum of consumptives. He proceeded with the operation of staining, decolorizing, etc., and finally showed the minute germs clearly under the lens. Dr. Riehl made no claim to originality in the method employed, but showed how he handled the material so as to disclose the bacilli quickly for purposes of diagnosis. Discussion ensued as to the value of different methods, Dr. Ferrar and Dr. Mouser maintaining the value of the careful and exact methods of procedure laid down by the German investigators for purposes of exact determination. Dr. Mouser showed a very handsome piece of apparatus called 'Schlessing's Thermo Regular' which he had just received from Germany. It is to be attached to the incubator used in cultures of bacilli, etc., in such a way that the water of the incubator comes in contact with the rubber plate of the regulator and expands it. This expansion of the rubber presses upon the other parts in contact with it and partly closes the pipe, admitting gas to the jets which heat the incubator. The appliance is so delicate that an elevation of one-tenth of a degree in the heat will act upon the gas flame and reduce it.

President Wickson exhibited a specimen of sonorous sand sent to Professor Hilgard by W. G. Thompson, of Pescadero, and referred to him for examination. Mr. Thompson's letter explained that the sand when driven over or walked on, or even disturbed with a stick or with the hand, gives out a distinct musical sound. Perhaps the strangest thing about it is that the persons longest in the vicinity of Pescadero seem not to know of the existence of such a place. It is away from the usual places of resort. The much-talked of 'singing beach' of Manchester, Mass., is only one-fifth of a mile long, while Mr. Thompson has traced this sand at Pescadero along the beach for over a mile and a half. Mr. Wickson remarked that the subject of sonorous sand had been before the society some years ago in connection with specimens sent from the Sandwich Islands and had been studied by Professor Hanks. The society's cabinet contains a slide of the Sandwich Island sand. The Pescadero material would be studied in the light of these facts, comparisons made, and the subject presented at a subsequent meeting. Specimens of the sand were distributed to those present.

J. Z. Davis showed a sample of kelp from the southern coast covered with minute shells of mollusca so that the green kelp seemed almost white. The subject was referred to Dr. H. W. Harkness with the request that he report at a subsequent meeting.

The society then adjourned. C. P. BATES, *Secy. pro tem.*

NOTICES OF BOOKS.

A Course of Elementary Practical Histology. By William Fearnley. MacMillan & Co. New York. 1887. Flexible cloth. (pp. 363; pls. 45).

There are so many text-books on histology that a reviewer is somewhat puzzled when he takes up a new one for examination. They fall into several classes, to wit, those which treat only of very narrow and special topics, *e.g.*, 'Bacteriology,' 'Urinalysis,' etc., subjects which come within the range in a wide meaning of the term. Then there are the histologies which treat of the product particularly. Stricker's 'Manual' or Quain's 'Anatomy' are such; so, also, Foster & Langley's 'Practical Physiology.' Then there is a large number of works of varying length upon histology in which the greatest stress is laid upon the method of treatment and but little on the subject studied, which is to be sought in some such works as those of Quain or Stricker. It has always seemed to us that these latter and others of their class failed of greatest usefulness because, though they described histological structure with the utmost thoroughness and most satisfactorily, they do not tell the reader how he may prepare tissues for himself.

In the work before us the author appears to have attempted to supply the books needed to supplement the descriptive histologies and to have done it in the most satisfactory manner in which it has been done up to the present time. After a large amount of space (pp. 167) devoted to the details of microscopy there follows the best and most novel portion of the book, a set of very practical notes, occupying 40 pages, touching upon the points necessary to receive special attention in preparing material for study. These apply to the easiest mode of securing the material, cautions needful to secure the material in good condition at points where heed might not otherwise be given. Also, they give specific direction as to fluid for hardening, time during which they must remain in hardening fluid, proper washing fluid, recipes for all fluids; in fact, the directions are so clear and minute that we do not see how they can fail to be of very great assistance to the worker.

The second part of the work is occupied by 150 pages of topics, with space beneath for notes on observation. These could, with the addition of specific references to places where the objects referred to are treated at length, have been made much more useful to the student. Thus, on page 287, the true salivary gland, the true mucous gland, and the muco-salivary gland are all three to be cut and studied. A reference to them in the place where they are best treated would have been helpful. Among the formulæ we notice a very brief treatment of dissociation fluids. This process, we are convinced, is one which should receive more attention than it at present does in competition with the method by sections, and yet in nearly all text-books it is but lightly touched upon.

The work throughout is very satisfactory; the writer is a worker and understands the wants of workers, and has given us a valuable addition to the numerous text-books on histology. For its very clear typography, strong paper, flexible covers, and convenient shape, uniform with 'Practical Biology' and 'Practical Physiology,' and many others, the publishers deserve the thanks of all students who will handle the book at all constantly.

Exchanges.

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

Diatoms *Synedra superba in situ* upon alga (*Ceramium rubrum*) in exchange for good mounted slides in animal histology.
HENRY L. OSBORN, Hamline, Minn.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired.
M. A. BOOTH, Longmeadow, Mass.

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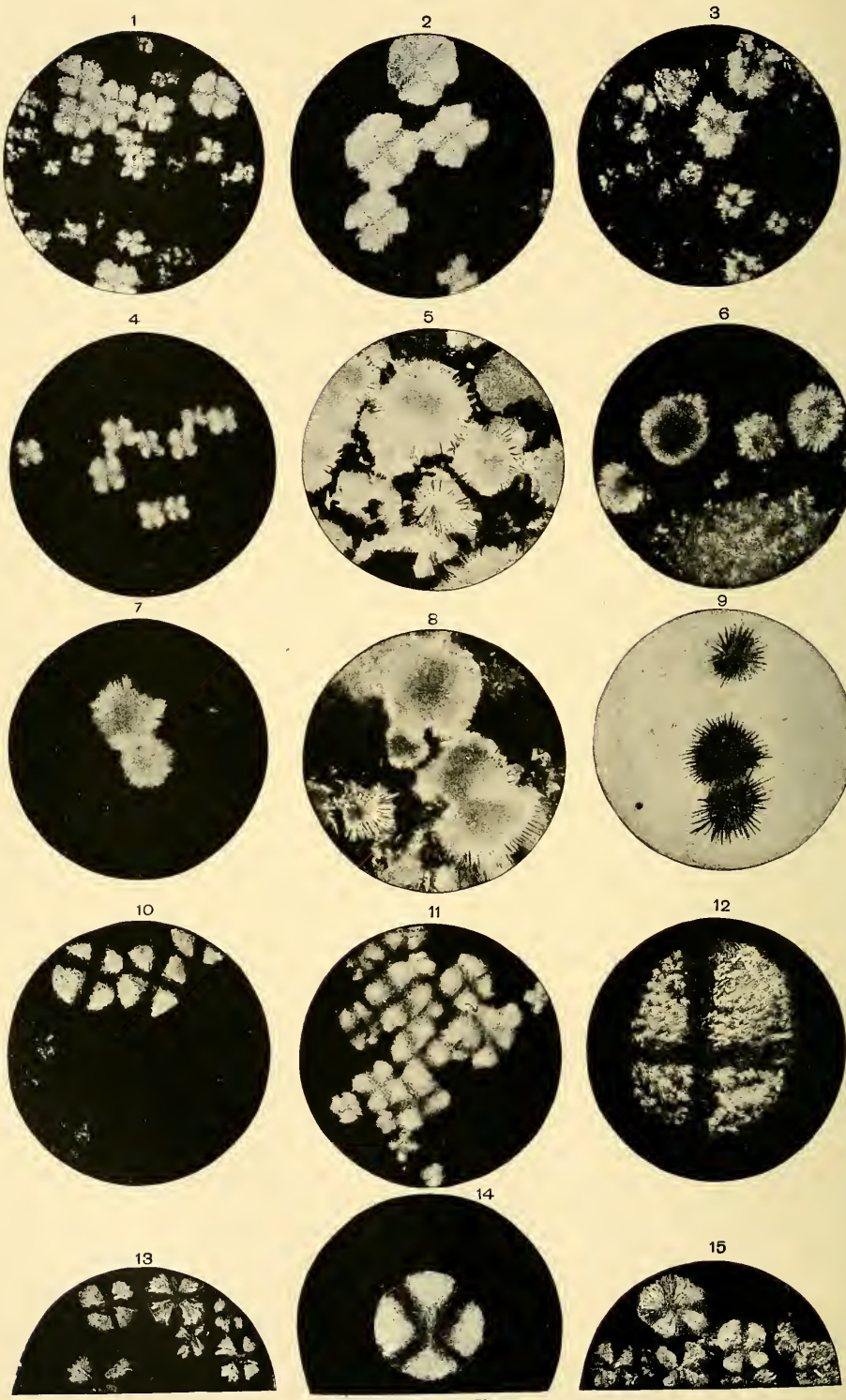
PLATE IV.

CRYSTALLINE FORMATIONS OF "OLEO" & BUTTER.



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Elementary histological studies of the Cray-fish.—VI.

BY HENRY L. OSBORN.

CHAPTER II.—THE 'LIVER.'—(*Continued from page 169.*)

2. **Gross anatomy.**—When the shell of the cray-fish is removed, as directed on page 167, the student will find a number of organs exposed to view. Of these he should find out which one is the 'liver' and make it a subject of special observation as to both its own make-up and its connections, or, as the anatomists say, its 'relation' to other organs. To make this study to the best advantage he should harden the fresh tissues somewhat with alcohol, doing it under close observation, to see that the different organs are not adherent to each other in such way as to obliterate what in the living creature are spaces between them. This can be quite easily accomplished if the hardening is watched under a lens. It will take about twenty minutes' watching to harden the specimen enough to make it possible to study it conveniently.

Examination of the organ called 'the liver' reveals a yellowish-brown mass on either side of the body, the parts on the right and left sides being separated from each other by the stomach and intestine and by the heart and median arteries. The two parts or halves are seen to be alike in shape, so that we can recognize them as a right and left half; structures thus alike, as 'rights' and 'lefts,' are said to be paired. Each part is seen to extend from a point near the front end of the stomach to the hind end of the thorax, or often into the abdomen a greater or less distance. Further examination shows that each half is divided into three lobes: an anterior lobe, which reaches forward; a posterior lobe, which reaches backward; and a median lobe or 'lateral'* lobe, which lies over the anterior and posterior lobes at the break between them. As the 'liver' is examined there can be seen a fine membrane, which, with teasing needles, can be removed from the surface of the lobes upon the ends of the fine tubes of which it is seen to be composed. This membrane is the sack in which the lobe is contained. It is the membrane or capsule of the gland.

Still closer examination of the substance of the liver with a hand-lens will show that it appears to be made up of small tubes, which are blind and free at one end and fastened at the other, and arranged, roughly speaking, radially upon some attachment which is in the centre of the mass of tubes. Looking still more closely and very carefully we can find a sort of stem, which runs from the place where the three lobes of the 'liver' are joined to the organ just behind the transparent part of the stomach and in front of the intestine called the 'pyloric portion of the stomach.' This stem is a hollow tube

* Huxley, The Cray-fish, p. 66.

which conducts between the pyloric stomach and the 'liver,' and is the outlet of the liver, the 'common duct,' or the 'hepatic duct.' This duct may be followed, if sufficient care is exercised, into the lobes, and it is found to branch into three tubes, one of which runs to the anterior lobe, another to the median or lateral lobe, and a third to the posterior lobe. These ducts are lost among the tubes, which will be found to be hollow, and into which they will be seen to open. Examination thus shows the 'liver' to be an organ which consists of three lobes, communicating by ducts with a single common duct on each side, which opens into the pyloric stomach. It also shows that the three lobes do not communicate by ducts with each other, and that there is only one common duct leading away from the 'liver' which leads into the alimentary canal. The most obvious 'relation' of the organ is with the alimentary canal by the 'hepatic duct,' but it is not independent of the other bodily systems, for it is connected with both the nervous system and the blood system; but the connections are too difficult of demonstration to come within the range of our present purpose.

It is because of this relation of the organ to the alimentary canal that it has received the name of 'liver' from most writers, a name which has become so firmly fixed that it will probably be retained, though it is not to be understood that the organ is the equivalent in any sense of the liver, as we know that organ in vertebrates. The organ appears to represent both the liver and the pancreas of vertebrates, so far as its function goes, and the name 'hepato-pancreas' which has been applied to it would be a better name if it had the authority of usage which belongs to the term 'liver.' It is in deference to this usage that I shall continue to call the organ a liver though it is quite as much pancreas, functionally, as liver.

3. **Minute anatomy and histology.**—It would be conducive to clearness if histologists would make a distinction in language between 'minute anatomy' and 'histology,' referring to cell structure and tissue structure under histology, and to finer arrangement of tissue in an organ by the use of the term minute anatomy. The two ideas are quite distinct. We shall proceed to consider the structure of the 'liver' as revealed by the study of sections in both of these lights:—first, the study of the arrangement of the various parts, then the fine cell structure of each part. For the former purpose figure 1 of plate ix must be closely examined; it is a representation of a characteristic cross-section of the posterior lobe of the liver. It is selected because it shows in a single slice more of the features common to most of the sections than any other single section.

On first examination this section is very probably nearly without meaning to an untrained observer of sections; to the practised observer it shows at once, when viewed with the benefit of the knowledge of the organ, derived from a study of its gross anatomy, the plan of structure of this organ, many of the parts of which it is composed and the manner in which they are put together, with perhaps something of the structure of each part. Such a view is obtained with a low power (46 diameters) under the compound microscope. The parts seen in the section (figure 1) are:—

(1.) A thin boundary line (G. m.) which follows the contour of the organ very closely, it is the *capsule of the gland.*

(2.) Star-shaped clear spots (J., I., M., & C.), surrounded by a belt of nucleated cellular matter, which is bounded by a sharp contour line, scattered through most of the space inside the capsule of the gland; these are *cross-sections of the tubules.*

(3.) Other clear spaces (B.) not star-shaped but elongate, and bounded by a belt of cellular matter with nuclei, these spaces in some cases communi-

cating with each other; these are *oblique or longitudinal sections of the tubules.*

(4.) Spaces (bl. c.) in which the tubule sections are imbedded, filled with granular matter and blood corpuscles as in the green gland; these are *blood spaces.*

(5.) A large oval body (H.) not found in all the sections and not a proper portion of the liver; it is an *encysted parasite.*

1. **The capsule of the gland.**—Attentive observation of the margin of the section will reveal in various places the edge of the capsule, the demon-

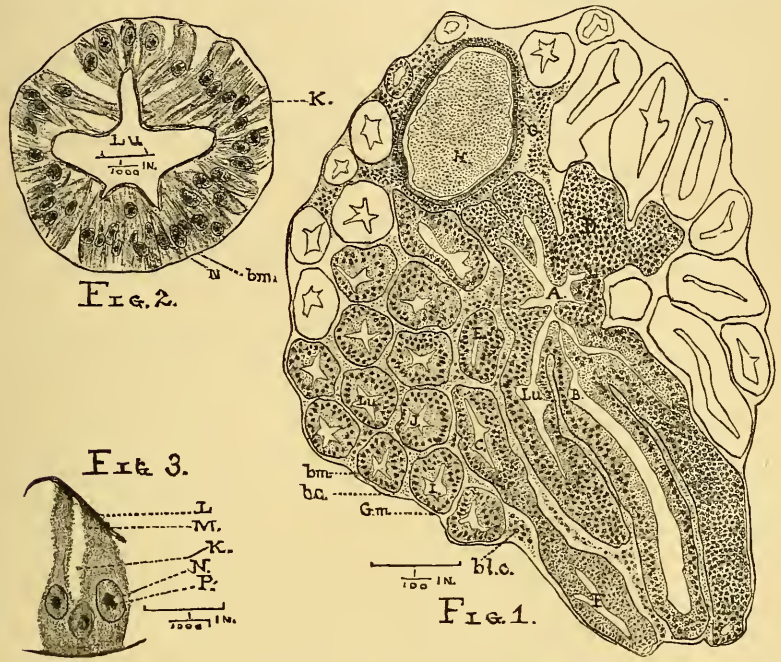

*PLATE IX.—'LIVER' OF *Cambarus immunis.*

stration of whose existence has been made in the preliminary coarse examination of the 'liver.' This edge will, in some places, if the section is a very thin one, be seen merely as a sharp line. It will almost never be traceable around the entire section, never unless the extremest care has been exercised in the preparation of the section, since accidents happening to the margin of the section at any place would destroy it first. But if it is detected in a number of places, and at different places in different sections, as it generally can

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*EXPLANATION OF PLATE IX.—*Reference letters to all the figures.*

A. Main duct of the gland lobe.
b. m. Basement membrane.
b. c. Blood space surrounding the gland tubules.
bl. c. Blood corpuscles.
C. Lumen or ductule of the tubule.
D. Surface view of tubule cells.
E. Lumen of tubule.
F. Lumen of tubule shown at E and C.
G. Sheath or cyst of foreign body.
G.m. General gland, sack, or capsule.
H. Section of foreign body.
I. and J. Lumen of tubules cut across.
K. Space between cells in epithelium.
L. Outer end of epithelium cells.
Ln. Lumen of tubule.
M. Protoplasmic substance of cell.
N. Nucleus of cell of hepatic epithelium.
P. Protoplasmic contents of nucleus.
Figures are drawn with camera lucida.
Fig. 1. Cross-section of posterior lobe with sheathing membrane somewhat diagrammatic; magnified 46 diameters.
Fig. 2. Cross-section of one tubule showing characteristic hepatic epithelium; magnified 240 diameters.
Fig. 3. Two hepatic cells in position, L being at the end toward the lumen; magnified 410 diameters.

be in good sections, enough can be seen to leave no doubt as to its relation to the remainder of the organ. It is thus determined to be a sheath, which invests and holds together the parts within. Such membranous sheaths surround very many of the organs of animal bodies; sometimes threads run in from the sheath or capsule to become twined around the parts inside, but there is no evidence that such is the case in *Cambarus*, unless to a very slight extent. The capsule belongs to a system of tissues in the body whose purpose is to bind together parts too delicate to hold themselves together, and it is called the *supporting system* or the *connective tissue system*.

The fine structure or the cellular structure of the sheath itself cannot be determined from the inspection of perfectly vertical sections; but, since many of the sections in which the capsule shows will not be vertical to it, a more or less perfect surface view of the capsule can at times be obtained and the composition of the capsule determined. But a very much better way to arrive at this result is to especially prepare a bit of the capsule for examination, which may readily be done in the following manner:—Carefully lift off from the surface of an undisturbed portion of the liver of a specimen which has been for some time in alcohol, whether previously preserved with other reagents or not, a portion of the capsule, pulling it about as little as possible. With a pair of fine, very sharp scissors snip out of the disengaged part of the capsule a piece about an eighth of an inch square and transfer it to a watch-glass containing 70% alcohol. From this point it should be manipulated with a section-lifter and with all possible delicacy. Transfer it from the 70 per cent. alcohol to a bath of borax-carmine and leave it for a few minutes; five or ten minutes will probably be long enough.

From the borax-carmine transfer for one minute, or about that time, to washing solution (H. cl., 2 per cent. + 70 per cent. alcohol, 98 per cent.) Transfer to 70 per cent. alcohol, thence to 95 per cent. alcohol, thence to 100 per cent. alcohol, thence to pure turpentine or oil of cloves, thence to slide, and mount in balsam as usual. This course will result in the production of a surface exposure of the bit of capsule ready for examination. Examination with a power of 150 diameters will show the membrane to be dotted throughout its entire extent with nuclei, somewhat evenly dispersed in a single layer, thus allowing one to form a fair inference as to location of the boundary of the cells to which the nuclei belong. But the walls of the cells are so very dim that they cannot generally be seen after this treatment. We must think, then, that the capsule is made by the close juxtaposition of cells in one layer to form an expanded sheet, which may be used to wrap about delicate organs for their protection. In this form it is one of the varieties of connective tissue; some others beside it will be found to occur in the body of *Cambarus*. I may say here that the capsule affords an excellent example of one of a class of structures called by the histologists 'tissues.' A tissue is usually defined as an 'assemblage of similar cells.' It is the feature of a tissue that its cells are similar in both structure and function, and in this capsule we have a good instance of a tissue. The term is often loosely and improperly used with a less definite signification for the substance of which either animals or plants are composed.

2. **The tubules of the gland.**—An examination of the light-colored star-shaped bodies in the gland will soon convince the reflecting observer of the section that these are empty spaces, and that they are of the same nature as elongate bodies, whatever that nature may be. That these spaces are the lumina of the tubules may not at first be manifest, but I think it must become so after a study of their position throughout the section. At A there is seen a central opening with several spaces leading out from it, one of them, B, running down as an elongate space, bounded by a peculiar wall. The wall is bounded on the side farthest from the space by a sharp boundary line which

follows it everywhere. Upon the right side of this body there lies a second, like the first in shape but altogether unlike it in appearance, for the elongate space runs into it and along it part way and then stops, while the boundary substance fills the entire body except at the tip, where a very small space may be seen. On the left of our first body a third one is seen resembling it, but shorter than it, and on its left a third, with two spaces, one at each end, and entirely disconnected from the central space A in the section. These facts, taken in conjunction with our observation of the gross anatomy of the 'liver,' will permit of but one interpretation. The space A is the main duct of the gland lobe; the space B is the duct of one tubule cut along the entire length of the tubule, blind at one end and opening into the main duct at the other, and the other projections from A are other ductules which have been cut across before their end was reached as they passed out of the plane of the section. In some cases the sections are obliquely across or square across the tubules, and in those cases the space is elongate or not, but in either case are entirely surrounded by the boundary substance, which is the glandular epithelium.

The glandular epithelium is sometimes seen in cross-section and sometimes as at E, and in the tubule backing the ductule before mentioned in horizontal section, which gives a surface view.

3. **The blood space** and the contained corpuscles may be seen everywhere dispersed through the section, but everywhere showing the same relation to the lumen of the gland as was observed in the green gland,* namely, the lumen of the duct and the blood space are everywhere separated from each other by the glandular epithelium, and cannot connect except through this wall of cells. The blood spaces, however, surround every tubule, as evidenced by the sections, so that everywhere the tubule is bathed in blood. How does the blood get through the capsule if it completely surrounds the gland lobe? The way in which this entrance of the blood through the capsule and into the spaces is not shown in sections prepared after this manner.

4. **The foreign body.**—It is not by any means infrequent to find in all parts of cray-fish livers small black spots, which are among the tubules. They are readily seen by the naked eye and are larger than the tubules. In sections of the liver one often chances upon these bodies, which are no part of the normal liver, but which do not appear to exercise any malign influence upon the organ. They are seen to be independent of the tubules and imbedded in the body space within the contour of the gland. Neighboring tubules are uninfluenced by them to all appearances. Each such body is surrounded by a thick-walled cyst, and upon this there is to be seen a thick mass of corpuscles investing it. Within the cyst a body is seen which, when treated as these sections were, is a structureless, finely granular, scarcely staining mass, of a character not as yet determined. What its real character is is an interesting question for further study, but need not be answered at present, as it does not directly concern the minute anatomy and histology of the cray-fish's liver.

