MICRO-NOTES

Devoted to Microscopy

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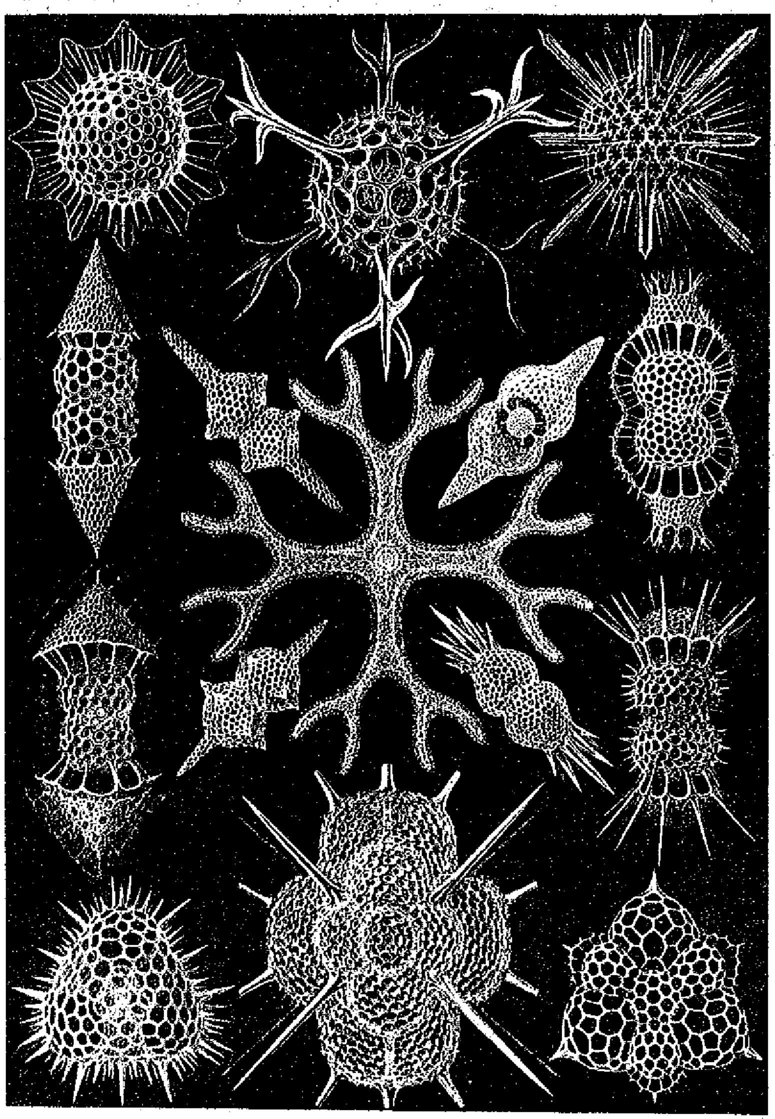
Haeckel, Kunstformen der Natur. Tafel 91 [illegible]



Spumellaria. — Schaumstrahlinge.

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Volume IV, Number 1

Contents for January - March, 1949
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ARTICLES Page

DEPARTMENTS

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TROCHOCERCA CAPUCINA

An European Cuckoo or an American Cow Bird among the Rotifera

By C. Rudlin, F.R.M.S., M.A.M.S.

- * -

In the summer of 1948 while examining some material collected from Alberton, Essex the previous day (containing among other rotifers a number of specimens of Keratella quadrata, K. cochlearis and Asplanchna priodonta) I saw a slim, graceful form dart across the field of view which on further investigation turned out to be a specimen of Trichocerca capucina. While watching this beautiful rotifer darting hither and thither with the smooth, clean sweeps characteristic of this species, I saw it suddenly make a dash at a K. quadrata which was carrying an egg (attached as usual to the post-ventral part of the body), seize hold of the egg, pierce it with its jaws and suck out the contents. At first I thought that this might have been an unpremeditated action, or that a single specimen had discovered this easy way of getting a meal. However, I kept other specimens under observation for several hours and saw the same thing happen again and again, the "foul deed" being carried out each time in a workmanlike manner. It would appear therefore that this is a normal habit of Trichocerca capucina.

Later while watching the T. capucina (and incidentally seeing several more Keratella eggs "go west"), I observed a specimen of Asplanchna priodonta with two attachments which, on closer examination, proved to be two rather small (in relation to the Asplanchna), round, brown eggs. This struck me as being very strange as this species is normally viviparous and, apart from the resting eggs (which are proportionally quite large and carried internally) does not lay eggs, much less carry them attached to its body. Another Asplanchna was seen with an egg attached just below the head (of all places!) These specimens were kept under observation and after half an hour one of the eggs showed signs of hatching. A short time later a young Trichocerca capucina emerged. The other eggs were also observed to produce this species.

The question now remained - how did the eggs become attached to the Asplanchna? Were they laid haphazard and being perhaps sticky became attached by accidental contact? Or were they deliberately attached by the mother?

