I will also add here that careful examination of the guinea-worm (*F. medinensis*) has led me to conclude that in this congener worm also the intestine terminates in an anal orifice a little within the concavity of the curled tail, and so in this anatomical point the worms are in unison.

Merging of the two Uterine Channels or Horns into one common Tube.—It is quite clear that this is incorrect. The two canals, diverging from the vagina, do not coalesce, but continue separate throughout, though placed in close apposition and bound one to the other by numerous fibres. When within a distance of the tail varying from 3 to $1\frac{1}{2}$ inches, each uterine horn merges into an ovarian tube, as detailed at p. 161 and illustrated in Plate XXXI., Fig. 7. The ovarian tube is coiled upon itself, but when extended averages 5 inches in length; it is continuous from one uterine horn to the other, and varies in diameter from $\frac{1}{200}$ th inch at its junction with the uterine channels to $\frac{1}{100}$ th inch midway, becoming again reduced to the smaller measurement at the extreme loop. The remarkably close binding of the one horn of the uterus to the other in their course from the vagina to the ovarian tube, and the difficulty of unrayelling them without tearing their delicate walls and so obscuring accuracy of observation, led me to regard these tubes as one, but the tracing of the ovarian coils upwards has rendered clear these amended details of the generative system.

With these modifications I believe that the anatomy of the *Filaria immitis*, as detailed in my former paper, is substantially correct.

V.—How to prepare Specimens of Diatomaceæ for Examination and Study by means of the Microscope.

By A. MEAD EDWARDS, M.D., Newark, New Jersey, U.S.

[The Author having kindly forwarded to us early proofs of the following article, we have much pleasure in giving it insertion.]

HAVING accumulated a number of gatherings of rough material, which, a cursory examination has shown, contain specimens of Diatomaceæ, and which, it is judged, it will answer to clean and otherwise arrange and put up, or, as it is technically termed, "mount," for future study, the intending diatomist requires to be informed how he may best set about preparing his specimens in the most advantageous manner. The author of the present sketch has published, in the seventh volume of the 'Proceedings of the Boston (Mass.) Society of Natural History,' certain directions for collecting, preparing, and mounting Diatomaceæ for the microscope; and as that paper contains a large part of the information he desires to

impart at the present time, he will draw upon it pretty freely, supplementing it to such a degree as later investigations warrant, or as may seem desirable.

Although most of the published treatises on the use of the microscope in general profess to give directions for mounting objects in such a manner as to preserve them for almost any length of time, and at the same time exhibit their characters to the best advantage, and although we have in the English language at least three books treating specially of this subject of the preparation of microscopic objects, yet hardly any one of these volumes gives any concise, practical, and at the same time reliable descriptions of the best methods of collecting, preparing, and mounting specimens of Diatomaceæ. In books, generally, when the preparation of these organisms is treated of, it is usually the fossil deposits which are considered, and even such directions as relate to these are for the most part meagre and unsatisfactory; and, when the specific and special directions are, as is often the case, copied from one book into the other without having been tested by the copyist, any faults they may have possessed, as originally written, are merely repeated and not eliminated. To prepare and mount specimens of Diatomaceæ, for the purpose of sale alone, is one thing, and to prepare and mount them, so as to preserve and exhibit their natural characters and fit them as objects of scientific study, is another and very different thing. The latter can only be attained after considerable practice, and to do it properly a considerable amount of knowledge of their natural history is plainly necessary.

The Diatomaceæ should always be prepared and put up for a special purpose,—that of exhibiting characters peculiar to genera and species; and to do this those characters must of course be known. Muds, guanos, dredgings, and gatherings of that description can seldom be used for the purpose of exhibiting such characters, and when they can, in exceptional cases, be so employed, it is when the forms they contain are selected out in the manner to be described hereafter. Gatherings, likewise, which contain many species in a mixed condition, should, as a general thing, be rejected, unless there be present something of special importance, such as rare species, or some large and fine or distorted forms of common species. But even in such cases it will be found best not to mount the gatherings as collected, but to select out the forms desired and place them upon slides by themselves, and in such media as will exhibit their peculiarities to the best advantage. Of course it may be desirable to study the geographical distribution of the Diatomaceæ; and then mixed gatherings become of value as exhibiting the number of forms occurring at a particular station. Then, again, the fossil as well as the semi-fossil deposits and guanos may be cleaned and mounted as obtained; but even then it may become

desirable, if space can be spared in the cabinet, to have the various species found in each gathering separately mounted, so that they may be at any time studied in comparison with similar forms from other localities.

