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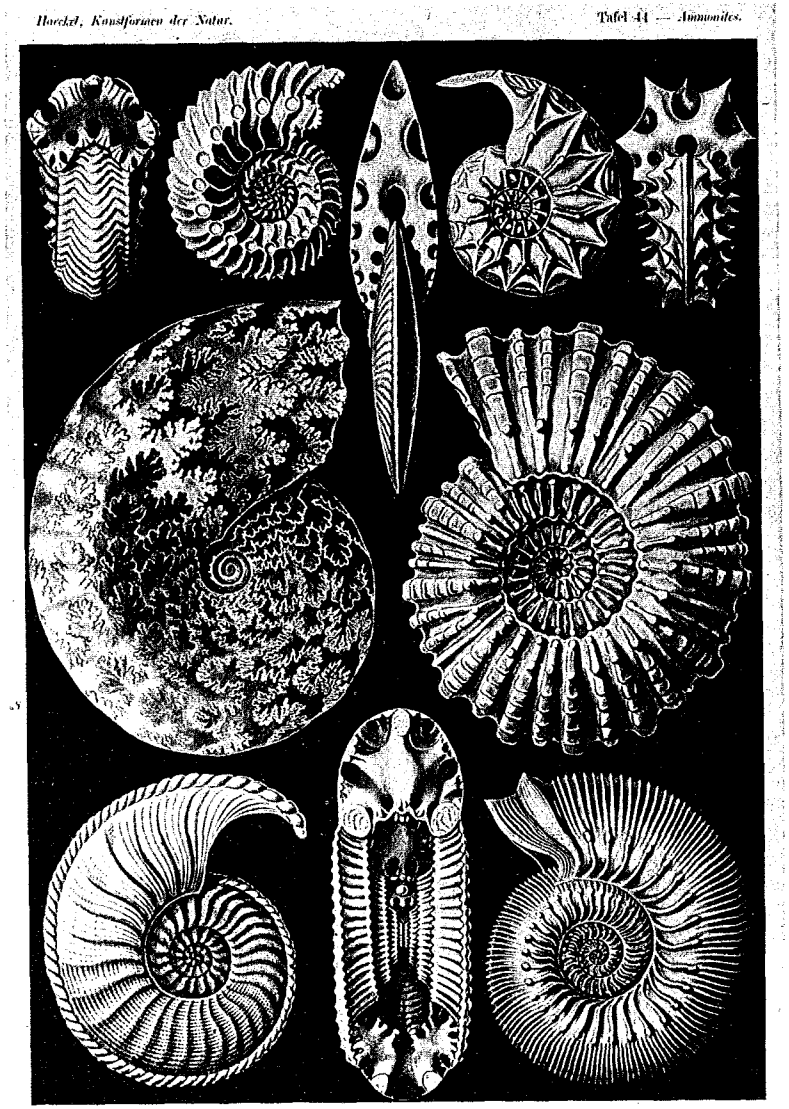

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THE MOUNTING OF ROTIFERA

By John Hanley

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Since Rousselet first published his method for narcotising Rotifera, this method, with omissions or additions according to the views of the authors, has appeared in the test books as the only successful way of dealing with these animals; this despite the fact that cocaine is now unobtainable by the majority of people (in Great Britain, at any rate), and that rotifera fixed with osmic acid eventually become practically useless. The general impression seems to have arisen that mounting rotifera is an exceedingly difficult operation, to be tackled successfully only by the expert after many years of striving.

The truth is that it is not only unnecessary, but definitely inadvisable to use the exact Rousselet method; and that although a fair amount of experience is necessary to deal with the more difficult species, very many species do not present any great difficulty and can be narcotised successfully after a very little experience, whilst some species are so easy that, with the methods following, it will be difficult not to succeed at the first attempt. The beginner can rest assured that he will have acquired the necessary experience to deal with the more difficult species long before he has exhausted the list of simpler ones, and will not have to wait many years (nor days, for that matter) before he can produce a presentable mount.

Bdelloids

It must be plain at the outset that this article does not apply to bdelloid rotifera, which, as far as narcotisation is concerned, must be considered a class apart. The methods given will succeed with some half a dozen species of bdelloids (including Rotaria neptunia, R. macrura, and R. rotatoria) but even with these the results are very uncertain.

Cleaning and Preparation

Rotifera should be got into fairly clean water before being narcotised, as under the influence of the narcotic they will be swimming around for a little time without proper control of their cilia, in which state they make most efficient brooms. Many species can be collected in a bright spot of light thrown on to the side of a jar; they will also collect over a white card slipped under the rim of a petri dish; but with some species there is no alternative but to pick them out individually into clean water. If time does not permit of this operation, then there is nothing for it but to narcotise them as they are and hope, by violently agitating them in clean fluid afterwards, preparatory to mounting, to remove any detritus that may be adhering to them.

It is advisable at first to have as many watchglasses as there are species it is wished to narcotise, and to deal with each watchglass from the point of view of one species only. It is quite feasible to narcotise a number of species together, obtaining all species extended, particularly with the rapid narcotising mixture mentioned later, but this necessitates either a knowledge of the reactions of the species concerned to the narcotic, or picking out individuals as they succumb and plunging them into the killing solution. The latter method, incidentally, is a most effective way of dealing with some of the more difficult species.

Handling

Rotifera are handled with very fine pipettes. The ideal pipette is short, so as to enable the hand holding it to rest against the edge of the microscope stage, and the internal diameter of the end should be only a little larger than the rotifera being dealt with. These pipettes are very easily made; soft glass tubing about 5/16" external diameter is cut into 3" or 4" lengths, each end is heated and pressed down on a hot metal plate (an old saw blade on the gas-stove) to form a flange, the tube is then held by the fingers at each end and rotated in a flame playing on the centre. When the centre is sufficiently softened the tube is removed from the flame and the ends pulled apart. The fine glass tube resulting is then broken back with the thumbnail until it is of the required diameter, and a rubber teat is placed over the flanged end. The finer the pipette, the easier it is to handle.

The degree of manual dexterity required to use these under a 2" or 1½" objective is not great, and although the beginner is unlikely to meet with very much success the first evening he uses them, by the third evening he

should have become fairly proficient. His greatest difficulty will be in locating the end of the pipette; this is easily overcome by using a microscope condenser and placing the end of the pipette in the light spot. Needless to say, the pipette is held fairly stationary, and the watchglass is moved to bring the animals to the pipette.

Narcotising

I employ two narcotising solutions: one is a 2% aqueous solution of benzamine hydrochloride which I have used for some years; the other is a rapid narcotising solution that I have evolved fairly recently and which will be referred to later.

With the 2% benzamine solution, it is quite useless attempting to narcotise in cavity slides or anything of that sort - narcotisation takes too long, and the rotifera will die first due to evaporation or other causes. I use flat-bottomed Minot type watchglasses, and concentrate the rotifers into about 8 cc. of water - quite a number of rotifers are needed, otherwise they will be difficult to keep under observation in this quantity of water.

Narcotisation varies according to the species, the sex, sometimes the variety, and enormously according to the pH of the water, acid water requiring very much more narcotic and time. Assuming the water to be about pH 7.5 (tap water in my district) an <u>average</u> narcotisation would be:

Add one to 3 drops of 2% benzamine hydrochloride to the 8 cc. of water, and stir thoroughly (no need for caution at this stage.) Wait 20 or 30 minutes, then add one or two drops and mix cautiously. Kill about ten minutes later.

For some species one can add the narcotic drop by drop, at intervals, as in Rousselet's method, but generally speaking it is best to give them enough at the start and then leave them alone, apart perhaps from a finishing dose. If specimens contract or partly contract before narcotisation is completed, it is usually a sign that too much narcotic has been used.

Rapid Narcotic

For the last year or so I have been using a special mixture, made up as follows:-

2% aqueous solution of benzamine hydrochloride	3 parts
Water	6 parts
Pure cellosolve (ethylene glycol mono-ethyl ether)	1 part

This is used quite differently. Usually, to every 1 cc. of water containing the rotifera, from 1/8th to ½ cc. of the mixture is added, and stirred up quickly. The rotifers will show signs of sleepiness immediately, and narcotisation is extremely rapid - Synchaeta can be narcotised in 3 minutes and Testudinella in a minute. Apart from its speed, however, the results are astounding - rotifera will only tolerate a very little of the plain 2% benzamine solution, but will tolerate a very great deal of the benzamine-cellosolve mixture, and, in fact, obviously enjoy it. I rarely use the plain 2% solution now, except for marine forms. The natural differences in the reactions of different species are also largely neutralised, and it is much easier to narcotise a number of species together.

There are, of course, variations in the use of this mixture. With some difficult species, the rotifers are squirted into either pure narcotising mixture, or 50% narcotising mixture, and killed almost immediately; one can also narcotise more slowly, using less narcotic, or add a little of the narcotic from time to time. It is in all cases helpful to add just one drop of the mixture and stir up before narcotising properly; this has a wonderfully exhilarating effect, and the correct amount of narcotic can be added in a minute or two.

With this mixture, if the specimens contract or partly contract before narcotisation is complete it is usually a sign that <u>not enough</u> narcotic has been used.

Killing

This is done with Formalin. Osmic acid must never be used for fluid mounts - this was Rousselet's great mistake, and although he believed he had stopped the osmic acid blackening with his bleaching process, it is only too obvious today that all he did was to delay it, and the great majority of his preparations are now so blackened as to be useless except for external features. I have dealt more fully elsewhere with Rousselet's method(1) and Hollowday (2) has reported on the condition of the Rousselet collection in the possession of the Quekett Microscopical Club.

