Journal of
THE MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA
Volume 4 Number 10 October 1999

Using the Diatom Test Plate for Checking Microscope Optical Resolution, and Klaus Kemp's 8 Forms Slide

Ron Morris

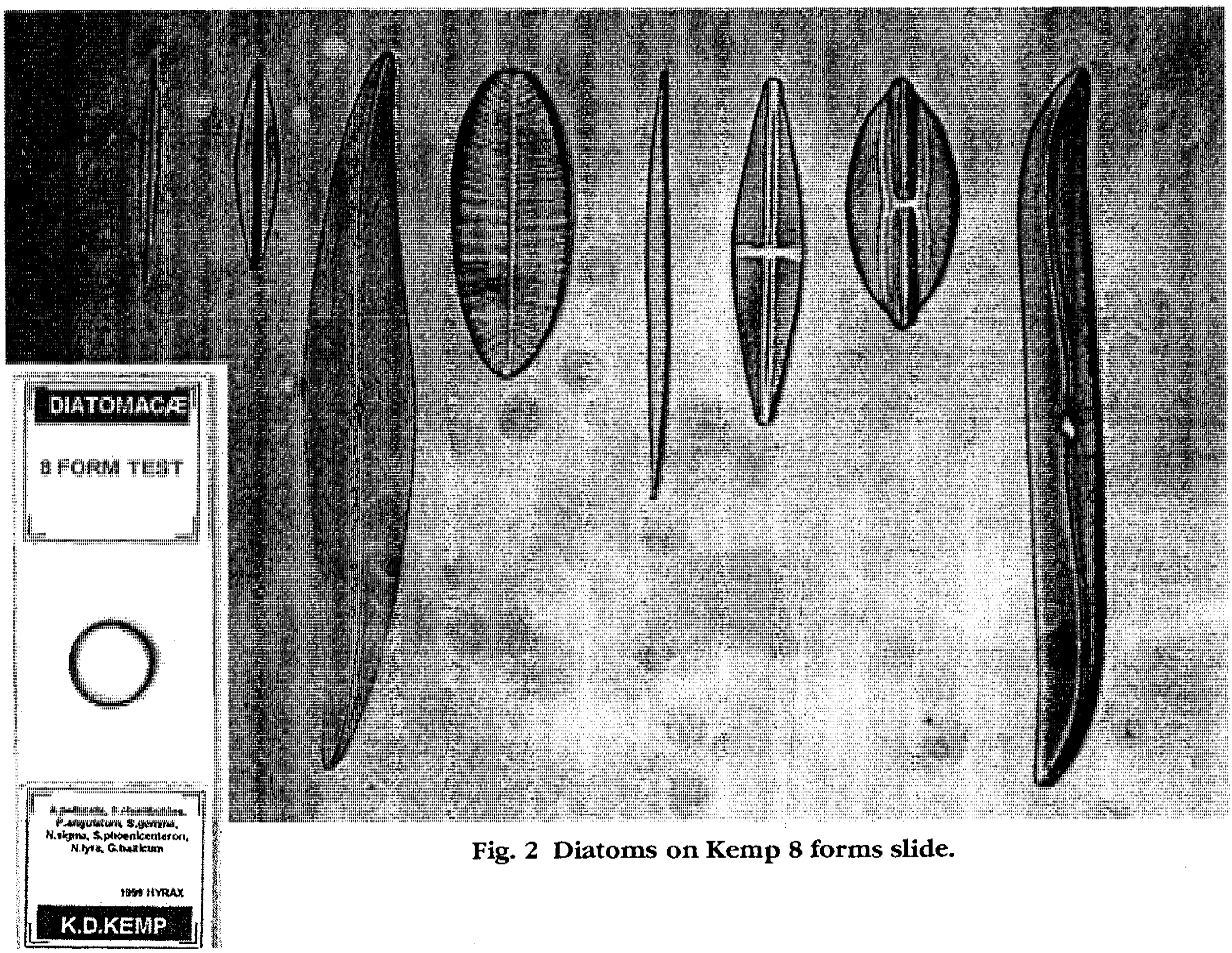


Fig. 2 Diatoms on Kemp 8 forms slide.

Fig. 1 Klaus Kemp's 8-form test plate slide.

Ever since microscopes were first designed commercially, there has been a need to determine exactly how well the microscope, and it's various optical components: the eyepiece, the objectives, the condenser system, and even the illumination system, actually compare with other instruments.

Questions regarding the microscope's performance, such as resolution, contrast, flatness of field, and images free from aberrations/ false artifacts, were of concern to both manufacturers of microscopes, and the actual end-users of microscopes.

The other question that faced microscopists is whether or not what they see through the microscope is actually the true representation of the original specimen object on the slide? We can often compare against a standard that is well known, such as a test plate as a form of "sanity check" to verify the true performance of an optical instrument, such as a microscope.

Diatoms have been used for many years to test the optical resolution of microscopes. The idea to use diatoms for such purposes has been attributed to Mr. J.D. Sollit of Hull, who in 1841, saw lines on Pleurosigma Hippocampus. Later in 1868, the striae on Amphipleura Pellucida were first resolved into the individual dots.

In Germany, Dippel (2nd edition in 1882), stated that Amphipleura pellucida was the most difficult diatom test object used at the time. He said that it should be resolved to a fine level with at least a numeric aperture (N.A.) of 1.16. Oblique illumination, along with homogeneous (oil) immersion was recommended.

Spitta in his book *Microscopy* , describes the use of naturally occurring test objects, such as the class of aquatic organisms called diatoms- specifically the diatoms Amphipleura pellucida and Pleurosigma angulatum.

Spitta goes on to say that the ideal test object should include common geometrical objects, such as squares, lines, and circles-with known geometries and spacing. Objects that have features that can function as scale bars or shapes (similar to the ruling on a stage micrometer slide) are also very useful.

The diatom test slide would provide simple test images to a microscopist, that allow future reference for comparisons with unknown specimens.The purchase cost of the diatom slide would also be within the realm of most microscopist's budget, unlike the diamond-stylus ruled test slide, such as the Nobert (1870), or the modern day laser lithographed versions.