General directions for collecting Diatomaceæ have been already given in part seventh; but it will be desirable to again allude to a few points in connection with this portion of our subject. Some years since, an article entitled "Hunting for Diatoms" was published in a London journal called 'The Intellectual Observer.' The author's name was not given, but internal evidence would seem to indicate that it was penned by a deceased botanist of note, who was a decided authority on this branch of biology. This paper contains some valuable hints respecting the places in which to look for diatoms, and some of the suggestions contained therein I have ventured to transfer to these pages, as they will be found of value to the intending diatomist. Thus, the exquisite *Arachnoidiscus*, *Triceratium Wilksii*, and *Aulacodiscus Oregonensis*, may be looked for on logs of wood which have been floating in the sea, and imported from New Zealand, or Vancouver's Island. So, on logs from Mexico and Honduras may be found the curious *Terpsinæ musica*. The nets of fishermen, especially from deep water, may yield algæ bearing such forms as *Rhabdonema arcuatum* or *Adriaticum*, *Grammatophora serpentina* and *marina*, various *Synedras*, and other fine forms. On oyster shells may be found algæ bearing upon their fronds *Biddulphia regina*, *Baileyi* or *aurita*. *Rhizosolenia styliiformis* is said to be almost sure to be there likewise. After a ship is unloaded, and as it floats higher in the water, its sides may be searched for treasures of the diatom world, and *Achnanthes longipes* and *brevipes* found, or even *Diatoma hyalinum* and *Hyalosira delicatula*. The sea-grass, or *Zostera marina*, growing along our coast, often bears upon its waving ribbons fine forms of diatoms, and that used for stuffing chairs, and lounges or mattresses, and imported from abroad, will yield foreign species to the collector. There is a plant known in England as "Dutch rushes," which is imported into that country from Holland, and which is used for chair bottoms. These plants grow in the brackish water of the marshes, and hence upon them are to be found the delicate *Coscinodiscus subtilis*, *Eupodiscus Argus*, and *Triceratium favus*. Both of these two last-named forms occur commonly on our Atlantic coast, and muds from Charleston, S.C., and Wilmington, Ga., have provided me with them in plenty. Cargoes of bones, which present green incrustations from having lain in the water for some time, are said to yield diatoms, some of which may be rare, as coming from foreign ports. The state of New Hampshire has not yet been sufficiently gone over for it to be said what the characteristic forms of Diatomaceæ growing within its boundaries are, but yet we

may safely predict that the lakes, ponds, streams, and sea-coast of that state will yield to the searcher ample material of beautiful forms.

If the microscopist wishes to mount a few slides of recent diatoms just to show what diatoms are, nothing is easier. It is only necessary to boil a small mass of them in strong nitric acid in a test-tube over a spirit lamp, and, when the acid has ceased to emit red or yellowish fumes, wash them thoroughly with clean water, allowing them to settle completely. Then a little of the clean sediment, consisting almost entirely of the shells of the diatoms, is taken up by means of a "dip-tube," and placed upon the central portion of a glass slide. Here it is dried, and the slide warmed over a lamp; then a drop of Canada balsam is permitted to fall upon the diatoms. As soon as all bubbles have cleared off from the balsam, a warm cover of thin glass is carefully laid upon it and permitted to settle into place. When cool, it is ready for examination by means of the microscope, any balsam which has exuded around the cover being washed off with alcohol. In this way rough and tolerably clean specimens may be obtained; but such would not, or, at all events, should not, satisfy the student of the Diatomaceæ. For him more elaborate methods are necessary, and these we will now proceed to consider.