Use as much as possible of as low a solution as possible. I usually add 4 cc. of 2½% or 4% formaldehyde solution to the 8 cc. of water containing the rotifers, or a proportionate quantity if using rapid narcotic and

less water. It is important not to be confused between Formalin and formaldehyde; Formalin is a commercial solution of formaldehyde, usually 40%. So 4% formaldehyde is 10% Formalin, and 2½% formaldehyde is 1 part of Formalin to 15 parts of water. Throughout this article percentages of formaldehyde are given.

Sometimes it is necessary, with difficult species such as Euchlanis, to use 10% or even 20% formaldehyde, and this particularly applies when rotifers have to be squirted into the pure or half-strength rapid narcotising solution, as if 2½% formaldehyde only is used the cilia of some species, in particular of Euchlanis and Epiphanes, may be partly disintegrated. There is considerable risk of distortion, however, and in general if the rotifers are properly narcotised there is no need to use a strong solution to kill them quickly. Even with 2½% or 4% formaldehyde solution there may appear to be some distortion at first, but this will disappear later.

The killing fluid is squirted in briskly with a fountain pen filler and quickly and thoroughly stirred up, so as to mix quickly. It is impossible to specify the exact time for killing, as it depends upon the species, but it can be said that usually rotifers have to be killed whilst the cilia are still moving, and that if left until the cilia have stopped it is too late. A useful, but by no means infallible, indication is given when they start hitting into each other and pushing each other about in the water without contracting. When in doubt, it is best to carry out tests by picking out a few rotifers and squirting them into 2½% formaldehyde solution and examining the result.

Washing

The next step is to transfer the rotifers from the weak formaldehyde solution in which they will now be resting into the centre of the watchglass by vibration, picking them up with a fountain-pen filler, and placing them in a tube full of 2½% formaldehyde. Let them settle to the bottom, pipette off as much of the fluid as possible, refill with fresh 2½% formaldehyde, and turn the tube end over end to shake up the rotifers. Repeat this operation whenever convenient - 4 to 6 times in all.

Unless the narcotic is washed out, crystals will appear later in the mounts.

Mounting

There is now only one method worth considering for mounting rotifera, or indeed for any other fluid mounts. This method, which was devised by Dr. Spence(3) and which I have now succeeded in adapting to suit Formalin mounts

of free-floating rotifera, is the supreme fluid mounting method; it is complicated, but its great advantage is that it is the only really everlasting fluid mount known. I should add that a somewhat similar method was used by Myers, but he ran in a solid seal, which is unreliable since sooner or later it will crack.

The first step is to turn a cell 3/8" diameter approximately. The cement used must be capable of withstanding the action of Formalin and must also stand up to a fair amount of heat; in addition it should not require too many ringings to make a cell of sufficient depth, and should dry fairly quickly. The only cement I have found so far that will comply with the first two essential conditions, and which also complies with the other two, is a black microscopic cement supplied by Messrs. Vicsons of 148 Pinner Road, Harrow, London, England. This cement dries with great rapidity so that if half a dozen slips are rung at the same time, the first slip is ready for its second ringing by the time the sixth slip has had its first ring, and so on. From three to six ringings with this cement would be necessary to make a cell of sufficient depth, depending on the size of the rotifers to be mounted, and cells will be dried sufficiently to be used in two hours at normal room temperature.

This cement has one serious disadvantage, however, in that it does not adhere very firmly to the glass (for this reason it must not be used for outside ringing, except for appearance only). As a result, if slides are sent through the post the black cell will sometimes come adrift and move in the vaseline seal, with the result that the vaseline protrudes into the mount and the specimens will stick to the vaseline. It is advisable, therefore, to make what I call a semi-laminated cell ring, using both this black cement and another cement (I use Flatters & Garnett's Brown Cement; a suitable cement can also be made by dissolving shellac in methylated spirits). The black cement ring is carried up to half the height required only, and allowed to dry, when the top surface will be fairly flat. Outside and touching this cement ring is turned another ring of Brown cement, which is carried half-way over the top surface of the black cement. This can be done in one ringing operation. When this has dried (a day or two) further black cement is turned on, over the existing black cement and over the inside edge of the brown cement ring. The cell is carried up to the required height with the black cement.

The result, when the cell has dried, is that only the black cement will be in contact with the mounting fluid, but outside, and keyed into it, is a brown cement ring to anchor it to the glass.

Guide Line

On this 3/8" cell, a 5/8" cover will eventually be placed, and to enable this to be centred a guide line has to be made on the slip. This is just a fine line (as fine as possible) of any black cement (not the one recommended for making the cell) rung just inside the mark where the edge of the 5/8" cover will come.

Protective Coat

The third step is to apply a protective coating outside the area covered by the coverglass. This is made of Samsonite (obtainable in this country from Messrs. Woolworth) or Durofix, either being very considerably diluted with acetone. A band of this, about 1/8" wide, is rung outside and up to the mark where the edge of the 5/8" cover will come. It sets quickly into a very thin film, so a good deposit will be needed. It will help when ringing to remember that only the inside edge of this band is important - the outside edge can be irregular.

Towards each end of the slip, this band is run out into a broad splotch.

When this has dried, which does not take very long, the cell is ready for use.

Inserting Specimens

If kept in store; the cell will probably have accumulated dust. This is removed by brushing under water with a soft camel-hair brush kept solely for this purpose. Shake off, fill with 2½% formaldehyde, shake off, and cover immediately with a watchglass.

The specimens are then tipped out into a watchglass, picked out with a fine pipette, and placed on the floor of the cell. Fill the cell to excess with fluid - as much as it can hold and still be handled. Place the slip with specimens on the microscope stage, remove any detritus, specks of dirt, and bubbles with a fine pipette, and remove some, but not all, of the surplus fluid. Then collect the specimens into the centre of the cell by vibration and place a polished 5/8" coverglass on the cell with forceps (do not attempt juggling feats with points of needles!) The surplus fluid should be squashed out, and it is helpful if this reaches the edge of the coverglass. If the cover floats on a pad of fluid without squashing it out, wait for the specimens to settle, then tap the cover down smartly, which will not disturb them.

Now push the coverglass into place, concentric with the black guide line, with a bent wire, and then remove the surplus fluid outside the cell with filter paper and cigarette paper. Be sure to remove all the fluid outside the cell; the filter paper will appear to do so, but there will still be a rim of fluid left outside the cell and this must be removed with cigarette paper until it is seen that a dry ring appears round the lower part of the black cement cell - this will be seen at once when it occurs.

Running in the Seal

The mount is now placed on a warm plate, and as soon as the slip has become sufficiently warm, very hot (but not boiling) white vaseline (obtainable from any drug store) is run in under the cover so as to completely fill the space between the edge of the cover and the black cell. This is done by picking up the vaseline in a warm pipette and placing a drop on one of the blotches of Samsonite as close to the cover as possible, so that as the vaseline is run out from the pipette (which should have a rubber teat) it touches the edge of the cover, when it will immediately run in, and if the slip is sufficiently warm it will run straight through in one clean sweep, which is the ideal to be aimed at. If the slip is not sufficiently warm, the vaseline will check half-way,and when the slip is warmed enough to start it again, it will probably enclose an air bubble, which does no harm but looks unsightly. If any fluid was left outside the cell, this will be concentrated into one spot and enclosed by the vaseline to form a water bubble, and will look unsightly.

The slip is removed immediately from the warm plate,and placed on a cool surface to set the vaseline, which only takes a minute or less, and is then placed in water. It is left there for ten or fifteen minutes, then removed, the edge of the Samsonite blotch opposite to the one on which the vaseline was run in is raised with a safety razor blade, and the whole Samsonite layer is stripped off in one piece, taking with it every scrap of vaseline outside the coverglass, and leaving a grease-free surface on which the ringing cement can key. It will be found that, due to the soaking in water, the Samsonite layer peels off very easily indeed.

Finishing

The slip when dry is placed on a turntable, and a good thick ring of some mechanically strong cement is turned around the edge of the cover - shellac dissolved in methylated spirits is excellent for the purpose,although

I use Flatters & Garnett's Brown Cement. If necessary, a second ringing should be given. The object of this ringing is not to seal the mount - this is done by the vaseline - but to prevent the cover from being slid off when cleaning the mount, so mechanical strength should be aimed at.

Finally, the mount can be rung with any colored cement that is preferred.

Summary

The various stages in the actual mounting, as distinct from the narcotisation, etc., are therefore:-

(1) Make the cell to half height with black cement
(2) Ring outside and over the edge with brown cement
(3) Finish to required height with black cement
(4) Turn centering line
(5) Add Samsonite protective layer
(6) Clean cell
(7) Add specimens and cover
(8) Centre cover
(9) Remove surplus fluid
(10) Run in white vaseline
(11) Immerse in water, then remove Samsonite protective layer
(12) Ring the mount

Corrections

Since things do not always go strictly according to plan, especially when trying a new mounting method for the first time, perhaps the following tips may be useful. If bubbles or detritus are found to be included in the mount when the coverglass is put on, or if the specimens are washed out, the cover can be slid off to one side and the bubbles removed or the specimens replaced - the cover can be moved wherever you like on the slip, provided it is moved slowly and is given some fluid to move on. Air bubbles enclosed in the vaseline can be removed by holding the slide up and applying the back of a hot teaspoon to the bubble. Water bubbles enclosed can sometimes be removed by running in a very fine pipette, keeping the vaseline molten all the time, but this is a very delicate operation. If, when the vaseline has set, it is found that the cover is slightly out of centre (probably moved when applying filter paper) it can be pushed back into centre provided the amount of eccentricity is not great compared with the cement width. Vaseline that has spread beyond the area protected by the Samsonite layer should of course be wiped off before the slide is placed in water. If vaseline has been allowed to get on to the

cover itself, place the slide on the turntable and remove as much of the vaseline as possible by applying the edge of a piece of stiff paper to the spinning cover. Then ring with the shellac, or Brown Cement, neither of which seems to be much upset by vaseline. When this first ringing has dried, the surface of the cover can be wiped clean, the probably very irregular edge of the cement trimmed up with a scalpel whilst the slide is spinning on the turntable, and then the second ring can be applied and the mount finished.