MSSC Journal
Volume 4 Number 10 October 1999
CONTENTS

JANUARY WORKSHOP RESCHEDULED TO THE SECOND SATURDAY. JANUARY 8, 2000.

MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA

President- George G. Vitt Jr. 2127 Canyon Drive. Los Angeles, CA 90068. 323-464-6503 gvitt@att.net
Vice President - James D. Solliday, 1130 S. Austin St. Santa Ana, CA 92704. 714-775-1575 jdsolliday@att.net
Treasurer - David L. Hirsch, 11815 Indianapolis St. Los Angeles, CA 90066-2046 dlhirsch@pacbell.net
Secretary - Ronald F. Morris, 1561 Mesa Drive. #25. Santa Ana Heights, CA 92707. 714-557-6567 tronm@earthlink.net
Program - Larry Albright, 1704 Mandeville Lane Los Angeles, CA 90049. 310-471-0424. albrite@Plasma-Art.com
Workshop - Steve Craig, 3455 Meier St. Los Angeles, CA 90066 310-397-8245. srcraig@mediaone.net
Education -James D. Clark Jr, 11518 Valle Vista Road. Lakeside, CA 92040. 619-443-6154. jjclark@cts.com

Publication Correspondence To
Editor
Gaylord E. Moss
P.O. Box 9130
Marina del Rey, CA 90295
Tel/FAX (310) 827-3983
gmoss@mediaone.net

Dues and Membership Applications To
Treasurer
David L. Hirsch
11815 Indianapolis Street
Los Angeles, CA 90066-2046
Tel (310) 397-8357
dlhirsch@pacbell.net

Prospective new members, please write to David L. Hirsch for membership application. Dues are $50 yearly for regular members and $40 yearly for corresponding members who are geographically too distant to attend regular meetings. Please make all checks payable in the name of our treasurer David L. Hirsch, NOT to MSSC.

Diatoms, which are naturally occurring objects, are uniquely suited for testing the resolution of the microscope, perhaps better than any other object. They are of the size that will largely fill the field of view at the magnifications commonly used on a given microscope-100x, 200X, 400X, 600X, 1000X, etc.

Even though there is no shortage of material available; the effort is getting them clean of organic material, and the careful and skillful mounting of them intact. Several modern day mounters, including Klaus Kemp of England, have perfected this fine art.

I will now briefly describe the structures of diatoms.

A diatom (or diamtomace) is a family of Confervoid (Golden) Algae, of a very peculiar character, consisting of microscopic brittle organisms, found in almost all fresh, brackish, or salt water. They sometimes form an uniform yellowish-brownish layer on the bottom of the water, at other places they may be found adhering to various water plants, such as the Water Lily, decaying stems, stones, etc. They can also be found among Mosses, and on the damp ground surrounding a body of water.

The individual cells of the Diatom are called frustules or testules, and are covered by an exterior shell of silica. They consist of two generally symmetrical halves, or valves, comparable to a bivalve shell. The separate valves are of various shapes- circular, oblong, elliptical, linear, saddle-shaped, boat shaped (navicular), undulate, and sigmoid. The surfaces of these various diatom shapes exhibit delicate markings and sculpturing, in the form of bands, lines, either in parallel, radial, or criss-crossing each other. The dots or puncta also form a cellular (areolate) appearance.

These structures are used for testing the resolution of microscope optics. For the purposes of this article, I will be using the "8 Forms test plate" by Klaus Kemp, item number B25D. For around $20 U.S., it is a fine slide to use to test your optics, and in my opinion, a real bargain. Carolina Biological sells the same slide, albeit for more money. Other similar slides are available from Schuleter, and N.B.S. There is some variation in size among the diatom samples, however, the important features such as the dotted striae remain consistent and will perform well as a test.

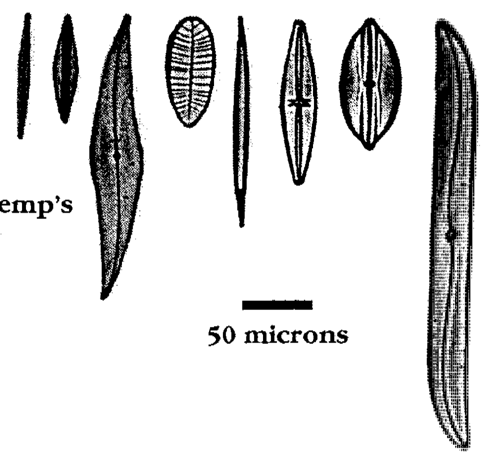


Fig. 3. Diatoms on Klaus Kemp's 8-forms slide. Item B-25-D

This test plate has structures ranging in length from about 50 microns up to 280 microns in length. The various striae range from 37 per 10 microns, down to 8 per 10 microns.

The 8 diatoms on this slide are as follows: in order, (from right to left).

Specimen	Length in Microns	Striae per 10 microns	Objective used
1.) Gyrosigma Balticum	280	15	20-40X
2.) Navicula Lyra	160	8	20X
3.) Stauroneis Phoenocontereon	150	14	20X
4.) Nitzschia Sigma	200	23	100X oil
5.) Suriella Gemma	100	20	40X-100X oil
6) Pleurosigma Angulatum	150	19	20X-40X
7.) Frustulia Rhomboides	50	34	100X oil
8.) Amphipleura Pellucida	80-140	37	100X oil

Nitzschia sigma-This is a long diatom, (200 microns), and at 400X power, the center of the field of view through the microscope oculars should be in sharp focus.The other 2/3 or so of the diatom should also be in razor sharp focus, and show the clearly defined outline of the diatom.This is a great diatom for testing the flatness of field of your microscope .The entire length of this diatom should be in crisp focus.There are approximately 23 striae per 10 microns.