5. **Summary of minute anatomy.**—We are now prepared to definitely state our idea of the anatomy of the liver of the cray-fish, which we may do somewhat as follows:—It is a paired three-lobed body, made up of numerous tubes, blind at one extremity and opening at the other into a main duct; this in turn opens into a duct in common with two other main ducts, and the principal or common hepatic duct opens into the alimentary canal. We have still to examine into the cellular structure of the hepatic epithelium and to make a comparison between the liver and the green gland.

[*To be continued.*]

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*See above, p. 125.

Notes from Japan.—III.

By ROMYN HITCHCOCK.

SILK REELING AND TEA FIRING.

For two months, since the date of the last contribution from this pen, the writer has been so closely engaged upon the work of the eclipse expedition that he has not been able to write upon, much less to think about, microscopical matters.

A plan had been formed to spend the entire summer in Yezo, among the Ainos, but upon reaching Yokohama he was asked to take charge of the photographic work of the American Eclipse Expedition to Japan, in charge of Prof. D. P. Todd. This afforded an opportunity to make some observations and experiments that had long possessed an interest to him, and the plan for some original work in this connection had already been formed in his mind. But the unexpected invitation came too late to permit of the necessary preparations, hence the additions to knowledge are not so great as they might have been.

The eclipse station was at the town of Shirakawa, about 113 miles north of Tokio. It is an important centre of the silk industry, and a few words about this may not be out of place.

The silk-worms are grown in houses scattered here and there through the village, and fed with mulberry leaves that are brought in from the country in large cylindrical packages, loaded on pack-horses. The season of feeding ends about the middle of August.

The cocoons are spun in large bamboo, or straw, basket-work trays, furnished with ingeniously twisted wraps of straw to afford places of attachment for the cocoons. One of these large trays, with the cocoons attached, will be sent to the National Museum at Washington.

The reeling is done both in private houses and in two large filatures. The hand reeling is done by girls, who are able to earn, when very skilful, what is equivalent to eight cents for a day of eleven hours.

The cocoons are first sorted, and the different qualities set apart. Passing along the streets, great quantities of them may be seen spread on mats in front of the houses, almost dazzling in their snowy whiteness when the sun is bright. In this way the chrysalis is killed by the heat of the sun. They are then gathered in neat bamboo baskets, which are the cocoon measures. The unit is the *sho*. One *sho* is equal to 1.804 litres, or 0.397 of a gallon.

One girl will reel, by hand-reel, about three *sho* of cocoons in one day, from which she will get ten *momme* of thread (1 momme = 3.757 grammes = 0.1325 ounce). I believe this information to be correct, although it is extremely difficult to get accurate information of this kind from the Japanese. Apparently they do not know just what the average product of their labor is, and the most conflicting statements are given by different individuals doing the same work. There seems to be no intention to deceive; but a Japanese always has an answer ready, and sometimes it requires to be verified. As an indication of this, I was told at the filature that 12 *momme* are produced from 1 *sho* of cocoons. The discrepancies are serious, but at present, pending further investigation of the subject, I am inclined to believe that the former statement is true for ordinary hand reeling. One hundred momme of hand-reeled silk, of first quality, known as *ki-ito* (fresh thread), is worth $3.00. Such thread is made up of six fibres running together from as many cocoons.

The operations of reeling are very simple, but require great skill and experience. The girl sits, Japanese fashion, beside the reel, and turning the

crank with her left hand she uses her right to keep the cocoons in action. Occasionally one of the six minute filaments will break. She sees it instantly. The reel stops, a thread from another cocoon is caught and dexterously attached, when the work goes on. The operations will be fully illustrated in the National Museum, a complete set of the apparatus used having been secured—all but the girl.

The ordinary product of the Japanese hand-loom is quite inferior to the factory or filature silk, which, being reeled by machinery run by water or steam power, under the careful superintendence of experienced men, is more even and perfect. In the filatures a single operator produces from 60 to 80 momme of reeled silk in one day. The highest rate of wages there paid is about 15 cents per day, and this is for skilled female labor.

The microscopist will now understand the complex structure of a silk thread such as is used in weaving. First we have the five or six exceedingly fine filaments which run together and become immediately united to form the single thread of reeled or raw silk, then come the several operations of doubling and twisting to make the thread used in weaving, and the still coarser thread for sewing. It will be of interest to remember that five cocoons run into one thread together made a thread 3,280 feet in length. This is the length of silk spun by a single worm in making its cocoon.

One of the last excursions made before leaving Osaka was to a celebrated tea producing district known as Uji, where some of the best Japanese tea is grown. Uji is not far from Kioto, from which city our party started in Juirikishas early one morning in June. The best tea of the season had been picked, but the second crop was coming on, and it was our purpose to observe all the operations of picking and firing as conducted by the Japanese. It may not be generally known that the tea prepared by the Japanese, and universally used by them, has to be redried, and otherwise treated, before it can be sent abroad.

The leaves are picked from the tops of plants, which may be fifty, or, perhaps, a hundred years old; only the tender, green tufts being used. These are carried in large baskets to the firing place, where they are first steamed for a moment, and immediately carried to the firing trays. These are made of paper, about four feet long by three in width, and five inches deep, set over a smouldering fire of straw. About five pounds of green leaves are worked in one tray. The workman, having no regard to the prevailing ideas of propriety in the West, wears only such clothing as the present laws of Japan require (and that is not much), and for half an hour he stirs and brushes about and rolls the leaves with his hands, and gets about 12 cents a day for it.

The leaves having thus become heated through, quite limp, and somewhat dried, are then given to another man, who manipulates them in the same way, but as this man is paid 40 cents per day it is clear that there must be some peculiar knack about the work, for that is high wages in Japan. This man works one hour, and the leaves are then dry, neatly twisted, and ready to be cleaned and sent to market.

The operations of the manufacture I have watched in detail, and therefore I know whereof I speak. The particulars are of no consequence here, as the brief outline above given will suffice for what the microscopist needs to know. But it is proper to say that in getting verbal accounts of the operations from men engaged in the business (not the firers or laborers), I was given such confusing and contradictory statements that I was forced to discard them entirely. For example, the first story was that the tea was fired in four successive trays by as many different men. Then it was four trays and one man. Then somebody else said three men, with a well-graded scale of wages. The

upshot of it all was that I did not believe a word that was told about it, but relied entirely upon what I could see; and I do not quite believe that 13-cent and 40-cent wages' story either, but must await future opportunities to learn the truth.

The tea thus prepared is used by the Japanese. The usual price paid for native tea is about 40 sen per pound, and a very good tea can be bought at that price. The best native tea brings $7 or $8 per pound. It is prepared from choice varieties of the tea plant, cultivated with especial care; but the processes of drying are the same as for common tea. It is a rare product.

As already stated, the native tea requires further drying to fit it for transportation. This is done by the foreign dealers, who buy the native dried tea and prepare it for shipment in large go-downs at Yokohama and Kobe. The work is all done by hand, except in one establishment at Yokohama, where machinery is in successful operation. It is nothing more than a process of drying, in pans or in baskets, skilfully conducted by Japanese laborers, men and women working together. If coloring matter is used it is added during the firing, and not only improves the appearance of the tea, but it is said to aid in preserving its quality. In any case the quantity added is too small to be harmful, even if the materials used were not in themselves inert substances, such as soapstone, indigo, and occasionally a little graphite.

It will be observed that the operations in the preparation of Japan tea are much simpler than those described in China. The Chinese prepare their tea ready for shipment abroad, and the foreigners in the China tea business do nothing but buy and sell, having no occasion to remanufacture it.

It was a great disappointment not to be able to collect more from the pools this summer, but the work at Shirakawa was too pressing to be neglected, and the few specimens found have not yet been examined.

YOKOHAMA, *Sept. 6th, 1887.*

The Ninth International Medical Congress.

BY E. A. BALLOCH,

WASHINGTON, D. C.

Viewed from a microscopical standpoint, the Ninth International Medical Congress was barren of results. There were few papers bearing upon microscopy directly, but in all the sections the importance of the microscope as a diagnostic instrument was accepted without question and its employment regarded as a matter of course.

Perhaps the most interesting paper was the one by Prof. Mariano Semmola, of Naples, entitled The Experimental Method in Scientific Medicine and its Relations to Bacteriology.

His argument was that the experimental was the true method in medicine, and that it had for its object the determination of the phenomena of nature and their causes. The physician should obey nature and not command her. In biology, and especially in the progress of pathology and therapeutics, this fundamental principle is very often forgotten, and this is the true cause which has paralyzed till now the useful results of the immense mass of researches made in the field of medical science.

At the present time medicine continues to be the victim of system, and the system of to-day is bacteriology. Men of genius, like Brieger, Klebs, Sternberg, and others, have stated the limits to be fixed to this new era of pathology, but mediocrity overwhelms all and conquers the masses and inspires the unthinking. The only reason which has permitted the domination of this system is the complete forgetfulness of the laws of the experimental method

in the progress of medicine. The idea of living germs, which penetrate the human organism, is not new. The speaker then sketched the rise of the bacterial theory, and said it should have inspired observers with caution, but that instead of that micro-biology aspired to become itself pathology.

It was a whirlwind, enveloping all, and at the side of precious discoveries like those of the bacillus of anthrax, of tuberculosis, and some others which are an honor to science, came forth from every part microscopical researches on the existence of new microbes in all diseases, and every sickness seemed to have found its germ, destined perhaps to die before being registered. One could scarcely open a paper without seeing the announcement of the discovery of one or more new pathogenic microbes. Pathology has come to be proclaimed almost the same as bacteriology. Bacteriology has gone beyond its premises, and is an unworthy invasion in the field of evolution. The claims of Klebs to discriminate between a poisonous germ and a large family of non-poisonous germs seems unproven. In disease, when several microbes are present, we cannot discover which is the fatal one. Plants are edible in proportion to the cultivation and soil, not differing morphologically from their poisonous fellows, and if an analogous condition holds good with microbes, the reasoning of the bacteriological method is false.

Who has seen diphtheria or malaria, or any other disease, in which it was *proven* that the disease depended upon the microbe?

He did not see in modern methods of bacteriological research the true experimental method. Diseases are produced by inoculation; but are these morbid processes dependent upon the germ or upon the soil in which it was implanted? Demonstration by this method fails, and in the majority of cases common good sense pronounces against the attempted proof.

The true part played by bacteria in pathology is the production by them of certain noxious elements in the blood, which substances, and not the bacteria, are the potent factors in the causation of disease. The dictum of modern therapeutics is that remedies are given to destroy germs. The speaker then went on to refute this dictum, and closed by an eloquent appeal to American observers to follow closely the experimental method, since it was not only the method of science but of their government, and recalled to them Virchow's remark that 'Science is unproductive when it has no national character.'

Among most of the essayists, however, the bacterial theory had a strong foothold. One speaker even presented the fourth and fifth cultures of a bacterum from a uterine myoma. He did this modestly, however. Pasteur and his theories received a somewhat rough handling at the hands of Dr. Whitmarsh, of England, who called attention to errors in his processes and conclusions, and thought it by no means certain that rabies was due to the microbe to which it is assigned by Pasteur. He asserted that, in several cases, death has followed inoculations by Pasteur in which the symptoms clearly showed that death was due to the inoculations and not to rabies, and thought we were in danger of a new disease—Pasteurphobia.

Dr. Domingo Freire, of Rio Janeiro, forwarded a paper, which was read by Dr. Le Mounier, of New Orleans, in which the author narrated his experiments on the inoculation of yellow fever. The microbe, he said, is an infinitesimally small vegetable organism found in the blood as well as the secretions of yellow-fever patients. In the concluding portion of his paper the author gave his results. He claimed that vaccinations had been made during a severe epidemic of the disease, in the worst quarter of the city, among persons mostly foreigners, and therefore were susceptible to the disease, and living in a condition of almost inconceivable wretchedness. The results had been that, with almost no exceptions, those vaccinated had escaped the disease, though exposed to it, while the unvaccinated died in great numbers.

Among the other papers were the following :—The *Bacillus Malariæ* and the Means of Protecting the Human Race from Malaria, by Tomasi-Crudelli, of Rome ; A New Method for the Certain Detection of *T. spiralis* in Meat, by Dr. James A. Close, of Summerfield, Ills. ; The Crystallography of Fats, by Dr. Thomas Taylor, of Washington, D. C. ; Experimental Researches Concerning the Infectious Nature of Traumatic Tetanus, by Dr. E. O. Shakespeare, of Phila., Penn. ; Experiments on the Preventive Inoculation of Rattlesnake Venom, by Prof. Henry Sewall ; The Production of Immunity by the Hypodermic Injection of Sterilized Cultures, by Dr. D. E. Salmon, of Washington, D. C. ; Histological Alterations Following Amputations in the Peripheral Nerves, the Spinal Ganglia, and the Marrow, by Dr. E. A. Horner, of Finland ; and, The Basal Ganglia of the Brain as Psychic Centres, by Dr. Daniel Clark, of Toronto, Canada.

The largest collection of slides was that of Mr. Reynolds, of Detroit. Mr. Heines, of Chicago, showed his freezing microtome, which, while very efficient, seems too bulky and cumbersome for general use.

Bausch and Lomb and Queen & Co. had large exhibitions of instruments, but one looked in vain for samples of the work of foreign makers with which to compare the work of our own manufacturers. The exhibit of McIntosh, of Chicago, was also noteworthy.

The sections were well attended, and much work of scientific value was done ; but, owing to the absence of the best men, both of our own and foreign countries, it must be confessed that the Congress did not rise to the level of some of its predecessors. It cannot be doubted, however, that American medicine directly, and American science indirectly, have received a strong impetus from the Congress.

The crystallography of butter and other fats.—III.

By Dr. THOMAS TAYLOR,

U. S. AGRICULTURAL DEPARTMENT, WASHINGTON, D. C.

EXPLANATION OF PLATE IV.

Figs. 1, 2, 4, and 11. Crystals of boiled oleo (Armour). × 70 to 140.

Figs. 3, 5, 6, 7, 8, and 9. Crystals of boiled oleo in process of decay. Such forms are frequently observed in oleomargarine. × 140.

Fig. 10. The butter crystal as photographed by Detmers.

Fig. 12. A crystal of oleo and lard made by Prof. Weber, which, he says, cannot be distinguished from that of pure butter. (See figs. 10 and 14).

Figs. 13 and 15. Crystals of boiled butterine as prepared by Prof. Weber and photographed by Prof. Detmers, representing the butter crystal according to Prof. Weber.

Fig. 14. The true butter crystal, photographed by the late Dr. Bernard Persh. Compare the above plate with the transition stages of butter crystals, Plate I.

Cover-glass preparations in bacteriological investigations.

By FERDINAND HUEPPE.*

After it was discovered that the morphological elements in the blood dried in a thin layer were not materially altered by drying, Koch (1877) first em-

* From 'Methods of Bacteriological Investigation,' by F. Hueppe ; translated by H. M. Biggs, M. D. New York. D. Appleton & Co. See this Journal, Vol. VI, p. 220.

ployed these casual observations methodically in bacteria investigation. He spread out upon a cover-glass in a very thin layer a drop of fluid containing bacteria, so that the individual elements were brought very nearly in the same plane. This thin layer was then fused by simply drying in the air. In order to eliminate the slight alteration produced by this it is necessary afterward to cause again a swelling up of the bacteria. If the layer which has been dried in the air remains too long in the water or glycerin used for this purpose it is entirely dissolved, instead of only partially swelling.

If the cover-glass with the dried layer is laid in absolute alcohol, or a one-half per cent. solution of chromic acid, the layer is rendered insoluble in water and glycerin and no longer swells up. But if the layer which has been made insoluble is put into potassium acetate it swells up sufficiently without being entirely dissolved, and all forms seem to be in a natural condition. The solutions of the analin dye have the same action and cause the same swelling without removing the layer, and at the same time stain the bacteria.

In the use of this method in the investigation of the blood, Ehrlich found that the rapid drying prevented coagulation of the cell-albumens and retained the natural staining capacity of the elements. Only the hæmoglobin was extracted by aqueous and glycerin solutions of the dyes. But if the preparations were kept for a few hours at a temperature of 115°–120° C., the elements of the blood, without any important alteration and without the appearance of artificial products, retained their elective affinities for dyes. In following up these observations Koch (1881) discovered that in place of the fixation by alcohol the application of heat for only a few minutes answered the same purpose.

A drop of the fluid containing bacteria, either undiluted or after the addition of a drop of distilled water (according to the amount of its morphological elements), is spread out in a thin layer upon the cover-glass by means of the point of a scalpel or platinum wire, and the excess of fluid soaked up with filter-paper; or a drop on one cover-glass, and a second is applied to this, which through its pressure spreads out the drop in an even layer. If, then, the two cover-glasses are drawn apart with pincettes we have two similar preparations. The cover-glasses, protected from dust, are allowed to remain until completely dry, or they can be dried in a dry oven somewhat more rapidly. The drying can also be hastened by holding the cover-glass with the prepared side upward high above the gas flame, and moving it to and fro to prevent the direct action of the flame.

Upon the dried preparation a drop of the staining solution can then be placed to stain the elements, but only in case the fluid is free from albumen and the staining follows quickly, since by the prolonged action of the staining solution the layer is completely loosened. If the dried layer consisted of an albuminous substance, such as blood, tissue fluids, or sputa, on the addition of the staining solution precipitation occurs.

On this account it is especially necessary that the preparation, after drying in the air, should be more securely fixed by heating. For this purpose the cover-glass may be placed in a drying-box, or upon a copper plate. The copper plate is laid upon a tripod, and one end is heated by a gas flame, so that the different portions, at different portions, at different distances from the flame have varying degrees of temperature. A few minutes exposure to a temperature of 125° C., or ten or twenty minutes at 110° C., is sufficient to thoroughly dry bacteria preparations. This may be done more conveniently, and in some cases also with certainty, according to Koch-Loefflers, if the cover-glasses with the dried layer are drawn rather rapidly three times through a gas or spirit flame.

The reason for heating in exactly this manner, according to Koch (1884),

is this:—because in preparations which have not been heated the above-described precipitation occurs, while in preparations which have been passed through the flame only once or twice, the fixation of the elements, especially in those containing much albumen, is not sufficient for all cases. In those forms passed through the flame three times, while the forms themselves are not materially altered, the capacity for staining is retained, and the albuminoid material has become so insoluble that precipitation no longer takes place. Passing the preparations through the flame a yet greater number of times destroys the susceptibility of the bacteria to the staining fluid.

The want of success in making preparations, which many beginners experience, seems to be generally due to the fact that the preparations are generally heated before they have completely dried in the air. If the preparation still contains any water, coagulation of the albuminoid material occurs when heated, while in those completely free from water this does not happen, and the albumen is rendered homogeneous by heating.

The preparations dried in air, and then drawn three times through the flame, are now stained. The cover-glasses, with the prepared side upward, are laid on a piece of filter-paper, and, by means of a glass rod, a cap pipette, or the glass-stopper, with the capillary tube, a few drops of a staining solution are placed upon the preparation. The staining fluid should remain about twenty minutes, or until it is seen by an inclination of the cover-glass that the preparation has already taken up the color. If the action of the staining solution ought to be prolonged, then it should not be placed, drop by drop, on the cover-glass, because, in drying, the staining solution forms a ring of color at the edge which it is difficult to remove. In this case a sufficient quantity of the staining solution is placed in a watch-glass, or crystalization-glass, and the cover-glass is then taken, with the prepared side downward, between the thumb and index, or middle, finger, and allowed to fall flat upon the surface of the staining solution, so that it swims with the prepared side upon the surface of the fluid. To prevent evaporation, the disk is covered with a glass plate.

For the removal of the excess of coloring matter, a stream from a wash-bottle is thrown obliquely from above upon the cover-glass, taking care not to strike the surface of the preparation directly; or the cover-glass, held in pincettes, is moved to and fro in a beaker filled with distilled water; or the excess of the fluid may be soaked up with filter-paper, a few drops of water added to be soaked up anew, and so on until none of the coloring matter is given up to the filter-paper. Then the cover-glass preparation is examined in a drop of distilled water.

The upper side of the cover-glass is freed from every particle of water by soaking it up with filter-paper, because on it must be placed a drop of oil for the homogeneous immersion lens.

If the cover-glass preparations are to be preserved, the oil is removed with filter-paper, and chloroform, the water by careful warming or evaporation (protected from dust), and the dried preparation is directly imbedded in Canada balsam.

Different dyes are used for each variety of bacteria, since some stain only the bacteria; others, at the same time, the fine gelatinous sheath; others, the capsule. On this account the corresponding pictures in all the methods of staining are not absolutely similar; so that it ought to be self-evident that always, and in comparison, only preparations should be used which have been treated in exactly the same manner. These considerations must guide one in the choice of a staining solution. We must therefore distinguish between staining for a special purpose, *i. e.*, for the establishment or employment of coloring methods which have been described, or proved to be best, in partic-

ular cases, and the investigation staining used especially to prove the presence of bacteria.

Since in cover-glass preparations almost all bacteria can be stained by watery solutions of the basic anilin dyes, saturated watery solutions, or the equally valuable alcoholic solutions, are first employed. The saturated watery solutions have for this testing an advantage, becaus all basic anilin dyes are known to be applicable, so, with a few preparations, the different colors can be tried.

If no bacteria come to view in this way, notwithstanding their supposed presence, then anilin water, with methyl violet or fuchsin, is used, or the stronger alkaline solution of methyl blue.* The trial examination as to the presence of bacteria resolves itself, in the larger number of cases, into the following procedure :—

1. Drying in a thin layer.
2. Fixation by passing the cover-glass three times through the flame.
3. Staining by placing a few drops of a watery or dilute alcoholic solution of a basic anilin dye upon the preparation.
4. Removal of the excess of the coloring-matter by washing or soaking up with filter-paper.
5. Examination in a drop of distilled water.

For the isolated staining of bacteria in cover-glass preparations they can be laid for about one minute in a half-saturated solution of potassium carbonate, or, if they are stained in anilin-water gentian-violet, the remaining elements can be decolorized according to the method of Gram. The stained cover-glass preparations are, for this purpose, laid for about one minute in a solution of potassium iodine (iodine 1 part + potass. iodid. 2 parts + water 100 parts) and then placed in absolute alcohol until they appear decolorized. The alcohol is soaked out and the preparations examined in water.

For double-staining the cover-glass preparations, after decolorizing according to the Gram method, they can be taken from the alcohol and placed in a weak watery solution of vesuvin. Then the bacteria remain blue, often almost blue-black, while the nuclei are stained brown. The preparations stained red or blue can also afterward be stained with carmine or hæmatoxylin, yet this double-staining has much less value in the cover-glass preparations than in sections.

EXAMINATION FOR TUBERCLE BACILLI IN SPUTUM.