It will be seen that, from the commencement to the end of the process, the slip may have to be placed on the turntable a dozen times, and it is practically essential to have a turntable equipped with three little brass studs for "centring" the slip. In fact, of course, they do not centre the slip at all - they would only centre the exact size of slip for which they were made - but the amount of eecentricity would be difficult to detect visually, and they do ensure that the slip always goes back in the same position, so that all ringings are concentric.

I do not know what materials are available in the U.S.A.- there should be no difficulty in finding a substitute for Samsonite or Durofix, if these are unavailable, but it will be more difficult to find a suitable alternative for the black cement for making the cell.

I need hardly add that I should be glad indeed to hear from anyone interested in rotifera, and glad to give any assistance in my power to anyone wishing to mount them.

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(1) Hanley, J. The Microscope & Ent. Monthly, Vol. 7 (1949)
(2) Hollowday, E. Jnl. Quekette Micros. Club, Series 4, Vol. III, 1949
(3) Spence, D.S. Watson's Micr. Record No. 25, 1932.

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THE GARDEN POND AND BIOLOGY

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By H. G. S. Wright

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While it is true that one of the pleasures of microscopical freshwater biology is the visiting of natural waters for fresh material, there is no denying the advantage of having a rich pool within sight of one's home. A brief sketch of the writer's experience with an artificial pool in his back garden in the suburbs of Liverpool, England, may appeal to others who share his interest in the Rotatoria, Infusoria, etc.

The pond, made of brick faced with concrete, is 6 feet long by 2½ feet wide, and is 1 foot deep at the sides, going down to 2 feet in the middle. It was constructed in April, 1938, and filled with tap water. A lily root and sprigs of Myriophyllum spicatum were planted and various grasses rooted in side pockets.

During the first fortnight the Rotifer, Epiphanes senta, with the Infusorians, Histrio and Euplotes were found in the water, but how they reached the pool is difficult to say unless they came on the feet or feathers of bathing birds. The water became turgid, but cleared suddenly at the end of June, and thereafter a remarkable history was set down in the writer's monthly diary of the pond's progress, due to his habit of putting into the pool a portion of every catch made in the field.

Epitomizing the story, it may be said that the ensuing August produced the following species of Rotatoria: Rhinoglena frontalis; Brachionus quadridentatus, B. urceolaris; Testudinella patina; Mytilina sp.; Monostyla lunaris; Anuraeopsis fissa; Keratella quadrata var. brevispina; Colurella sp.; Trichocerca carinata; Notommata aurita; Philodina megalotrocha; Collotheca ornata and its varity cornuta.

The chief Infusoria were Urocentrum turbo, Strombidium, Halteria, Actinosphaerium and Peredinium, the last-named being present in clouds that colored the water.

Later in the month the Collotheca had spread all over the pond, clustering thickly on the Myriophyllum. Infusoria had developed greatly and now included Paramecium caudatum, P. aurelia and P. bursaria; Euplotes and Stylonichia soecies in vast numbers almost equalling the prodigality of the Peredinium; Epistylis alboflavicans; Acineta mystacina; the minute tree-like colonies of Dendromonas virgaria, and a great quantity of collared monads (Choanoflagellates).

The second year brought a repetition of most of the forms named, with the Collotheca abundant in May. A few Stephanoceros fimbriatus (probably half a dozen) were introduced, and these found conditions so agreeable that by September they became "a perfect riot" that continued until the beginning of November, when the outbreak burnt itself out. Till then they were found in countless numbers, in superb condition and of great size on every plant, rootlet and stick. This was a good year also for Rotifer macrurus, which first showed up in April, maintained a high peak from June to September, and lasted until November.

During subsequent years there have been several bursts of activity. Not every species transferred from natural sources to the pool has thrived there, but several not already mentioned have done very well and cropped up year after year without renewals from outside, such, for example, as the Rotifers Brachionus quadridentatus, Trichotria pocillum, Euchlanis dilata, Dapidia pellucida, D. pyriformis; Colletheca gracilipes, C. ambigua; Ptygura pilula, P. velata, P. crystallina; Floscularia ringens, F. melicerta.

For two years the large and beautiful spheres of the Chlorophyte, Volvox, was abundant, including great numbers of colonies invaded by the parasitical Rotifer, Ascomorpha volvocicola; and two Springs and Autumns brought broods of that magnificent ciliate, Caenomorpha medusula.

This note could be much extended, but may be fittingly brought to a close by mentioning that a prodigious development in the pond of the blue-green alga Oscillatoria has so defied attempts to destroy or check it that it has been necessary this month (January, 1950) to drain the pool and scrub it clean for a fresh start in the coming Spring.

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WIDGETS AND GADGETS

No.8- Focusing a Photomicrographic Camera.

Dan M. Stump
F.R.M.S.

Microscope objectives are usually designed and corrected for visual use with an eyepiece located a definite distance above the objective, (most manufacturers have standardized on a mechanical tube length of 160 mm.,Leitz uses 170 mm.) for a cover-glass thickness of 0.18 mm., and with the eye relaxed at infinity. A variation in any of these conditions will result in spherical abberation with an attendant loss in sharpness of the final image. High power dry objectives are very sensitive to variations in cover-glass thickness. When working with these objectives and optimum images are desired, either the tube length or correction collar should always be adjusted until 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 focus.

When we place a camera above the microscope, the optical conditions are very apt to be disturbed.If an ordinary camera with its regular lens set at infinity is placed above a microscope which has been sharply focused visually with the eye relaxed at infinity, quite probably a sharp image will be formed at the plane of the photographic plate or film, and no further focusing will be required. Mimicam eyepiece cameras often contain such a correcting lens to accomplish this result.

If, however, a conventional photomicrographic camera is used, without such a correcting lens,an adjustment in the focus will be necessary to sharpen the image on the ground glass. If a low power objective is being used, this sharpening of the image may be accomplished by use of the regular fine adjustment of the microscope, and with little or no loss in the quality of the final image.

However, if a high-power dry or immersion objective is being used, a very much better final imsge will result if this final focusing is accomplished by either raising the eyepiece in the tube or by extending the draw-tube of the microscope in its slide. In either case we are thus increasing the mechanical tube length. By this procedure the optical tube length remains undisturbed,spherical abberation is not introduced, and an optimum image may result.

The distance that the tube will need to be extended to make the visual and the camera images parfocal will always be the same for any one eyepiece at the same camera extension, regardless of the objective being used. The required increase for each eyepiece may then be determined experimentally, and recorded for future use.A set of sleeves of proper thickness fitting over the eyepiece bodies, inserted between the top of the draw-tube and the flange of the eyepiece, provide a convenient means for the necessary adjustment.

ON THE ACTION OF THE GENE

By Peter J. Squicciarini

I. Introduction

Genetics, which is comparatively a new science offers the investigator a broad field in which to practice his specialty. The biologist, the chemist, the physicist, and the statistician all has his place in the "New World of the biological sciences". Since the beginning of the twentieth century the relationship between Man and his environment has been clarified to a great extent by the work done in genetics.

It has been more or less established that a certain "something" exists in the cells of an organism; and that these structures exert a strange power over plants and animals. These elusive and practically inexplicable bodies seem to determine certain of our morphological and systemic characteristics. These structures are now called genes. It is probably due to its impenetrable mysteriousness more than anything else, that the gene has gained the attention of some of the greatest minds in the history of American science. And so the gene, a will-o'-the-wisp, has lured Morgan, Davenport, Stern and a host of others down the road of experimentation -- like so many children at the coattails of the Pied Piper of old.

In the following pages we have not attempted to formulate any large scale conclusions. Instead, we have tried to give a short survey of the work done on the gene, and in doing so have strictly adhered to the implications and language the individual workers have given to their researches. And so to the gene - - - .

II. The Gene

A. Location, Size, Structure, and Number of Genes

The gene, in its functioning form is found only in the cells of plants and animals. More specifically it is found upon structures known as chromosomes. These

chromosomes go to make up the nuclei of cells. Concerning its chemical structure, size and function, there is a great deal of dispute, which is quite normal in a new science that is still developing its techniques. Morgan thinks that the size of a gene may be of the order of a large sized protein molecule. Its stability may depend upon its chemical property, or, on the other hand, it may not. All in all, though, the best hypothesis is that the gene is constant because it is a chemical entity, since this view is constant with all that is known about the stability of the gene (8). The number of genes per chromosome is difficult to ascertain but it has been estimated that per long chromosome of Drosophila there might be 1,000 genes. In the human gamete the number may approach a total of $(3 \pm 1)\ 10^4$. This, as may be seen, is an astronomical number, which may, in itself, act as an indication as to the broad influence they have on life functions.