This problem was solved next day. Fresh material was collected from the same source and kept under observation for over an hour before anything happened, apart from the fact that several T. capucina again made meals off the Keratella eggs. Then suddenly one of the latter made a dash at one of the Asplanchna, held on to it by its jaws and laid an egg which it attached to the body of the Asplanchna near the geneto-urinary opening. Having accomplished this, it relinquished its hold and swam away. Subsequently this observation was repeatedly confirmed.

In short, it would seem that Trichocerca capucina is parasitic in much the same way as the cuckoo, with the difference that while attacking the eggs of at least one species of rotifer, it chooses as a "foster-parent" a species that does not normally lay eggs or carry them. I have not been able to find any earlier account of these interesting habits in the literature.

These records are published at the suggestion of my friend, Mr. A. L. Galliford of Liverpool, to whom they were communicated when he was staying with me in September 1948, and who considers that they form a valuable addition to our knowledge of the habits of this species.

****

We thank Mr. Rudlin for his very interesting article. Mr. Rudlin has for many years made a special study of Rotifers and would like very much to correspond with any persons who have made similar studies. His address is: "Owl Hoot" West Mersea, Essex, England.

WHAT IS THE RELATIONSHIP?

****

By J. E. Nielsen

\- * -

When one talks about something it is a nice thing to know what one is talking about. A considerable amount of work may be done in any field without knowing much about the basic concepts involved; thus we have electric light and radio without knowing what electricity is. We may all take photographs of mediocre or highly artistic quality by simply pressing a button and without having the slightest idea about localized energy-levels of haline atoms or the exact nature of the latent image. The same holds true in the biological sciences. One may grow beautiful roses, be interested in the embryology of leaches or the habitat of blue-green algae without being much concerned about their particular relationship or their relationship to other forms of life as long as it is a rose, a leach,or a blue-green algae.

Now the question may be put: 'Why is a leach not a half-cousin to a blue-green algae?' It sounds like a very stupid question, but actually there is a very, very far off relationship which may be followed up on a genealogical tree, if we have one.

The student who is anxious to envisage an orderly 'Systema Naturae' of interwoven relationship will find the field wide open, a lamentable fact considering the weighty brains who, in the past, have splurged their energy on it. The lower down one attempts to go on the genealogical ladder, the more confused becomes the issue. In this paper we shall relate some probable relationships among the lowest forms of plant life.

Already in 1911 Professor V. Frantz (1) pointed out that it is a mistake to base a systematic phylogenetic system on the assumption that single cellorganisms are sole forerunners for all multiple cell organisms. Thus, it is quite reasonable to postulate that some single cell organisms are offspring from multiple cell organisms. Based on similarity in reproduction, membrane, and chemical contents, this author suggests a scheme of relationship as shown in Fig. 1. If protozores are the precursor of plants and animals, or if the reverse is the case is an irrelavant question in the scheme suggested by Professor Frantz. If the scheme he outlines appears cursory, it should never - theless not be lost sight of as a reasonable starting point.

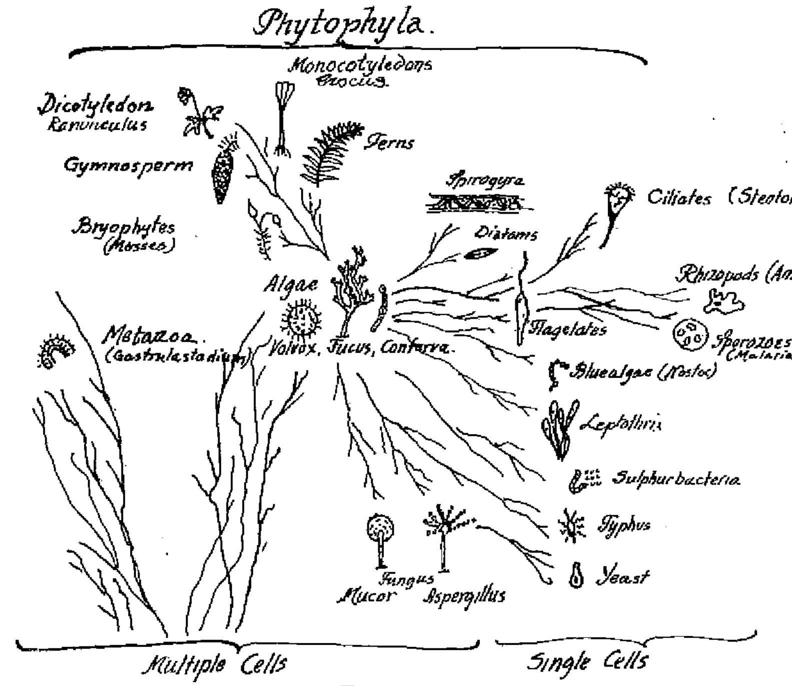

Fig 1.