These preparations can be stained according to the Gram method; but by this both the tubercle bacilli and other bacteria are stained blue in contrast with the brown nuclei. For the differential diagnosis this is not sufficient, and for this purpose the principle established by Koch must be exclusively observed, *i. e.*, that the tubercle bacilli should be stained in a different color from other bacteria and the nuclei. Koch succeeded in doing this in preparations stained for twenty-four hours in a weak solution of methyl-blue, and then placed for a short time in a watery solution of vesuvine. In this way the tubercle bacilli (and the bacilli of leprosy) are stained blue; all other bacteria and nuclei brown. After this important principle was discovered, Ehrlich showed that anilin-water† was a still better method for increasing the intensity of the color, and that in the preparations stained with analin water the tubercle bacilli withstood decolorization by nitric acid, while all other bacteria were decolorized by this mineral acid. But the preparations cannot be left so long in the acid that complete decolorization occurs, because then also many

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* Concentrated alcoholic solution methyl blue . . . . . 30 c.c.
Solution caustic potash, 1 to 1,000, ... 100 c.c.

† Pure anilin oil in excess (about 5 c.c. of oil and 100 c.c. water) is shaken with distilled water for one-half to one minute. Then, after allowing it to stand five minutes, the mixture is filtered. The filtrate must be perfectly clear, and serves in place of water as a menstruum. It is very unstable, and should be prepared fresh each time.

or all of the tubercle bacilli are decolorized. They should remain in the acid until the red (fuchsin) or blue (methyl violet) hue has changed into a yellowish red or greenish blue. At this stage the preparations are placed in water, and again a red or blue color appears. By the action of the acid the simple acid union (red or blue) is changed to a triple acid (yellow-red or blue-green), and, by the addition of the water, the triple acid union is destroyed and the red or blue hue reappears. The preparations decolorized by the acid are not washed in water, but in 50 or 60 per cent. alcohol; then they are stained in a dilute solution of methyl blue (or vesuvin). After washing away the methyl blue (or vesuvin) the preparations are examined in water, or, after removal of the water, preserved in Canada balsam.

After this whole procedure the tubercle bacilli retain their red or blue color, and are easily recognized among the other elements. Aside from this differential diagnostic action of the double-staining, the subsequent staining in another color has an advantage by affording an easier examination of the specimens.

Concerning the choice of material containing bacteria, it is to be noted that the cheesy masses are to be spread out thin with a sterilized scalpel. Nodules of tubercle must be crushed with a scalpel, or between two scalpels, and then be pressed flat upon the cover-glass. The tough yellowish masses from the sputum are used. One of these particles is taken and spread out in a thin layer on the cover-glass, or flattened by pressing one cover-glass upon another, so that, after separating the two cover-glasses with pincettes, two preparations are obtained. The entire method is, according to Koch (after the adoption of the anilin-water staining of Ehrlich), briefly, as follows:—

1. Pass the dried cover-glass preparations three times through the flame.
2. Stain with Weigert-Koch* solution of methyl violet or fuchsin for twelve hours.
3. Treat with dilute nitric acid (1 to 3 or 4) for a few seconds.
4. Wash in a 60-per cent. solution of alcohol by a to-and-fro motion.
5. Stain in a dilute solution of a vesuvin or methyl blue.
6. Wash and examine in water or mount in balsam.

This method is the best thus far discovered, and serves as a control in all doubtful cases.

MICROSCOPICAL TECHNIQUE

Notes on staining vegetable tissues.

By W. R. LIGHTON,
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Those who are at the beginning of the study of microscopic science are not unfamiliar with the beauties of stained and double-stained organic tissues, and yet there are probably few who have watched this staining process while going on in the tissues of living plants. The following is a simple way in which one can follow the process and get a clear insight into the principles of circulation.

If a fresh green stem is cut from a plant and the newly-cut end be placed in a solution of any of the substances commonly used for staining, this coloring matter will gradually be absorbed in the process of circulation and be distributed through the tissues. Select a plant with the leaves sufficiently

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* Saturated anilin water . . . . . 100 c.c.
Concentrated alcoholic solution, methyl violet or fuchsin . . 11 c.c.
Absolute alcohol . . . . . 10 c.c.
This solution cannot be kept more than ten or twelve days without losing its coloring power.

translucent to admit of examination by transmitted light under low powers. Cut off a small branch and place the end of the stem in a bottle or other vessel containing the coloring solution. Place the vessel conveniently near the microscope, so that one of the leaves of the cutting may be laid out over the stage, as is done with the foot of a frog in the examination of its circulation. Then watch the absorption of the coloring matter as it passes from cell to cell.

In selecting specimens for use in this experiment the newest shoots will be found most satisfactory, because the absorption of the coloring matter is more rapid and, consequently, more easily watched. As the preparation is not a permanent one, it is unnecessary to give it the careful preliminary treatment required in mounting.

Some coloring matters are more readily absorbed by the living plant than others. The various coal-tar derivatives are taken up very slowly, and so is the ordinary carmine and cochineal if simply dissolved in water. The most satisfactory, simply because they are the most rapid, are the colored writing *fluids* of commerce, more especially the scarlet and purple. With some of these the leaf is thoroughly stained in the course of fifteen minutes, making a beautiful object even to the naked eye.

The study need not be confined to leaves, as the flowers may also be subjected to the same operation and the mode of circulation be observed even in the organs of reproduction. In the leaves the stronger and more prominent veins do not take up the color readily while the plant is living, but the finer veins and cellular tissue are readily colored.

These coloring fluids may be injected into the stem of the rooted plant, but greater care and patience are necessary than by the method of cuttings.

Hereafter will be described some of the results obtained by this method of studying circulation, more particularly in the vital organs of various plants.

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The Cell Question.—Prof. Schafer took the lead in a discussion at the British Association upon 'The Present Aspect of the Cell Question.' He said the typical cell is a protoplasmic body surrounded by a net-like substance, with a central nucleus. Contrary to the view taken by many observers, he held that the essential part of the cell was not the reticular substance, but that which was contained within it, which was really the protoplasm of the cell, the substance upon which what was used to be known as the vital functions depended. In support of this view he referred to the amœba, which presented, he believed, no reticular structure, and, in a more important sense, to the white corpuscles in the blood. These corpuscles, viewed under a higher power of the microscope, presented the reticular structure, but the movements of the corpuscles were produced, not by this substance, but by the contained protoplasm, which was extended in pseudopodia-like processes. Prof. A. Weissman read a paper on 'Polar Bodies' as a contribution to the discussion. He said that the polar globules might be regarded as insignificant rudimentary organs as long as they were only known in a few groups of the animal kingdom. But as their existence was now proved in nearly all classes of animals, and as they appeared in all of them in the same manner, they were compelled to assume that they possessed at least some physiological significance. Prof. Lankester drew attention to a statement made by the president of the Association in his opening address. Sir Henry Roscoe had stated that protoplasm was not a chemical substance, but a structure. Although this statement must shock the susceptibilities of many biologists, he (Prof. Lankester) had no hesitation in saying that it was perfectly correct. The term 'protoplasm' was originally applied by Von Mohl to the whole of the slimy structure within the vegetable cell wall. But nowadays biologists were more

and more limiting the term 'protoplasm,' and applying the term 'true protoplasm' to the chemical substance of highest elaboration, which is the important living part of Von Mohl's protoplasm. Prof. Lankester suggested that the term 'plasmogen' should be used for this chemical substance, so as to avoid misunderstanding. With regard to the structure of protoplasm, he held that it was vesicular, the reticulum or walls of the vesicles being the part of the protoplasm in which the plasmogen resides, which is not contained in vesicular spaces. The plasmogen was probably most abundant in the nucleus, and the idioplasm and germ-plasm of Prof. Weissman were varieties of the plasmogen. Prof. Marshall Ward agreed with Prof. Lankester as to the necessity of a new word. They ought to seek for names for those parts into which they were breaking up protoplasm anatomically. They must remember that it was a step forward in itself to have brought before them clearly defined ideas as to the substances or structures contained in protoplasm.—*Eng. Mech., Sep.* 2, '87.

EDITORIAL.

The address of Professor Rogers, of Colby University, at the recent annual meeting of the American Society of Microscopists, is an interesting article upon the microscope as an instrument of exact physical research. The prelude to his paper upon microscopy as a science contains many very sensible remarks, calling attention to the fact that the microscope has found its application as an instrument of exact research in very many directions. 'The limitations which necessarily belong to a definition of physical science are clearly expressed by Tate in his most admirable treatise on heat. He says:—"Nothing can be learned as to the physical world save by observation and experiment, *or by mathematical deductions from data so obtained.*" Now the microscope as an instrument of research stands unrivalled, not only in respect to the precision of the observations made with its aid, but also in the universality of its application in furnishing what Tate calls "the data so obtained."

'Each succeeding year witnesses an extension of the range of its applications. Within a few years, while retaining its claim as an essential factor in scientific research, it has also become a very material aid in many mechanical industries. It is a common impression that the microscope is too delicate an instrument to be used in the ordinary operations of mechanical construction, and that the apparent necessity of using transmitted light for the purpose of illumination is an absolute barrier to any extended employment of the instrument. The latter difficulty is entirely obviated by the use of the opaque illuminator invented by Tolles, by which a bright metal surface can be examined with the utmost ease, while actual experience has shown that it is by no means necessary that the instrument should be mounted upon massive piers insulated from surrounding objects.'

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This defense of the claim of microscopy to the title of a science does not seem to us to be especially valuable, because there seems to be no dispute as to the facts and claims in the case except as to a matter of nomenclature. Microscopy as a science means, according to Prof. Rogers, that there has been a vast accumulation of knowledge regarding physical nature, made by the use of the microscope, which he would call the 'science of microscopy.' Part of this we are prepared to fully corroborate, and are heartily interested in noting every new application of the instrument and every improve-

ment of its capabilities. And further than this, we may go and speak in the warmest commendation of the able manner in which the author proceeds in the latter portion of his article to show the special appreciation of the microscope ' in determining a constant in nature.'

And yet we would beg leave to call attention to the fact that sciences are not named in reference to the instruments employed in their study, but with reference to the objects studied, and that the mass of facts collected by the aid of the microscope as an instrument cannot with any beneficial result be treated as a single science, or, if we follow the analogy of nomenclature in vogue for the other sciences, given the name microscopy. We might term the scientific study of the branch of optics which treats especially of the microscope as its subject-matter microscopy if we cared to do so, but we should depart from the usages of nomenclature to term such a heterogeneous mass as the biology, mineralogy, pathology, etc., etc., which is pursued with the microscope, by a name, supposing it to stand for one department of natural science.

Now, no one would attempt to make the name have any such meaning. The science of biology would never be understood to leave off and microscopy begin, or petrography leave off and become microscopy at the line where we cease to see with the unaided eye and call on a lens to help us out. It is for this reason that we say there is no dispute about the claims, except as to the mere matter of nomenclature. We see no advantage to be gained by naming a science which does not exist. In a truly scientific sense there is no such thing as a science of microscopy, as defined by Prof. Rogers. The bond of union between the heterogenous facts of the so-called science is not a natural one, but only one artificially placed on the objects of study because of their extreme interest through their connection with the instrument. In writing thus we have no desire to take away from the importance of the microscope in most departments of physical research. Prof. Rogers most happily says in his address :—' The microscope supplements the natural vision to such an extent that we can submit nearly every theory, nearly every deduction from experiment, nearly every fact of observation, to the supreme and only test by which a real truth in nature can be established, viz., through the medium of one of the senses with which we have been endowed by the Creator.' A sentiment which we most heartily endorse. We are bound to do and have done any and everything in our power to further its wide use and improvement.

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A correspondent who has recently written to us regarding the *pursuit of microscopical studies*, as an amateur, has suggested some thoughts upon the subject which have been running unsaid for some time. The writer, who is in the banking business, has his days fully occupied, but plenty of time at night for mounting, etc. Now, the question arises, how can a man, who uses the microscope and studies pursued by its aid as a means of recreation, retain his interest in the subject. There is no need to say that the student, who has gotten an introduction to nature's mysteries, and who is beginning to unravel tangled threads of meanings, will never have his interest flag be he never so busy during his days, and be he amateur or professional. It is also needless to say that be he never so untiring, and even had he all his time at his disposal, he will never exhaust all the questions which call for investigation. But if he has not received his introduction to nature's questions, so that he recognizes a mystery when he sees it abroad, and begins to try its solution, then what must he do to acquire it?

We can readily see how one, who prosecuted in an amateur way the collection of mounted slides, and derived his pleasure from them as mere curi-

osities to excite a passing interest, would, in time, come to an end of the interest of the subject. With the true aim of study with the microscope before one, and thoroughly appreciated, interest cannot flag. But to be a little more concrete. There are many lines of study which are to be pursued by the microscope, and which have an end, or aim, beyond mere accumulation; an end interesting in itself. One of these is found in animal histology, a line of study which, though it receives so much attention, is still far from worked out, and which would interest most students once well initiated, so that they would never tire of its pursuit. Plant histology, and embryology of both plants and animals, pathology, petrography, and so on, all furnish lines of work of perennial interest to the student. We may say that any line of study, when it is real, genuine scientific study, will stimulate growing interest in almost any studiously inclined mind.

But how shall the isolated amateur, who uses the instrument only in the evenings, become properly introduced to nature so as to be an intimate acquaintance of nature and not a mere spectator. Of course the first answer to this question is the recommendation to attend a laboratory course in the line desired, when, by precept and the stimulus and suggestions from fellow-workers, one can find the true road and learn to walk therein. But this is not often possible. In that event we should suggest that one select a subject sufficiently definite, and, by correspondence, guide-books, etc., pursue it persistently until the path was found. One line which would be of continual interest, we should think, would be pathological histology, especially for the physicians, and for such the course would be to buy or borrow some typical slides and some prepared material showing definite disorders, and study them in comparison with the normal tissues till the normal structure is understood and the particular abnormality detected.

It is by no means to any one line that we would confine this recommendation; we mention it as one example. If interest in microscopical studies flags it is because the student has ceased to seek the answer to questions as his aim, and is merely collecting specimens. His interest in collecting may go on indefinitely, or it may cease; but, if he has an unsettled question to answer it will stimulate him to fresh inquiry. The nature of the question individual taste must determine.

MICROSCOPICAL SOCIETIES.

San Francisco, Cal.

The regular semi-monthly meeting, held on August 24, 1887, at its rooms, 120 Sutter street. President Wickson occupied the chair.

Dr. Harkness made a preliminary report on the kelp covered by mollusca, which was referred to him at the last meeting. A more complete examination of the material will be made in due course.

The resignation of A. H. Breckenfeld, offered on account of his approaching departure for San Diego, was accepted. President Wickson spoke feelingly of the exceedingly pleasant relations which had always existed between the retiring officer and the society, and at the conclusion of his remarks a cordial vote of thanks was tendered Mr. Breckenfeld for his services as recording secretary. Under a suspension of the rules he was duly elected an honorary member of the society, and thereupon fittingly expressed his appreciation of the honor conferred. His successor will be elected at the next meeting.

A piece of wood, apparently fossilized, was sent in by Geo. A. Raymond, with the information that it had been struck at a depth of 325 feet in an artesian well now being bored in Kern county, Cal. The overlying material was mostly clay, and the sur-

rounding country was entirely destitute of timber. After an interesting discussion the specimen was referred to Prof. Hanks for microscopical examination.

Dr. Riehl donated a slide of a very minute larval form of insect, in which the vascular system was particularly clearly shown.

A varied assortment of entomological, botanical, and mineralogical specimens was donated by F. L. Howard, who had collected them on the slopes of Mount Shasta. Some peculiar varieties of porous obsidian attracted much attention.

Mr. Riedy stated that the work of stamping the books, plates, etc., in the library with the cut recently adopted by the society had been commenced and would soon be completed.

The meeting thereupon adjourned to the 14th prox.

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Kansas Society of Natural History.

The society includes in its membership specialists in many departments of science, but this meeting was given up entirely to microscopic work. Several of the members have lately become possessed of fine instruments, and considerable interest is being awakened in microscopy.

Dr. Charles R. Carpenter read a paper, Sept. 29th, 1887, on The Functions of the Microscopic Cryptogamia, with special reference to their influence upon disease, and the recent progress made in the study of their development and the causes which may lead to epidemics.

Professor Wm. Lighton read a paper upon Methods of Illuminating Microscopic Objects, which was illustrated with numerous large drawings. He gave a history of the successive order in which these methods had been discovered and used, with the particular value of the various pieces of apparatus, and also described several of his own devices.

NOTICES OF BOOKS.

The Naturalist's Monthly; a Journal for Nature-lovers and Nature-thinkers. Vol. I, No. 1. Edited by Dr. J. W. Williams. London and Toronto. (pp. 20). Sept. 1,'87.

This first number of a new popular journal devoted to natural history in the widest sense of that term serves to indicate at least the growing inquiry which is springing up all around about scientific things. Its appearance, in addition to the many now in existence, augurs hopefully for the spread of interest in scientific matters. This first number has much to commend it; its articles—Pathology of Celandine, The Evolution of the Fish-hook from the Flint Hook of Prehistoric Man to the Salmon Hook of the Present Day, A Study in My Garden (on the aphides), Binary Suns, Biography of Charles Darwin, Chapter on Centipedes, Snails and Slugs in My Garden, Origin of Fresh-water Faunas, and others—cover a very wide range of subjects. They are, however, treated in a popular way, but not familiarly or jocosely. The reading of them would interest and improve anyone. From the serious tone of the writers we can safely prophesy good to the readers. We trust the appreciation of the readers will insure the journal a wide enough circulation to make it prosper.

Supplement to Australian Museum Report for '86; Technological, Industrial, and Sanitary Museum. (50 pp.)

We dip with interest into this large report from New South Wales to see what is doing in that distant land, and remark the great interest which must prevail, as shown by the report. Thus during the year (afternoon only) the attendance was total 49,234, of which 17,937 attended on Sundays, while on week days the number was 31,297. The bulk of the report is occupied with a list of accessions to the museum and library during the year. This list cannot be reproduced even in brief with any very interesting result, but it shows very great activity on the part of the curators and general prevailing interest in the success of the institution.

Biological Instruction in Universities. By C. O. Whitman. From *American Naturalist.* June, 1887.

This address, before the American Society of Naturalists, is on a well-worn theme, but one not yet sufficiently apprehended by educators. The author strikes the key-note when he remarks that we should not 'fit' college men to be teachers, but 'equip'

them for that work. We cannot make a successful teacher by merely teaching him; we must make him a teacher. In biology, as elsewhere, the student must become an original independent student before he leaves the college, or he can never properly instruct in his turn. The objection to the specialist that he will form one of a class who will be able to furnish a rare article, but for which there is no demand, is nonsense. It costs money to have a properly equipped biological department, but the country has money and will come to see the value of better instruction. It is now seen in some few, alas! how very few, of our universities, while in more, one man grapples with zoology, botany, and in some cases geology too.

This, in effect, is the gist of Dr. Whitman's address. It would be a good thing if it could reach the eyes of all boards of trustees, be thoroughly understood by all faculties, and backed by the purses of the schools supporters, and the same principles escape into the other school departments, for they would make the mental development of man in this fast age keep pace with improvements along other and meaner lines.

The Maverick National Bank Manual. July 1, 1887. Boston. Wright & Potter. (pp. 200).

A history of American finance, containing chapters on the National Debt, Credit of Nations, State Debts, Savings Banks, Coinage and Currency, Clearing-Houses, Railroads, Land and Agriculture, Coal and Iron, Electricity, Boston Statistics. The work is a brief compend of the chief facts which would be interesting and necessary to any one, and particularly men making a special study of finance.

We desire to acknowledge, with thanks, the receipt of the following:—1. *State Board of Health Bulletin*, for month ending June 30, '87, vol. II, No. 12. (pp. 12). 2. *Notes on North American Julidæ, with Descriptions of New Species.* By C. H. Bollman, New York. 1887. (pp. 20). 3. *New Genus and Species of Polydesmidæ.* By C. H. Bollman, New York. 1887. (pp. 2). 4. *The Bible and Nature.* By D. W. Dennis, Richmond, Ind. 1887. (pp. 16). 5. *Enamel and Dentine: Some Thoughts Concerning their Structure.* By Geo. S. Allen, D. D. S., New York. 1887. (pp. 5). 6. *Life in the Bahama Islands.* By T. Wesley Wills. From *Canadian Record of Science.* (pp. 16). Montreal, 1887. 7. *Comparative Psychology.* By T. Wesley Mills. From *Pop. Sci. Mo.* (pp. 10). Montreal, 1887. 8. *The Retention and the Loss of the Hair from a Physiological Standpoint.* By T. Wesley Mills. Montreal, 1887. 9. *Contribution to the Histology of the Harderian Gland of Amphibia.* By G. A. Piersol. *Archiv. für Mikros. Anat.* (29, pp. 594–608). Munich, 1887. 10. *On the Electrical Phenomena which Accompany Muscle Work.* By Frederic S. Lee. From *Archiv. für Anatomie und Physiologie.* (pp. 204–223). Liepsig, 1887. 11. *On the Use of the Amplifier.* By Geo. Rafter. (pp. 35). 12. *The Development of Craugon Vulgaris* (second paper). By J. S. Kingsley. From *Bulletin Essex Institute.* (xviii, pp. 99). 153 plates. I and II. Salem, Mass., 1887.

Exchanges.

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

Correspondence relative to exchange in microscopical material or prepared mounts.
HENRY L. OSBORN, Hamline, Minn.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired. MARY A. BOOTH, Longmeadow, Mass.

Fossil Diatomaceous deposits wanted from Bermuda, Virginia, California, etc.
I. ELLIOTT, Aberystwith, Wales.

Publisher's Notices.—All communications, exchanges, etc., should be addressed to Henry Leslie Osborn, Hamline University, Hamline, Minn.

Subscriptions, and all matters of business, should be addressed to the Business Manager, P. O. Box 630, Washington, D. C.

Subscription price $1.00 PER YEAR *strictly in advance. All subscriptions end with the December number.* A pink wrapper indicates that the subscription has expired.

Orders for slides advertised by A. J. Doherty in the Journals from January to April, 1887, may be sent through the Business Manager, 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, to the order of the Business Manager. 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 following prices which are net:—Vol. II (1881) complete, $1.50; Vol. III (1882), out of print; Vol. IV (1883) complete, $1.50; Vol. V (1884) complete, $1.50; Vol. V (1884), Nos. 2–12, $1.00; Vol. VI (1885), $1.50; Vol. VII (1886), $1.00.

THE AMERICAN

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VOL. VIII. NOVEMBER, 1887. No. 11.

Elementary histological studies of the Cray-fish.—VII.

BY HENRY L. OSBORN.