B. Theory of Self-Duplication in Genes

Beadle, speaking to the American Philosophical Society, states that there appears to be no obvious reasons for believing that genes have any function other than that of serving as templets for the construction of complex protein molecules (10). Beadle also entertains a master molecule (gene) theory. In it, he suggests that genes can add or subtract from themselves. And if subtracted long enough, they may be reduced to entities resembling viruses - neither animal nor plant (11).

Sonneborn suggests that although genes are responsible for individual characteristics, the cytoplasm may have something to say as to which genes are to develop. We draw this conclusion from experiments with Paramecium. This may hold in Paramecium because the cytoplasm is well developed even at division; however, this is not likely in higher organisms, he thinks, since new cytoplasm is undeveloped and "inexperienced" (11).

C. Chromosomes of Drosophila

It was found necessary by the geneticist to obtain some types of experimental animals on which to experiment and make his cytological observations. Soon Drosophila made its appearance as a useful vehicle for experimentation. It was small, easily and quickly bred; showed many mutations, and most important in the cells of the salivary gland there were four and four only, giant chromosomes. This was what the biologist needed. From then until now Drosophila, small of size, hitherto unimportant in existence became a hero in the experimental scheme of things.

D. Substance and Pattern of Genes

Waddington (1940) divided genes according to their action into "substance and pattern" genes. For a twofold attack on the action of "substance and pattern" genes, the lepidopteran are of great value since their wings are virtually two dimensional. Caspari (1949) used a moth Ephistea Kuhniella and Ptychopoda Seriata with excellent results in the study of "substance and pattern" genes by investigating eye color and wing pattern mutants in this animal (4).

E. DeVries' Theory

DeVries, in dealing with the location of genes in related species, says that elementary species are made up of a large number of identical genes; and that their differences are due to different recombinations of these genes. It was illustrated in East's experiment with Nicotiana (8, 13). In this experiment the mutant gene of one species behaved toward a gene of the other species in the same way as it behaved with its partner (8). From the results of this and other crosses of a similar nature, the hypothesis of multiple factors has grown (13).

F. Presence and Absence of Genes

The theory has been advanced that characteristics depend upon the presence of their gene for appearance. In other words, it is simply a matter of having a gene for color if one is ever to have brown eyes and black hair. If one has not the genes for color, one will be, in all probability, very light skinned -- and so an albino. This theory seems logical; however, Morgan reminds us that sometimes Albino guinea pigs have a few colored hairs on their toes. If color depends upon a gene then this gene is present in Albino guinea pigs having the colored hairs (8). This indicates that the color gene concept is not altogether true.

Yet, as important as the gene is, in some cases its presence is not required even in the function of a key metabolic process. Beadle's work with Neurospora-a mold-shows how true this is. He bred Neurospora until it lost the gene for producing certain essential amino-acids. He fed his reduced forms these amino-acids and found that they survived even without these genes, (2, 11).

III. Biochemistry of the Gene

So far, we have been implying that the biochemistry of the gene is the important matter in connection with the behavior of the gene. It would be wise then to consider some of the ideas encountered in the bio-chemical work on the gene.

A. Phosphorous and Proteins

In connection with what has been previously stated about the self duplication of genes, it might be added that -- "of known proteins, those containing phosphorous would most likely be of the autocatalytic type or self-duplicating" (Spiegelman and Kamen).

B. Relation, Gene to Gene, in Cytoplasm

They also propose that genes continually reproduce at different rates partial replicas of themselves, which enter the cytoplasm. These replicas are nucleoprotein in nature and possess, to varying degrees, the capacity for self-duplication. Their theory concerning this proposal is that:

1. These cytoplasmic self-duplicating entities compete
2. The outcome of such competitive interaction would determine the enzymatic makeup of the cytoplasm.
3. Inherent in this concept is the possibility of changing the ultimate result of this competition by varying the conditions at which it takes place.

The unique feature of this kind of theory is that while supplying a link between gene and enzyme, it at the same time predicts that cells with identical genomes need not possess identical enzymatic constituents (14).

C. Genes and Chemical Reaction

The chemical action of genes on the cytoplasm may effect pigmentation of skin, hair, and eyes; therefore, it may seem that parts of genes enter into chemical equations, with certain cytoplasmic substances forming pigment formulae. Sonneborn, Bonner, Stern and Snyder, all of whom have approached the biochemistry of the gene seem to be in agreement with this statement.

"Bio-chemical investigations --- show that a gene mutation which gives rise to a growth factor requirement represents in reality, a loss of ability to carry out a specific biochemical reaction." This view is further supported by the fact that independent mutations of the same gene invariably are associated with loss of the same biochemical reaction.

D. Bonner's Theory and Gene Control of Metabolism of Amino Acids

These observations have led in turn to the working concept that single genes control single chemical reactions. And this control is exercised through control of enzyme productions. Along with this, Bonner sets forth the following parents:

1. It is suggested by evidence that genes exert their morphological control through control of biochemical reactions.
2. Some of the earliest evidence of this relationship stems from the study of the hereditary diseases in man, particularly those that center around the metabolism of the two amino-acids phenylalanine and tyrosine.
3. The genealogy of families affected with diseases such as alcaptonuria pointed many years ago to the genic control of biochemical reactions.[3]

The disease Alcaptonuria is in itself rare in occurrence. It has been established conclusively as hereditary and it deals with man's ability to reduce this material - alcapton.

Alcapton is known better as homogentisic acid and has a chemical formula of: $C_6H_3(OH)_2CH_2COOH$.

Most people have the ability to break down this acid into carbon dioxide and water; therefore, the gene for this reaction is dominant and its presence keeps this reaction normal. If this acid is not broken down it is excreted in urine which turns black upon standing. This disease is then called Alcaptonuria (2). It also seems to be further support of the theory Bonner sets forth for the action of the gene.

Another example of the diseases associated with gene presence and absence is the failure of some humans to oxidize phenylpyruvic acid. Again most people are capable of handling the phenylpyuric acid they produce.

The normal change is from phenylpyuric acid to p-hydroxy-pyruvic acid. Those who cannot do this are phenylketonurics, most of whom are idiots or imbeciles. Both of these diseases occur only in the homozygous recessive state. The biochemical implications of the gene and metabolic functions are so widespread that no less an investigator than Stern says, "In its final form the problem of the nature of the gene and their allelic varieties belongs in the sphere of the chemist."

IV. RADIATION-MUTATIONS

A. The Effect of X-Ray and Gamma Radiation

In man's experiments with mutations, none have been produced so readily and clearly than those caused by irradiation with X-ray or gamma rays (radium).

1. Radiation Effect on Drosophila

In their joint work with low dosage of gamma rays on Drosophila, Caspari and Stern found that: As a general rule the mutation rate is directly proportional to the dose of radiation, as expressed in r (roentgen) units. This linear proportionality between radiation dose and mutation rate applies to all dosages of X-rays tested to the present time (1948) except for the highest dosages, in which a "saturation" effect comes into play. It was further found that at high and medium dosages, the mutation rate was independent of the intensity - that is, of the time over which the application of a certain number of r units was spread. This was established by Patterson (1931) and Oliver (1932) for X-rays and by Hanson and Heys (1929-32) and Paychandhuri (1939) for gamma rays.

Timofeeff-Ressovsky and Zimmer (1935) have calculated that in all experiments a dose of about 3600 r would result in a mutation rate of ten sex-linked recessive lethals per 100 treated sperms (5).

Offerman (1939), tested the increase of X-ray mutation rate in aged and non-aged sperm Drosophila. His experiments seem to indicate that the effect of aging on induced mutation rates would result in an increase in mutation rates rather than decrease.

2. Radiation Effect on Mice

It is interesting to note that Lorenz and Heston found that mice bred from five to six generations, while continually exposed 24 hours a day to 1.1 r and .11 r of radium gamma radiation, showed no damage to chromosomes - as evidenced by normal litter size and life span.

Deringer et al exposed mice chronically for 8-24 hours a day to 8.8 r or 4.4 r. The total accumulated doses for females was 770 r. and 880 r, and for males 110 r. No evidence for the production of visible genetic changes was obtained in the immediate offspring of mice thus radiated. However, radiation in excess of this has produced 4 mutants: One case of aligodactylism, one case of temporary sterility and two cases of retarded growth. Also, some instances of anemia occurred (6).

Snell found that one-third of the progeny of mice whose testes were exposed to acute doses of about 600 r produced litters of reduced size. This semi-sterility was believed to be due to translocation (a chromosomal and not a gene mutation.)

3. Cytogenetic Effects in Corn Exposed to Atomic Bomb Ionizing Radiation at Bikini

The following may act as a summary for the work on corn and its radiation effects:

a. The germinability of seeds used in this experiment was not effected by X-ray or the Atom bomb.

b. Those seeds closest to the target area and those treated with X-ray (10,000-15,000 r) showed retarded growth and lacked 5 to 10% of normal growth at maturity. The seedling leaves were mottled.

c. Plants that were mottled in the seedling stage had three distinct types of visible sectors in the older leaves of the nearly mature plants which were readily classified as:

aa) Chlorophyll deficiencies
bb) Morphological anomalies, including twisted, crinkled, diminutive,

or otherwise deformed leaves.
cc) Dead tissue which often results in a longitudinal split in the leaves.

There were fewer sectors in samples of seeds grown from farther distances from the blast.

4. It may be concluded from this experiment that the dosage of blast radiation equals about the same as that of the X-ray (10-15,000 r).

5. Both sources of ionization radiation produce similar phenotypic effects in plates grown from the irradiated seed. But the bomb produced relatively more chlorophyll deficiencies and dead tissue occurring as sectors than did the seeds treated with the X-rays (9).