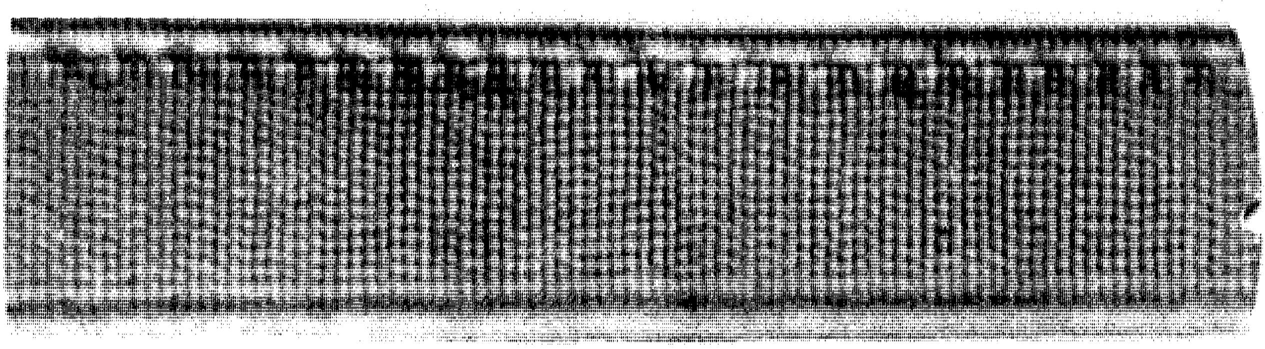


Fig. 4. Nitzschia Sigma

Pleurosigma Angulatum -approximately 150 microns long, and the lines of dots are 0.50 microns apart. A good test object for both contrast and resolution. This diatom is perhaps the most popular, and the most written about diatom for testing medium powers, such as the 40X or 63X objectives. Using a 10X eyepiece, and a 40X objective, preferably with a correction collar, the outline of the diatom should be sharp, and well-defined.

The field of view of the entire length of the diatom should be in sharp focus, and the line down the center of the diatom, or the raphe, should be clearly defined, and the very fine crossing lines should be visible.The dots on the lines might be also discerned, if the microscope is correctly set up, however contrast enhancement, such as phase or DIC, may be needed to fully resolve the dots. Darkfield or Oblique illumination may also help resolve the dots. If the optic quality or setup is poor, then only a fine cross-hatching pattern may be visible, instead of the dots.