CHAPTER II.—(*Continued from page 185.*)

4. **Histology.**—We have now considered the anatomy of the liver of the cray-fish and find it composed of these different parts, viz: the capsule or investing sack of the gland; the lining of the passages of the gland, or the glandular epithelium; and the blood contained in the blood-space. The structure—that is, the shape and size—of the cells composing these, together with any facts we can learn as to the parts composing these cells, if any can be found, form the subject-matter of histology. To prosecute this study it is positively necessary that the student be furnished properly prepared sections. The study of minute anatomy can be prosecuted with no great detriment upon sections which are not preserved in the most perfect manner, or cut with the extremest skill. A large share of the study, which is most commonly called histological, is more exactly of minute anatomy, the particular study of the cell itself not being its object so much as the study of the arrangement of the tissue of which it forms a part. But when the details of structure of so small and delicate a body as an ultimate cell of any tissue is to be investigated, great caution must be observed to assure one's self that it has not been given some unnatural look under our treatment. And this is a matter of great difficulty, and gives rise to most of the discussion as to the relative merits of different modes of treatment of sections. In estimating the value of a method, then, we try to see in how far it fulfils these requirements; that the cell shall not be distorted by sudden osmotic changes; by sudden great changes of temperature; by handling which would tear its delicate walls, or subject to the action of agents which would remove any of its parts. We cannot, at this time, go into details upon this portion of the subject, for space does not permit. We can only suggest this hint of the principle on which the choice of histological methods is based. Let us then make an actual study of the cells of the various sorts which make up the organ called the liver.

1. **The glandular epithelium.**—Where cells cover in a space, forming a wall for that space, they are usually called, collectively, 'an epithelium;' and one individual cell is called 'an epithelial cell.' To learn the cellular structure of the glandular epithelium requires the use of somewhat high magnifying powers and well prepared sections. The section shown at figure 1 in the plate (ix, p. 183) is sufficiently thin to show the cellular structure of the epithelium, but it is not magnified enough to do so. An experienced observer would be able from this section, which shows more than the figure, to arrive at a correct inference as to the shapes of the cells of the epithelium,

but the learner, to reach these cells, must employ a higher magnifying power —one of 240 diameters is sufficient.

With this power the appearance is such as is shown in figure 2. Here the beginner should follow much the same course of observation as was detailed in the earlier pages of this article, where he proceeded from his numerous actual observations by appearances in his sections to interpret or put together the real actual structures which he does not see at any one time or place in their entirety. We shall not occupy the reader with such a tedious course again, having already insisted upon the necessity of pursuing just such a tedious course, until the eye and judgment are trained, but will in this chapter assume that he has profited by all the lessons of the first chapter, and can look beyond the appearance he has in his section. He finds at once a very different tissue from the one so widely found in the green gland. Throughout the tubules, excepting at their tips and at their opening into the main duct, he finds, first, an arrangement of matters which seems to be radial from the centre of the section but stopping short to leave the empty star-shaped lumen in the centre. Half way across the rays he finds dense oval bodies with a still denser central body inside them. The radial matter is not entirely continuous, perhaps, but breaks here and there seem to leave empty spaces, though the lumen is bounded by a line in which no breaks are seen. The tubule also is surrounded by a hard line in which there are no breaks. These briefly are the various facts he at first observes. Closer observation of the radial matter shows to him here and there a sharp line in places; he can perhaps trace it down from the lumen, and it may seem to surround some of the finer matter and one of the dense oval bodies. By a few examinations he can convince himself that the epithelium is made up of a row of cylindrical bodies which are not nearly as straight-sided as the cubical blocks which line the cavities of the green gland or nearly so regular in outline. Some are globular and tapering, others are long and narrow and somewhat wavy; they are very seldom perfect cylinders, yet they fit together so as to fill in the wall, and the long axis of the cell runs at a right angle with the long axis of the tube and radially from a common centre. These bodies are the cells, the units, which taken together form the glandular tissue of the liver. The shapes of individual cells can be seen here and there at favorable places, and such a place is represented in figure 3.

But what of the breaks in the epithelium so very conspicuous in the figures 2 and 3? Here the observer has before him an appearance which every consideration goes to show is abnormal and is the result of some imperfection in the treatment. The simplest proof that it is abnormal is given by the fact, easily proved, that it occurs only here and there and at no definite intervals, and that it does not occur in sections treated in a different way. The nature of the imperfection may be seen—a very slight shrinking throughout the epithelium, so that the cells in places no longer form a continuous wall for the tubule in all places. That the imperfection has not been so serious as to utterly ruin the sections is shown by the fact that the walls of many of the cells are unbroken and the outline of the central body, the nucleus, is entire, and the lining next the tubule is entire. We see then that we can learn much from the section, though we cannot, of course, be as confident in doubtful matters as we could be if the section were perfect.

It having been settled that the shape of the cell is some modification of a cylindrical form, we may inquire further of its parts, and find that it is made up of granular matter which stains very readily with most of the reagents—it is the protoplasmic content of the cell. In the centre of the cell, sometimes nearer the end toward the lumen, usually more deeply situated, is the oval body, the nucleus, with its very sharp limiting line and within granular

staining matter, and a central very densely stained part, the nucleolus. Recent histology is interesting itself with studies which pass far beyond the recognition of the parts of the cell thus far detailed. and finds that the protoplasm of the cell, and of the nucleus and nucleolus, are arranged in a very definite way which seems to throw some light upon just what processes take place in the cell when it works. But we must be content to stop short of following these deeper secrets of cell structure until by practice we are more than 'elementary' histologists.

Before we leave the gland-cell of the liver, it will be worth our while to notice some points of comparison between it and the green-gland cell. The cells in both cases present the same parts, namely, a cell wall, protoplasmic cell substance, or 'cell-contents'—a nucleus with its own parts. Further, in each case we may distinguish two ends of the cell, one of which, the outer end, is toward the lumen of the gland cavity, and the other, the inner end, is away from the cavity. Here the inner end is seated upon a basement membrane, which intervenes between the cell and the blood in the blood-space surrounding the tubule, and the same relations were observed in the green gland. But the cells are very unlike in shape and size, and important differences in their finest structure could be observed upon still more detailed study, as is shown, for instance, very plainly in the nucleolar matter of their nuclei.

2. **The blood.**—In the spaces beyond the inner ends of the gland cells, which spaces can, in no place, be found to open through the glandular wall and into the lumen of the tubule, except at breaks, which are abnormal and not natural to the gland, granular matter will be found distributed with no apparent regularity, and scattered through it can be found oval bodies of the same size and shape as the blood corpuscles already studied in the green gland. (See page 102).

3. **The capsule of the gland** is composed of cells, the details of whose structure have been spoken of before in another connection, and we need say nothing more of them since the section figured is not made by a method favorable for their demonstration.

In conclusion we may say that these two organs, the liver and the green gland, are very favorable, indeed, to form the subjects of the first studies of the animal histologist, for they bring him into the presence of a great variety of objects of study, yet in a much simpler form than they have in many other cases. These tissues are of sufficient complication to furnish good training introductory to the study of the far harder ones of higher animals, and are yet sufficiently developed and specialized to be an introduction to them. The intestine is a good subject for further study where glandular and muscular tissue are found in the wall of the gland cavity, and to them are added connective tissue—the three combined to form a simple kind of organ. And, later, the eye may be studied as an organ of very much greater complication and furnishing lessons of the kind which must be well learned before the difficulties of vertebrate histology can be successfully faced.

The biological examination of water.—III.

By ROMYN HITCHCOCK,

OSAKA, JAPAN.

(*Continued from page* 171).

In connection with the previously contributed notes on the examination of water, it will be of interest to say a few words to indicate how much value the officials in this enlightened country (Japan) attach to the results. It

should be explained that at Kobe, a port of entry, there are health officers whose duty it is to examine certain articles as imported, and, among other things, ice seems to be one of their favorite subjects of examination, probably because it is so easily tested (by their methods). Not long ago a reputable firm of business men in Kobe imported a cargo of ice which was condemned by the health officers, and its sale was forbidden. The writer was then asked to examine the ice, and the results of this examination showed that the ice was perfectly good, and even the report of the native officials showed that their condemnation of it was purely arbitrary, and an act of meddlesome officialism on the part of irresponsible persons. Perhaps the best evidence of this will be the official report, of which the following is a copy:—

'RESULT OF ANALYSIS OF ICE.

On application of the above firm, the analysis of the ice has been made, and the following results have been obtained. The ice being not good, is considered injurious to health for drinking purposes:—

Color,	none.	Ammonia,	none.
Smell,	"	Ashasan,	"
Taste,	little.	Shasan,	"
Chlorine,	some.	Organic matter,	some.
Lime,	"	Floating matter,	little.
Sulphuric acid,	none.		

Under the microscope examination the living insects are seen, not destroyed in the body temperature.

May 17th, 1887. (Signed) HYOGO KEN.'

The report is quoted as officially translated. On inquiry the following lucid explanation of the last sentence was given:—'There are two kinds of bacteria, one kind appearing in all water and is harmless; the other kind is injurious to health, and is found in the Tientsin ice.'

The examination upon which the report was based was made on board the vessel in the presence of one of the owners, the analyst having stated that it would take him only ten minutes to determine if the ice was fit for drinking. The time actually consumed was about twenty minutes.

The object in quoting the report in full is not to criticise it, for it is quite beyond that, but to show how completely the business of a port like Kobe, one of the most important in Japan, is subject to the will of meddlesome officials. It was naturally supposed by the importers, and by the writer, that such a superficial examination would be immediately set aside when the results of a careful biological examination were presented. But such was by no means the case, and for weeks before we left Osaka the ice was melting away in a go-down, and the whole cargo has probably been a total loss.

This is not an isolated case, for the writer has been informed of a number of instances where chemical examinations of imported products, made by the government analysts, have shown impurities in the purest articles. It has usually been found convenient to pass such articles, however, but I believe the examiners have never acknowledged their mistakes. They say:—'Well, it is not good, but we will let it pass,' and so nobody hears any more about it, neither manufacturer nor importers seeming to attach any importance to such condemnation of their goods.

Another report of an examination of ice lies before us, this time from the Imperial Sanitary Laboratory of Osaka, signed by the analyst and by the director of the laboratory. The analysis consisted in an examination of color, taste, and smell. 'Traces' of chlorine and lime and evaporated residue were found, and 100,000 parts of the samples, respectively, decolorized 0.16 and 0.102 parts of permanganate solution. The writer then says:—'From the

analytical results, as above stated, we are of opinion that the two samples of ice water are unfit for drinking purposes on account of the large quantities of organic suspended matter they contain.' One of the samples was from Hakodate ice, the other from Tientsin, China ; but the examiners did not know that!

Japan is a country that is advancing in many ways, but much of the progress we hear of is not real. This is not the place to consider the subject at length, but the analyses referred to above may be taken as fair samples of much that is done here, and the unwillingness to acknowledge a mistake, or change a decision made in error, has led to many amusing, but sometimes very annoying, incidents. The occasional persistence of Japanese government officers in maintaining what they know to be wrong, even in trivial matters, is almost incredible. The matter of the Kobe ice is a case in point. The writer's examinations led to results that were unquestionable, and the Japanese examinations were utterly valueless, as shown by their own report. There was not a single indication of contamination discovered by them. The microscopical examination, made in a few moments (if, indeed, it was made at all), was a farce, and unworthy of serious attention. Yet the native results of twenty minutes' work cannot be overthrown. Thus we see the high estimation in which scientific work is held here, and also an indication of the character of the native analytical work in two important cities.

YOKOHAMA, *Sept. 7th*, 1887.

Reminiscences and notes on recent progress.

BY ROMYN HITCHCOCK.

Our last letter was written in Yokohama. Since then we have returned to Osaka, and find two numbers of the JOURNAL, some numbers of the *Journ. Royal Micr. Soc.*, and a lot of other reading matter of various kinds.

Prof. Osborn is certainly giving a great deal of time and labor to the preparation of articles that should be highly valued by many readers. The Histological Studies of the Cray-fish, for example, will serve as an admirable guide to the student. Dr. L. C. Stevens seems to have compiled his Key to the Rotifera with intelligence and care, and it will be a welcome aid to many a beginner in a field of study as yet but little cultivated in the United States. On the whole there seems to be considerable and constantly increasing activity in microscopical work at home, of which the JOURNAL is a fair index. Looking at the subject from afar, where no paper can reach one in less than about a month after it is printed, it is some satisfaction to think that at least a portion of the interest and advancement we see is due to the establishment of this JOURNAL eight years ago.

Probably there are not many who have observed the recent gradual but steady progress, or have had as good opportunities to do so as the writer has done. Eight years ago Mr. Zentmayer was almost the only American maker of microscopes with wide and well-established reputation. The establishment of the *Amer. Journ. Micr. & Pop. Science* aroused the interest of a large number of amateurs, some of whom have since become famous for their skill in microscopical manipulation. At this time Mr. Bulloch, who has since taken a high position for his ingenuity and skill in devising stands and accessories, was scarcely known outside of Chicago, and his abilities were first generally recognized when the present writer, then having recently removed from Chicago to New York, took up the pen in Mr. Bulloch's behalf in the columns of the journal referred to. Mr. Gundlach, an optician of acknowledged ability, was better known through his photograph lenses

than for his microscopic objectives, which were then coming more into favor. Mr. Grunow was favorably known to a large number of physicians, but not to the world of amateurs that was then being slowly evolved.

Finally, the very useful and ably-edited journal ceased to be published. Its business management was bad, and the dates of publication were rather uncertain. Then came the present journal to take its place. It was successful from the beginning; for the interest in microscopy had been aroused and would not readily subside. Meanwhile the Bausch & Lomb Optical Company had been formed, and no words of ours are needed to tell how, by strict business principles and careful attention to details in manufacturing their goods, they have succeeded in establishing upon a solid basis the extensive business they now control. Mr. Walmsley's extensive trade has also grown almost entirely since our first number was printed, a fact that is largely due to improvements in the manufacture of stands by the Messrs. Beck.

These few words will indicate how rapid and satisfactory the progress of microscopy has been and how closely identified with it this JOURNAL has been. If, on the one hand, the wide circulation of the JOURNAL has spread abroad a knowledge of what the microscope reveals in the common objects around us, and thus directly encouraged the sale of microscopes and opened the way to large business enterprises, the dealers, with but a single very notable exception, have, in turn, liberally aided the publisher and made that success possible. Indeed, it may be truly said that the advertising pages of this JOURNAL have been and are a reliable index of the prosperity and enterprise of the dealers in microscopical goods in the United States.

But one other reminiscence and we will pass to another subject. The lenses of Carl Zeiss, now known all over the world, have gained their greatest reputation within eight years. We may go back a little further and find occasional notices of Prof. Abbe's work, but certainly very little was known in America of the principles he had applied to the construction of objectives at the time this JOURNAL was established. We now have homogeneous immersion lenses in every working laboratory, and the apochromatics are an improvement upon them.

Coming down to the present, without further reference to what has been, the reference to the new objectives calls to mind the matter of eye-pieces, for projection, a subject that has already been brought forward in these columns. But it is still new and important. It will be remembered that the late Dr. Woodward was the first to apply an amplifier in photomicrography in such a manner that it would preserve the correction of an objective and materially increase the magnification. Prof. Abbe has devised a projecting ocular which enables an object to be sharply defined, over a comparatively large field, with a short camera. This is far better and more convenient than the amplifier, and the problem that Dr. Woodward long desired to solve has at last been successfully mastered. The new ocular would seem to be an extremely valuable accessory to all who are engaged in photography with the microscope.

While upon this subject we may refer to a form of camera recently described by Gottlieb Marktanner-Turneretscher in *Photog. Correspondenz*, which presents some points of novelty. It is attached to an upright, German stand. The bottom is made of two boards hinged at one side, the lower fitting over the body-tube and sustaining the weight of the camera; the other, of the same size, forming the true bottom of the pyramidal camera. The focus and illumination are first adjusted by turning the camera over to one side, as provided for by the hinges, when the ocular projects above the lower baseboard. This is a great advantage for rapid work, and when the new oculars are applied the device would seem to be most excellent. When an exposure

is to be made the camera can be instantly turned up in position, the focus corrected, and the plate exposed. The plates used measure 6 by 6.5 cm.

Just here let it be noted that Dr. Dallinger has given his unqualified endorsement of the new oculars of Zeiss, known as compensating oculars, not only with the objectives of that maker, but also with objectives of English construction. This, of course, is quite apart from the use of such oculars in photography. Indeed, I believe that the projection oculars are not quite the same as those used for eye observations.

In looking over the June number of the *Journ. Royal Micr. Soc.* I find a description of Schiefferdecker's Apparatus for Marking Microscopical Objects, which calls to mind a much simpler, but no doubt quite as efficient, device for the same purpose, that I have used for years. It was made, I believe, by Mr. May, of Philadelphia, and consists of a simple rod of brass about $\frac{1}{4}$ of an inch in diameter, with a screw at the top that fits into the nose-piece in place of an objective. A tube fits loosely over this rod, bearing a diamond point below, slightly eccentric. This is turned by a milled collar, so as to scratch minute circles on the cover-glass.

I know of no contribution to microscopical literature of recent date that equals in its far-reaching significance, as well as the industrious and continuous observation upon which it is based, the last address of Dr. Dallinger, President of the Royal Microscopical Society. Here we have the results of seven years of continuous painstaking observation, begun with a definite purpose and carried on with increasing zeal until an accident happened to the apparatus and put an end to the work. Already another series of the same kind of observations is under way. The problem set forth for solution was to determine the influences of changes of environment upon the life-history of organisms having a short period of existence, and to observe the changes of an adaptive character that might be induced. The investigations were undertaken with the monad forms, with which Dr. Dallinger is so well acquainted. The organisms were submitted to gradual increase of temperature, and the effects carefully noted. Beginning at 60° F., the temperature was gradually raised, in the course of two months, six degrees, then two degrees per month, and then, when the temperature had reached 74°, the increase was very slow. At 78° the temperature remained unchanged for eight months, during which time an elevation of half a degree could not be safely borne. But, by giving sufficient time for adaptation to the changed conditions, the temperature was finally raised to 158°, and the organisms continued to live and multiply! Then the apparatus gave way, and the long experiment was ended.

It is always a source of satisfaction to find one's own observations confirmed by independent workers. In 1883 it was my good fortune to trace the development of *Ulothrix* from *Pleurococcus*, and the results were briefly described in Vol. IV, p. 191. Lately I find that Mr. de Wildeman has confirmed this, and that Dr. Braxton Hicks has also observed it.

OSAKA, JAPAN, *Sept. 15, 1887.*

The meeting of the American Society of Microscopists.

BY C. M. VORCE,
CLEVELAND, OHIO.

The working session at Pittsburgh demonstrated the firm hold which this feature of the annual meeting has upon the interest of the members and the public. Notwithstanding the attendance at Pittsburgh was smaller than expected, the character of the work done at the working session was fully up to the standard of former meetings and the interest of the members and visitors

equally active. It is quite apparent, from observation of all the working sessions which the society has held, that those methods of technology which relate directly to the preparation and mounting of objects for study or exhibition possess much more attraction for both members and visitors than methods relating to the manner or character of study by means of the microscope. Section cutting, hardening, imbedding, staining, mounting, and finishing of slides, and such processes, receive the attention of nearly all in attendance, while methods of illumination, testing and correction of objectives, measuring aperture, etc., receive attention from the few only. This seems to be an indication that the majority of those in attendance are desirous of extending the range of their studies rather than improving the character of their methods, and is doubtless due to the fact that those whose researches tend to emphasize the need of the highest development in technique are apt to seek out and acquire the information needed to perfect their skill outside of the society meetings, the ground to be covered being less than in the other case, where, no matter how extensive the ground already gone over, the working session is sure to open up new fields. Well may we all say, in the words of Dr. Reeves, of Wheeling, 'Bless the man who invented the working session.'

An interesting and unusual feature of the meeting at Pittsburgh was the collection of works on microscopy and allied subjects exhibited in the reception room at the Monongahela House, where the headquarters of the society were located. The books were gathered from the various private libraries in the city and comprised a collection such as few individuals can boast of. A number of old, rare, and exceedingly interesting works on microscopy and optics were among the number. The larger number were from the library of Mr. C. C. Mellor. Members who have attended most of the former meetings noticed the absence at Pittsburgh of some familiar faces whose presence at the meetings has come to be expected as a certainty. Among the more prominent may be mentioned ex-Gov. J. D. Cox, Mr. W. H. Walmsley, and Mr. E. H. Griffith. This is the first meeting of the society at which Mr. Walmsley has not been present; Mr. Griffith, too, missed his first meeting on this occasion. Gov. Cox, Mr. Brearly, Prof. Tuttle, and some others, who joined the society later, have been usually present. The absence of Dr. Allen Y. Moore, whose death, in April last, was mentioned in an earlier issue, was sadly noticeable to nearly all in attendance.

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The following list includes the principal papers read at the Pittsburgh meeting: Comparative size of the blood corpuscles in man and domestic animals, by Freda Detmers, of Ohio University; Disease germs, by T. J. Burrill, of Champaign, Ill.; Bacterial origin of foot rot in sheep, by W. H. Detmer, of Ohio University; Methods of preparing tape-worms for the museum and the miscroscope, by J. M. Stedman, of Cornell University; An erector for binocular microscopes, by R. H. Ward; Crystallization by cold, by Dr. F. L. James, of St. Louis; Certain low forms of life in water, by D. S. Kellicott, of Buffalo; Effects of powerful electric currents on the tissues of animals, by Dr. G. E. Fell; Comparative qualities of cements and waxes to be used in the preparation of objects for microscopical investigation, by Dr. W. H. Seaman; Fallacies of popular bacteriological research, by Dr. G. W. Lewis; Trichinæ in pork, by S. H. Gage; Ending and relation of the muscular fibres in the muscles of minute animals, by Susanna S. P. Gage. The papers were all interesting and brought out considerable discussion.

The following officers were elected for the ensuing year:—President, Professor D. S. Kellicall; Dr. W. H. Detmer, first vice-president; Dr. S. P.

Gage, second vice president; Professor T. J. Burrill, secretary; Dr. S. M. Mosgrove, treasurer; C. C. Mellor, Dr. Seaman, and Dr. Maudeville, executive committee.

The soiree was a grand success, with 123 microscopes in position, and over 3,000 people to enjoy them. It took over an hour to make the rounds. Among the specimens we mention the following:—Dr. S. M. Mosgrove, sections of a normal and a deseased lung, showing most clearly the bronchial tubes and artery in the former as they are in a healthy babe's organ, and in the latter as they are in the first stage of consumption. C. C. Mellor, infusoria and other inhabitants of an east end pond. Professor James H. Logan, living embryos of snails and infusoria from Pittsburgh water. Dr. Depuy, a longitudinal section of a human tooth, $\frac{1}{200}$ part of an inch thick. Dr. Geo. E. Fell, letter O occupying space of one millionth part of an inch, magnified 3,200 times; also micrometric scales of from 5,000 to 12,000 lines to the inch. Dr. Edward H. Small, the proboscis of a mosquito. Professor C. M. Vorce, skin of shark and jaw of leech. Bausch and Lomb, a number of the finest microscopes made in this country, and selected slides. Professor S. H. Gage, the muscular fibres of the mouse. Dr. Frank McDonald, micro-photographic slides of the Lord's Prayer, and the picture of 'Pharoah's Horses,' both smaller than a pin's head to the naked eye. The Microscope's Laboratory; bacilli and embryonic subjects under six microscopes. Miss Mary A. Spenk, section of lung tissue and other objects. Dr. Frank L. James, extremely beautiful salicin crystals polarized. Dr. W. S. Bell, hooked wing of a hive bee. Dr. T. L. Hazzard, *trichina spiralis* obtained from a local case. C. G. Milnor, diamond beetle and diatoms. George H. Clapp, eye-spot on wing of Luna moth and gold-plated diatoms. —*Nat. Druggist.*

On the early history of the foot in Prosobranch gasteropods.*

By HENRY LESLIE OSBORN.