The results of radiation mutation studies are dramatically illustrated in what occurred at the Bikini soirree.

V. SPONTANEOUS GENE MUTATION

In all organisms studied there is a spontaneous mutation rate which has an average value such that the probability of mutation is of the order of 10^{-5} to 10^{-6} per gene, per generation and appears to be independent of average life span.

It has been estimated that serious deleterious and lethal mutations constitute one-quarter or less of the spontaneous mutation and that minor recessive mutations predominate.

SUMMARY

From the preceding data, we may conclude that some of the characteristics of the gene are as follows:

It occurs on the structure known as the chromosome in linear arrangement. Its form is not clearly known; its chemical properties are that of a large sized protein molecule. It is believed to be a constant entity, since this coincides with all known data on the gene. The number of genes per cell may reach astronomical proportions in some animals and plants. DeVries states that species may vary because of recombination of genes peculiar to both. Geneticists working on the biochemistry of the gene believe them to be bio-catylsts which control chemical reactions of the cell. These entities

are suspected of having the power to duplicate themselves. They may enter into some chemical reactions, e.g. with certain compounds to form hair, skin and eye pigments. Certain hereditary diseases have been traced to a lack of enzyme controlling (producing) genes.

Genes seem to be changed by exposure to X-rays and gamma rays. Mutants have been produced because of them. It was found, however, that genes can tolerate small doses of the otherwise poisonous rays. All organisms display spontaneous gene mutations. It has been estimated that for the most part spontaneous gene mutations are of the minor recessive type.

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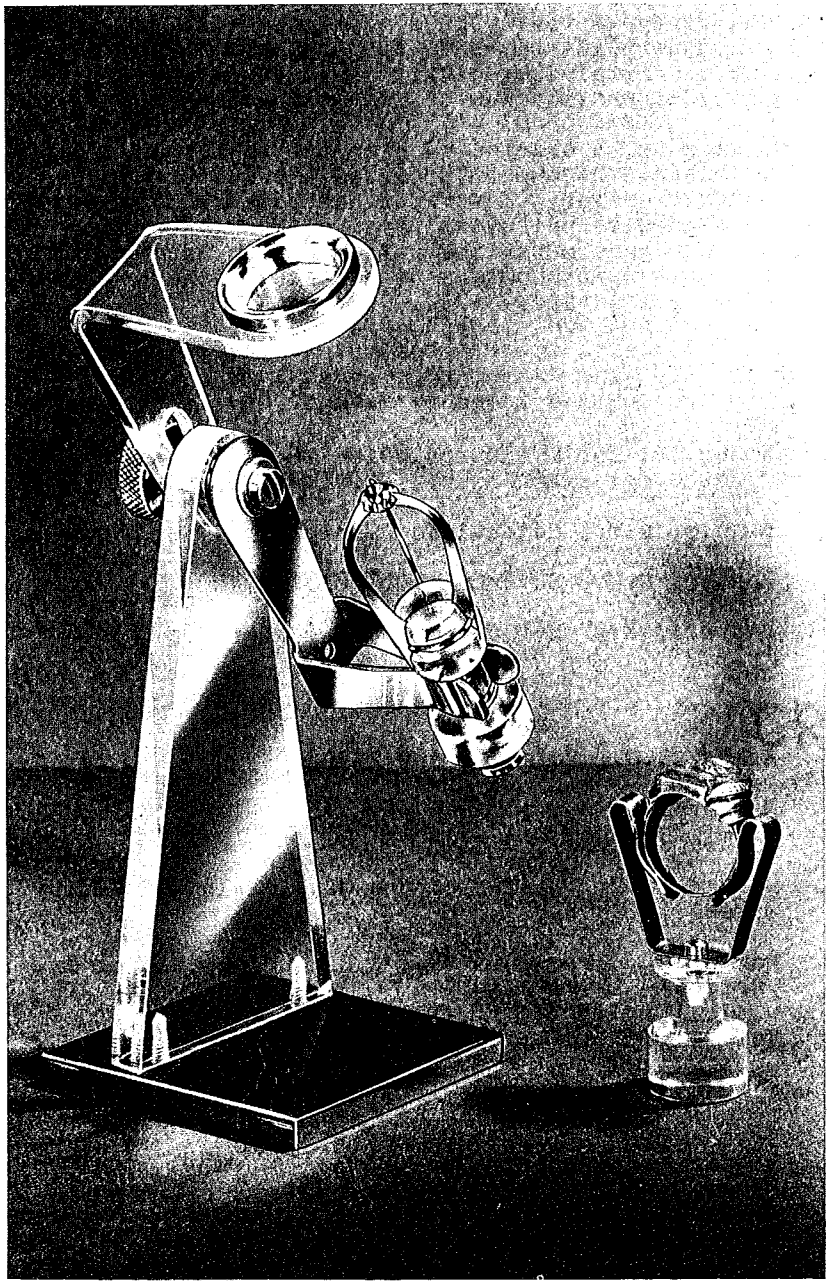


N E W P R O D U C T S

ROLF THIENEMANN'S VIEWER

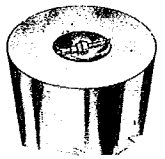
The countless hidden beauties in flowers, the amazing tools with which insects are equipped, and the gems of the crystal world are brought out with this simple instrument made by Mr. Thienemann at 6320 North Legett Avenue, Chicago 30, Illinois, and illustrated on page 122.

The instrument may possibly be classified under dissecting microscopes. However, it is essentially a viewer as the name indicates. Magnifications generally used are 5X or 7X.

The viewing arm holding the magnifier is rotatable and adjustable for the convenience of the observer. After the specimen is brought into focus it remains in focus regardless of its position, since the rotating stage-arm with its "Chuck" holds the object, which is being viewed, at a central focusing point through a 360 degree rotation in any direction while the top, sides, and bottom are being inspected.

The viewer can be supplied with a number of interchangeable object holders, or chucks, as the inventor calls them.

The illustration on the opposite page shows a jewel being viewed; it might as well have been a crystal, a small piece of granite, or a flower.



Another chuck has a depression in which a minute object or a drop of water may be placed. At a demonstration a live, new-born shrimp taken from an aquarium found a temporary haven in such a miniature pond. Its beauty and movements attracted admirers and held their attention.

A third chuck, not illustrated, is supplied with a needle on which, for example, an insect or a flower may be placed for inspection.

The viewer without a chuck is priced at less than ten dollars; the chucks may be bought separately at correspondingly low prices.

BIGLIOGRAPHICAL NOTES

DIATOM LITERATURE

In Vol. III, page 69, we gave a condensed book review on Fr. Hustedt: Diatom-Flora von Java, Bali u. Sumatra. We are now informed that "Schweizerbartsche Verlagsbuchhandlung" in Stuttgart offer diatom literature for sale as follows:

Hustedt, Diatomeen-Flora v. Java, Bali u Sumatra Vol. I., U.S.	$18.00
Hustedt, Diatomeen-Flora v. Java, Bali u Sumatra, Vol. II., U.S.	$38.50
Hustedt, Diatomeen von Abisco, Lapland	$ 5.50
Hustedt, Bacillariophyta Heft. 10	$ 7.00

A number of new plates of A. Smith's Atlas prepared by Dr. Hustedt is now to be had by Fielder in New York at $1.00 a plate. We also understand that above-mentioned works are to be had at a better exchange price if ordered from New York book dealers than if ordered directly from Germany.

The Bacillariophyta Heft 10 of Susswasser Flora Mitteleuropa by Hustedt and published by A. Pascher is almost a "must" book for any serious diatomist; it is one of those basic works without which it is difficult to get along.

From Antiquariaat Junk, (Dr. R. Schierenberg) Lochem (G) Netherlands, we note:

Pantoczek, J. Fossilen Bacillarien Ungarns 2nd Aufl. 1903-1905 120 Plates	$200.00
Schmidt, A., Atlas der Diatomeen-Kunde - Heft 1-98, 1874-1934 392 Plates	$895.00

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REPINTS

Of particular interest to Zoo geographers are two new papers by our old friend, Dr. V. Brehm, now at Lunz Hydrobiologische Station, Austria:

1) Einige Bemerkungen zur Systematie and Tiergeographie der Diaptomiden Nordamerikas (Mitteilung aus der Biologischen Station Lunz)

2) Reflexiones sobre relaciones zoo geographica de la fauna de aqua dulce de la Peninsula Iberies. Barcelona

Both these papers are zoogeographically important because they bring us an up-to-date summary of the differences in relationship of fresh water species and genera on the two sides of the Atlantic Ocean. It verifies Wegener's idea that during the long geological time, when the North-South Atlantic Canyon opened up there was no contact between South Africa and South America since the Mesozoic age, while in the region of the northern Polarsee there was still contact between these two continents into the glacial period.

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OUR FRONT PAGE

This is a reproduction of Tafel 44 found in Kunstformen der Natur by Ernest Haeckel (1899-1901).

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MICROSCOPICAL SOCIETIES

The State Microscopical Society of Illinois

Among members of the State Microscopical Society of Illinois there seems to have been considerable uncertainty in regard to the legal standing of the Society and about annual reports of corporate nature.

In order to clarify matters the Corresponding Secretary of the Society, Vida A. Latham, M. D., D. D. S., approached the proper State Authorities and requested a written statement in regard to these points.