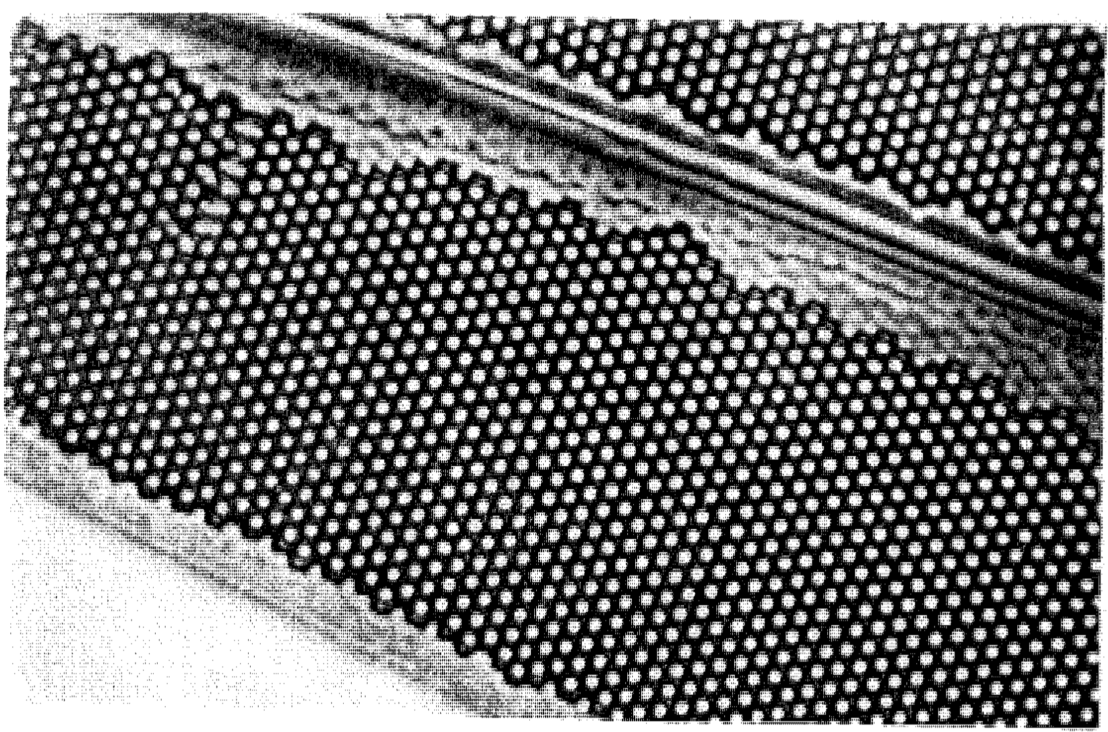


Fig. 5 Pleurosigma Angulatum-1250X, DIC

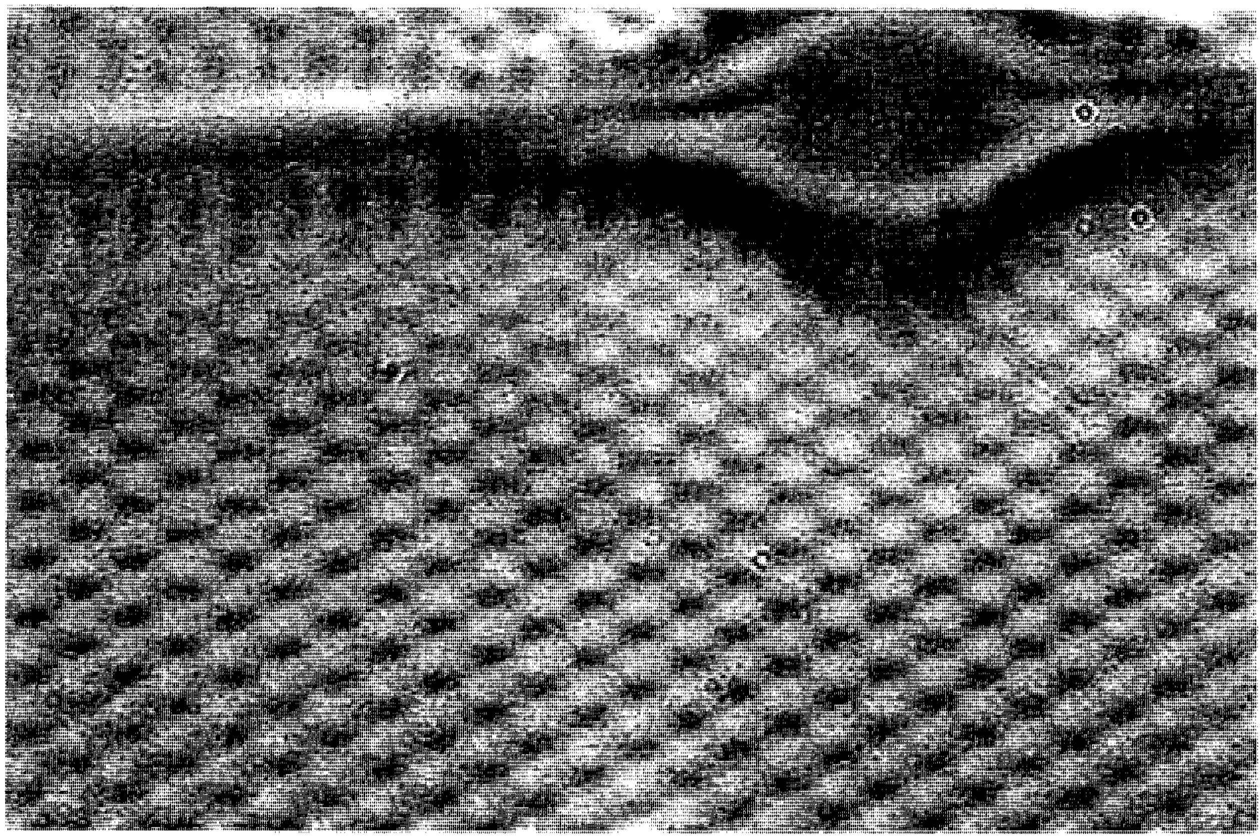


Fig. 6 Pleurosigma Angulatum-1000X

Amphipleura Pellucida- Approximately 80-150 microns long, with dots 0.20 microns apart. This is perhaps the best diatom for higher power objective testing., especially 100X oil immersion objectives. The striae should be clearly seen at about 42 per 10 microns. The fine lines that are at right angles to the long axis of the diatom should be resolved, but the individual dots in these lines is near the resolution limit of an optical microscope.

If a 20X to 25X eyepiece is used instead of a 10X, oiled condenser and objective, with a green filter, the striae can be seen as individual dots, with the space separating them being approximately 0.2 of a micron. This is close to the theoretical limits of an optical microscope, and only the best microscope optics will show the extremely fine striae.

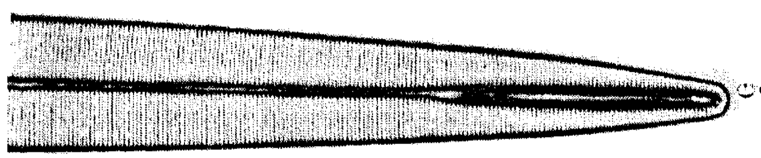


Fig. 7 Amphipleura Pellucida

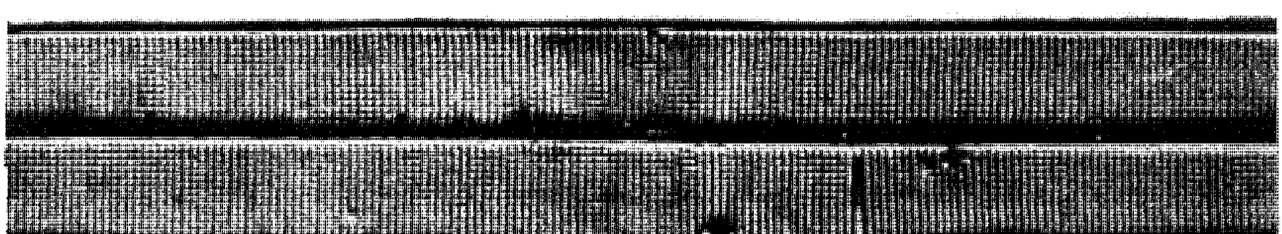


Fig. 8 Amphipleura Pellucida

Stauroneis Phonicenteron- approximately 150 microns long, the lines of dots are 0.75 microns apart. This is a popular diatom for testing 10X, 20X and 40X objectives. Flatness of the entire field of view should be apparent, and with a 10X or 20X objective, the unresolved dots will appear as fine lines. The outline of the diatom's main features should be sharp.

With a 40X objective, the rows of dot structures should be clearly defined. By moving the fine focus to and from, the dots will be resolved as black and white features that will come into focus, as the depth of field is slightly changed. This phenomenon is known as phase shift.

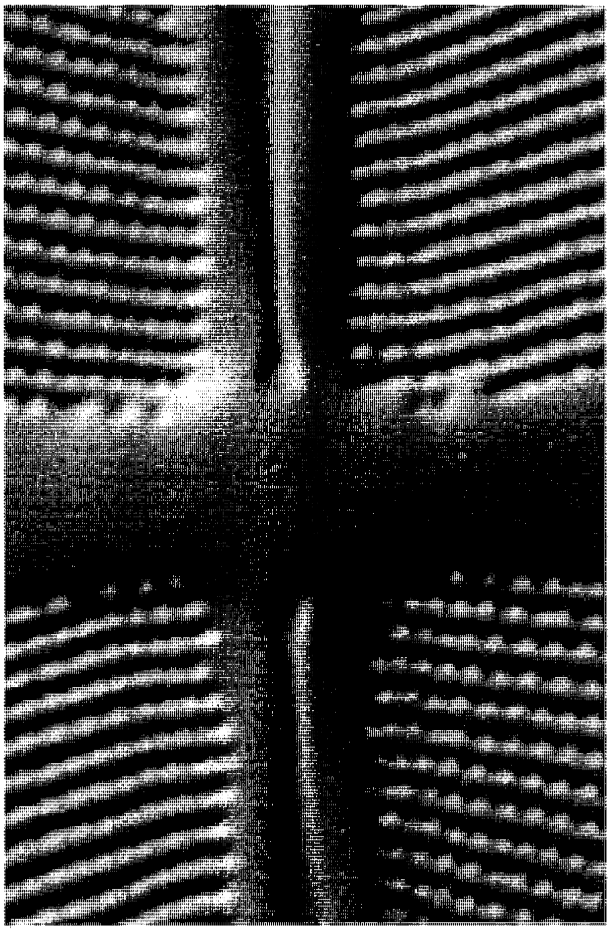


Fig. 9- Stauroneis phoenocentereon- 1250X, DIC)