Apparatus and Chemicals necessary.—A chemist's retort-stand, which is a heavy iron plate with an upright rod projecting from one side of it. Running on this rod, and so arranged that they may be fixed by set-screws at any height, are a series of rings of various diameters, which are to be used to hold the vessels in which the specimens are to be manipulated over the source of heat used. Mr. C. G. Bush, late of Boston, Mass., who has had considerable experience in cleaning Diatomaceæ, tells me that he uses a lamp burning petroleum oil, as cheaper than a spirit lamp, and, to support the vessels he employs, has a little metal arrangement on the top of the chimney, such as is supplied for the purpose of holding a small tea-kettle and the like. The only objection to the oil lamp is, that, unless the wick be well turned down, we are liable to have our vessels blackened. However, the heat given off by burning petroleum is very great, and I have often used such a lamp with advantage. If desired, of course, the source of heat used may be gas, burned in a Bunsen's burner, or a spirit lamp; and this last, especially if it be supplied with a metal chimney to cut off draughts, is, all things considered, the best, as it is very cleanly, not being liable to smoke the bottom of the glass or porcelain vessels used. If we are going to work with large quantities of material, we shall require a small sand-bath to heat the glass vessels upon. In small quantities, the diatoms may be boiled in test-tubes, when some sort of holder will be required. The metal ones, sold by

dealers in chemists' apparatus, are extremely handy; but I have found that we can make very good ones out of old paper collars. One of the kind called "cloth-lined" may be cut into strips about three-quarters of an inch wide and three inches long. Such a strip is folded around the test-tube near the top, and the ends, brought together, are held between the forefinger and thumb. In this way the tube is firmly grasped, and can be held over the lamp without much danger of burning the hand, as the paper collar strip is a bad conductor of heat; or the paper strip may be grasped in an "American clothes-peg," which has a spring to force its parts together. Large quantities of diatoms are best boiled in porcelain evaporating dishes, glass flasks, or beaker glasses. The last-mentioned vessels are also by far the best things for washing them in. A few, say three or four, glass stirring-rods will be found useful; and one or two American clothes-pegs to take hold of hot evaporating dishes with. Then there will be required a few dip-tubes, made of small glass tube, drawn out over a flame, so that the opening is considerably diminished. The mode of making these cannot be given here, but will be found in books on chemical manipulation; and it will be well for the student to learn to make his own dip-tubes, as a number will be required first and last, and they are easily broken. Of course there will be required a number of glass slides of the usual dimensions of three inches by one. These should be of as white glass as possible, and it will be found best to procure those with ground edges, as they are the neatest in appearance. Only such as are free from scratches or other blemishes in the central square inch should be used; and although even such as have bubbles or scratches near the ends only will not look ornamental in a cabinet, we should remember that microscopic objects are not generally mounted to look well in a cabinet, but to be useful out of it; so that if the central and useful portion of the slide be perfect it need not be rejected. Some persons make their own glass slides, but I have never found it answer to do so, as it is difficult to get the right kind of glass, not at all easy to cut it or grind the edges, and it is liable to be scratched while cutting or grinding. Thin glass, such as is made on purpose for microscopic use, will be required; and this, also, it will be found best to buy ready cut than attempt to cut it for one's self. The thin glass used for covers may be of different thicknesses, but the thickest made will not do for diatoms, and a certain amount of the very thinnest will be required for small and delicately marked forms, on which very high power objectives will have to be used. The covers must be perfectly clean, which may be ensured by soaking in caustic potassa solution, and then washing thoroughly in clean water. The thinner kinds of glass are rather difficult to clean; but with a little extra caution it may be accomplished, the last polish being given to it by a piece of an old and

well-worn cambric handkerchief. The covers, always round, should be separated into sizes and thicknesses, so that the exact kind of cover required can be found without having to search for it by turning over a number, scratching or breaking them, and losing much valuable time. We shall also require a pair of forceps for holding the slides over the lamp; and such as are sold at house-furnishing stores and by grocers, under the name of American clothes-pegs, and which have been already mentioned, are by far the best I have ever seen or heard of. A small pair of brass forceps which close with a spring will be needed, and they are best set in a wooden handle so as to protect the fingers from the heat; and another pair, which spring open and may be closed by means of the finger and thumb, will be wanted for taking hold of and adjusting the thin covers. I do not advocate the use of paper covers for slides, but labels of some kind will, of course, be required, and I have found the plain circular white ones to look the best. There are very pretty square labels sold by dealers in these things that I have used and liked. For making cells to hold specimens put up in a fluid, a turn-table and brushes and some cement will be necessary. The cement I use and prefer above all others is good old gold size used warm.

The chemicals required are nitric acid, sulphuric acid, hydrochloric acid, bichromate of potash, caustic potash, alcohol, and, above all, a plentiful supply of clean, *filtered* water. The water should be such as leaves hardly any residuum when a quart of it is evaporated to dryness; and it must be filtered just before use, to remove any minute organisms, diatoms especially, which it may contain. A certain amount of washing soda will be wanted, if guanos are to be cleaned.