By return mail a letter was received from the Secretary Of State of Illinois, Edward J. Barrett, which clarifies the situation. Since this letter should put all minds concerned at ease and also at the same time will throw some light on the history of Microscopy and conditions as they were nearly one hundred years ago in Illinois we are taking the liberty of reproducing the document on the following page.

****

EDWARD J. BARRETT
SECRETARY OF STATE

STATE OF ILLINOIS

OFFICE OF THE SECRETARY OF STATE

SPRINGFIELD

May 4, 1949.

State Microscopical Society of Illinois,
V.A. Latham, M.D.D.D.S.,
1644 Morse Ave.,
Chicago 26, Ill.

Gentlemen:

In answer to your letter of May 2nd, please be advised the above organization was created by a Special Act of the 26th General Assembly in 1869, and, therefore, is not required to file documents in this office.

I am returning herewith your copy of Charter, Constitution, By-Laws and List of Members.

Very truly yours,

Edward J. Barrett

SECRETARY OF STATE

CORPORATION DEPT.
EJB*TJ*EWH

NEWS FROM THE FIELD
****

SUPERMICROSCOPE USING MIRRORS SOON AVAILABLE FROM U. S. FIRMS

WASHINGTON, October 6 (Science Service by JANE STAFFORD) Supermicroscopes that use mirrors instead of lenses to peer into the chemistry of cancer and other living tissues will soon be available to American scientists who have heretofore known them only through reports from English and Dutch scientists.

Because these new microscopes use mirrors instead of lenses, scientists can use them with both visible light to see the cancer or other tissues and with the invisible light of infra-red rays to identify chemical compounds in the material being seen through the microscope. They may also be used with ultraviolet light.

Reflecting microscopes developed abroad use aspherical mirrors which must be polished and corrected by hand, a costly and time-consuming process. Now a new system, using spherical mirrors which can be made by standard machine methods, has been developed by Arthur J. Kavanagh, research physicist at the American Optical Company's Stamford, Connecticut research laboratory.

Plans to manufacture the new optical parts for use on any standard microscope stand are now being made at the company's instrument division in Buffalo, New York, Alva H. Bennett, director of the company's research laboratories, announced at the meeting here of the Electron Microscope Society of America.

Scientists at the U. S. Bureau of Standards where the meeting was held were also informed that another manufacturer of optical equipment, Bausch and Lomb, has developed a reflecting type objective for use in ultraviolet light.

HEART IN BEGINNING IS VERY SIMPLE STRUCTURE, KEEPS GOING WHILE ORGAN GROWS

URBANA, Ill., October 10 (Science Service). -- When the heart starts out in the beginnings of a new life, it is a very simple sort of pump and not the complex organ that it is when the animal gets to the point of starting a life on its own, Dr. Bradley M. Patten, anatomy professor of the University of Michigan School of Medicine, explained tonight in his first national Sigma Xi lecture at the University of Illinois here.

The first heart beat does not occur in a miniature of the chambered and efficiently valved adult heart, Dr. Patten explained. In the egg cell there are very simple structures that develop into a temporary cardiac pump that starts the circulation going and keeps it in operation during the time the most elaborate heart mechanism is being formed.

The young heart cannot cease operations "for alterations" Dr. Patten explained. All the time it is changing from the simple tubular structure which first sets the blood in motion, until it becomes its chambered and valved final form, the circulation can never be allowed to cease, even momentarily.

Although most of Dr. Patten's work has been done on the chick, studies show that there are similar stages in the human and other mammal hearts, and that the stages in the formation of the blood corpuscles and the beginning of circulation are similar.

ELECTRON MICROSCOPE REVEALS ELEMENTARY CELLULOSE PARTICLES

PHILADELPHIA, October 20 (Science Service). -- Discovery of the real elementary particles of cellulose, one of the basic substances of all plants, including wood, cotton, etc., was revealed in a paper by Dr. The (CORRECT) Svedberg, Swedish chemist, upon the occasion of the award of the famous Franklin Medal, highest honor of the Franklin Institute here.

Consisting of equal-sized rods of small size, visible by means of the electron microscope but far beyond the reach of the ordinary microscope, these cellulose particles or molecules seem to be the same whether they are in wood closely bound to lignin or in the fine hairs on cotton seeds. Dr. Svedberg's communication, sent from Sweden, explained that these and other giant molecules can be sorted out in the ultracentrifuge, a research upon which he has spent nearly half a century and which has brought him world recognition.

The way in which the cellulose in plants is formed is different than the way other big molecules are synthesized in non-living matter. This may give useful hints toward understanding living processes.

PLANT CELLS IN COAL REVEALED BY NEW MICROSCOPE TECHNIQUE

NEW HAVEN, CONN., October 26 (Science Service). -- A new

method of preparing specimens for the electron microscope reveals the cell structure of the ancient plants that went into the formation of coal.

The new technique consists of taking a plastic impression of the surface of a polished cube of coal, and then photographing the impression through an electron microscope. The older technique of peeling or slicing thin sections of coal gives specimens which are too thick for profitable study. The plastic replicas are about one-tenth of a micron, the desirable thickness.

Outlining the method in the forthcoming issue of Economic Geology, J. T. McCartney of the Pittsburgh station of the U. S. Bureau of Mines says that the coal cubes, about the size of large dice, are polished and then placed briefly in an etching bath of chromic acid-sulfuric acid. After washing and drying in filtered air, they are dipped in a solution of polyvinyl formal. Over this a second layer of film, nitrocellulose, is applied. When dry, the double film of polyvinal formal and nitrocellulose is stripped off. This film, bearing an impression of the coal's surface structure, is photographed through the electron microscope.

Dr. McCartney believes that these studies will reveal more clearly some of the finer details of coal structure that are not yet fully understood.

CANCER FIGHT HELPED BY MIRROR MICROSCOPE

NEW YORK, October 27 (Science Service). --Cancer fighting is now being done with mirrors, lenses, and invisible ultraviolet and infra-red light rays. They are being used, in special microscopes, for seeing more of what goes on inside the cancer cell, what special chemicals it needs for its diet, and what chemical changes in normal cells may be linked to the start of cancer.

A new microscope lens for this kind of cancer fighting, developed by David S. Grey of the Polaroid Corporation, was demonstrated at the meeting here of the American Cancer Society. Development of lens was sponsored by the Office of Naval Research. It is being manufactured by Bausch and Lomb Optical Company and is already in use at two research centers.

ARTIFICIAL SAPPHIRES ARE NOW MADE INTO LENSES

BUFFALO, November 1 (Science Service). -- Artificial

sapphires can now be made into lenses for microscopes and cameras, and it is expected that these jewel lenses will be of particular use in correcting optics for color transmission.

Dr. Robert E. Hopkins and Brian O'Brien of the University of Rochester's Institute of Optics reported to the Optical Society of America here that a lens of one-inch focal length and f/1.5 has been constructed with two sapphire elements.

Sapphire of acceptable optical quality has been manufactured in sizes up to 20 millimeters diameter. Methods of polishing this material which is harder than glass have been worked out.

Manufacture of artificial sapphires was begun in this country during the war to provide hard and long-wearing bearings for precise instruments needed in military work.

FUNGUS NOT FROST CAUSES WINTERKILL

STATE COLLEGE, Pa., November 12 (Science Service). Jack Frost has been acquitted. For years farmers have held him guilty of winterkill, that annual round of cold-weather killings that takes such a heavy toll among the pasture grasses.

Long and patient detective work has finally revealed the true culprit, a cold-weather fungus with a string of aliases and a long record as a crop-spoiler. It goes by the names of crown rot, stem rot, and, when it moves in scientific circles, Sclerotinia trifoliorum.

Each year when the cool weather starts setting in, it has been noted that winter annual and perennial legumes the pasture grasses like alfalfa, red clover, Ladine clover and others, are subject to an attack of what has been called up to now, winterkill. It was thought that frost and freezing caused it.

But plant pathologists at the U. S. Department of Agriculture's Regional Pasture Research Laboratory here have now demonstrated that it is caused by this fungus, which lies dormant during the warm weather and stirs to its lethal activities as soon as the temperature starts to drop.

LENSES OF GERMANIUM METAL TRANSMIT INVISIBLE HEAT

CHICAGO, November 25 (Science Service). Lenses that

will transmit invisible heat radiation, promising spectacularly improved infrared equipment for scientific and industrial use, can be made out of pure germanium and silicon metals as the result of researches made known to the American Physical Society here by scientists from Purdue University.

Even though the metals are opaque to ordinary light and may be an inch thick, they transmit the infrared rays over a broad portion of their spectrum. Heretofore, rock salt and other materials softer than metal and attacked by moisture have been used for optical work with infrared radiation, which war applications showed was important for many uses.

The researches were done by a group of scientists headed by Dr. Karl Lark-Horovitz of the Purdue physics department and including K. W. Meissner, M. Becker and H. Y. Fan.

These researches are the outcome of electrical measurements on germanium alloys, which Dr. Lark-Horovitz and his colleagues in 1942 produced in such a way that it was possible to make them semi-conducting either negatively or positively. Semiconductors with known and predictable properties were available then for the first time.

Investigation of the optical properties of these materials followed. Dr. Lark-Horovitz found that the material with high conductivity in the very far infrared has much higher reflectivity than the material of high resistance. It also has a smaller transmission of infrared radiation.

Pure germanium and silicon metals have been prepared which transmit 50% of the infrared "light" beyond 2 microns in wavelength. The loss that occurs is primarily due to the reflections and not to absorption.

Filters as well as lenses will be made of these stable materials. Grinding the metals to dimensions will be easier than with softer materials now used, and Dr. Lark-Horovitz predicts that the new development will result in a wider investigation and use of infrared phenomena in the future.