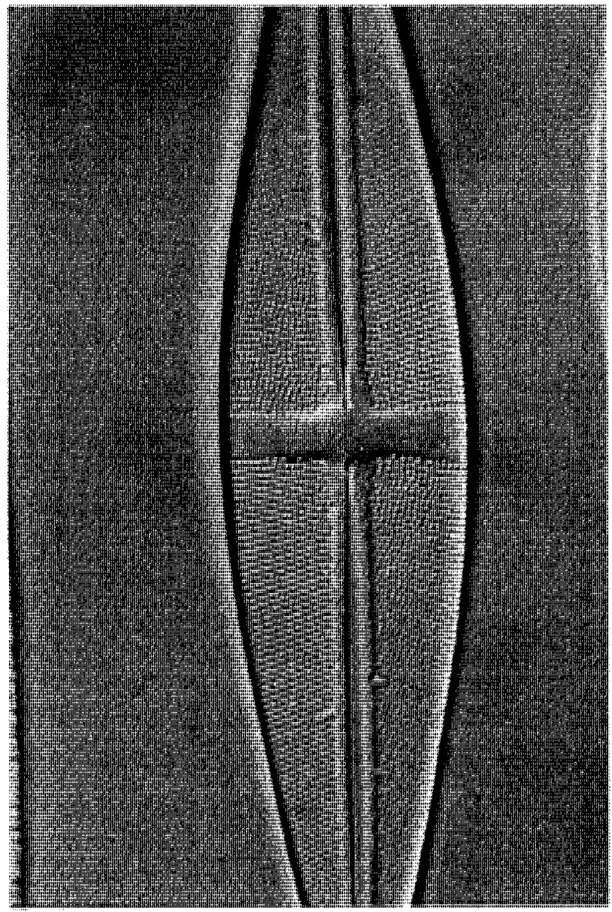


Fig. 10- Stauroneis phoenocentereon

Frustulia Rhomboides- approximately 50 microns long, and the lines of dots are 0.3 microns apart, for testing the highest powers, such as 90X+ objectives. This rather delicate diatom, has both lengthwise and horizontal lines (striae) of dots that should be seen with a 100X oil immersion lens together with a 10X ocular, and a very high 1.3-1.4 N.A. aplantic condenser. Both the 100x objective, and the condenser should be oiled to the slide with high N.A. immersion oil. The lines of dots should be clearly seen, but resolving the individual dots in the lines requires the best of lenses, and may be hard to discern.

The apex of the center raphe rib has the appearance of a pencil or crayon tip.

This diatom species may be near the optical limit for many microscopes.