By employing a completely different mode of attack, Professor Mez of Koenigsberg University arrived at a picture very much different. This worker used a serodiagnostic method, based on injecting animals with albumen solution or infusion of algae or bacteria. The serum in injected animals will develop substances which have a property of forming a precipitate or aglutination if added to the albumin solution or to the infusions used in the preliminary injection. A precipitate will also form in albumen solutions originating from plants which are in close relationship to each other, and the closer the relationship the heavier the precipitate will be.Are the plants in a distant relationship only, then no precipitate will form. This same condition holds true for the agglutination method. In Fig. 2 we have reproduced the picture Professor Mez arrived at for the lower Algae and Fungi. It is striking that the Heterocontae forms the base for the Flagelates; and in the Flagelates we find the tie with the Animal Kingdom with Amoeba and Myxomycetes closely branched. Strange is also the isolated position of Volvox. Note, also, the close relation between Diatoms and Peridinales, much closer than to Desmids which are on an entirely different branch.

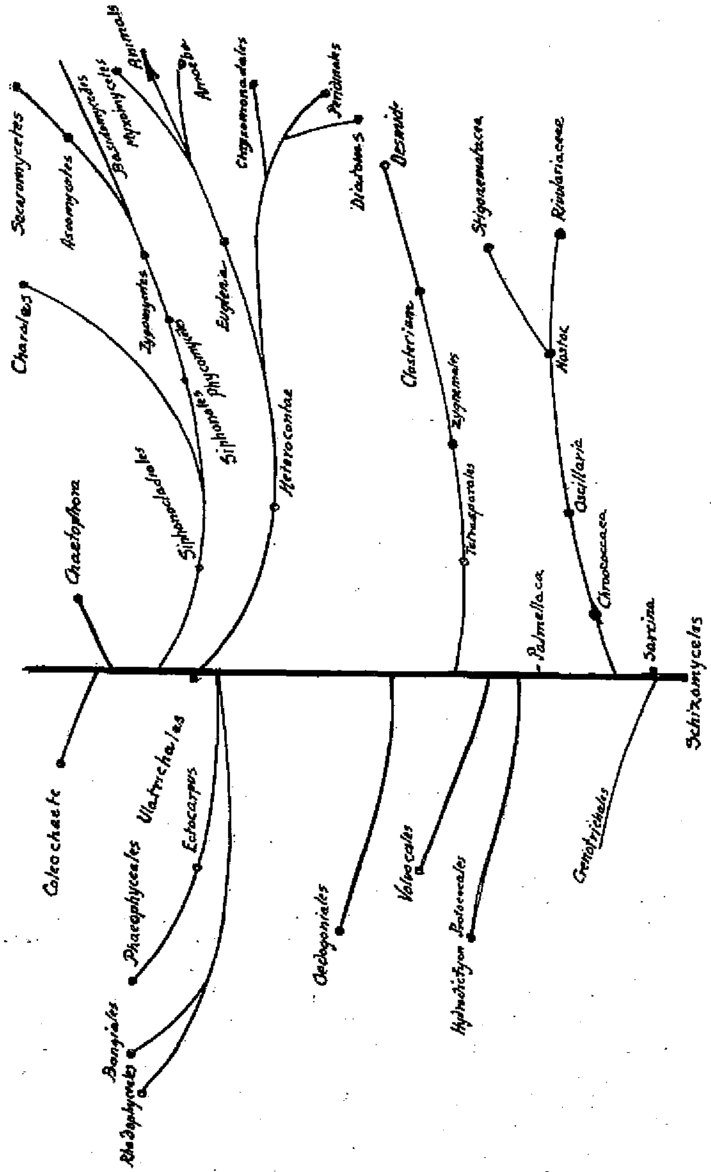

Fig 2.

Both of these suggested schemes are in variance with the ideas of many workers, and also with many text-books. Thus, G. M. Smith (2) admit a more or less arbitrary classification (Fig. 3). On a morphological or physiological basis, he recognized nine classes or series among algae.

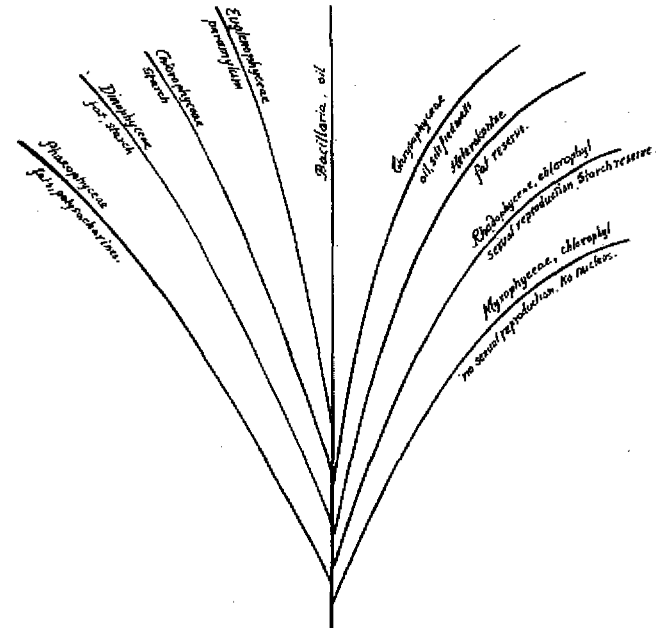

Fig 3.