The literature of animal morphology is becoming more and more devoted to the subject of organogeny. The study of the development of organs is throwing much light on the story of their origin, the origin of species as well. The testimony of authors on gasteropod morphology prior to 1886 is to the effect that the foot throughout the group arises as a median elevation of the ectoderm upon the ventral surface behind the blastopore. Among the various writers who have given expression to this view are Carpenter, Bobretzky, Koren, Butschli, Salensky, Rabl, Balfour, and others, and their researches have extended to *Fusus*, *Nassa*, *Natica*, *Cytherœa*, *Trochus*, *Vermetus*, *and Paludina*. Their reports leave little doubt of their observations on this point.

MacMurrick, in a paper in 1886 on the development of Prosobranchs, figures but does not describe the first appearance of the foot in *Fulgur* not as a median but as a paired structure.

In studies in 1884 upon *Fasciolaria* and *Fulgur* I observed and figured the first stages in the development of the foot. In both cases it arises as a pair of entirely independent elevations in the ectoderm behind the velum and blastopore on the ventral surface. Sections show them filled with mesoderm, the beginnings of the musculature, and the nervous system of the foot arises as two independent parts later united. It is very early that the two separate mounds coalesce to form the single median structure which persists as the peculiar form of foot.

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* Abstract of paper read before Biological Section of the A. A. A. S. in New York.

In view of these observations, it would appear that we must accept an amendment to the current statement of the facts as to the origin of the Prosobranch foot to the effect that in some cases (so far as at present known two cases) the organ is at first a paired structure like the beginnings of locomotor appendages in arthropods and vertebrates, and only later in the ontogeny median in position.

Further, we may open the question whether these facts may be taken to have phylogenetic significance or to be a falsification of the phylogenetic record. The latter view would seem improbable, because the foot in gasteropods is of no use in the early larval life, the velum being the organ of locomotion.

It would be equally difficult to see how the paired condition of the foot could have been acquired secondarily from an ancestral form with a single median one, both because of its probable rarity in the group and because of the absence of function of the foot in early life. On the other hand, the supposition that the gasteropod foot originated as a median structure from the ventral creeping surface of a Vermian ancestor would seem natural and easy, being in accord with the facts of anatomy and the few hitherto published facts of embryology. In thus seeking a meaning for this appearance in these two forms, which deviates from the position commonly held, I have no desire to attempt to force a few facts to support a superstructure of speculation but rather to propose the question for future determination when a larger number of forms shall have been studied.

Report on methods of stating the results of water analyses.

By G. C. CALDWELL,

ITHACA, N. Y.

At the Buffalo meeting of the American Association for the Advancement of Science a paper on this subject was read before the Chemical Section by Prof. W. H. Seaman, embodying the report presented to the Washington Chemical Society by a committee of that society. Some of the results arrived at by that committee, and their recommendations, are given in the following extracts from that report.

After giving a 'list of forty-two methods of statement or expression, based on an inspection of about a thousand analyses,' and noting that 'in some places three scales were found in the same table, a part expressed as grains per gallon, another part as milligrammes per litre, and the hardness in Clark's degrees,' the report goes on to say:—

'These can nearly all be reduced to one or another of four common methods of expression as detailed by Nichols, viz:

1st. Grains per English or imperial gallon (277 cubic inches or 10 lbs.—70,000 grains of pure water).

2d. In grains to the U. S. or wine gallon (231 cubic inches—58,372 + grains of pure water).

3d. On a decimal basis as parts per 100, 1,000,1,000,000. This is generally used in France and Germany, also in the Reports of the Rivers Pollution Committee of Great Britain, and in this country in reports of the National Board of Health and of many State Boards of Health.

4th. As so many milligrammes to the litre. (This would be the same as parts in 1,000,000 if the water had the same density as pure water).

'After careful consideration the committee would recommend the following conclusions, viz:—

1st. That water analyses be uniformly reported in parts per million or mil-

ligrammes per kilogramme, with the temperature stated, and that Clark's and all other systems be abandoned.

2d. That all analyses should be stated in terms of the radicals found, both elementary or compound.

3d. The constituent radicals should be arranged in electro-chemical series, the positive radicals first.

4th. The combinations deemed most probable by the chemist making the analysis should be stated both by symbols and by name.'

After some discussion of the matter the following committee of the Chemical Section was appointed to report for the consideration of the section at its meeting in 1887 a scheme for a uniform method of stating the results of analyses of both mineral and potable waters:—Professors G. C. Caldwell, J. W. Langley, W. P. Mason, J. R. Myers and R. B. Warder.

This committee, concluding that the scale which would be convenient and suitable for a mineral water would if applied to a potable water involve the use of inconveniently small decimals, recommended the adoption of two scales, and, furthermore, as will be seen on comparison of their recommendations with those of the committee of the Washington Chemical Society, of many of the features of that report.

I. Scheme for a mineral water.

The composition shall be expressed in parts per thousand.

The number of parts per thousand shall be given of each electro-positive or basic element, K, Na, Li, Ca, Mg, Fe^{11} $(Fe_2)^{vi}$ etc., and of each electro-negative or acidic element, Cl, Br, I, S, etc., that may reasonably be supposed to be combined directly with an electro-positive element, all these elements being arranged in the order of their electro-chemical character, the electro-positive first. The remaining portions of the electro-negative elements shall be given, together with all the oxygen of their salts, as in the present generally accepted empirical formulas of those salts, such as SO_4, PO_4, CO_3, etc.

The number of cubic centimetres per litre shall be given of CO_2, H_2S, etc., expelled on boiling.

The combinations deemed most appropriate by the chemist making the analysis shall be stated both by symbols and by name.

II. Scheme for a potable water.

The composition of the water shall be expressed in parts per million (milligrammes per litre) as follows:—

Total solids . . . . . .
Chlorine . . . . . .
Nitrogen expelled on boiling with Na_2CO_3 . . . . . .
equals 'free ammonia' . . . . . .
expelled on boiling with alk. permang. . . . . .
equals 'albuminoid ammonia'. . . . . .
as nitrate . . . . . .
as nitrite . . . . . .
Hardness . . . . . .
Oxygen consumed (by permanganate treatment). . . . . .

After discussion of the report it was voted that it be printed and a copy be sent to each member of the section, and that it be referred back to the same committee for further consideration in the light of such criticisms and suggestions as may be received from others, to the end that in the form finally approved it may have the widest possible adoption.

The committee therefore invites from all who may see this report, and are interested in the subject, an expression of approval of the schemes proposed, or of disapproval, with the reasons for the same and suggestions for their amendment. Communications may be sent to the chairman of the committee at Ithaca, N. Y.—*Journal of Analytical Chemistry.*

Protoplasm.

Sir H. E. Roscoe, in his address as president of the British Association, in a *résumé* of the history of chemistry, remarked of protoplasm as follows :— 'But now the question may well be put, Is any limit set to this synthetic power of the chemist? Although the danger of dogmatizing as to the progress of science has already been shown in too many instances, yet one cannot help feeling that the barrier which exists between the organized and unorganized worlds is one which the chemist at present sees no chance of breaking down. It is true that there are those who profess to foresee that the day will arrive when the chemist, by a succession of constructive efforts, may pass beyond albumen and gather the elements of lifeless matter into a living structure. Whatever may be said regarding this from other standpoints, the chemist can only say that at present no such problem lies within his province. Protoplasm, with which the simplest manifestations of life are associated, is not a compound, but a structure built up of compounds. The chemist may successfully synthesize any of its component molecules, but he has no more reason to look forward to the synthetic production of the structure than to imagine that the synthesis of gallic acid leads to the artificial production of gall-nuts. Although there is thus no prospect of our effecting a synthesis of organized material, yet the progress made in our knowledge of the chemistry of life during the last fifty years has been very great, and so much so, indeed, that the sciences of physiological and pathological chemistry may be said to have entirely arisen within this period.'

MICROSCOPICAL TECHNIQUE.

A new paraffin imbedding apparatus.*—Those who have had much experience in imbedding in paraffin are aware of the difficulties and risks which attend the imbedding of delicate objects on account of the danger of overheating the imbedding mass. The trouble with heat regulators is that they get out of order and give trouble, aside from the difficulty which arises from the variations in the pressure of the gas in the pipes which supply the burners, and which is entirely beyond the control of most forms of the thermostat. As a substitute for them the following plan is suggested by Prof. Ryder in the *American Naturalist*:—

A triangular sheet of copper, slightly less than $\frac{1}{16}$ in. thick, 18 in. long, and 10 in. wide at one end and running to a sharp point at the other, is supported horizontally upon two legs at the wide end, and at some distance from the pointed end by another leg, these three legs constituting a firm tripod base for the whole device. Under the pointed end of the triangular plate of copper a flame is allowed to burn steadily and permitted to play upon the copper plate at a distance of about 1 in. from its extreme point; the whole plate will soon be heated, but the temperature will be found to gradually diminish towards the wide end. At a distance of about 12 to 13 in. from the point where the flame acts upon the copper plate the temperature will remain steadily at about 56° C. (133° F.), with the temperature of the room at 22° C., or 71° F. As long as the temperature of the room remains nearly the same the temperature of the plate at any given distance from the burner will also remain at the same point. This constancy is due to the fact that the heat which is conducted through the copper plate with constant rapidity from

* We have taken this account of Prof. Ryder's excellent device, shortened and with minor omissions, from the *English Mechanic*. It is especially valuable because of the readiness with which it can be used with an alcohol lamp. It, however, would seem more subject to change in temperature in the room than the water-bath apparatus.—Ed.

its source—the burner—is radiated into the surrounding air at an equally constant rate, and, as one passes towards the wide end of the plate from the burner, trials with the thermometer show that there may be found an infinite number of points in succession at which the temperature is very nearly constant.

In order to use the paraffin itself as an indicator of the proper temperature a new type of cup in which to melt the paraffin was employed—a trough, made of copper, tin-lined, and 6 in. long, 1½ in. wide, and 1¼ in. deep. In practice the cup is half filled with paraffin and placed lengthwise on the copper plate, with its narrowest side towards the flame, and about 9 in. from it. The paraffin cup may be covered with a strip of glass to exclude dust. If the burner plays upon the plate as directed, and the trough is in the proper position, in about an hour it will be found that the paraffin in the trough has been melted at the end nearest the burner, but has remained congealed at the other. Moreover, it will be found that the point where the melted comes in contact with the nearly frozen paraffin is very constant, and it is just at this point where it is safe to place objects which are to be imbedded.

It is clear, from what has preceded, that a shorter cup or trough filled with soft paraffin melting at 36° C. may be placed still farther away from the burner, alongside of the vessel containing hard paraffin fusing at 56° C., while mixtures of turpentine and paraffin, or chloroform and paraffin, would remain molten at a still greater distance from the flame.

The applications and possibilities of this new device will be readily appreciated by histologists and embryologists, since it can be quickly seen if objects are in danger from overheating by simply noting whether the point, where the paraffin remains molten in the trough, has advanced farther from the flame. This can be easily observed through the transparent cover of the trough.

For large laboratories, where a number of students are engaged in imbedding, a simple modification of this device suggests itself. For such a purpose a horizontal disk of sheet-copper, of the same thickness, but 3 ft. in diameter, would afford room for a large number of paraffin imbedding-troughs, which could be arranged in a circle around, and some distance from the centre, at which point a larger burner would be applied underneath. The temperature in such a device would diminish from the centre towards the periphery of the disc. The troughs would be placed upon different radii upon the surface of the disc, just as two or three troughs may be placed upon different radii of the triangular plate, which is practically the sector of a disc, as described above. For imbedding delicate objects, small cups made of tinfoil, pressed into shape in circular, tapering moulds, may be satisfactorily employed with this apparatus, in the same way as the troughs. The device described above can be made by any coppersmith for about two dollars.

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Nerves in the Liver.—Mr. A. B. Macallum, of Toronto, Canada, presents (*in Q. J. Micros. Sci., v. 27, p. 439*) the results of his studies upon the termination of nerves in the liver. These studies were made upon the amphibian *Necturus* and upon the human liver, and studies which were less satisfactory were based upon material from dog, rabbit, and frog. In studies on *Necturus*, the following method was employed:—pieces of liver were hardened for a week or more in Ehrlich's fluid, or for several days in ⅛–⅕ % chromic acid solution. Sections cut with freezing microtome were placed in a weak solution of formic acid (5) for one hour, transferred to a 1% solution of gold chloride for 20 minutes, then washed in distilled water, and the gold afterward reduced in the dark with a 10% solution of formic

acid. The sections then had a deep red color or tinged violet. The chromatine of the nucleus of the hepatic cells took on deep violet tint; the caryoplasma, light violet; while the cytoplasma came out very distinct as a meshwork with pink or light carmine color. The nerve fibres appeared deep violet, and the connective tissue assumed a light red, or sometimes deep red color. Study of *Necturus* was rewarded with better success than the human liver, on account, probably, of the much greater size of the hepatic cells. In the latter case the author finds an intercellular nervous network from which excessively fine twigs are given off, which terminate each in a delicate bead in the interior of the hepatic cells near the nucleus. In *Necturus* the nerves also break up into very fine twigs, which enter the gland cells and branch and terminate in beads or swellings near the nucleus which are in immediate contact with the protoplasmic reticulum within the cell.

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Bacillus tuberculosis.—Dr. H. Tholman employs in his medical practice this useful method of staining *Bacillus tuberculosis*. The patient is directed to collect the sputum in a wide-necked bottle containing a solution of—

Ehrlich's analin water, . . .	8.0 grms.
Fuchsin, ...	2.0 grms.
Carbolic acid, 10%.	0.5 grms.

It here escapes putrefaction, and a saving of time in coloring the bacteria results. The sputum remains in this mixture 24 hours and is then spread out on cover-glass heated in flame decolorized with 5% nitric acid solution. If the sputum be not sufficiently colored in 24 hours it may be then colored by the Koch-Ehrlich method. Longer in the coloring solution the sputum becomes brittle.—*Medical Record*, Oct., '86.

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Petrographical Microscope.—Dr. Geo. H. Williams, of Johns Hopkins Univ., the Professor of Lithology in that institution, having suggested the advisability of constructing a sufficiently inexpensive instrument for rock-study, to meet the wants of most students, the optical firm of Messrs. Bausch & Lomb have constructed an instrument after his designs. One of these instruments was shown by Prof. Williams at the New York meeting of the American Association before the section of geology. We do not design to give a description of the instrument here, but shall perform a service to geology by referring any of our readers to the manufacturers for particulars regarding description, price, etc. The instrument is handy and satisfactory in every respect and more economical than foreign instruments, which must be imported.

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Preparing tendon-cells and cells of loose subcutaneous tissue.—Dr. A. Dogiel obtained very good preparations of tendon by placing rat's tail in Grenacher's alum-carmine for two or three hours, or, still better, for a week or even a month. The tendon bundles swell up and become transparent, and the cells appear beautifully stained. The elastic fibres stand out very clearly. The same effect may be obtained if tendon be placed in a saturated solution of potash or ammonia alum, and afterwards staining with Grenacher's alum-carmine, alum-logwood, hæmatoxylin, eosin, etc. Mounted in glycerin, the preparations keep for a long time, but afterwards a slight discoloration takes place. Permanent preparations of tendon are better placed in spirit than oil of cloves, wherein they are teased out, then dammar or balsam. For the subcutaneous tissue it is recommended to take a piece free

from fat from the inguinal or abdominal region of a mammal, and, having spread it out, to stain with a concentrated solution of fuchsin diluted with an equal volume of water, and then stain under the cover-glass where the preparation lies in half per cent. solution. For permanent preparations picro-carmine, glycerin.—J. R. M. S.

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How to draw with the camera lucida.—In order to draw a picture by means of the camera lucida without painfully straining the eyes, it is necessary that the microscopic image and the paper and pencil be uniformly illuminated. If the image has, in comparison with the paper, too strong a light, the pencil will be seen with difficulty, if at all. On the contrary, if the paper, in comparison to the image, be too strongly illuminated, the delicate outlines of the latter will be indistinct. This difficulty may be remedied by throwing either the image or the paper into a shadow. Both may be done simply with the hand, or by a properly constructed screen of paper, or by a disk of pasteboard set up at some distance, and the like. A few trials with the microscope with different magnifications will afford the necessary experience for properly managing the light. In tracing the outlines of the image under the camera the pencil used should not be too hard, and the lines should be very light.

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Double staining botanical preparations.—The following method is suggested by Prof. J. J. Rothrock, of the University of Pennsylvania:—Immerse the section in an extremely weak solution of anilin green for twenty-four hours. At the end of twelve hours the section will most likely have absorbed all the green, in which case add two drops more of the mother solution. Then take a middling strong solution of Beale's carmine, and immerse the section in it for from one to five minutes only; then prepare with alcohol and oil of cloves in the usual way, bedding in dammar lac or Canada balsam.—*Eng. Mechanic, Sept.* 2, '87.

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Mounting perishable crystal sections.—A mounting medium should be transparent, and colorless if possible, of an index of refraction having reference to the subject treated, and free from moisture. It must not be a solvent of the matters that it is employed to preserve. As media of this kind especially worthy of attention for mounting perishable crystals, or such as lose their polish or become opaque in Canada balsam, as well as in the air, Prof. Johnstone, of Johns Hopkins University, recommends the following:—(1) Finest gum copal dissolved in chemically pure absolute alcohol; (2) Finest copal dissolved in chemically pure absolute alcohol; (3) dammar resin dissolved in rectified spirit of turpentine. No heat should be used in making these solutions, and the resultant liquid should be very thick. (4) Dammar resin dissolved in well-boiled balsam copaiba; (5) boiled Chian turpentine dissolved in boiled balsam copaiba; (6) dammar resin boiled until the rising scum becomes nearly dissipated, the remaining scum to be removed with a spoon.

EDITORIAL.

The death of Professor Spenser Fullerton Baird has doubtless long since become known to our readers. Professor Baird has been since 1850 intimately connected with the best scientific work in this country, especially in the department of zoology, and has created the U. S. Fish Commission and the National Museum. Of the importance of the former institution we

may judge from the very general recognition its work has received in foreign countries, for some of which it has served as a model, and from the honors given to Professor Baird and his colleagues in this line of work at various times by foreign powers. The work which he inaugurated and so well established will live after him, for now the worth and value of both these scientific institutions, whose aims are to systematize the information regarding even the meanest item of human daily life, and of information bearing on that, is universally recognized to be of a character of the highest practical as well as scientific value.

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We regard the appearance of a work like Haddon's Practical Embryology as another evidence of the advance of medical learning and literature in the right direction. For, as is universally admitted, the more general biological instruction which enters into the mental make up of a medical man the better, for medicine is 'passing out of the regions of empiricism and rule-of-thumb treatment, or maltreatment,'* and becoming a science. A great step of progress has been made when a great text-book has been produced, and Mr. Haddon has placed medicine under a very great debt by the preparation of his admirable exposition of the science of embryology—such an important chapter of the biological text-book of 1887. His work deserves to come to the notice of every one who claims to know the animal body with any approach to thoroughness, not in competition with the classic work of the wonderful F. M. Balfour, for that work is too special for any but the special embryologists, but for those who would understand this science without becoming more than readers. We do not see how any one can fail to understand the clear treatment, and congratulate medical literature upon the accession to its ranks of this admirable addition.

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The Journal of Morphology has made its appearance from the hands of Ginn & Co., of Boston, long expected by the zöologists of this country as the only distinctively American magazine in this department not connected with some society or university as the official publication; though not the only morphological journal, as we recall the Bulletin of the Cambridge Museum, the Transactions of the Connecticut Society, Biological Studies of Johns Hopkins Univ., and several others equally conspicuous. We are glad to welcome this new venture in scientific journalism, and trust it may receive sufficient patronage to establish it firmly and permanently. Its quality, if we may judge from the initial number, will make it a necessary journal whereever morphological journals are necessary. Would they were more universally so. Prof. Whitman has treated his readers to much of very great interest, and presented in the very highest style of the art, both as to the text and as to the execution of the plates. Without attempting, at this time, any analysis of the first number, we may say that it contains much that must interest any student of animal form and structure, and is a necessity to every worker. The second number is to appear in January, or as soon after as possible.

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We are glad to acknowledge the receipt from Mr. John Sloan, of New Albany, Indiana, of a slide of *Amphipleura peleucida* containing four specimens beautifully mounted, from 1. Aberdeen; 2. Moissac, France; 3. Erie Co., N. Y.; 4. Southern Indiana.

* Prof. H. N. Martin in address at opening of new biological laboratory at Johns Hopkins Univ., Jan. 2, 1884.

Referring to an editorial in our August number, in which we urged the importance of teaching microscopy in medical schools, the editor of *The Medical and Surgical Reporter* says :—' There is no denying the fact that many medical men are much less familiar with microscopical work than they ought to be. In no regard is this state of affairs more to be regretted than in the matter of the diagnosis of affections of the kidneys. The usual method of examining the urine only for albumen and sugar is too incomplete for the status of medical science in these days. If a physician has no microscope, or cannot use one, he will miss many a case of kidney disease which he would detect if he were better provided or better informed. No doubt a man may be a very successful practitioner without using a microscope, but no doubt, also, he would be a better physician if he did use one. To do this does not require the expenditure of much money or any prolonged course of study, and it would be a decided gain in the direction of scientific precision if more medical men would buy an instrument of moderate cost, and use it frequently. Of course the best way to learn to use the microscope is to have the help of a competent teacher, but all that is essential for ordinary practice can be learned from books ; and any one who will try it will be astonished to find what he can accomplish in a little while in this fascinating and useful study.'

NOTES.

The sanitary convention of the Michigan State Board of Health meets at Albion, Mich., on December 6 and 7, '87, L. R. Fiske, D. D., LL. D., presiding. ' This is not merely a doctors' convention, but it is for the people generally.' Among the topics for discussion are :—Disposal of waste in Albion by sewerage and otherwise, School Hygiene, Money value of sanitary work, and others. The activity in this State in health matters is, perhaps, largely due to the presence there of a most energetic investigator, Dr. Vaughan, who has already reached important results from his studies.

The loss of hair and its cause is considered in a brief paper by Dr. T. W. Mills in the *Canadian Record of Science* (Jy.,'87). Admitting that we seem to be bound toward a 'bald and toothless future,' the writer considers the two assigned causes, to wit :—First, that of Mr. Eaton, who ' attributes the growing tendency to loss of hair prematurely to wearing tightly-fitting hair coverings, living within doors, and keeping the hair closely cropped.' Mr. Eaton further thinks that the same principle, viz., disuse, will account for the early failure of the teeth. Secondly, that of Mr. Gouinlock, who attributes the loss of hair to the wearing of hats which constrict the arteries which nourish the scalp. Having found these insufficient to fully explain the facts, Dr. Mills is inclined to find the prime causes of baldness in the overwork of the brain, the excessive nervous work of the man of to-day, as shown in prevalence of nervous maladies which draw off from the blood which should go to the scalp to supply the brain ; that is, the loss of hair is one of many indications in the weakness of the other physical systems that man is increasing the nervous system faster than the other systems can progress. ' Baldness is one more of the many warnings of our day—one of nature's protests against the irregular and excessive activity maintained in this restless age.'