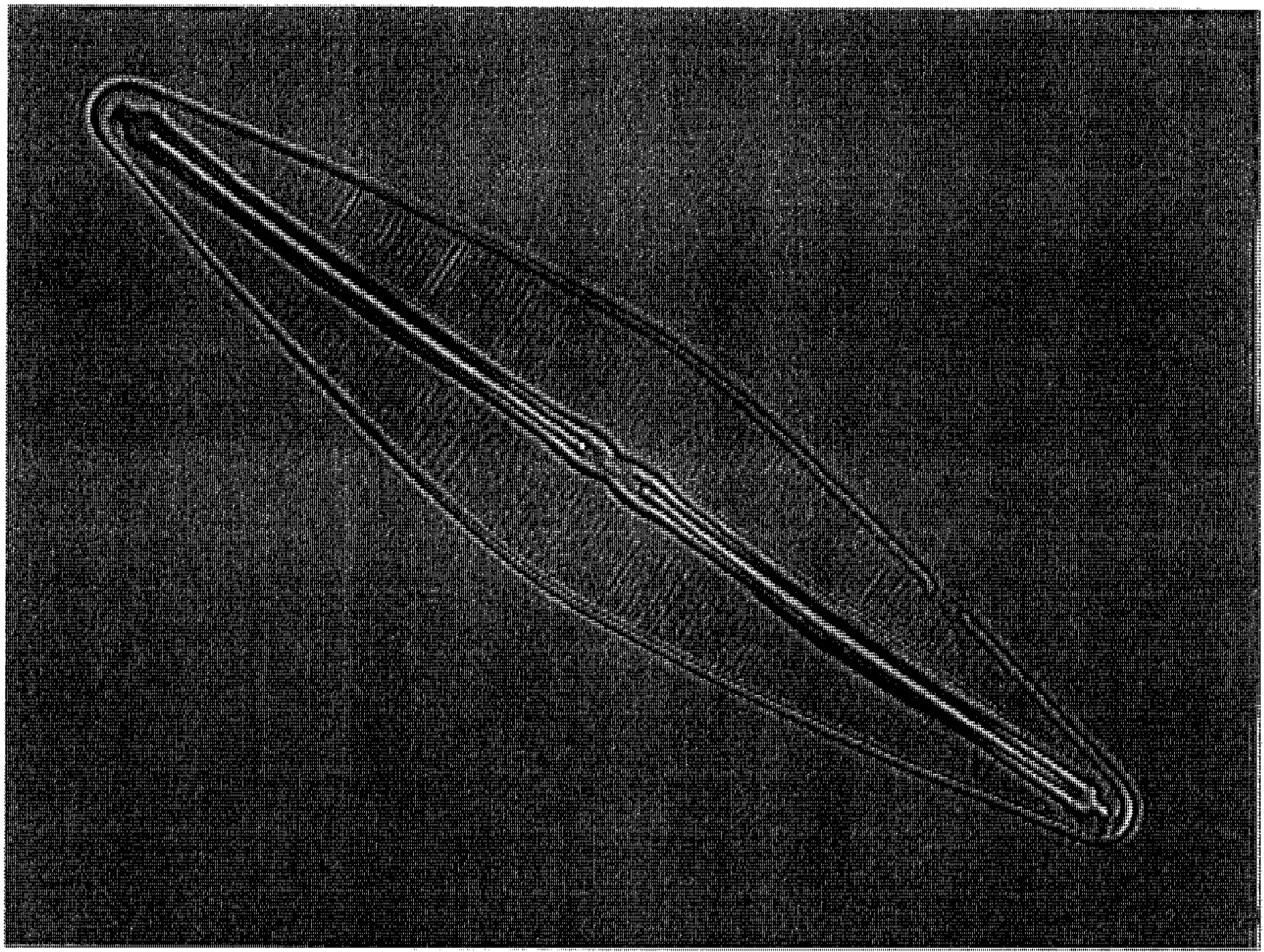


Fig. 11- Frustulia rhomboides

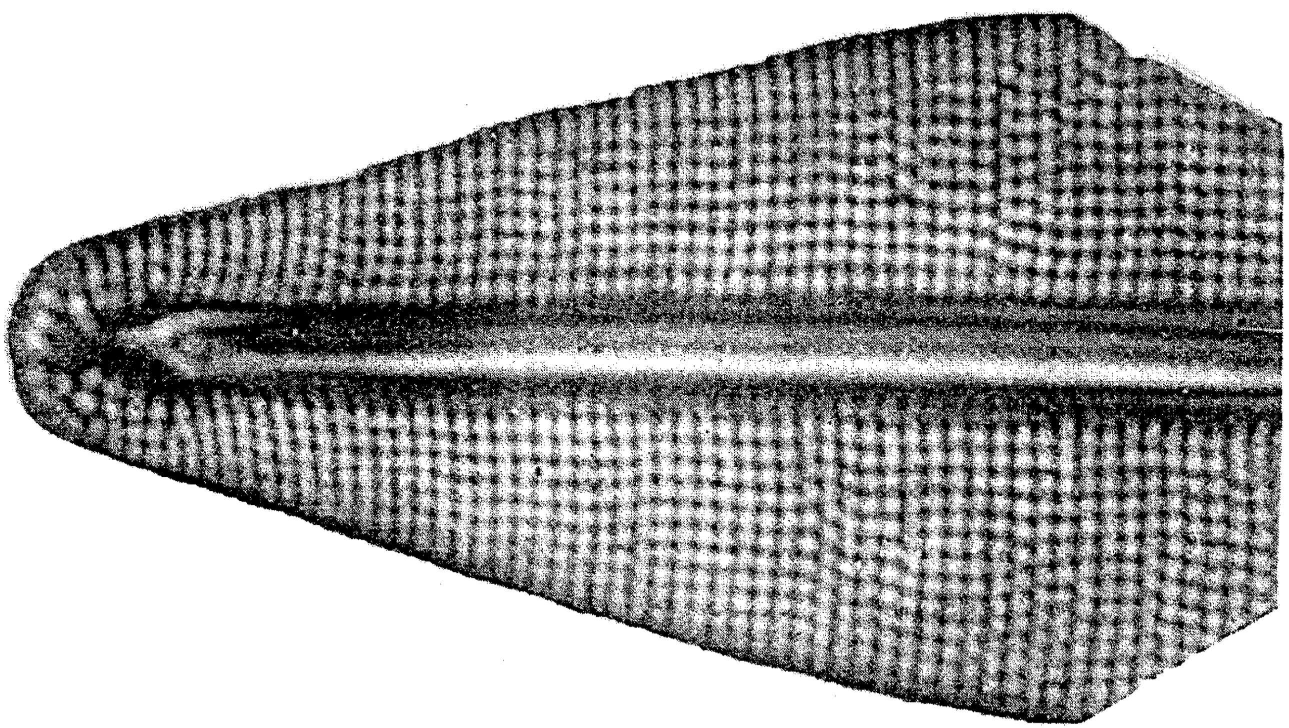


Fig. 12- Frustulia rhomboides

Surirella gemma -approximately 100 microns long, with lines of dots 0.5 microns apart. A good test object for medium to higher powers, such as 40X and 63X objectives.

This is another very popular, classic test diatom, with heavy lines crossing the valve face. With a 10X ocular, and 40X objective, the heavy lines and white borders should be seen, and the much finer lines (striae) that are crossing the valve can also be made out. A very high quality 40X objective may be able to resolve the dots, however most 63X + objectives should have no problems resolving the individual dots.