Professor Mez assumes Sulphur or Nitro-bacteriae as the base of the geneological tree. This is an assumption not held by all investigators. Thus, virus and other forms of life near the chemical level have been suggested as a more reasonable starting point which again may bring the tree down to molecules, atoms, electrons, etc. with the possible further philosophical deduction that the origin of it all may be found in vibration or unbalance in something or another brought about by what? And that at the other extreme, our thoughts, which probably are the highest biological function, may be similar vibrations in various tissues near the cortex in the wrinkles of the brain.

Thus we go out where we came in, and, as Omar sang:
"With Earth's first clay They did the last man kneed,
"And then of the last harvest sowed the seed.
"Yea, the first morning of Creation wrote
"What the last Dawn of Reckoning shall read.

(1) Arch. f. Prolistenkunde, vol. 39, y. 263
Also Cliff Dobell: Principles of Protistology, Am. ... P., Vol. 23, 1911
(2) G. M. Smith; Freshwater Algae of the United States.

Notes on -- PLEASURES OF THE MICROSCOPE
****

By M. Rasmussen, Amsterdam, N.Y.

Professor Thomas Huxley long ago advanced a powerful argument in favor of the study of Natural History as a means of getting on. He says: "There is a way, I am convinced, in which Natural History may take a profound hold upon practical life,- and that is, by its influence over our finer feelings, as the greatest of all sources of that pleasure which is derivable from beauty. I do not pretend that Natural History knowledge, as such, can increase our sense of the beautiful in natural objects. But I advocate Natural History knowledge from this point of view, because it would lead us to seek the beauties of natural objects, instead of trusting to chance to force them on our attention.

To a person uninstructed in Natural History, his country stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of Natural History and you place in his hands a catalogue of those which are worth turning round. Surely our innocent pleasures are not so abundant in this life that we can afford to despise this or any other source of them. We should fear being banished for our neglect to that limbo where the great Florentine tells us are those who, during this life, 'wept when they might be joyful'."

My task in writing these notes is an earnest desire to assist in diffusing a love for an instrument which has been my constant companion for upward of twenty-five years; and because I am firmly convinced of its real and practical utility in education both during school and after school years. As an instrument for the advancement of knowledge, the microscope has no equal.

We can understand the reasons for the average educated man not owning an Astronomical Telescope. Astronomy with all its wonders demands many nights of observation, and expensive instruments which, if large enough, must be housed in specially designed buildings; and the study with the Telescope must be carried on in the temperature of the out-of-doors, there is no substitute for that.

But it is difficult to understand, or to formulate a satisfactory reason for the failure of men of refined tastes not to own a microscope and provide for themselves and friends the pleasures and advantages associated with microscopic observation. The average man does not seem to realize that the microscope will unfold nature's wonders and beauties without that long and careful study necessary to most scientific pursuits.

Those who procure a microscope for pleasure and recreation will quickly find the instrument and its revelations become the means of the acquirement of a very liberal education, for its influence is not confined to any one kingdom, but embraces every tangible and intangible subject from the air we breathe with its myriads of invisible friends and foes to human well-being, to the floors of the oceans with their minute flinty shells bearing markings exceeding in accuracy the power of any draughtsmen to depict, many of them measuring but 1/200,000 of an inch, and so fine that only the most powerful and accurate microscopes in the hands of experts will show them.

The milk we drink, the food we eat, the flowers, trees, worms and insects, as well as the waters and rocks of the earth, are, one and all, open books to the owner of a microscope; the real beauties of nature cannot be seen without it. Seeing a picture aids the memory, so a minute of ocular demonstration is worth hours of oral description.

A good microscope in the home is worth many times its cost. It needs no special brilliancy, no marvelous intellect to become familiar with the use of the microscope, and its revelations will quickly make a master out of its owner in some special department which he will adapt as his own.

*****

EARLY FLOURITE OBJECTIVE
****

F. J. Keeley of Philadelphia has given Dr. Vida A. Latham, who has been a member of the State Microscopical Society of Illinois for nearly sixty years, the following interesting facts:

"I do not remember whether in any previous letter I mentioned that my collection includes one of Spencer's objectives in which flourite was used and that this one possibly is the only one that has been preserved. It was made in 1860 for Dr. Louis Tice and passed into the collection of Dr. Charles E. West of Brooklyn. After his death, and the sale of his microscopical effects, it came to me. I enclose a note regarding it."

Mr. F. J. Keeley describes the objective as of one-fourth inch focus. It was recently necessary to take apart the back system for re-balsaming. It was thenfound that this system consisted of five lenses,three of which were convex and two concave. One of these lenses proved upon examination with polarized light to be flourite, which mineral, while isotropic, exhibits characteristic optical anomalistics between crossed prisms that permit of its identification, at least in contradistinction from glass or other material used for lenses. The fluorite lens is perfectly preserved, as might be expected from the stable character of the mineral. When objectives of more recent manufacture containing fluorite have deterorated, the fluorite has been blamed for faults which should undoubtedly have been attributed to unreliable glass used in connection with it.

This objective is historically interesting as it illustrates the complex nature of the correction adopted by Spencer at so early a date. It also confirms the previous reports that he had appreciated the possibilities connected with the use of fluorite in securing superior color corrections and employed it for this purpose twenty years before it came into use abroad.