We will now proceed to consider the manipulations necessary to prepare the various kinds of gatherings, always remembering that these methods will have to be modified to a certain extent for each specimen.

Recent Gatherings.—If there be sand in the gathering, it will be well to remove it before using acid, by shaking it in clean water and pouring off before the diatoms, which are lighter than the sand, settle. The water holding the diatoms in suspension may be poured into a test-tube, or beaker, the diatoms allowed to settle, and as much of the water poured off as possible. The diatoms are now covered with nitric acid to about the height of half an inch, and allowed to stand for a few minutes. Usually some chemical action takes place, and it will be well to wait until it subsides. The test-tube or beaker is then held over the lamp and carefully heated until the reaction of the acid upon the organic matter of the diatoms ceases. Thereafter, and while the liquid is still hot, I have found it often advantageous to drop in one or two fragments of

bichromate of potash. The organic matter is more thoroughly destroyed in this way than when the acid is used alone. Thereafter it is well to pour the acid and diatoms into a capacious beaker of clean water, washing the tube or smaller beaker out with a little water, and adding this to the other. After the diatoms have all settled, which will often require hours, the supernatant fluid is carefully poured off, and a fresh supply added; and this must be repeated several times until all of the acid and coloured chromium compound has been removed. When this point is arrived at can only be ascertained from experience. In this way the valves and connecting membranes of the diatoms are usually separated and cleaned ready for mounting, which process will be described hereafter.

Muds will have to be treated in a somewhat different manner from recent gatherings. If the mud is dry, it will have to be broken down by boiling for a few minutes in a solution of caustic potassa, the strength of which must be apportioned to the particular specimen under treatment. After it has been broken down into a soft mud, all of the potash is thoroughly washed off by means of clean water, and replaced by nitric acid, as in the case of recent gatherings. This is boiled, and a little bichromate of potash added as before, and the whole washed. It very seldom happens that the diatoms occurring in mud will be sufficiently cleaned by this process, so that it has to be supplemented by another. The sediment is therefore washed into one of the evaporating dishes and allowed to settle, and as much of the water poured off as possible. Then sulphuric acid, in quantity to a little more than cover them, is poured in, and the vessel gradually and carefully heated. As soon as the liquid shows signs of boiling, bichromate of potash is added, a very little at a time, until the green colour first formed by its reaction upon the organic matter begins to assume a yellowish tint, when no more is dropped in; but a few drops of hydrochloric acid are permitted to fall in, and the liquid is allowed to cool. Of course it will be best if the person undertaking to clean diatoms is somewhat versed in the use of chemicals; but at any rate care must be taken not to drop any of the acids upon the clothes or skin, and great caution must be exercised in not inhaling any of the vapours given off. Those evolved after the addition of the hydrochloric acid are especially irritating and dangerous, and must be avoided. As soon as the liquid has cooled a little, water should be added cautiously, as great heat will be generated thereby, and there will be danger of its boiling over. Thereafter it may be poured into a large beaker-glass of water and thoroughly washed as in the former case. If it be found that the precipitate is not quite white, it will be necessary to boil it again in sulphuric acid, with bichromate of potash and hydrochloric acid, until it is quite clean. If, on examination by means of the microscope, it is found that there is much

flocculent matter present besides the diatoms and sand, this can be removed by boiling for a few seconds in a weak solution of caustic potash, and washing quickly and thoroughly with plenty of clean water. When we have recent gatherings of filamentous or stipitate forms of Diatomaceæ, which we desire to preserve in the natural condition, they should be immersed for about twenty-four hours in alcohol to dissolve out the endochrome. If this does not answer, it will be well to soak the mass of diatoms or plants upon which they are adherent in a solution of hypochlorite of soda, an impure variety of which is sold in the shops under the name of Labarraque's disinfectant, for about the same length of time. This will generally destroy all colour, and leave the specimens transparent. It is best, however, in many cases not to remove the endochrome, but leave it, and mount the specimens in such a way as to show them in as natural a condition as possible. How this may be done will be described hereafter.