More new elements.—The investigation of the so-called ' rare earths,' which has engaged the attention of Lecocq de Boisbaudran, Crookes, and other investigators, has rendered it evident that several of the bodies which had been regarded as elements were themselves compounds of two or more elements. In this way, some four or five of the supposed elements of the ' rare earths ' have been made out to contain perhaps ten or twelve different elements, the nature of which has, however, not yet been determined chiefly because the material from which they can be obtained is only of rare occurrence, and because the separation of the several bodies is excessively difficult and tedious, owing to their great similarity. The spectroscope, however, furnishes the chief guide in ascertaining the claims of any of the bodies to the title of an element.

Gerhard Krüss and L. F. Nilson have recently studied five of these bodies, namely, *Ermium*, *Holmium*, *Thulium*, *Didymium*, and *Samarium*, and have shown conclu-

sively that none of these can be regarded as elements. In fact, it appears from their investigations that not less than about twenty new elements will have to be assumed to take part in their constitution.—*Am. Druggist.*

Amphipleura pelucida.—We have received a very handsome photograph of this diatom from Mr. N. F. Smith, of Hartford, Conn. It is enlarged 3000 diameters from specimen on Möller's Balsam 'Probe-platte,' by Dr. A. J. Wolff, with Spencer $\frac{1}{16}$ homogeneous immersion lens, numerical aperture 1.35.

Prof. C. R. Barnes, one of the editors of the *Botanical Gazette*, has accepted a position at Madison, Wisconsin, at the University of Wisconsin, as Professor of Botany.

It is thought that Prof. Henry Drummond, of University of Edinburgh, the well known author of Natural Law in the Spiritual World, will be called to the position vacated by President James McCosh at Princeton University.

MICROSCOPICAL SOCIETIES.

Essex County, N. J.

The first meeting of the season was held at the residence of Geo. S. Allan, D. D. S., Montclair, N. J., on Thursday evening, Sept. 15th, the business of the evening being the election of officers for the ensuing year. The following gentlemen were elected as officers of the society:—Dr. Geo. S. Allan, president; Frank Vanderpoel, secretary; Geo. S. Woolman, treasurer; Executive Committee, Messrs. Jay L. Smith, Rev. F. B. Carter, W. C. Gardner.

The duties of the executive committee were defined as being similar to those of the executive committee of the American Society of Microscopists, and they began their labors immediately by obtaining promises from almost all of the members present to prepare papers for the coming meetings.

The outlook was very favorable for a successful season, and the feeling of encouragement to original research was very great. During the evening, Mr. Jay L. Smith, the retiring secretary, gave an account of the Pittsburgh meetings of the American Society, after which the meeting adjourned.

Morgan W. Ayres, M. D., *Secy. pro tem.*

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The second meeting of the season was held at the residence of Mr. H. F. Crosby, Montclair, N. J., on Thursday evening, Oct. 6th.

After the regular business of the evening had been attended to, the members were shown a number of sections of the earth-worm (Lumbricus Agricola) which had been carefully prepared and mounted by Messrs. Smith and Gardner. The number and structure of the different muscular bands, the position of the setæ, the muscles controlling the latter, and various other disputed points about the worm's anatomy were very clearly shown.

Under a dissecting microscope a worm had been placed, the first fifteen somites having been laid open, disclosing to view the various internal organs. To those to whom the subject was new, it was rather surprising to see so much complication in a creature of such apparent (external) simplicity as a common earth-worm, and all of the members felt that this, one of the humblest of created beings, apparently had enough about its structure to astonish and interest the most intelligent student of microscopy. The society adjourned to meet two weeks later at the residence of Mr. J. L. Smith, West Orange, N. J.

Frank Vanderpoel, *Sec'y.*

At the third meeting of the society, held Wednesday evening, Nov. 2d, the chief paper of the evening was a report by Rev. F. B. Carter upon original studies upon the the rhizopoda. We regret that this paper did not reach us in time for reproduction in the Journal.—[Ed.]

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San Francisco, Cal.

The meeting was held as usual Sept. 28th, Vice-President Dr. Ferrer in the chair.

Dr. M. C. O'Toole, of San Francisco, was elected a regular member.

Dr. Henry Ferrer exhibited a new rectilinear lens of wide aperture made by Steinheil of the old Fraunhofer Institute of Munich, especially for photographic purposes. It is the lens used by the Austrian government to produce reduced copies of charts

and war maps, so that they may be conveniently carried in the pockets of the officers. It secures as perfect definition at the periphery as at the centre. The lens is accompanied by a table by means of which one can easily calculate exactly what extension of camera and distance from the object is needed to secure any desired enlargement or reduction.

Dr. Ferrer exhibited some work he had done with the lens, producing reduced copies of some fine large drawing of his own, made with india ink, and showing sections of the human eye. The photographs and drawings were much admired. As such interest was manifested in the drawings, Dr. Ferrer exhibited the originals which they represented. The eye is submitted to the bichromate of potash hardening process, sometimes requiring months to harden. Then the specimen is imbedded in celloidin upon a base of cork. Placing this in the microtome, the eye is held firmly in the bedding, and perfect, thin sections secured. A number of these were shown well mounted for microscopic examination. After bedding, the eyes can be kept indefinitely by immersion in alcohol, and are always ready for cutting more sections or for study of the exposed surface and adjacent parts. To show the excellent work being done by members of the San Francisco Microscopical Society, Secretary Wickson read a letter which was recently received from Dr. Frank L. James, of St. Louis, editor of the *St. Louis Medical and Surgical Journal*, in which he made allusion to mountings of *Bacillus anthracis in situ* in lung tissue, made by Dr. S. M. Mouser, of San Francisco, stating it as his belief 'that a better preparation never has been made'—that he did not rely solely upon his own judgment but cited the verdict of Dr. D. V. Dean, of St. Louis, a thorough microscopist, who, after a long and careful examination, pronounced 'the slide the best he had ever seen.' This testimony is creditable to Dr. Mouser and to the San Francisco Society, and indicates that in scientific work, as in other efforts, California is making most gratifying progress.

By unanimous vote Dr. Henry Ferrer was elected president of the society to fill the vacancy occasioned by the resignation of Mr. Wickson, who retired from the presidency to take the chair of recording secretary.

At the next meeting there will be a demonstration of apochromatic lenses, in which some of the latest acquisitions by members of the society will be subjected to comparative tests.

NOTICES OF BOOKS.

An introduction to the study of embryology. By Alfred C. Haddon. Philadelphia. P. Blakiston, Son & Co. 1887. pp. 336, figs. 190.

We are thoroughly pleased to be able to present to our readers a notice and review of this valuable work and a very hearty endorsement of it. Of the importance of biological information to medical men too much has been written to make our omission on that point unjustifiable, and of the position which embryology holds in biology the same may be said. Mr. Haddon, thoroughly qualified by having studied embryology with the greatest embryologist, the late Professor Balfour, gives to the medical profession more especially, but to all biologists as well, a treatise upon the entire subject of animal embryology, exhibiting the present status of investigation and opinion in all departments. In treatment, the author's plan is as follows:—The comparative method is strictly adhered to throughout and the discussion by organs followed through their history in all animal form—the egg, segmentation and gastrulation, origin of the misoblast, general development of body form and embryonic form and appendages, epiolastic organs, glands, nervous system, sense organs, organs from misoblast, muscular system, body cavity, vascular system, excretory organs, generative organs, general considerations.

This hasty sketch is designed to show the plan in dealing with his subject. To one who is familiar with the subject of animal embryology, as it exists at the present day, with hundreds of writers who are investigating the topics, many of them still in hot dispute, the writer will seem to have performed a very difficult task in stating clearly the history of any organ the reader cares to state, giving as fact the undoubted portion and abstaining from discursive discussions on many of the fascinating theoretical digressions which have a merely speculative basis. For Mr. Haddon has summed up in his volume of 336 pages, in clear and readable style, the entire matter, and pre-

sented to us the most valuable text-book of embryology which has appeared since Balfour's Comparative Embryology.

The work is brought down to include even the latest information on all matters. Thus, in the account of the fœtal membranes of mammals and their origin, the results of the very recent researches of H. F. Osborn and Caldwell, which contain important additions to our former information, are summarized. But while the writer deals largely with fact, so far as it is settled what fact is, he is not dogmatic, nor does he fail to impress on his readers the important idea that embryology is not a dead science with all its parts stiff, rigid, and fixed; on the contrary, he gives sufficient scope to the speculative element in embryology, so characteristic of a young and growing department of science. By the device of introducing such matter in a finer type, it is sorted for the benefit of those readers who do not care to follow the theoretical aspects of questions. He has also a chapter at the close of the book wholly devoted to the consideration of general questions. To add to the usefulness of the work the indexer and bibliographer have performed their parts admirably.

It would be a pleasure to follow the author more into detail, but this our space will not permit. The figures employed to help out the meaning of the text are excellent, selected from a great variety of sources, and well copied; they clearly show the point to be illustrated. The work will be desired by all working embryologists, but should be brought to the notice of all medical students, for whom it is especially designed. We should be glad to see its introduction upon the works of reference and study in all medical colleges, and to find it in the library of every live practitioner.

Intermediate Anatomy, Physiology, and Hygiene. By John C. Cutter. Philadelphia. J. B. Lippincott & Co. 1887. (pp. 221, figs. 69).

Twenty years ago no treatise on human physiology was better known than Cutter's 'Anatomy, Physiology, and Hygiene.' Its disuse of late has arisen from the fact that it was not revised and renovated to keep pace with the immense recent advances of the science. It is fortunate for the cause of elementary instruction in this department that a son of the elder Cutter has followed in his father's track, learned the practice of medicine, and attempted to place before the school world an elementary work on physiology, which is written by one who knows the subject and can avoid telling too much. A high school student will learn much from the work, and what he learns will be useful and a foundation for later studies. To meet the demand for physiological text-books which treat of the harm to the body from stimulants in general and alcohol in particular, the reviser has added to the hygienic part of the old editions special paragraphs upon alcohol, tea, coffee, etc., which occupy due prominence and are clear and intelligible, not a mere meaningless rant on the harm without stating wherein the harm lies. Each function, as it is described with the organs which serve it, is considered separately as to its hygiene or healthy operation, and as to the common practices which interfere with its healthy working.

Exchanges.

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

Correspondence relative to exchange in microscopical material or prepared mounts.
HENRY L. OSBORN, Hamline, Minn.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired. MARY A. BOOTH, Longmeadow, Mass.

Fossil Diatomaceous deposits (marine) wanted from Bermuda, Virginia, Maryland, California, etc.
I. ELLIOTT, Ardwyn Villa, Aberystwith, Wales, England.

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Orders for slides advertised by A. J. Doherty in the Journals from January to April, 1887, may be sent through the Business Manager, P. O. Box 630, Washington, D. C.

A few copies of Leidy's Fresh-Water Rhizopods, of North America, can still be had at $5 00 per copy.—P. O. Box 630, Washington, D. C.

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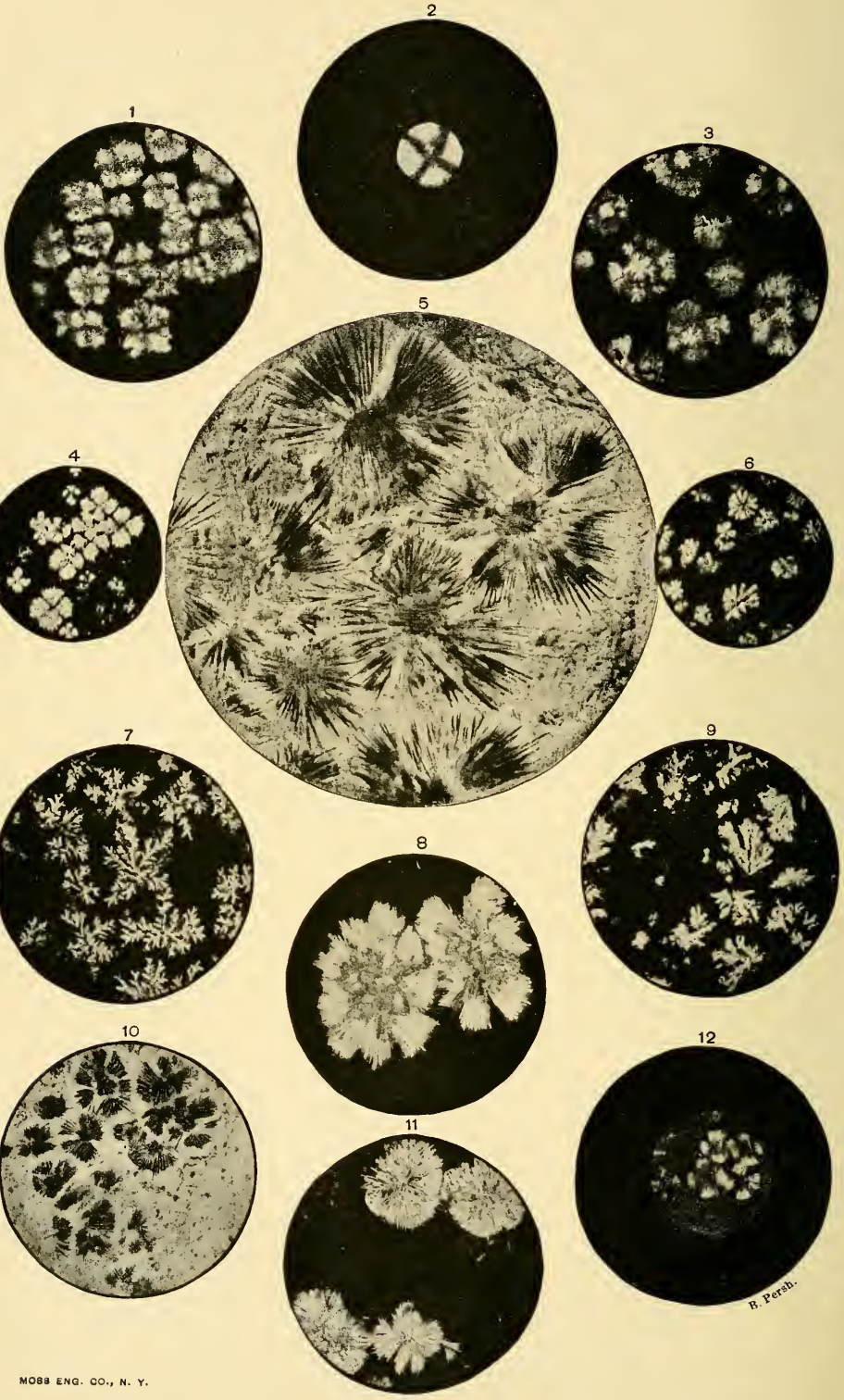

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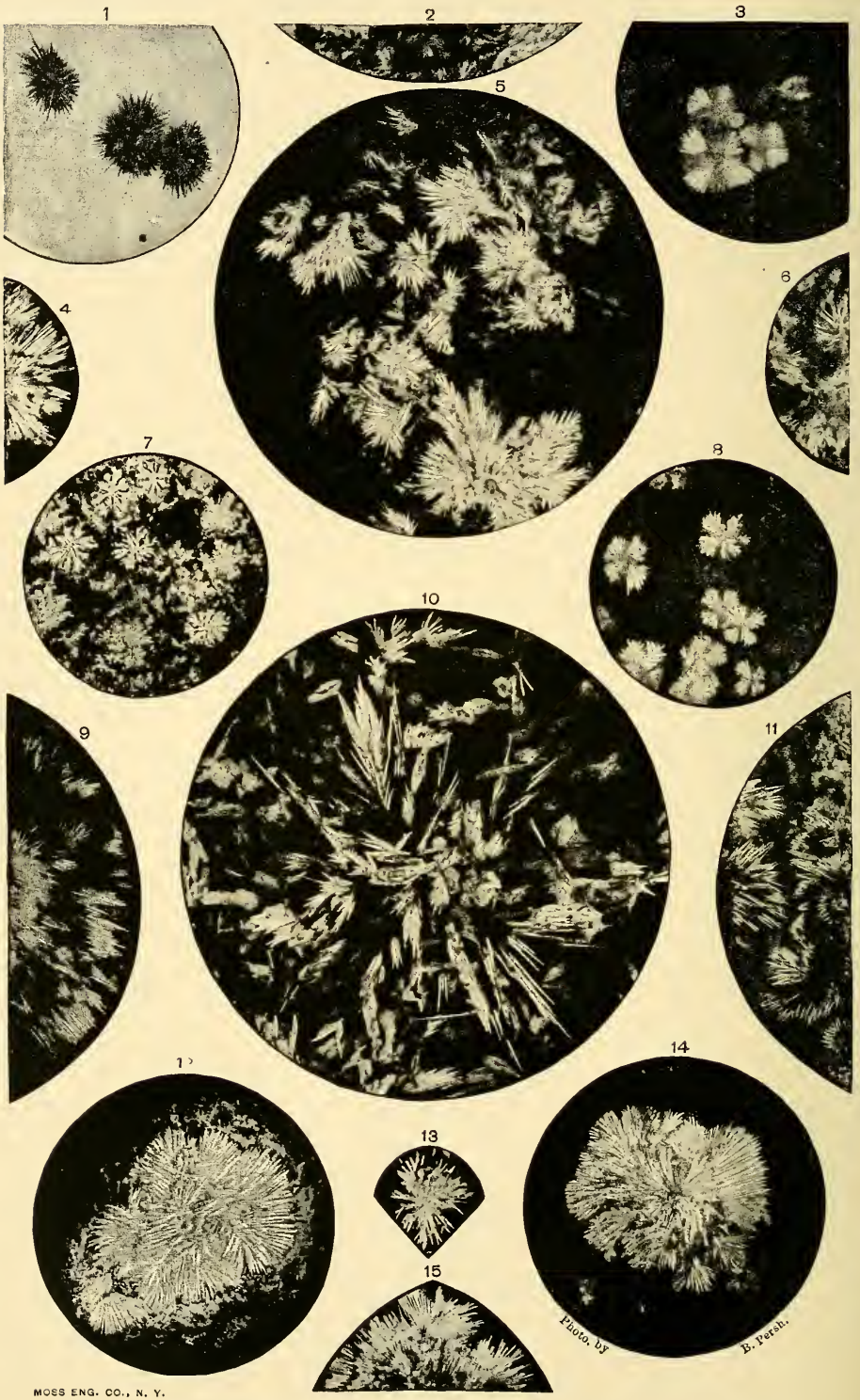

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Spirillum, Finkler and Prior, in hepatized lung-tissue.*

BY THEOBALD SMITH, M. D.,

WASHINGTON D C.

The invariable presence of a specific microbe, the so-called comma-bacillus, in the intestinal tract of cholera patients was first demonstrated by Koch.

The interest which after the publication of his investigations attached itself to forms resembling this comma-bacillus led to the more careful study of two other microbes closely resembling this. One, found by Finkler and Prior in the stools of patients affected with cholera nostras, gave rise to much discussion at the time as to the real value and significance of Koch's discovery. Careful observation, however, of the growth of this second form in culture media showed well-marked and constant differences between it and Koch's comma-bacillus. Moreover, its presence in cholera nostras has been demonstrated in a few instances only, and it has been found by W. D. Miller in a tooth cavity and by another observer in the cæcum of a man who committed suicide.† A third form, found by Deneke in cheese, was likewise differentiated from Koch's comma-bacillus by means of cultivation, so that the latter still remains to be found in localities other than the intestines and dejecta of cholera patients.

Recently these comma-bacilli have been classed as spirilli. Although there may be some doubt as to the strict propriety of this nomenclature, it is certainly the best at our disposal, and in this paper they shall be so denominated.

Several months ago, in examining cultures from hepatized lung-tissue of a cow, the result of pleuro-pneumonia, I found in every one of twelve tubes several kinds of bacteria. Among others, a spirillum was present in almost every tube, the close resemblance of which to the spirillum of cholera and to the others mentioned above was of sufficient importance to warrant a more careful examination. Various media, including nutrient gelatin and agar-agar, blood serum and beef infusion had been inoculated by adding a minute bit of recently hepatized tissue (red hepatization) to each tube. The various microbes, chiefly bacilli, which had multiplied in the cultures after one or two days, had, very probably, found their way into the lung-tissue shortly before or after death and multiplied there. The heat was very great at the time and no special precautions had been taken by those removing the lungs from the body to keep foreign bacteria away. The source of the spirillum cannot, therefore, be inferred. It may have come from the ice which had been placed upon the lungs during transportation. After the rather laborious process of isolating it from several liquefying bacilli various culture media were inoculated in order to observe its mode of growth. Through the kind-

*From *Medical News* Nov., 5, 1887, p. 536. † Flügge: Die Mikroörganismen, 2d ed., p. 385.

ness of Dr. E. O. Shakespeare I was enabled to compare it with cultures of the three spirilla thus far discovered. By making cultures of all at the same time and exposing them to similar conditions of temperature, relative alkalinity, and concentration of culture media, accurate comparisons could be made.

The spirillum under consideration resembles the spirillum of Finkler and Prior so closely that it may be regarded as a slightly modified variety of this microbe. For the sake of brevity it will be denominated spirillum β, the original spirillum of Finkler and Prior spirillum α. The spirilla mentioned above have been very carefully described in many publications by writers on cholera, so that the reader will be spared any unnecessary repetitions.*

In tubes and on plates, spirillum β liquefies the commonly used 10 per cent. gelatin *much more rapidly* than spirillum α. At a temperature of 22° to 24° C. the plate containing colonies of the former was completely liquefied on the third day, that containing colonies of the latter only partially so. The colonies† of these two forms do not differ in any other way. Before liquefaction sets in, they present a homogeneous, circular disk with sharp, regular margin and a darker central nucleus which appears on the second day.

In tubes spirillum β liquefies the gelatin twice as rapidly as spirillum α during the first two or three days. Later on, both microbes seem to experience the same difficulty in the downward liquefaction of the gelatin, and after the first week they look alike.

On boiled potato spirillum α grew best at 20°–24° C. Spirillum β multiplied very slightly at this temperature. A feeble growth may appear at 35° C., which then resembles that of spirillum α in color and consistency. In general the latter grows far more vigorously on potato than the former.