"DWARF" GERMS DEVELOP FROM BIG ONES DOSED WITH PENICILLIN

LONDON, November 28 (Science Service). "Dwarf bacteria or germs in layman's terms, develop from some common bacteria after treatment with penicillin, Dr. Robert

Tulasne, of the University of Strasbourg, France, School of Medicine, has discovered.

Their place in the disease and epidemic picture may be important, he suggests.

These dwarf bacteria are too small to be seen under the microscope and small enough to pass through fine-pored filters. They may, Dr. Tulasne suggests in a report to the journal, Nature, here, have quite different disease-causing powers than the visible forms of bacteria from which they sprang.

Dwarfs from one kind of bacteria, Proteus vulgaris, can revert to the normal form when grown on culture medium without penicillin. Others may be able to do the same.

Plague germs and one of the food poisoning family of germs also can develop dwarfs under certain circumstances.

The whole problem of the "filterable" forms of bacteria, especially those of the tuberculosis and syphilis organisms, may need reinvestigation, Dr. Tulasne thinks. Such reinvestigation may, in his opinion, lead to the solution of some outstanding general problems of disease and epidemics.

MICROSCOPE GETS X-RAY EYES TO PEER INTO INTERNAL DETAILS

PHILADELPHIA, December 3 (Science Service). A microscope has now been given X-ray eyes to enable scientists to see very small internal details of living and non-living materials.

Excellent results in first tests of the instrument were reported by Miss Charlys M. Lucht of the General Electric Research Laboratory, where it was made, at the meeting here this morning of the American Society for X-ray and Electron Diffraction.

She predicted that the instrument may compete in the future with the electron microscope, which is the most powerful magnifying instrument now in use. Electron microscopes use a beam of electrons instead of light to form an image of materials under study.

With the X-ray microscope, X-rays are passed through the material being studied and then strike a pair of curved mirrors at an angle of less than one-half degree. The mirrors bend the X-ray beams in such a way as to cast a magnified X-ray image of the sample on a photographic film.

The mirrors are platinum coated slabs of fused quartz which are as nearly flat surfaces as can be made. They are curved by mechanical pressure which can be adjusted by hand. This, Miss Lucht explained, makes it possible to change the curvature of the mirrors in order to improve focusing.

At the present stage of development, magnifications of 100 diameters have been produced. X-ray images magnified 10 times are magnified another 10 times by photographic enlargement without serious loss of detail.

Objects studied so far have been fine mesh screens, selected for testing of the instrument's ability to show small details. Because the X-ray microscope, unlike the electron microscope, does not require samples under study to be in a high vacuum, it may make possible examinations of living materials at much higher magnifications than ever before.

DELICATE INSTRUMENT HANDLES LIKE JOY STICK OF AIRPLANE

NEW YORK, December 5. (Science Service). Handled like the joystick of a light plane is a new micro-manipulator with which it is literally possible to write your name legibly in a space no thicker than a human hair.

Invented by Dr. Pierre de Fonbrune, chief of the Laboratory of Pasteur Institute, Paris, France, the device on display at the 22nd Annual Exhibition of Chemical Industries here, offers researchers an easily controlled method of delicate dissection for delving into the innermost secrets of single cells.

Thin tubes of glass drawn out to the finest of hooks are the surgical tools, the movement of which is observed under the microscope. The mechanism which imparts the reduced motion, variable to 1/2,500th part of the movement of the control handle, is in the form of two pistons and cylinders, at right angles to each other. These are connected to the "joystick" and by tubing to diaphragms similar to those in an aneroid barometer. A third piston-cylinder combination in the handle extension of the control rod itself brings about an up and down movement of the glass instruments.

The micro-manipulator is manufactured in this country by the A. S. Aloe Company of St. Louis.

TEN TOP SCIENCE ADVANCES IN 1949 SELECTED

WASHINGTON, December 5 (Science Service). The ten most important science advances made during 1949, as picked by Watson Davis, director of Science Service, are:

1. Atomic explosion in Russia.

2. Harmones, cortisone and ACTH brought dramatic relief to sufferers from arthritis and promise to be useful in muscle weakness, kinds of cancer, aging disabilities and even mental illnesses.

3. Use of anti-allergy drugs to relieve the symptoms of colds.

4. Demonstration that dramamine relieves air and sea sickness and other nausea.

5. Non-stop round-the-world flight of Army bomber in 94 hours.

6. Development of guided missiles, although details are still secret.

7. Commercial synthesis of chloromycetin, antibiotic for disease-fighting, first chemical manufacture of such material.

8. Discovery of Stone Age man in Alaska, giving man a greater antiquity in America.

9. Development of fluorocarbons as a new and promising class of chemicals, useful particularly as lubricants.

10. Discovery that lenses transmitting infra-red (heat) can be made from germanium metal opaque to ordinary light.

SECRET MILITARY DEVICES USE MASS-PRODUCED SCHMIDT LENS

SOUTHBRIDGE, Mass., December 16 (Science Service). Military devices with uses not yet revealed by the government were possible during the war because of a secret method of producing Schmidt corrector plates disclosed here today. A Schmidt corrector plate provides a lens ten times faster than a high-speed camera lens.

Schmidt-type lenses today are used in the "Big Schmidt" camera on Mt. Palomar and in Schmidt cameras for mass

public tests in the campaigns against tuberculosis as well as in secret military instruments.

Dr. E. D. Tillyer, inventor of the process for which a patent has just been granted and research director of the American Optical Company here, discovered after the war that he had won a race with German scientists. They had been working day and night to perfect a method of mass-producing the lenses.

Prior to the war there were less than 50 lenses of the Schmidt correcting type in the world and these were used in high-speed astronomical photography, Dr. Tillyer states. These required weeks and sometimes months to make, and because of the multiple curves of the lens, it was considered impossible to mass produce them according to Dr. Tillyer.

The new process consists of making a special mold having wave-like curves that produce the desired shape in the finished lens. A ground and polished sheet of optical glass is placed on the mold and both are heated. One side of the lens then has the required Schmidt curves, and the other can be reground and polished as desired.

Secret of the mold lies in the materials of which it is made--kyanite and ball clay. The former has a tendency to expand, while the latter tends to contract.

AMATEUR HAILED FOR BRINGING FRESH VIEWPOINT TO SCIENCE

NEW YORK, December 28 (Science Service). The scientific amateur was hailed here tonight for "his fresh viewpoint and freedom from bias which have often led to discoveries which his more inhibited professional brother had overlooked.

Although "much missionary work must be done before a rabid Dodger fan" gives up baseball for botany and sets out "to collect the flora of Flatbush," Dr. Edmund W. Sinnott, director of Yale's Sheffield Scientific School, speaking this evening as retiring president of the American Association for the Advancement of Science, cited several organizations which are already at work bringing science and the layman closer together.

He cited the contributions of the American Association of Variable Star Observers, and the "revolution in our knowledge of bird migration" brought about by amateur bird-banding groups.

A good start in widening the participation by laymen in

scientific work, he noted, is being made "by the hundreds of science clubs, organized under the auspices of Science Service," and by the nationwide Science Talent Search which is "another important means of attracting into science some of the best of our youngsters."

Dr. Sinnott stressed that familiarizing laymen with science is very important in this highly technological age when sciences are all too frequently regarded as "primarily a sort of glorified gadgeteering."

To guard against "the twin evils of indifference and intolerance," Dr. Sinnott invoked "the spirit of science ... which leads both to that freedom and tolerance so necessary for the democratic way of life."

X-RAY-EYED MICROSCOPE GROWS MORE POWERFUL

STANFORD UNIVERSITY, Calif., December 29 (Science Service). The microscope with the X-ray eyes for peering into specimens of living tissue is growing more powerful. A new instrument with a magnification of 50 to 100 diameters, instead of the 10 reached by an earlier model, was announced by Dr. Paul H. Kirkpatrick of Stanford University at the meeting here of the American Physical Society.

The microscope, Dr. Kirkpatrick said, has a resolving power comparable to that of many microscopes operated with ordinary light. This resolving power, which is the ability of an optical instrument to give a distinct image, is more important than magnification.

SMALL QUANTITIES

Some plants will noticeably increase their growth when as little as one part of pure B1 is added to every million parts of their nutrive solution. Talking about the alchemist's goal of weighing the soul, Adrenaline will make noticeable changes in intestinal mobility produced by 1:800.000.000. The spectroscope will detect as low as one part in a million; however the human nose will rapidly register concentrations of Butyric acid (a constituent of Body Odor) as small as six parts in 100 billion.

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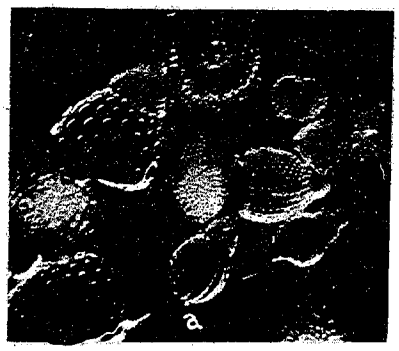
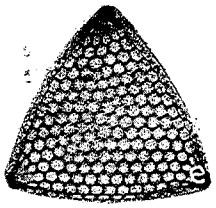
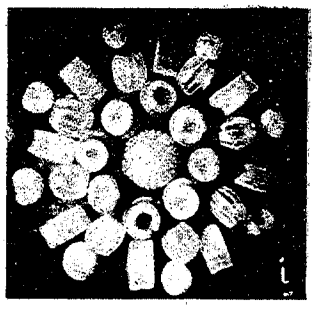
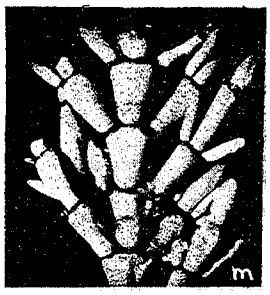
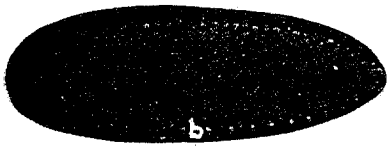
NOTE: When ordering slides by number please mention this magazine.