The objective has an aperture of 142 to 152 degrees, according to position of adjustment, which acts by rectilinear movement of back systems, and is unusually well corrected for color. It resolves Pleurosigma angulatum sharply into dots with central light from mirror, and with oblique illumination resolves markings 76,000 to the inch. In some respect, its performance was possibly slightly sacrificed in eliminating color for with a large central illuminating cone, its definition is somewhat inferior to that of objectives of similar power made by Tolles at slightly earlier and later dates which show considerably more color. The latter, although over sixty years old, compare favorably, optically and mechanically with the best achromatics made today,and it seems not unlikely that Spencer abandoned the use of fluorite because he realized that sharp definition was more important than the elimination of the last trace of color, rather than from any fear of its lack of permanency.

*****

WIDGETS AND GADGETS

by Dan M. Stump

No.6- Correcting for Cover-glass Thickness.

Let us try a little experiment tonight. Select one of your pet slides,preferably a diatom slide or one showing fine structural detail. A micro-photograph or one of the stage micrometers produced by photography with areas showing distinct silver grains would be excellent.

Set up the slide under a high-powered dry objective and adjust the illumination to produce a clear even field, the substage diaphragm opened as wide as possible without fogging the image. For most makes of objectives the body tube should be adjusted to a tube length of 160 mm. (Leitz uses 170 mm.) from the shoulder of the objective to the top of the draw-tube, at which distance the objective usually will be corrected for a cover-glass thickness of 0.18 mm.

Now, hunt around the slide and select a small sharply defined marking on the surface of the object or a small speck of debris located in the same plane. Focus carefully on this tiny speck, then focus slowly upward and notice the change in its appearance as it goes out of focus. Refocus on the speck and then focus the same distance downward and again notice the out-of-focus appearance of the speck.

If a general softening of the image is observed on both sides of the focus, and the out-of-focus appearance is about the same both above and below, the tube length is correctly set for the cover-glass thickness of that particular object.

Usually, however, there is a tendency toward a sudden "mistiness" on one side of the focus, and a "hard" appearance on the other. If the "hard" image appears when focusing down, it indicates undercorrection of the objective, caused by the cover being too thin, and the tube length is consequently too short to allow the formation of an image of optimum sharpness. The remedy obviously is to increase the tube length until the appearance of the images on both sides of the focus are nearly identical.

Conversely, if the "hard" image appears when focusing upward, overcorrection due to too thick a cover is indicated, and the remedy is to shorten the tube.

Now, if the hard image appears when focusing down, the tube may be extended a few millimeters at a time and a position will usually be found where the above and below focus images are similar. The amount of tube extension necessary to correct a given variation in cover thickness varies with different objectives and must be found by trial. (One of my dry objectives, a 4 mm. with an N.A. of 0.95 which I have carefully calibrated,requires a tube-length extension of about 9 mm. to compensate for a decrease of 0.01 mm. in the cover glass thickness. An Abbe Test Plate with its graduated wedge shaped cover provides a convenient means for such calibration.) A mounted object with a cover thinner than 0.10 mm. is seldom encountered, and most stands are constructed to allow for a tube extension sufficient to correct for this amount.

However, if the hard image appears when focusing upward, trouble may be encountered. Very few stands are constructed to allow a sufficient shortening of the tube to correct for a cover much thicker than about 0.20 mm. Many otherwise excellent mounts have been carelessly prepared so that the effective thickness of the cover exceeds this amount, and when such a slide is encountered the tube length simply cannot be shortened sufficiently to produce a really good image with a high powered dry objective.

In the first place, many mounters do not select suitable covers by measuring each one and discarding those over 0.18 mm. thick. I have even known some mounters who prefer thick covers because of the lessened liability to breakage, completely ignoring the optical effect. Even when the covers are carefully selected for thickness, the object is often mounted directly on the glass slip with a relatively thick layer of mounting medium between the object and the under side of the cover which has the effect of increasing the thickness of the cover. Sometimes such a slide may be reclaimed by removing the protecting ring around the edge of the cover, heating the slide and squeezing the cover closer to the object, but it is a messy job and the mount may be ruined during the operation.

In my own personal collection of mounts the printed label provides for the recording of the thickness of the glass slip and the effective cover thickness. When purchasing new mounts, unless of especial interest and not replaceable, I discard any mount with an effective cover thickness greater than 0.20 mm., not only because of the danger of damaging the front lens of an immersion objective, but also because it would be impossible to obtain a really good image from such a slide with a high-apertured dry lens without a major remodeling operation either on the stand or the objective.

If your dry lens is equipped with a correction collar, the correction for cover thickness of course may be made by adjusting this collar instead of changing the tube length. If the "hard" image is encountered when focusing down, turn the collar in the direction calling for a thinner cover glass until the above and below focus images are similar. Conversely, if the "hard" image appears when focusing up, turn the collar in the direction calling for a thicker cover.What the collar really does is to vary the distance between between the front and rear elements of the lens, separating them for a thin cover and bringing them closer for a thick cover.