Guanos.—The preparation of these substances, so as to obtain the microscopic organisms they may contain, is rather difficult, tedious, and dirty, and should only be undertaken by a person somewhat versed in chemical manipulations, and in a proper room as a laboratory, where there is no danger of harm resulting from the fumes evolved. As the ammoniacal guanos are those which contain the most diatoms, and consequently which answer best to clean, we will begin with them, and take as a type that which comes from the islands on the coast of Peru. As it comes into commerce this guano is a moist powder of a light iron-rust colour, smelling strongly of ammonia, and having scattered throughout its mass lumps of ammoniacal salts of a more or less solid consistency. The guano should be thinly spread out upon a stiff piece of paper and exposed to the air, and, preferably, to a moderate heat for several days or even weeks. In this way most of the moisture and much of the ammonia will evaporate, and less acid will be required to clean the guano. It will now have become much lighter in colour, and crumble to a dry powder. A tin pan is now about half filled with a solution of common washing soda in clean filtered water, and placed over some source of heat, as on a stove. The strength of this solution is not a matter of any great moment, and must vary with the guano manipulated. As soon as it begins to boil, the guano is dropped gradually in, a little at a time, while the liquid is stirred with a glass rod or stick of wood. Considerable effervescence takes place, ammonia being given off, and therefore it must be kept continually stirred, and care exercised to prevent its boiling over. After a while it is poured into a plentiful supply of clean water and washed therewith several times, care being taken to permit all of the diatoms to settle. As soon as the wash-water is only slightly coloured, the guano is transferred to a good-sized evaporating dish,

and covered with nitric acid, and boiled. While it is boiling, a few crystals of bichromate of potash are dropped in, and the material washed as in the case of muds. Thereafter the diatoms are boiled in sulphuric acid with bichromate of potash and hydrochloric acid, as before described.

Phosphatic guanos, as that from Brazil, are somewhat more difficult to treat. They are generally drier than the ammoniacal kind, and must be boiled in a large quantity of hydrochloric acid as many as three times, and the acid must be poured off while still hot. Thereafter nitric acid and sulphuric acid and bichromate of potash must be employed, as in the other case.

Lacustrine Sedimentary Deposits.—For the most part these are pulverulent, and easy to clean. Some, as found in nature, are so pure that they require no cleaning except washing in clean water. Burning on a plate of platinum or mica will often serve to clean some specimens; but it will, in general, be found best to boil in nitric acid with a little bichromate of potash, and subsequently in sulphuric acid and bichromate of potash, with the after addition of hydrochloric acid. Occasionally a certain amount of flocculent matter will be left, which it will be necessary to remove with very careful heating, not boiling, in a weak solution of caustic potash, and immediately pouring into a large quantity of clean water and thoroughly washing.

Marine Fossil and Sub-Plutonic Deposits, being stony, and possessed of very much the same physical characters, are manipulated in the same manner. A small lump of the deposit is placed in a test-tube, and covered with a strong solution of caustic potash. It is then boiled for a few minutes, and usually it immediately begins to break up and fall down in the shape of a soft mud-like material. At once the liquid, with the suspended fine powder, is poured off into a large quantity of clean hot water, and if the whole of the lump has not broken down into a powder, what remains has a little water poured over it in the test-tube, and it is again boiled. It will be found that a little more will now crumble off. This is added to the rest in the large vessel, and if the lump has not now broken down, it is again boiled in the alkaline solution and in water alternately, until it has all been disintegrated. It is then all permitted to settle for at least three hours, when it is thoroughly washed and boiled in hydrochloric acid for about half an hour. There is then added an equal amount of nitric acid, and the boiling continued for a short time. It is then washed and heated in sulphuric acid, with the addition of bichromate of potash and hydrochloric acid.

All mixed gatherings of Diatomaceæ, and particularly all muds and deposits, should be separated into densities, so that for the most part the larger forms are collected together, free from sand, and separate from the smaller species and broken specimens. This is

done by using a number of beaker glasses, of various sizes, in the following manner:—Into a 1-ounce beaker the cleaned diatoms are placed, and the vessel filled with water. It is then well stirred up by means of a glass rod, and, after resting about five seconds, poured off carefully into a 6-ounce vessel so as not to disturb the sand which has settled. Again the vessel is filled up with water, stirred, allowed to settle for the same length of time, and poured into the same vessel. This is repeated until it has been done at least six times, when we shall find all of the sand, free from diatoms, in the small beaker. This can be thrown away, and as soon as the material in the large beaker has settled it is returned to the small one, and the same process gone through with, only extending the time of settling now to about ten seconds. The next density is that which settles in twenty seconds; and so on, five or six densities may be obtained, and if carefully prepared they will be found to contain forms varying very much one from the other. The large species of *Triceratium*, *Aulacodiscus*, and the like, will be found in the coarsest density, and the broken diatoms in the lightest.