In liquid media such as simple beef infusion, or beef infusion containing 1 per cent. peptone, both made slightly alkaline with sodium carbonate, the multiplication of this organism and of the other spirilla deserves some attention. The employment of liquid media as an accessory means of distinguishing them from one another has not received any attention whatever, although it is of considerable value as the following shows:—If the spirilla of Koch, Finkler and Prior, and Deneke be added to beef infusion and the tubes placed in a temperature of about 35° C. the following changes may be seen after twenty-four hours. The tube inoculated with Koch's spirillum will be clouded and the surface of the liquid covered with a delicate but complete membrane. Beneath this the upper strata will be quite turbid from the very abundant massing of spirilla. The infusion inoculated with the Finkler and Prior spirillum is barely opalescent, without any trace of a surface membrane. The third tube inoculated with the Deneke spirillum remains permanently clear. These differences have reappeared with each succeeding test, so that they may be regarded as constant; the same is true of beef infusion containing 1 per cent. peptone.

That the spirillum of Koch has a tendency to rise to the surface in culture media and there form a membrane is not a new fact. It has been made use

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* Very good descriptions will be found in Flügge (l. c.)

† In studying these it is very important not only to know the concentration of the gelatin employed, but to keep it in as uniform a temperature as possible, since both of these conditions have a marked influence upon the characters of the colony in its development. It is exceedingly difficult to realize a uniform, low temperature, both in summer and winter. In summer, the temperature in this climate is above the melting point of 10 per cent. gelatin for weeks and months. In winter a thermo-regulator usually fails within the narrow limit between the average temperature of the laboratory and that at which it is desirable to maintain the gelatin. A given per cent. of gelatin at a low temperature is equivalent to a larger per cent. at a higher temperature. The density, in other words, is increased when the temperature falls. We know, for instance, that the most important diagnostic feature of the cholera spirillum is the peculiar appearance of its colonies on the gelatin plates—a certain irregularity of outline combined with a marked refrangibility as of 'particles of glass.' The writer has, however, seen these very colonies present smooth, sharply outlined disks, differing from those of the other spirilla only in size. This loss of characteristic features was due to an abnormally low temperature at the time. A few days later, another plate growing in a higher temperature presented colonies of the usual type.

of by investigators (Schottelius. Büchner, Gruber) in demonstrating the presence of this microbe in cholera stools. A minute portion of the latter is added to beef infusion and the whole allowed to stand in an open vessel in a warm place. After a few days, sometimes only after five or seven days (Gruber), the spirilla will be found on the surface. It must be borne in mind that by this process a number of bacteria are introduced into beef infusion at the same time with the spirilla, which may interfere more or less with the growth of the spirilla at the surface. That the three spirilla may be thus readily distinguished in pure beef-infusion cultures has not yet been suggested so far as I know. It should not be lost sight of in endeavoring to identify the spirillum of Koch in cases of suspected Asiatic cholera.

The spirilla α and β entirely agree, so far as their growth in liquids is concerned. In a few cultures of β. a membrane has appeared, but only after standing undisturbed one or two weeks.

In milk kept at 22° C. there is for nearly two weeks no microscopic change. At the end of this time, however, spirilla α and β have caused precipitation of the casein. The precipitate contracts into a very firm mass at the bottom of the culture tube, and a layer of acid watery fluid, equal in bulk to about one-half the original volume of milk, rests above the coagulum. A parallel culture of the spirillum of Koch shows even at the end of three weeks no change. When placed at 35° C. the process of precipitation and settling sets in in four or five days with the spirilla α and β, while no change is observed in cultures of the spirillum of Koch after two weeks.

The microscopic examination of the various culture media reveals organisms not differing appreciably in size or form from the other comma-bacilli. It is, in fact, quite impossible to distinguish them by this means alone, especially when we bear in mind that all vary slightly in dimensions and form according to the composition of the culture medium and the age of the culture. The short comma form always predominates. In older cultures, particularly in beef-infusion, numerous perfect spirilla are found consisting of from one to very many complete revolutions of the spiral body. When dried on cover glasses and stained in an aqueous solution of fuchsin prepared from an alcoholic solution these longer spirals are, as a rule, resolved into commas, and the true spirilla form is more or less obliterated. The comma forms are exceedingly active in their movements, even when the cultures are two or three weeks old. They dart to and fro with great rapidity, or resolve about one of their extremities as a fixed point. The spirilla, whose movements are slower, show very well the corkscrew-like revolution about their long axis as they move across the field.

This spirillum was destroyed by a ten minutes' exposure to 58°–60° C. When taken from gelatin cultures and dried on sterile cover-glasses it was incapable of infecting beef-infusion after four hours, indicating that in cultures four to five days old no resistant spore-state had been formed. No inoculation or feeding experiments were made upon animals.

The rather tedious and laborious work of identifying this microbe has led to the following results:—A comma-bacillus or spirillum not distinguishable from the spirillum of Koch under the microscope was found in hepatized lung-tissue. After isolation and cultivation in different media it resembled the spirillum of Finkler and Prior very closely, and was therefore easily distinguishable in this way from Koch's cholera spirillum. It differs from the former only in liquefying gelatin more rapidly and in growing more feebly upon boiled potatoes. The name, spirillum of Finkler and Prior β, is provisionally suggested.

The conclusion which was reached by Koch that the spirillum found by him is exclusively associated with Asiatic cholera is not modified but rather

confirmed indirectly by these results. They throw no light, however, on the supposed relation between cholera nostras and the spirillum of Finkler and Prior.

Internal parasites of teredo navalis.

By W. F. DURAND.
AGRICULTURAL COLLEGE, INGHAM CO., MICH.

In the autumn of 1886 a large float at the Norfolk navy yard was hauled out of the water for repairs.

On stripping off the old bottom it was found to be badly attacked by the mollusk *Teredo navalis*, the so-called 'ship-worm.' Many of them were found in their burrows, and, thinking that they might prove interesting for microscopical examination, a number were collected for that purpose.

Remembering the wonderful series of internal parasites of the white ant, and Leidy's statement that wood-boring and wood-feeding animals are apt to be infested with such parasites, it seemed at least possible that some such forms might be found within the *teredo*.

Examination proved the correctness of the supposition, showing various forms, as represented in the accompanying sketches.

Fig. 1.

Fig. 2.

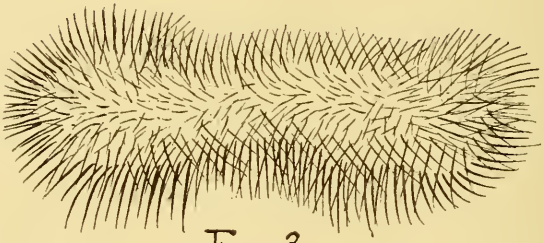
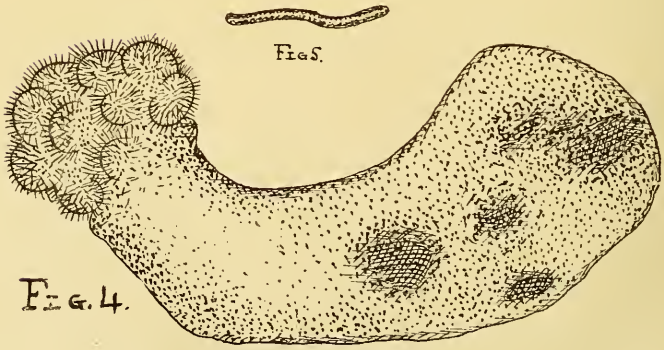


Fig. 3.



Parasites of *Teredo navalis*.

Type A (see fig. 1) was most common, and seems to be in some ways similar to that type of the white ant series named by Leidy *Trichonympha agilis*. It has not the long coma distinctive of the latter, but instead seems to have a shorter development at each end, that at what may be called the head end being usually set oblique to the general direction of the body. It is not impossible that the coma at the tail end is formed of the ends of filaments inserted near the head or along down the body; but, if so, it has not the capability of the free swirling motion frequently noticed in the coma of *trichonympha*, and the appearance was not very unlike the accompanying sketch. The color was a light semi-transparent gray, with a few darker spots, and usually an appearance as of a nucleus.

Their movements were quite lively at first, but they do not seem to be as hardy as *trichonympha*, so that they could only be observed for a few moments, after which motion ceased and dissolution set in.

Another especial point of difference between this type and *trichonympha* is the absence of the marked spiral form of structure so peculiar to the supposed immature forms of that type. In point of size they are not very different, ranging from 50 to 75 μ in length by 20 to 30 μ in diameter.

The form represented in figure 2 is, perhaps, another stage of A, though it presents quite noticeable points of difference. The head end is quite pointed, the coma radiating and flowing backward from it as in *trichonympha*, though not nearly as long, while the body, as a whole, increases in size toward the tail, giving it a marked conical aspect. At the tail-end, as in A, is found a short, bristling coma.

In point of size, these were rather smaller than A, ranging about 50 μ in length by 15 in diameter.

The form C (see figure 3) has the appearance of being quite distinct and remarkable. It was about 130 μ in length by 75 μ in breadth, with sluggish, though quite distinct, movements. The chief peculiarity, as shown by the figure, is the abnormal development of hair-like filaments all over the body surface, giving it quite the appearance of a porcupine, or a hedge-hog at bay.

No differentiated internal structure could be observed in this form, perhaps on account of the great development of coma.

In D (see figure 4) we have another apparently quite distinct, and perhaps the most remarkable, form. It was the largest in size, ranging from 130 to 160 μ in length, with proportionate breadth, as shown. In motion it is slightly similar to Leidy's *Pyrsonympha vertens*, though totally different in appearance.

As far as observed, what may be called the hinder portion of the body is little moved, if at all. The outline and structure of this portion seemed to be more or less vague and indistinct. Not so, however, with the head-end, which is a well-defined, somewhat *morula*-shaped, object, bristling all over with short hairy filaments or spines. This the creature raises and waves about in all directions with a ponderous swaying motion, the remainder of the body remaining stationary.

An object more threatening or forbidding in appearance than this as it waves its knotty, spine-covered head about, is seldom to be found in microscopical research.

Lastly, we have the form E, figure 5. This has much the appearance of a nematoid worm. In size they were about 10 μ long by 2 μ in diameter. No differentiation into head or tail-end was observed. They were frequent and lively in their movements.

Taken as a whole these parasites were far less numerous than those usually found in the white ant. They were also less hardy, rendering their observation for any great length of time impracticable.

Slightly saline water was the only medium employed, and it is possible that with some other medium, such as serum or the white of an egg, their existence might have been considerably prolonged.

Unfortunately, however, the supply of *teredo* suddenly fell short, and, no more being obtainable, the observations were brought to a close.

As far the author is aware, these parasites have not heretofore been noticed, or at the most, but little is known of them. It is possible that further examination in this direction may reveal the existence of still other forms than those noted here, or of forms intermediate between some of these.

It remains also for future observation to determine the life history, habits, and detailed structure of these creatures.

It was the author's intention to repeat these observations and make this series of parasites the subject of more prolonged examination. The opportunity for such study, however, being relegated, seemingly, to the distant future, these imperfect results of the first observations are given as a hint where a comparatively little worked field of examination may be found.

The crystallography of butter and other fats.—IV.

By Dr. THOMAS TAYLOR,

U. S. AGRICULTURAL DEPARTMENT, WASHINGTON, D. C.

EXPLANATION OF PLATE V.

Crystalline Formations of Oleo and Oleomargarine.

Fig. 1. Boiled oleo by plain light, exhibiting spines. × 140.

Fig. 3. Boiled oleo by polarized light, showing a cross. × 140.

Figs. 2, 4, 5, 6, 9, 11, 12, 13, 14, and 15. General appearance of oleomargarine as sold in the market. × 75 to 110.

Fig. 7. Armour's oleomargarine boiled and cooled. × 140.

Fig. 10. A specimen of oleomargarine composed mostly of stearin and cotton-seed oil. × 110.

Fig. 8. Boiled butterine (Armour's make), showing the oleo crystals. × 110.

The above crystals were all photographed by polarized light, except in the case of fig. 1, which was by plain light.

EXPLANATION OF PLATE VI.

Figs. 1 and 3. Respectively primary and secondary crystals of loon fat. × 110.

Figs. 2 and 8. Primary and secondary crystals of musk-rat fat. The primary (No. 2) are always very small, measuring about three-one-thousandths of an inch in diameter.

Fig. 4. Crystals of oleo. × 140. (Extract of beef-fat).

Fig. 5. Crystals of common lard by plain light. × 400.

Fig. 6. Secondary crystals of butter. × 110.

Fig. 7. Crystal of beef-fat. × 140.

Fig. 9. Crystals of deer-fat. × 140.

Fig. 10. Lard by plain light. × 140.

Fig. 11. Crystals of the solid fat of cotton-seed oil. × 110.

Fig. 12. Neutral lard crystals, immature. × 140.

MICROSCOPICAL TECHNIQUE.

Staining of schizomycetes in sections and dry preparations.*

C. Gram proposes the following method of producing an isolated staining of pneumonia-cocci, leaving the nuclei and other elements of the tissue uncolored, the deep staining of the cocci usually found in the several shells causing them to be more readily found than in ordinary preparations. The method he considers applicable also to almost all examinations of schizomycetes, in sections and dry preparations.

He takes the ordinary Erlich's anilin-gentian-violet solution. The sections to be examined for schizomycetes must be preserved in absolute alochol, and brought direct from it to the staining fluid; here they remain from 1–3 minutes (in the case of preparations of tubercular bacilli from 12–24 hours); they are then placed in an aqueous solution of potassium biniodide (1 part I, 2 parts KI, 300 parts water), without or after a slight washing with alcohol, where they remain again from 1–3 minutes. A precipitate takes place in the iodine solution, and the sections, previously a dark blue-violet, become a blackish purple-red. They are now laid again in absolute alcohol until the color is again entirely removed, the alcohol being renewed once or twice. They are then clarified in the ordinary way by clove oil, the remainder of the pigment being given off to the oil. The nuclei and the fundamental tissue are now colored light yellow by iodine, while the schizomycetes, if present in a section, are of a conspicuous intense blue color, often nearly black, the color being much deeper than in any other mode of staining. After the application of alcohol the sections may be placed for a moment in a weak solution of Bismarck brown or vesuvin, in order to produce a double-stain.

Permanent preparations have been kept for four months without change in Canada balsam, hylol, or gelatin glycerin. The whole of the process takes a quarter of an hour, and the preparations may remain for some days in clove oil without losing their color. The method can also be applied to dry preparations, the cover-glass being treated as a section. The following tissues were tested for schizomycetes by this method:—Pneumonia cruposa, pyæmia, nephritis suppurativa, arthritis suppurativa after scarlatina, multiple brain diseases, osteo-myelitis, typhus, liver abscesses, erysipelas, tuberculosis, cattle distemper, as well as the bacteria of putrefaction. After treatment with iodine the following schizomycetes remained colored in alcohol:—The cocci of crupose pneumonia, the schizomycetes of pneumonia, the cocci of the liver abscesses after perityphlitis, the cocci and small bacilli in circumscribed infiltration of the lungs, the cocci of osteo-myelitis, of arthritis suppurativa after scarlatina, of nephritis suppurativa after cystis, those of multiple brain abscesses, of erysipelas, the bacilli of tubercular cattle distemper, and the schizomycetes of putrefaction. On the other hand no staining was exhibited of the capsular cocci in a case of crupose pneumonia, or of the capsules without cocci in another case, or of the bacilli of typhus.

Staining bacillus tuberculosis.

The following modification of Ehrlich's method of staining *Bacillus tuberculosis* was devised by Dr. Heneage Gibbes:—

'(1.)† Take 2 grms. of magenta crystals, 3 grms. of pure anilin, 20 cc. of alcohol (specific gravity .830), 20 cc. of distilled water. Dissolve the anilin

* *Journal Royal Microscopical Society* for 1884, p. 817–8.

† 'A Synopsis of the Bacteria and Yeast Fungi, and allied species,' by W. B. Grove, p. 103–4.

in the spirit and rub up the crystals with it in a glass mortar; add the spirit gradually till they are dissolved; then add the water slowly, while stirring, and keep in a stoppered bottle. (2.) Make a saturated solution of chrysoidin in distilled water, and add a crystal of thymol to make it keep. (3.) Make a dilute solution of commercial nitric acid, one part of acid to two of distilled water. Spread a thin layer of sputum on a cover-glass and let it dry; when quite dry pass it two or three times through the flame of a small Bunsen burner, and let it cool. Filter two or three drops of the magenta solution in a watch-glass; place the cover-glass, with the sputum downwards, on the stain, taking care that there are no air-bubbles under it. Let it remain for fifteen or twenty minutes; then wash in the dilute acid till all color has disappeared. Remove the acid with distilled water; then place the cover-glass, in the same manner as before, on a few drops of chrysoidin filtered into the bottom of a watch-glass, and let it remain for a few minutes, till it has taken a dark brown stain. Wash off the superfluous color in distilled water, and place the cover-glass in absolute alcohol for a few minutes. Then remove and dry perfectly in the air, and mount in a solution of balsam. The bacilli are visible with a quarter-inch objective. By this means only *B. tuberculosis* is stained, the ordinary putrefactive bacteria remaining colorless.'

The following is Heneage Gibbes's rapid method of demonstrating *B. tuberculosis* without nitric acid:—

'Take of rosaniline hydrochloride 2 grms., methyl-blue 1 grm.; rub up in a glass mortar. Then dissolve anilin oil 3 ccm., in rectified spirit 15 ccm. Add the spirit slowly to the stain till all is dissolved; then slowly add distilled water 15 ccm., and keep in a stoppered bottle. Place a few drops of the stain in a test-tube and warm; as soon as steam rises pour it into a watch-glass, and place the cover-glass as before. After four or five minutes wash in methylated spirit till no more color comes away; drain thoroughly and dry, either in the air or over a spirit lamp. Mount in Canada balsam. A section of tissue containing bacilli can be treated in the same way, only it must be left in the stain for several hours.

'If gentian-violet be used after the nitric acid treatment, the putrefactive bacteria will be stained, and not the tubercle bacilli, which are thus strongly differentiated. The latter are also stained by fuchsin.'

—o—

Use of the cell nucleus.—An interesting experiment performed by Herr G. Klebs, an account of which is published in the 'Biologische Centralblatt,' seems to throw light on this subject. The cells of Zygnema, a common fresh water alga, were plasmolyzed by immersion in a 16 per cent. aqueous solution of sugar, which strongly contracts the protoplasm without destroying its life. As a result of the contraction the cell contents were observed to divide into two portions, each containing one of the two chlorophyll bodies, while the nucleus was not divided but remained in one of the halves. This division appears to be purely a mechanical process, the result of the plasmolysis. The plasmolyzed cells were cultivated and it was found that the two portions behaved very differently, the one which contained the nucleus soon formed for itself a new cell wall, the single chlorophyll body divided into two, and the half cell soon became a complete normal cell. Not so, however, with the half cells which did not contain nuclei. These retained their vitality for many days and produced starch abundantly, but had no power to form for themselves a cell wall or to increase in length. The nucleus, therefore, seems to be necessary both to the increase in the length of the cell and to the formation of the cell wall.—*West. Druggist.*

EDITORIAL.

With the close of the year there comes a proper and welcomed opportunity to express our thanks to the multitude of friends who have favored us with their contributions and their patronage the past year. We have been especially pleased and placed under obligation to those who have been kind enough to say that the JOURNAL has been constantly improving in their estimation. When things run a little unsatisfactorily, and our readers are far less likely to know it than we are, it is of great value and encouragement to be favored with a voluntary note of commendation. We also feel under obligation to those who have given us kind suggestions relative to points in which their interest could be more largely stimulated by some action on our part. Perhaps the most gratifying fact is this, that during the year not a single growl or ill-natured comment of any sort has reached us. This is, doubtless, better treatment than we have deserved, and it goes to the credit side of our account with every friend and patron of the JOURNAL.

It would not be modest for a scientific periodical trusting to intrinsic merit for support to give way to the holiday whim of making great promises for the new year; not that our contemporaries who indulge in this custom are insincere at all, but that all experience shows it better to do and not promise rather than to promise and not do.

Propriety, however, will permit us to say that Professor Osborn is expected to continue in editorial charge, at least until the return of Professor Romyn Hitchcock from Japan next August, and that contributions will meantime be made by the latter. Beginning with the January number, Mr. Chas. W. Smiley becomes a partner with Mr. Hitchcock in the ownership of the JOURNAL, and will manage its business affairs. This gentleman has, for a number of years past, been connected with the United States Fish Commission. He has edited and published a dozen volumes or more under the guidance of the late Professor Baird, and is well known in college circles as one of the editors of the *Alumni Record* of Wesleyan University, from which college he graduated in 1874. Mr. Smiley is not a microscopist, but is interested in economic science, having been elected Vice-President of that section of the American Association for the Advancement of Science at its last meeting.

According to our rule, all subscriptions expire with this number, and in each case the fact will be emphasized by a pink wrapper. A few exceptional subscriptions run over into 1888, and we should now be glad to have these extended to the close of that year. In sending in your renewals for 1888, you can make us doubly glad by adding the names and addresses of your acquaintances who own microscopes, and to whom it might be a mutual advantage for us to send a copy of the JOURNAL. Every little courtesy of this sort helps to cement our friendships all around. It is too trite to say that the resultant successes of the JOURNAL react in improvements upon those who render the aid.

This, then, is about all we have to say upon the topic which is uppermost in the minds of all managers of periodicals. We have now so much to thank you all for that the garments of the beggar do not fit us. We appreciate your kind support, and have tried to merit it.

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Science and freedom.—It would be difficult to utter anything new on the topic of original research, and especially on the duty of encouraging it and the values which result from its pursuit. Professor Agassiz asserted that the study of natural science, by requiring its devotee to study for himself

the main facts and their meaning, liberated a man from a state of bondage to his fellow-men. This is education, the process of lifting a mind above the domain in which it accepts everything on the authority of some source, in which case it is subservient to that source of authority, into a higher realm where its vision is not hindered and where it can be trusted to see for itself. Thus education is freedom, first of thought then of body. No higher tribute to the power of science to elevate the intellect and make man free can be found than the action of the Russian ministers of state who are trying to exclude it from the schools because, unlike linguistic studies, it tends to make men think. This sentence from the article on Russia in the November *Century Magazine* puts it well.

Professor Whitman, in an article to which we have already alluded,* touches upon the same ground when he shows that for a teacher no better training can be had than original work which will fit him to be the intellectual guide of his students who, like him, must learn to go for knowledge, not to dusty books, but to the objects of nature themselves; by no means despising the work of others, but not trusting to their work and failing of the individual benefit of first hand knowledge.

As a thoughtful nation and a free people we have not, as Americans, as yet fully measured up to our privileges in regard to educational matters. We are doing much which make us proud to look upon. An expedition like that the United States Fish Commission Steamer *Albatross* is making now should be justly viewed with pride as a great scientific event, and we are glad that our Government, with no niggard hand, maintains so well her scientific enterprises; among which we are glad also to recall the zoological station at Woods Holl, the National Museum, the Smithsonian Institution, and the Geological Survey, with its various lines of activity. And our great institutions of learning and some of our cities are doing much for the cause of general liberty by public libraries, public lectures, public museums, public zoological and botanical gardens. And when we reflect on all this we are glad for the cause of knowledge. Last summer, at Boston, we found the wonderful museum of Prof. Agassiz and the great one of the Boston Society of Natural History, and at the little town of Salem a natural history museum, and while there we saw it visited by crowds of people; many there from idle curiosity, but many also to learn. When enterprise pushes out, and a new work like the *Journal of Morphology* enters on its career, we are again proud, because it is one step further, and we shall regard it as a still better sign if it thrives, as we hope and trust it may.