It should be kept in mind that any change in either the tube length or the correction collar setting will produce a change in the final magnification, and also will disturb the parfocal adjustment of the lenses when used on a revolving nosepiece.

With low-powered dry objectives, those with an N.A. of less than about 0.65, the optical disturbance due to a reasonable variation in the thickness of the cover glass is small and usually can be neglected. This is also true with oil-immersion objectives so long as a sufficient working distance remains to prevent endangering the front lens of the objective by direct contact with the cover.

In general, the tube length specified for an oil-immersion objective should be strictly maintained. However, when the object is mounted in a medium of high refractive index such as realgar, and a material thickness of the realgar lies between the object and the cover, a slight shortening of the tube length will considerably improve the quality of the final image.

It might also be noted that undercorrection results if an immersion oil with too low a refractive index is used, and that it may be partially corrected by slightly lengthening the tube.

Before closing this article, I should mention the recent policy of manufacturers of microscopes to furnish their cheaper stands with a fixed tube incapable of adjustment. Such an instrument has the advantage of a lower cost and a permanent parfocal adjustment of several objectives on a nosepiece. Since the vast majority of workers with the microscope today are unwilling to learn and apply even the simplest fundamentals of how to properly adjust their instrument, it may be just as well to omit the sliding tube, on the same principle that better photographs will be obtained by many people with a fixed focus box camera than by these same people with a Contax or a Speed Graphic. For serious workers sufficiently interested in obtaining optimum images to adjust for cover glass thickness, research stands of better grade with tube adjustment are still available.

In case you cannot remember all of the above suggestions, cut out and attach the reminder appearing at the right inside the door of your microscope case.

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HARD IMAGE FOCUSING DOWN

UNDERCORRECTION

COVER TOO THIN

TUBE TOO SHORT

LENS ELEMENTS TOO CLOSE

OIL INDEX TOO LOW

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NEWS FROM THE FIELD

****

PLEUROSIGMA ANGULATUM

By J. E. Nielsen

The diatom has in the past been the problem child of microscopists and photomicrographers alike. It is one of the good test diatoms which may be resolved by an .75 NA lens properly manipulated. At a certain focus one will see white beads, and at a slightly lower focus it will be black dots, the war and fighting to this day has been about which is the correct focus.

The election microscope so far did not give a very convincing answer. A few weeks ago, Mr. A. C. Lonert of the General Biological Supply House, took P. angulatum under his arm and cornered Mr. A. Vatter, Biologist of the South District Filtration plant here, in Chicago, with the result that a fine electron stereogram was produced (Fig. 1). From this it is clearly seen that the valve consists of a coarse structure of ribs crossing each other at about 60° with oval shaped apertures between the intersection. Underlying this is a much thinner ribbed structure at an angle of about 30° with each of the upper heavy ribs and spaced almost exactly as the apertures in the former. The thin rubbed structure of the lower layer seem to be honeycombed with minute irregularly spaced perforations. How the two structures are joined together is not disclosed in this picture, but it seems certain that there must be some structural connection in order to keep the two parts so perfectly in alighment. Note particularly the fractured edge at the left hand side; it discloses many interesting details.

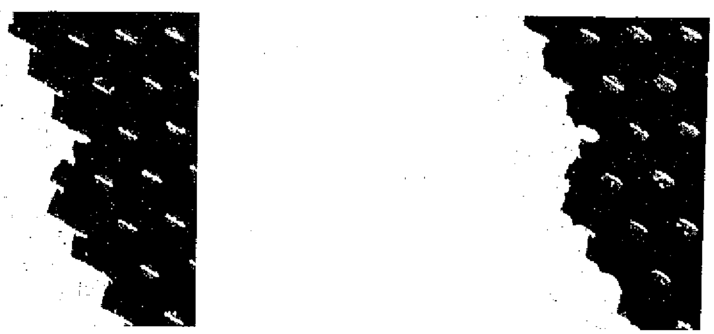

Fig. 1. Electron stereogram of Pleurosigma Angulatum

NEW PRODUCTS

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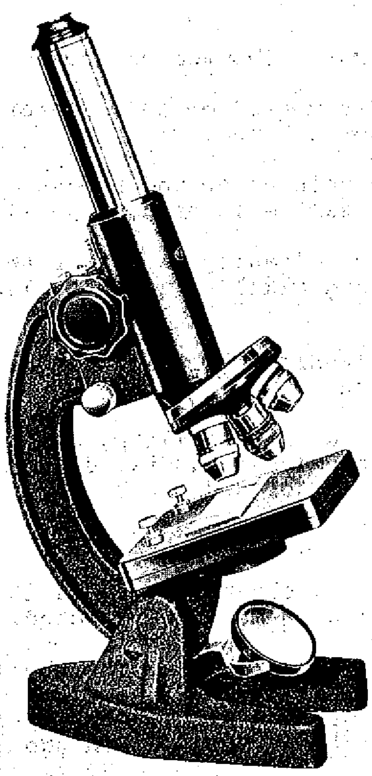
A NEW STANDARD LABORATORY MICROSCOPE

In announcing the new laboratory microscope Model F, the Testa Manufacturing Company, 418 S. Pecan Street, Los Angeles, California, furnishes proof that a good microscope must not necessarily be expensive, but that it is within reach of every scientifically minded person.