Preserving and Mounting Specimens so as to have them in a condition for study at any future time.—Of course, when possible, Diatomaceæ should be studied in the living condition. But there are many forms which have not been as yet found living, and these can only be studied as dead skeletons; and, in fact, it is in the dead skeletons of the Diatomaceæ that many of the most marked characteristics are to be found; and on such characteristics species have been founded. Besides, the most beautiful sculpturing of the valves is only to be seen after everything has been removed but the silicious cell-wall I have termed the skeleton. Therefore I advocate the cleaning of a portion at least of every gathering in the manner described, so that nothing will be left but the clean silicious cell-wall.

If we desire to keep specimens in a state as near that they present when living as possible, we have to put them in some preservative fluid in which they will not decay, and in which the softer parts will be preserved. Unfortunately these soft parts do not keep well; but the fluid which I have found to be the best for the purpose is distilled water, which has to every fluid ounce two or three drops of wood creosote added, and thereafter a sufficient number of drops of alcohol, which will be about double the number of the drops of creosote, to make the creosote soluble in the water, which it is only to a very slight degree under ordinary conditions. I do not advocate any fluid containing glycerine, or, in fact, any of the preservative fluids described in the books treating of the preparation of microscopic objects. The vessels in which the fresh specimens of Diatomaceæ are put up are what are known to microscopists as "cells," but how these are made cannot be gone into here, as the description would occupy too much space and time.

Suffice it to say that I prefer cells made of old japan gold-size, which can be procured of dealers in microscopic materials. Within such a cell, of sufficient depth and immersed in the preservative fluid, a few of the diatoms, or a scrap of the plant upon which they are growing, is placed, and the glass cover fixed over it in the manner described in the books upon manipulation. The filamentous forms are thus preserved almost in their natural condition; but, on account of the presence of the endochrome, the sculpturing of the silicious cell-wall is almost invisible. To show this character, while the filamentous form is preserved, another method of mounting is employed. A thin, clean covering glass is selected, and laid upon a clean piece of paper. A large drop of distilled water is then allowed to fall upon it, and in this drop the filamentous diatom is thinly spread out. Then the cover is taken up by means of a pair of forceps and held over the flame of a spirit lamp, which has been turned down so as to be quite small and steady. The cover is held some distance above the flame, and judiciously manipulated, so that the heat is evenly distributed over it, and it does not crack. As soon as all the water has been driven off without the formation of bubbles, the glass is brought gradually down almost in contact with the flame, and held at that point for a few minutes. Then the diatoms will be seen to turn black, on account of the charring of the organic matter contained in them. After a while this black carbonaceous matter will burn off, and they will become quite white. If, however, there seems to be any difficulty in burning off the last portion of carbon, the cover is lowered once or twice to come in contact with the top of the flame, and then raised again. In this way it will become red hot for a moment; and everything will be burned off except the silicious portions of the diatoms. Now the cover is removed slowly from over the flame, and held in the forceps until it is cold, but by no means laid down upon any surface until it is quite cold, otherwise it will fly into pieces. Then it can be laid upon an ordinary glass slide, and examined to see if it is worth preserving, which may be done in one or two ways: first, the glass cover is warmed, and a drop of good spirits of turpentine let fall upon it, covering the diatoms. Just before the spirits evaporate, a small drop of thin Canada balsam is added, and a slide taken, warmed, and a drop of balsam placed upon the centre part of it. Then the cover is brought down upon the slide, the two balsam-covered sides together, in such a way, by tilting the cover slightly, that no air is allowed to come between them, and the cover permitted to fall gradually into place, driving a wave of balsam before it. In this way we have the filamentous diatoms arranged as they grow, but with endochrome removed which would obscure the markings, and in balsam, which renders them transparent. Some forms, as some of the

Fragillariæ, become too transparent if put up in this way, and therefore another method of mounting must be adopted with them. They are burned upon the cover, as just described, but mounted dry in air; that is to say, a cell of gold size is made, the glass cover slightly warmed, and then placed upon the cell, with the side upon which the diatoms are fixed, downwards. The warmth slightly softens the gold size, and the cover becomes fixed.