It would be no difficult task to show that science is a good genius, that for every favor shown it, it heaps tenfold benefits on its friends in return, and that to neglect its teachings is hopeless retardation of improvement or even failure. Those who sing loud the praise of science are no fanatics; they are rational believers of what has ever proved to be the guide to man from misery to happiness, whether in his home, in his social relations, in health and disease, or in any conceivable situation where he comes in contact with his physical surroundings; and we think that every advance of science means one more step in the wonderful progress which has attended the course to which Prof. Agassiz referred—the observation of facts and study of their meaning rather than the acceptance of notions or authority without any test.

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Apropos of our remarks on the demand for improvement in medical courses, we quote the following extract:—

'The demand for a three years' course of lectures and medical study is be-

*See *ante*, page 199.

coming so great that it can soon be no longer ignored, even by schools which are ambitious of the largest possible classes. Recently the Executive Committee of the Alumni Association of Jefferson College adopted the following resolution :—

Whereas, it having come to the knowledge of this Executive Committee of the Alumni Association that four students have gone to the University of Pennsylvania to pursue their medical education, at the recommendation of the Alumni of this College, on the ground that Jefferson Medical College did not provide a three years' graded course, and did not furnish clinics or instruction on the special branches of medicine and surgery, be it

Resolved, That the Executive Committee, having the best interest of our Alma Mater at heart, respectfully announce these facts to the Faculty, that they may take such action as they deem best to overcome this apparent growing dissatisfaction of our Alumni.'—*Medical Record*, Nov. 12, 1887.

NOTES.

Prof. S. P. Langley was elected on Nov. 18 to succeed Prof. S. F. Baird as secretary of the Smithsonian Institution.

The Albatross, which is the U. S. Fish Commission's exploring steamer for use in deep-sea researches, has been ordered for service upon the Pacific coast, and left Washington recently on her voyage thither. It is supposed that she will not return to Atlantic waters for several years. Prof. Leslie A. Lee, of Bowdoin, goes with her as chief naturalist. Results of great interest, both economically and for the advance of theoretic science, are anticipated from the expedition, the work done in the Atlantic giving the basis for this expectation.

Origin of Sarcomata.—Dr. Jos. Schöbl, of Prague, has a very valuable paper in the September number of *Archiv. Für Mic. Anat.*, entitled 'A Sarcoma Composed of Epithelial-like Cells of Lymphoid-Cell Origin.' The tumor in question was found to be composed of cells not to be differentiated from epithelium, and mixed in with these in all portions of the tumor were large numbers of lymphoid cells. Between the two were found all possible gradations in form. It might be made an objection that the lymphoid cells were present as the result of inflammatory action ; but this is disproven by the fact that, in the hundreds of sections made, the most striking intermediate cell-forms were found in all. Again, the tumor, after its first removal, recurred with such rapidity as to fill the orbit in a couple of weeks (it grew originally from the lower lid). None of these epithelial-like cells were found in stages of subdivision, though many possessed double nuclei, and a few had taken on the character of giant cells. Considering the rapid growth, it seems, therefore, impossible that these cells could have arisen from others of like character. Whence did they come then? For an answer, Schöbl refers to the transitional forms found between them and the lymphoid cells. The question now arises :—If lymphoid cells can give rise to the epithelial-like cells found in the sarcomata, why should they not create cancer cells as well? And, finally, what is the meaning of the large numbers of lymphoid cells found in the growing portions of cancer, *i. e.*, the so-called indifferent tissue of the periphery?—*The Microscope.*

MICROSCOPICAL SOCIETIES.

San Francisco, Cal.

A regular meeting of the San Francisco Microscopical Society was held on October 12, President Ferrer in the chair. There was a very large attendance of members, and Dr. Joseph LeConte, of Berkeley, was present as a visitor. Dr. Julius Rosenthirn, of San Francisco, was proposed for membership, the vote to be taken at the next meeting.

A letter was read from Isaac C. Thompson, F. R. M. S., of Liverpool, England, concerning the announcement that interesting Sandwich Island material will come into the possession of the San Francisco Society. Mr. Thompson desires to secure material for

the study of minute crustaceans, a special line of investigation which he has pursued for some time, and upon which he has made valuable reports to the Liverpool Microscopical Society. His letter gave suggestions as to the use of the tow-net in obtaining the gatherings, and prescribed the following as a solution best fitted to preserve specimens of marine life :—Water, one part ; proof spirits, two parts ; glycerin, one part, with 1 per cent. of carbolic acid added. By securing gatherings from the Pacific Mr. Thompson hopes to add to his previous finds of new *copepoda*, which constitute the chief part of pelagic life. In an expedition to the Canary Islands Mr. Thompson captured from forty to fifty new species. The San Francisco Society will endeavor to obtain the material which is necessary for the study proposed by Mr. Thompson.

An interesting letter was read from W. F. Barraud, of Wellington, New Zealand. The Wellington Microscopical Society meets fortnightly, and its members are now making special effort to investigate and catalogue the fresh-water infusoria found in the district. Several interesting diatomaceous deposits occur in New Zealand, one at Oomaru being celebrated for its richness. Specimens of this earth have been quite widely distributed, and mounted slides of it have been shown in the San Francisco Society meetings. Mr. Barraud sent a sample of the earth, which will be worked up by Mr. Riedy, and a sample of the Nevada salmon-colored diatomaceous earth found some time ago by Professor Hanks will be sent to Mr. Barraud in exchange.

The chief part of the evening was given to an exhibition of high-power objectives recently received. Dr. Ferrer gave an outline first of the claims made for the apochromatic objectives and eye-pieces made with special kinds of glass by Zeiss, of Jena. After a conversational discussion of the points advanced, the Zeiss glasses, one-twelfth, were shown by Drs. Ferrer and Mouser, and Dr. LeConte used Spencer's one-tenth and one-eighteenth. Various objects were examined, including test diatoms and bacteria, and the work of the glasses very favorably commented upon. It was not intended to attempt to arrive at any definite and formal work of the glasses, but rather to give all members an opportunity to examine for their own satisfaction. Dr. Mouser worked his Zeiss one-twelfth up to 2,250 diameters with most admirable effects. The performance of the Spencer glasses was also very satisfactory.

As there was a vacancy in the vice-presidency, because of the elevation of Dr. Ferrer to the presidency, an election was held, and William Payzant, of Berkeley, was chosen vice-president. At the next meeting there will be a further exhibition of microscopic appliances and a report by Professor Hanks upon 'Coals,' a subject which he has been specially examining in the field during the last few months. After these announcements the society adjourned.

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The meeting of the San Francisco Microscopical Society, held on the evening of October 26, '87, was well attended and interesting. President Ferrer presided. H. H. Carlton, of San Francisco, was present as a visitor.

Dr. Julius Rosenthirn, of San Francisco, was elected a regular member. Dr. Douglass Montgomery and Dr. Kahn were proposed for membership—election, under the rules, being postponed until next meeting.

A letter was read from A. H. Breckenfeld, of Los Angeles, expressing continued interest in the work of the society, and sending a specimen of marine diatoms on seaweed from Professor Romyn Hitchcock. The material was collected at Osaka, Japan. Professor Hitchcock is one of the Smithsonian Institution staff who is now in Japan pursuing special investigations.

Dr. Ferrer continued his demonstrations of new accessories, of which a part was given at the last meeting of the society. He had just received from Zeiss, of Jena, a number of low-power objectives and oculars. These are apochromatic and are made of the new glass, the invention of which excited so much interest a year or so ago. Beside the lenses for ordinary use to the microscope Dr. Ferrer exhibited projecting eye-pieces which are inserted in place of the ordinary eye-pieces when the instrument is used in connection with a micro-camera for photographing. Dr. Ferrer said he had but just received the glasses and not fully tried them, but in his preliminary tests of their powers he was convinced of their wonderful definition. Comparative examinations were made of the Zeiss ordinary eye-piece and the 'compensating eye-piece' which occupied the members for a long time and afforded much material for discussion.

The society received several donations of material intrinsically valuable and still more to be prized because of its associations. 'Möller's typen platte' and 'probe platte,' a number of valuable micro-photographs, and a large collection of slides were

received as a gift from Mrs. W. Ashburner through Mr. Norris. They had been part of the collection of the late Professor. W. Ashburner, and will be cherished by the society which held him in such high esteem. There was also a donation by Mr. Norris of a number of mounted slides and prepared diatomaceous material, and upon motion of Dr. Selfridge the thanks of the society were extended to Mrs. Ashburner and Mr. Norris for their generous gifts.

Mr. Norris exhibited a slide mounted by Bourgoyne, of Paris, which contained 215 distinct varieties of diatoms from the famous Santa Monica earth, all arranged in beautiful form. This slide was presented by Bourgoyne to Professor Ashburner. It is a most entrancing object to one affected by the *diatomania*.

After an hour's discussion of current microscopical news and the relation of individual experiences the society adjourned.

EDWARD J. WICKSON, *Rec. Secr.*

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The regular meeting of the San Francisco Microscopical Society, November 9th, was well attended; President Ferrer in the chair, and C. P. Bates, secretary *pro tem.* Doctor Douglas Montgomery and Doctor Kahn, of San Francisco, were elected regular members.

A sample of Mono lake water was handed in by Dr. Mouser and was referred to Mr. Payzant for determination of crustaceans living in it.

The paper of the evening was by Mr. Henry G. Hanks, of San Francisco, concerning California rock salt, as follows:—

Some months ago I received some fine specimens of rock salt from Mr. J. S. Cook, of San Bernardino county, which I found very interesting, and at the same time I was impressed with the importance of such salt to our State and to the Pacific coast. But press of other business caused me to lay the matter aside for future consideration. Lately my attention has again been called to this very interesting subject, and I have discovered certain peculiarities in the mineral that I trust will be as interesting to the members of this society as they have proved to me.

Like the very best quality of rock salt, this mineral occurs in blocks of the utmost transparency. It is quite easy to read printing through a cube several inches in thickness. Some pieces are as clear, colorless and free from mechanical impurities as ice from distilled water, frozen in a vessel of porcelain. Others contain some foreign matter which does not enter into the composition of the salt. When dissolved and filtered the solution is perfectly colorless, and on applying the usual chemical tests, without observing sufficient care to detect minute traces, the salt is found to be almost absolutely pure. The fact that in a somewhat moist atmosphere it does not deliquesce is an additional proof of its chemical purity.

Some pieces, transparent and colorless, melt at a red heat on platinum foil without decrepitation to a transparent and also colorless fluid, which retains its transparency when cooled.

Other specimens show faintly opalescent lines meeting each other at right angles. If such a specimen is held at a certain angle in the sunlight, a multitude of reflecting surfaces like imbedded spangles may be seen which glimmer something like aventurine, or glow like a sunstone. It may also be seen that while the faint lines meet at right angles, a dividing line forms a mitre like the corner of a door panel. Such a specimen, when heated to redness, explodes with great violence, so much so that the experiment is one of considerable danger if the eyes are not protected from the minute flying cubes into which the larger one is broken by the explosion.

On obtaining these very interesting results, I naturally appealed to the microscope, our favorite instrument, for the cause of the violent decrepitation, in one case, and quiet fusion in the other. Nor did I seek in vain, as I hope to be able to show you this evening. I found the phantom lines and reflecting spangles to be minute cavities in the anhydrous salt, all of the same general form but varying in size from those so minute as to be scarcely visible under a two-thirds objective, to others that can be examined in detail. The cavities are box-shaped, mostly square but sometimes slightly oblong. They are generally from four to six times as broad as they are deep. All the angles are rounded, and all the lines marking the sides of the cavities curved just as we saw others some months ago while examining the beautiful diamond from Amador. Both these minerals crystallize in the same system.

All the imbedded cavities are empty. You may search them over and not see a particle of enclosed matter. But on the surface, where the walls are broken down,

they may be seen partly filled with the *débris* of the crushed salt, which proves that they are actually cavities and not illusory.

It having been proved that the salt contains only traces of water, it may be inferred that the cavities are filled with a gas or with atmospheric air. Otherwise it would be difficult to account for the explosion when heated.

On examining the salt after heating, it was found that the transparency was not materially impaired except at those points where the box-like cavities were shattered by the escaping air under pressure. They had lost their beautiful form and had become irregular, roughly globular cavities, filled with broken fragments of salt. In every direction from the shattered cavities the substance was fissured and fractured, showing the great force exerted by the escaping gas or air. It is a mystery how these beautiful cavities could be formed in so hard and anhydrous a substance as rock salt.

After actual food and water, salt is one of the most necessary requirements of man and animals, and it is a question if a healthy bodily condition could be long maintained without it. Salt is also largely employed in manufactures and the arts.

Rock salt is not always so pure as the specimens shown you this evening. In England it is colored red by the oxide of iron it contains. It is also sometimes contaminated by clay and sand, and often by imbedded associate minerals, as gypsum, anhydrite, borax, glauberite and others; still it is seldom, if ever, so impure as salt made from sea-water, for which reason it commands a higher price. It dissolves more slowly than the more impure varieties, which property fits it for certain purposes and uses in the arts. Pure salt does not deliquesce except in a very moist atmosphere.

Salt obtained artificially contains various impurities which impair its value. These impurities are generally magnesia, gypsum, bromine and iodine, with much organic matter, while rock salt is free from them. This has led to the theory that seawater takes its salt from beds of rock salt, instead of rock salt being deposited from the ocean. This theory is strengthened by the fact that rock salt is sometimes absolutely anhydrous.

While inferior salt may be extracted from brines found in nearly all countries, rock salt is rather rare. It occurs in very large deposits in England, Poland, Hungary and Germany. In the high mountains of Chili it is met with at an elevation of 9,000 feet above the sea level. In Spain, 16 leagues from Barcelona, there is a mountain of salt three miles in circumference and 500 feet high. It is quite pure. No gypsum is found with it. This mineral has been found also in considerable quantities in New South Wales.

It has long been known that rock salt existed in very large quantities in Nevada and Arizona. On Holt's map of California and Nevada, published in 1876, a deposit in Lincoln county, Nevada, is described as being five miles long and 600 feet high. This locality lies 53 miles, by the scale of the map, a little west or north from Callville, on the great bend of the Colorado river. Some years ago I examined specimens and found them to be very pure.

In Cleveland's 'Mineralogy,' published in 1816, I find a statement that 'rock salt is found in California in very solid masses.' The writer probably referred to the peninsula of Lower California.

In the sink of the Colorado desert in San Diego county, deposits of salt have been discovered, and are rather extensively worked, but this salt is probably the result of the evaporation of the waters of an ancient inland sea, cut off from the great ocean by the delta of the Colorado river, or by an upheaval of land, gradual or otherwise. The water, under the influence of the sun and the dry climate of the locality, became less until a resulting small lake of concentrated sea-water finally dried and left the deposit of salt. This is a good theory until a more thorough study of the deposit is made. It is now covered by silt and *débris* washed down over it during many winters of rainstorm and cloud-burst.

The associate minerals often found with rock salt have also great value. Chloride of potassium in very large quantities is extracted from beds overlying the salt deposits at Stassfurt, in Saxony. Some idea of the quantity may be inferred when the statement is made that in 1863–64, 400 tons of *carnallite* were raised. The yield increased annually until 1875, when the production was 494,414 tons. *Carnallite* contains theoretically 26.88 per cent of chloride of potassium.

If a deposit of this character should be discovered in connection with one of our great salt deposits, its importance to California and the Pacific coast can scarcely be estimated.

Mr. Hanks illustrated his essay with specimens which were examined under the

microscope, and found to bear out well the descriptions in the paper. The study of the specimens led to an interesting discussion of the subject.

Among the donations to the society's material were two specimens of diatomaceous earth from William Irelan, Jr., State Mineralogist. One was impregnated with asphalt, and was from the mouth of Dos Pueblos creek, near Naples, in Santa Barbara county, and the other was from Shasta county. The specimens were referred to Mr. Riedy and Dr. Riehl for examination and report.

EDWARD J. WICKSON, *Rec. Secy.*

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CARDIFF NATURALISTS' SOCIETY.

October 20, a biological and microscopical section was formed with C. T. Vachell, M. D., as president, and Prof. W. N. Parker as hon. sec. Papers by these officers were read, setting forth the objects to be attained by the section.

NOTICES OF BOOKS.

Practical Microscopy.—By Maurice N. Miller, M. D. New York. William Wood & Co. 1887. (pp. 217; figs. 126).

We have here a hand-book of practical instruction for the college laboratory, or the study of the amateur. It will be of special value to members of the medical profession who are not already skilled in the use of the microscope. The author gives the method of examining various organs of the body. The scheme, or plan of the structure, is first described, often by the aid of diagrams, after which the mode of preparing the section is indicated, and, under practical demonstration, every histological detail is tabulated in proper order. The drawings assist very much in the recognition of such elements in the field of the microscope. These are photo-engravings of the author's own pen drawings.

Only so much technique has been introduced as has been considered absolutely necessary. The processes for the preparation and exhibition of tissues are simple, and can be executed by any amateur. Among the organs to be demonstrated are the skin, teeth, stomach, lung, liver, kidney, ovary, pancreas, lymphatics, spleen, brain, spinal cord, and the nervous system. In each case the student is given a list of things which he is to observe, the power to use, and all other needed directions. For example, we select one of the shortest lessons, that upon the lung of a pig :—

'With a very sharp razor, cut half-inch cubes from pig's lung. Select portions free from large bronchi, with the pleura on one side at least, and harden with strong alcohol. Human lung, as fresh as possible, may be treated in the same manner. The epithelium of the alveoli shows best in the young lung. Pieces of fœtal lung are easily hardened, and should be studied with reference to medico-legal work. Lung must be made very hard or thin sections cannot be cut. If the ordinary 95 % alcohol does not harden sufficiently, the process may be completed by transferring the tissue for 24 hours to absolute alcohol. The celloidin infiltrating process is well adapted to this structure.

'Stain human lung sections with borax-carmine, and pig's with hæmatoxylin and eosin. Mount in dammar. (Figure 75 shows the section of a pig's lung enlarged 60 diameters).

'Things to be observed in this demonstration :—

'1. The large scalloped openings, transversely divided infundibula.

'2. The divided alveoli, so sectioned as to cut off both bottom and top, and show no epithelial lining, except at inner edge of periphery.

'3. The alveoli divided so as to show a cup-shaped bottom or top.

'4. The alveoli so cut as to leave most of bottom or top, showing an opening in the centre where the sac has been sliced off.'

The volume has a good index, and the publisher has taken the liberty to pad it with 62 pages of his advertisements, which are so numerous that he has added an index to authors whose works he has for sale.

Cottage Portfolio. By D. S. Hopkins, architect. Lithographed plates containing 12 designs of low-cost houses, with 43 illustrations and explanations. New York. 1886.

We are much pleased with the neatness and care with which this book of designs has been gotten out. Mr. Hopkins has written an explanation to accompany each plate; first stating the desirable features of the house, then the material from which it is to

be constructed, and, lastly, the estimated cost. The plates, twelve in number, contain the designs of cottages costing from $1,500 to $2,100. The houses are fitted with modern improvements, and are well supplied with rooms and closets. The windows are large and ornamental. The 'Portfolio' is worth the price ($1.00) as an aid to the builder or to persons contemplating a cottage of their own.

Woman's Work. Vol. I, No. 1. November. Athens, Ga. 1887.

This new monthly, 16 pages, size of *Harper's Weekly*, is devoted to whatever woman wishes to know about domestic economy. In appealing for contributions, the editress says:—'Tell us how to train husbands, children, and climbing vines.' If she gets that information there will, doubtless, be a great demand for this new periodical.

The Woman Magazine. Vol. I, No. 1. November. New York. 1887.

This magazine, large octavo, 72 pages, has nicely illustrated articles on Jean Ingelow and on the Astor Library, and a good deal bearing upon domestic economy. Articles on science are promised for the future numbers.

Medical Jurisprudence. By Prof. M. D. Ewell, LL. D. Boston. Little, Brown & Company. 1887. (pp. 409).

This subject is, for the first time, brought forward in an exhaustive manner by this author. It has been one of the missing links between two learned professions now well riveted by Prof. Ewell. Law, which the doctor must know, and medicine, which the lawyer will need to be familiar with, are here united. Of special interest to us is the part which the microscope may play in determining medico-legal questions, and this has been well set forth by the author. The microscopic examination of blood stains, the limits of sight and hearing, the examination of hairs and fibres in connection with the identification of criminals, the detection of the presence of spermatozoa, and other questions of microscopy are treated with good judgment. Some of the important chapters are upon the relations of physician to patient; on various signs, modes, and causes of death; on pregnancy, delivery, birth, abortion, infanticide, rape, sterility, sex, paternity, identity, malpractice, insanity, feigned sickness, the disposition of dead bodies, and general toxicology.

The Writer. Vol. I. Boston, Mass.

This is a monthly magazine for literary workers. Every beginner in writing for periodicals, and others who have long engaged therein, will find lots of labor-saving and money-producing hints in its pages. We especially wish that all who write for us would use it. Its price is but $1.00 per annum. We venture to offer *The Writer* and our JOURNAL for 1888 at a club rate of $1.80 for both.

Exchanges.

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

Wanted, Diatomaceous earth from Mégillanes, Bolivia, South America. Can give in exchange either Diatomaceous earth from New Zealand or cash. E. MICHALEK,
I. Fleischemarkt, No. 1, Vienna, Austria.

Mounted sections of Fœtal Lung (5 months), sections across entire lobe, $\frac{1}{200}$ in. thick, beautifully stained, in exchange for first-class pathological slides. W. C. BORDEN, M. D., U. S. A.,
Fort Douglas, Utah.

Correspondence relative to exchange in microscopical material or prepared mounts.
HENRY L. OSBORN, Hamline, Minn.

Wanted, earths, recent diatoms, and miscellaneous objects for mounting. Only first-class material offered or desired. MARY A. BOOTH, Longmeadow, Mass.

Fossil Diatomaceous deposits (marine) wanted from Bermuda, Virginia, Maryland, California, etc.
I. ELLIOTT, Ardwyn Villa, Aberystwith, Wales, England.

Publisher's Notices.—All communications, exchanges, etc., should be addressed to Henry Leslie Osborn, Hamline University, Hamline, Minn.

Subscriptions, and all matters of business, should be addressed to the Business Manager, P. O. Box 630, Washington, D. C.

Subscription price $1.00 PER YEAR *strictly in advance. All subscriptions end with the December number.* A pink wrapper indicates that the subscription has expired.

Orders for slides advertised by A. J. Doherty in the Journals from January to April, 1887, may be sent through the Business Manager, P. O. Box 630, Washington, D. C.

A few copies of Leidy's Fresh-Water Rhizopods, of North America, can still be had at $5 00 per copy.—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, to the order of the Business Manager. The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

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