The instrument, illustrated on this page, has standard optical dimensions and lens mounts, and will prove satisfactory for a wide variety of biological investigations inasmuch as it resolves fine microscopical details such as, for example, structure of Pleurosigma angulatum and striae in muscles.

Unlike many other inexpensive instruments which have but fixed magnification and lack many adjustments desirable for work with the microscope, the Model F provides separate coarse and fine adjustment for critical focusing, a triple nosepiece with three achromatic objectives and a draw tube.

Perhaps, the most interesting feature of the new Model F is the elaborate substage with iris diaphragm and condensing lens for proper light control. The substage as well as an instruction manual and a transparent plastic dust cover are included in the price of $89.00 for the entire instrument.

LABORATORY TECHNIQUES
****

CLEANING OF RADIOLARIA FROM BARBADOS
By Dr. V. A. Latham

Here is a method a friend gave me many years ago, and this method is suitable for the Barbados radiolaria deposits.

1) Soak the sand-stone for two hours in a mixture of two parts of rain water and one part of glycerine.

2) Transfer to rain water for two hours.

3) Dry in sun, on warm mantel or on radiator. Stove heat must not be used.

4) When dry, soak in rain water and repeat drying and wetting until sample is reduced to slime.

This gentle and slow way of cleaning is better than the alternative use of acids and alkalies as it is less destructive.

5) When all is slime, boil gently in hydrocloric acid on a sand bath.

6) After a couple of hours of boiling, cool, pour off acid, and flood with a saturated and cold solution of carbonate of soda.

7) Wash and examine.

If the radiolaria is now clean, use it as it is. If it is not clean, the process must be repeated.

Useless debris may be removed by putting the shells into a 10 inch burette jar, filling it with water, and letting it stand for four or five minutes to settle,and pouring or syphoning the water off to within two inches of the bottom.

Well cleaned radiolaria material is a beautiful sight under the microscope but good cleanings are seldom seen nowdays. Still, cleaning is not difficult. However, to get samples in these days is another story, on account

of the dearth of general microscopical journals which promoted exchange of material. Specialization and other hobbies may also have interfered.

Methods of lighting slides is also worth studying. Hence the question: Which give the better result - opaque or dark ground? Photographing radiolaria is quite a problem for their structure is complex both when alive and when dead.

Structural differences may be seen in the same species at low magnification. As an example - Astromma common in the sand-stone of Barbados, is a remarkable one for the range of variation compatible with conformity to a general plan of structure. Some may show a Maltese cross; others may show none at all.

Foraminifera and Polycistina are often mixed with Radiolaria and the separation of these from the sand-stone will be taken up in a comming number of the magazine.

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SPECIMEN EXCHANGE
****

RADIOLARIA MATERIAL

We have a small quantity of radiolaria material from Barbados for distribution among our readers. Send 9¢ in stamps to cover mailing and packing, to:
Dr. V. A. Latham, 1644 Morse Ave., Chicago 26, Ill.

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NOTE: This department is open free of charge to all subscribers of MICRO NOTES. Use it freely to the mutual advantage of all concerned.

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OUR FRONT PAGE
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TO MAKE YOUR OWN SLIDES

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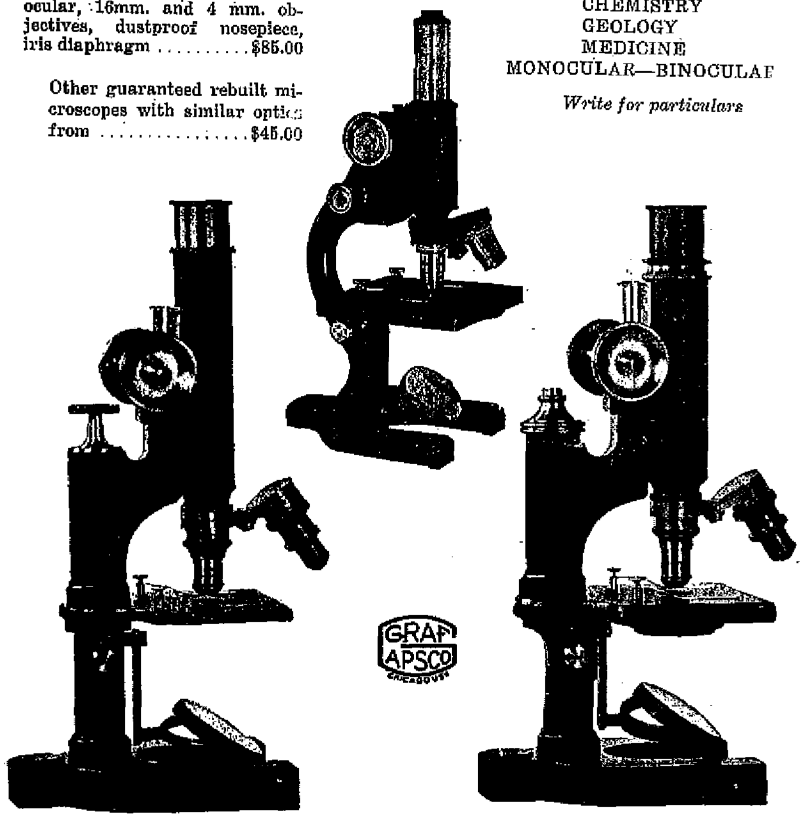
Model CS2 as illustrated 10X ocular, 16mm. and 4 mm. objectives, dustproof nosepiece, iris diaphragm $85.00