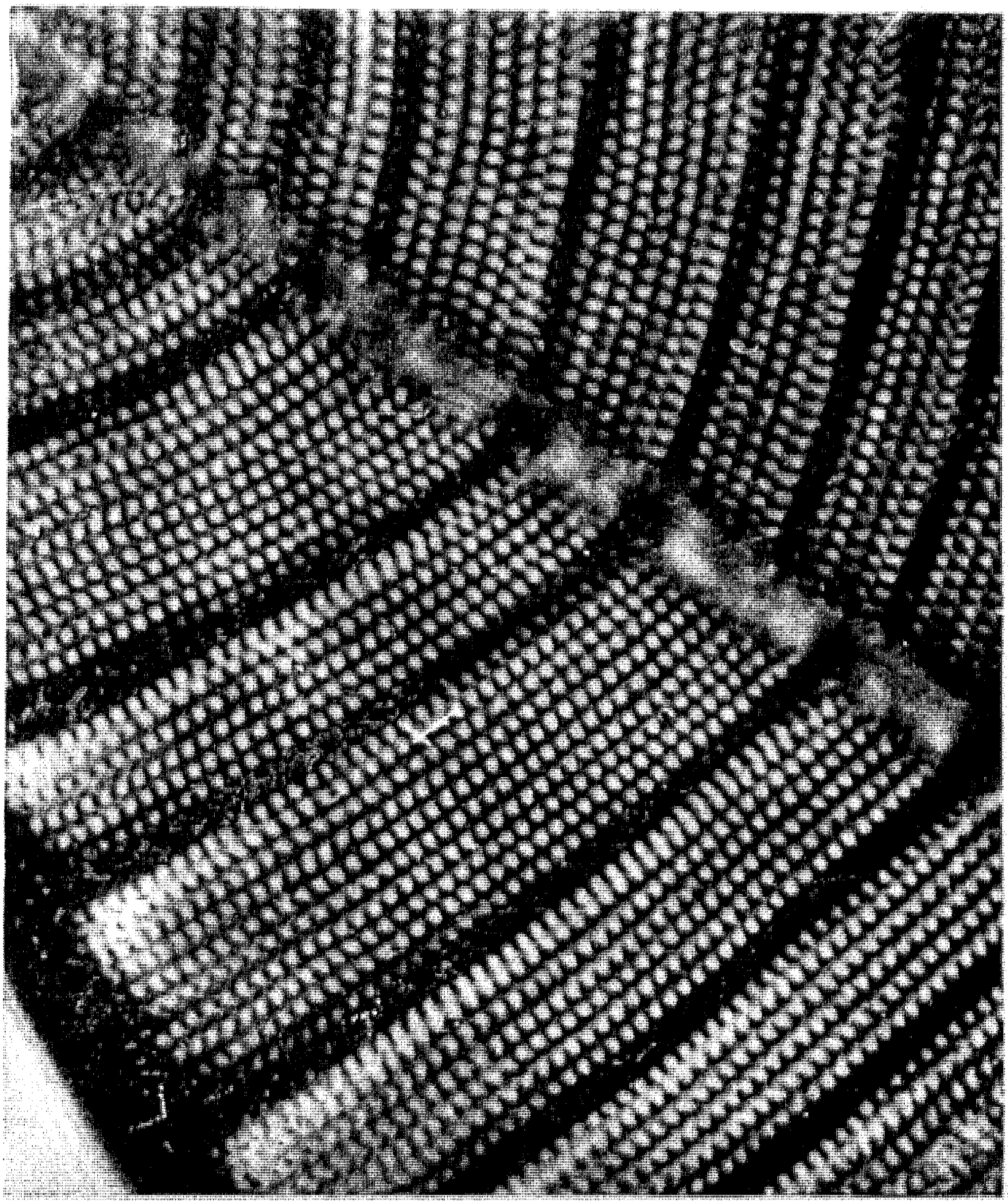


Fig. 13- Surirella gemma

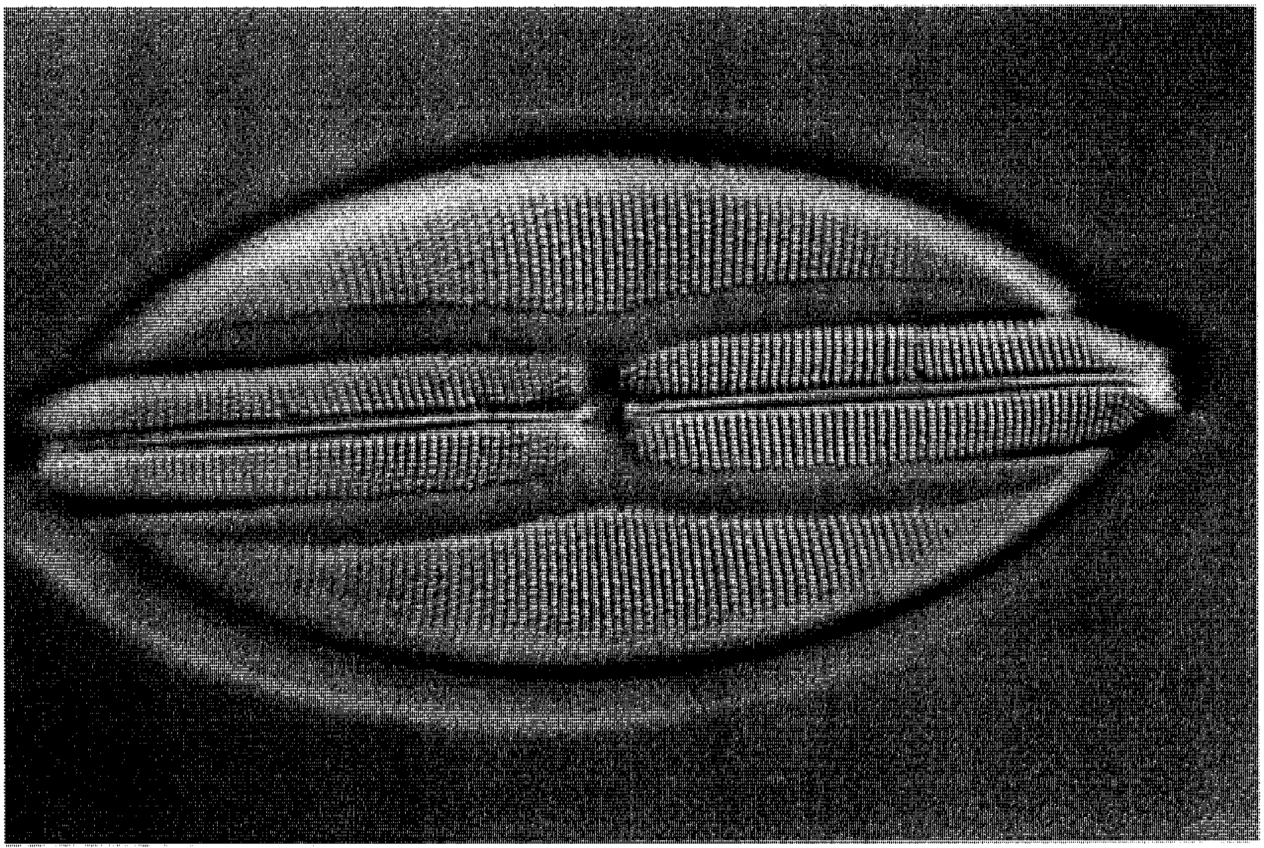


Fig. 14- Surirella gemma

Navicula Lyra- approximately 150 microns long, with 8 striae/10 microns.This boat shaped (navicula) diatom is good for checking powers at 200X and above. It is best for testing the performance of the central and intermediate regions of the objective.The dots may appear as white dots, or black dots.Black dots generally indicate better resolution, and can vary with focus.

The dots should be sharp and neatly defined, while the white sections stand out in sharp contrast.The whole diatom should be well defined, from end to end.A green filter may have to be used to get the best resolution possible. It is often used to check chromatic correction of objective lenses.Ideally, there should be no coloration if using monochromatic light,and the diatom should appear nearly pure white in contrast with the dark features.