Other forms besides the filamentous species may be mounted in fluid, or burned upon the cover and subsequently put up in balsam, or dry. But the commonest way of treating such forms is to clean them by means of chemicals, as already described, and then, previous to mounting them, divide the clean gathering, consisting of a white sediment of large and small diatoms along with fine sand, all mixed up together into densities. Of course, if some of this sediment were to be mounted in this condition, extremely unsightly slides would be procured; so it is best to separate the finer from the coarser diatoms, and these in turn from the sand. This is accomplished by what is known as elutriation, or, separating into densities after the manner already described. Then slides may be mounted from each of the densities in the following manner. A slide is thoroughly cleaned, and a good-sized drop of water placed upon the centre portion. A little of the diatom sediment is then taken up in a dip-tube, and the point of the tube brought just into contact with the drop. As soon as a few diatoms have run out of the dip-tube, it is removed. Then a small splinter of wood or stiff bristle is used to disseminate the diatoms through the drop of water in such a way that they will be pretty evenly distributed and not overlie each other. The water is then driven off by heat, a drop of thin Canada balsam placed upon the dry diatoms, and a cover placed on them in the usual manner. In many cases, especially when dealing with the smaller forms, it will be found desirable to mount them upon the cover in this same way, instead of upon the slide, as they will then be brought as near as possible to the objective of the microscope. Single or remarkable specimens of diatoms may be picked out and mounted by themselves; but the manner of accomplishing this would occupy more space than it has been thought desirable to devote to this portion of our subject, and the reader is referred to the books on mounting microscopic objects for the particulars of the process.

The main principles of preparing and mounting *Diatomaceæ* for preservation and study have been given, and the intending student will be able to devise modifications and improvements for himself, so that he will be able to put up specimens in as finished a manner as any to be procured from the dealers.—*From the Report of the Geological Survey of New Hampshire*, vol. i.

NEW BOOKS, WITH SHORT NOTICES.

The Anatomy of the Lymphatic System. By E. Klein, M.D., Assistant Professor at the Laboratory of the Brown Institution, London. I. The Serous Membranes. London: Smith, Elder, and Co., 1873.—Some of the results of the observations described in this memoir were published in 1872, in the January numbers of the 'Centralblatt für die Medicinischen Wissenschaften.' Dr. Klein has since that time carried his observations farther, and is of opinion that the anatomy of the serous membranes, so far at least as their lymphatic system is concerned, may be regarded as complete. The present work deals with the minute structure of the omentum, the centrum tendineum of the diaphragm, and the mediastinal pleura, both in their normal and pathological conditions.

It is almost impossible to criticize a book of this nature. The Teutonic carefulness, which insists on a knowledge of all contemporary work on a given subject, precludes almost any farther inquiry into facts and arguments adduced on one side or the other, where the only possible proof is a repetition of the writer's work and experiments. And it is only the careful histologist who can verify or pull to pieces such work as Dr. Klein's. Mere bibliographical research, with the addition of one or more presumably new facts, not necessarily supporting, or even antagonistic to, some stated text, is certainly too common a characteristic of authors in German "Archive" and "Zeitschriften." But no such fault is visible here. The facts observed are stated plainly and severely; the opinions of others put forward with fairness, whether they agree or differ with those of the writer; the conclusions of the observer himself offered modestly, though with no lack of firmness.

In his first chapter he points out that on the serous membranes in certain regions there is normally to be seen a *germinating* endothelium. For instance, the fenestrated portion of the omentum in various animals shows numbers of cells which are raised from the general surface by means of a stalk, and which possess in their peripheral spherical portion two nuclei or a nucleus in a state of division; and besides the appearance of constriction, and division of these polyhedral or club-shaped endothelial cells, there are always numbers of smaller spherical lymphoid elements which are detached from the surface, that is to say, which have become perfectly separated. The same character is possessed by the endothelium of the surface of certain nodular or cord-like structures, which are either isolated or in connection with the chief trabeculae of the fenestrated part of the omentum, in which larger blood-vessels or fat are contained. In the second chapter, in which he discusses the cellular elements of the ground-substance (matrix, basis-substance), he shows that the knots and cords are not exactly to be regarded as pre-existing adenoid tissue, nor as collections of lymph-corpuscles, but that they are developed for the most part out of the ordinary branched cells of the