Other guaranteed rebuilt microscopes with similar optics from $45.00

REBUILT MICROSCOPES
for:
RESEARCH
CHEMISTRY
GEOLOGY
MEDICINE
MONOCULAR—BINOCULAR

Write for particulars



Rebuilt VO Microscope

Rebuilt V Microscope

Model	Nosepiece	Eye-pieces	Objectives	Magnifications Obtainable	Light Control	Price Without Cabinet	Price With Cabinet
VO1	Double nickel plated	10x	10x & 43x	100 & 430	Disk diaphragm	$45.00	$4.00 additional
VO2	Double dust proof	10x	10x & 43x	100 & 430	Disk diaphragm	50.00	
V1	Double nickel plated	10x	10x & 43x	100 & 430	Iris diaphragm	50.00	
V2	Double dust proof	10x	10x & 43x	100 & 430	Iris diaphragm	55.00	

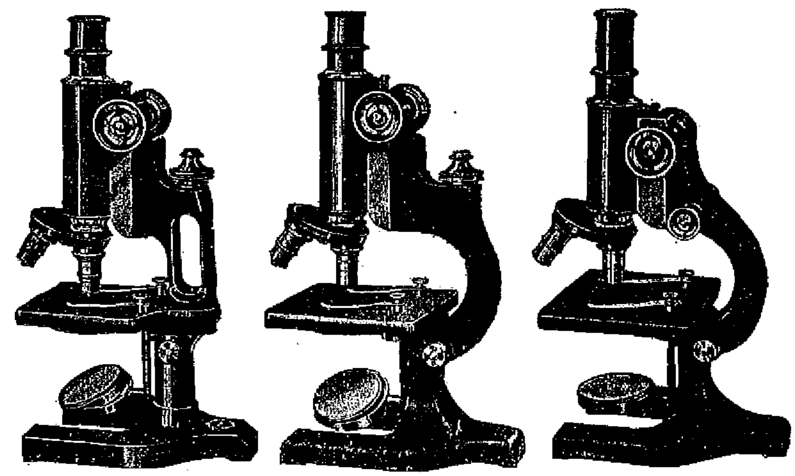
NOTE: A 5x eyepiece may be added to any of above instruments for $2.00 additional
This will add magnifications of 50 and 220. Any quantity of any model sold on approval.

THE GRAF-APSCO COMPANY 5868 BROADWAY CHICAGO 40, ILL.

GUARANTEED REBUILT MICROSCOPES.

GRAF APSCO CHICAGO U.S.A.

Any microscope purchased from us is guaranteed for ten years against defective parts or workmanship. These instruments are all shipped on approval with the understanding that they may be returned for full credit or refund if not mechanically and optically in excellent condition. Our best recommendation is that almost 90% of our sales are repeat orders, thereby proving the satisfaction we guarantee. COMPLETE SATISFACTION—REASONABLE CHARGES.



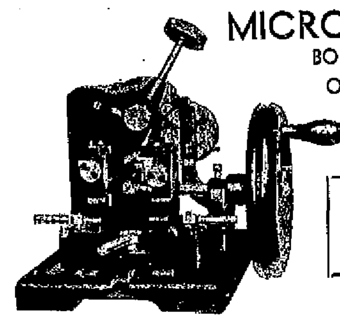
Rebuilt H Microscope Rebuilt CT Microscope Rebuilt CS Microscope

Model	Nosepiece	Eye-pieces	Objectives	Magnifications Obtainable	Light Control	Price Without Cabinet	Price With Cabinet
H1	Double nickel plated	10x	10x & 44x	100 & 440	Iris diaphragm	$57.00	$4.00 additional
H2	Double dust proof	10x	10x & 44x	100 & 440	Iris diaphragm	62.00	
CT2	Double dust proof	10x	10x & 44x	100 & 440	Iris diaphragm	72.50	
CT22	Double dust proof	5x & 10x	10x & 44x	50, 100, 220, 440	Iris diaphragm	74.50	
CS2	Double dust proof	10x	10x & 44x	100 & 440	Iris diaphragm	85.00	

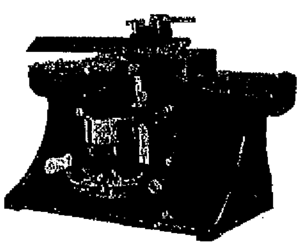
MICROTOMES SLIDING ROTARY

BOUGHT AND SOLD

Obtain Our Prices



WE REPAIR ANY MAKE OR MODEL MICROSCOPE



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