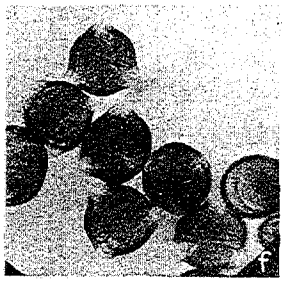


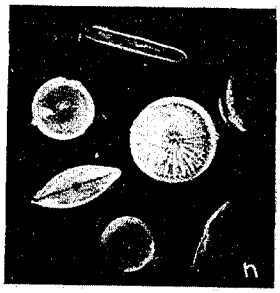


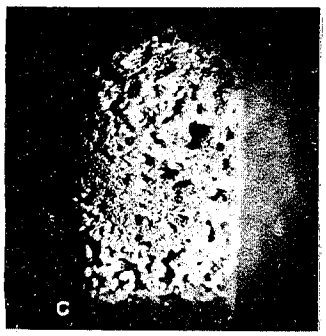


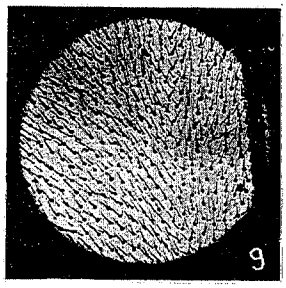


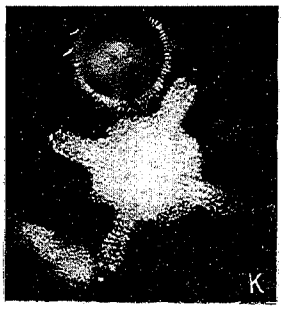


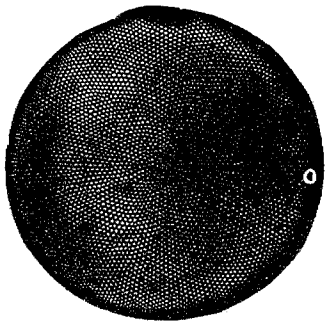


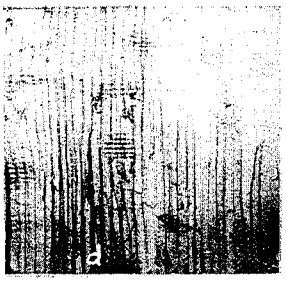


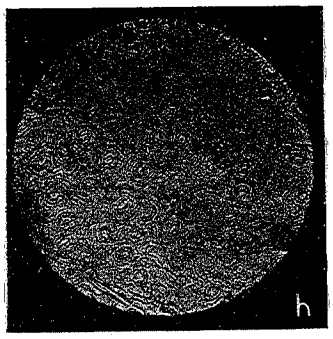


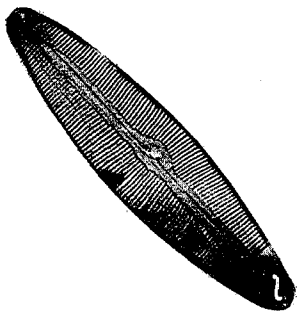


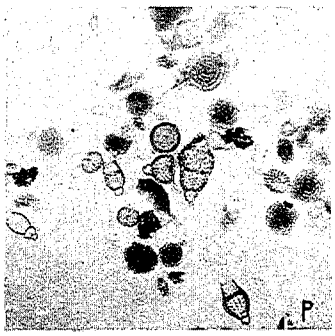


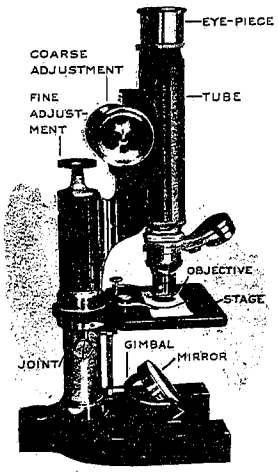








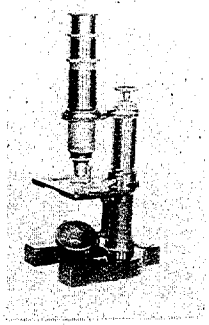




Here is the instrument you will want to use with each part labelled. Its cost is ?

LEGEND:

a) Radiolaria Slide #82 (dark-field)
b) Diatom Slides #44 - #45 - #46
c) Burnt head of safety match
d) Section of wood (white-pine)
e) Diatom Slides #64 - #65
f) Pollen
g) Wing of Common Fly - showing hairs
h) Stomata - tea leaf
i) Eggs - Butterflys and Moths
j) Leg of Spider
k) Radiolaria - #82
l) Diatom slides - #32 - #31 - #41
m) Algae - from sea
n) Diatoms
o) Diatom Slides #33 - #15
p) Radiolaria - light field - #82



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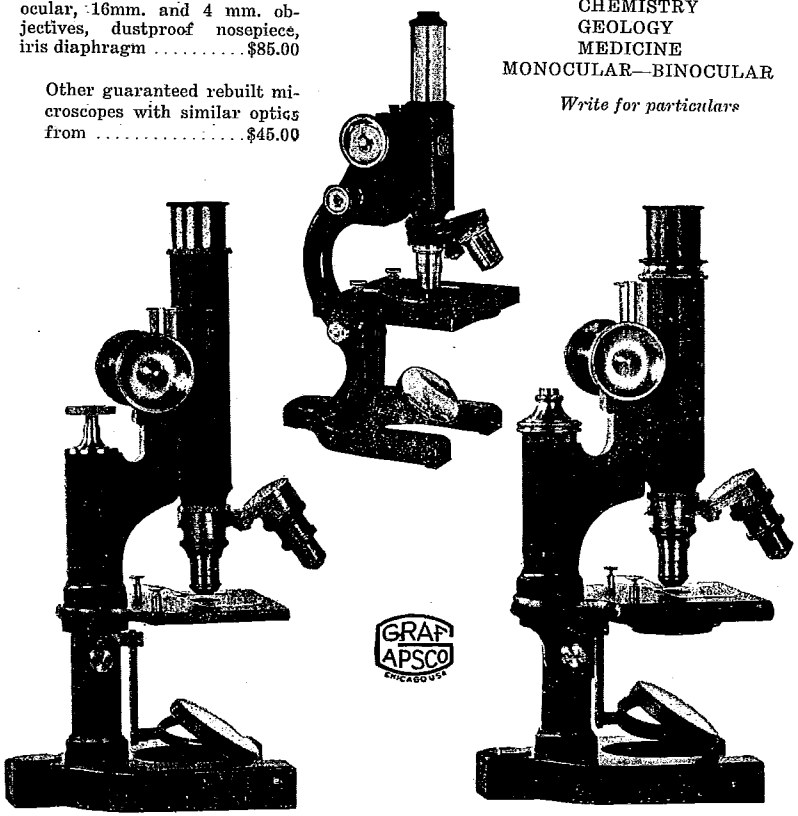

Rebuilt VO Microscope

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.

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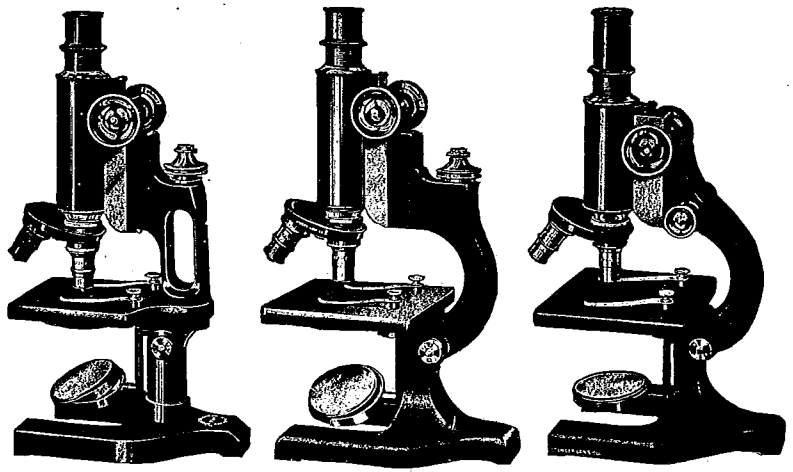

Rebuilt H Microscope Rebuilt CT Microscope Rebuilt CS Microscope

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	

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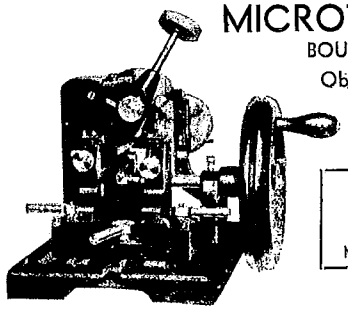

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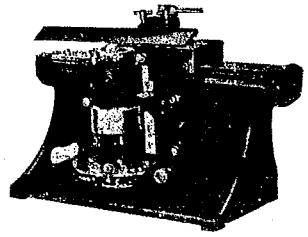

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