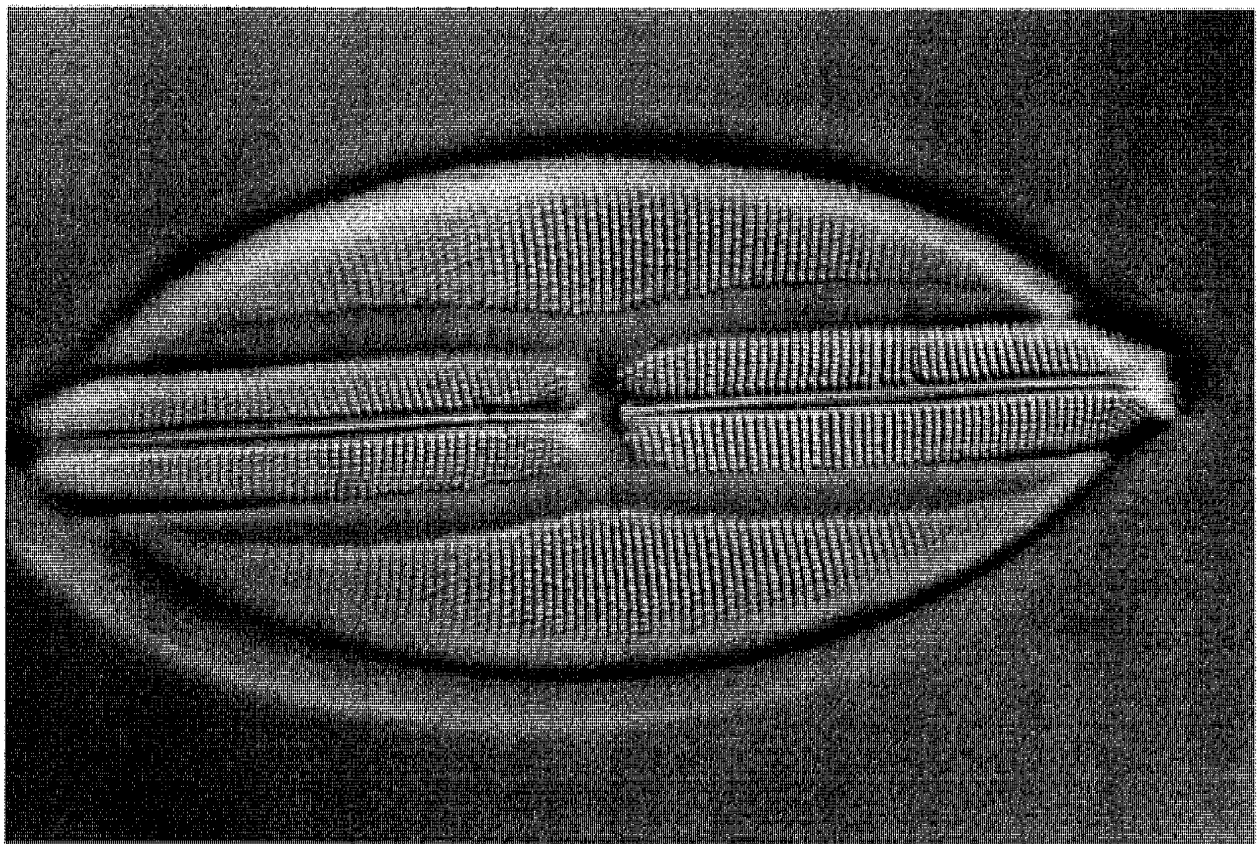


Fig. 15- Navicula lyra-1,250X DIC

Gyrosigma balticum- approximately 280 microns long, 15 striae/ 10 microns.This is the longest diatom on this slide, with gentle sweeping curve of the distal ends.This is a good one for testing the medium powers, 200X-400X. The central node should be sharp, and the entire diatom should be well defined.The center raphe line should be clearly defined, and flatness of field should apparent with the best lenses.At higher power, the crossing lines of dots should be clearly seen.

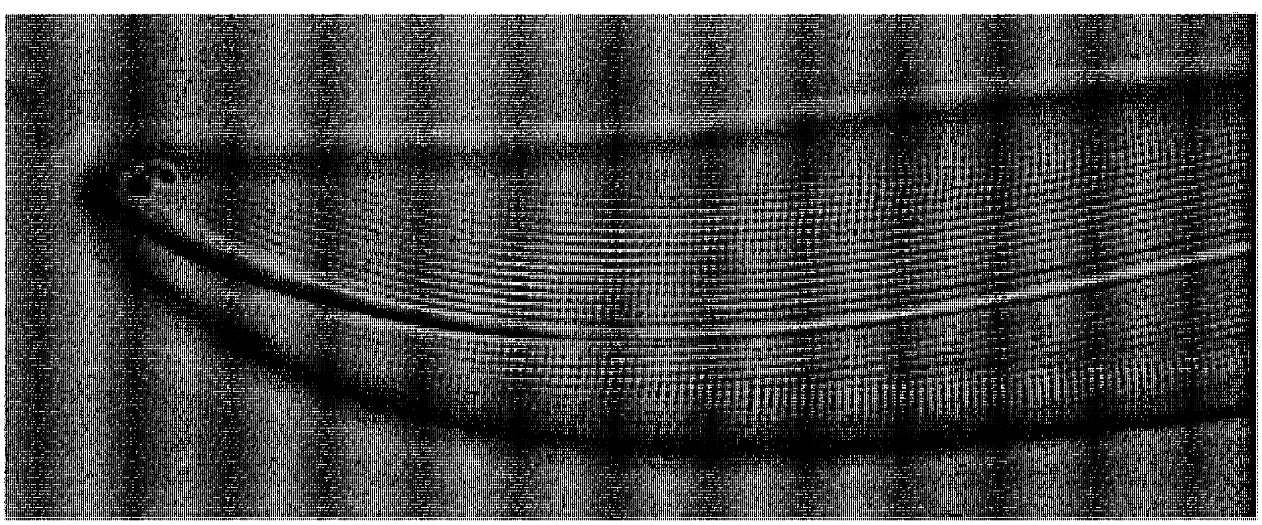


Fig. 16- Gyrosigma balticum, 400X DIC

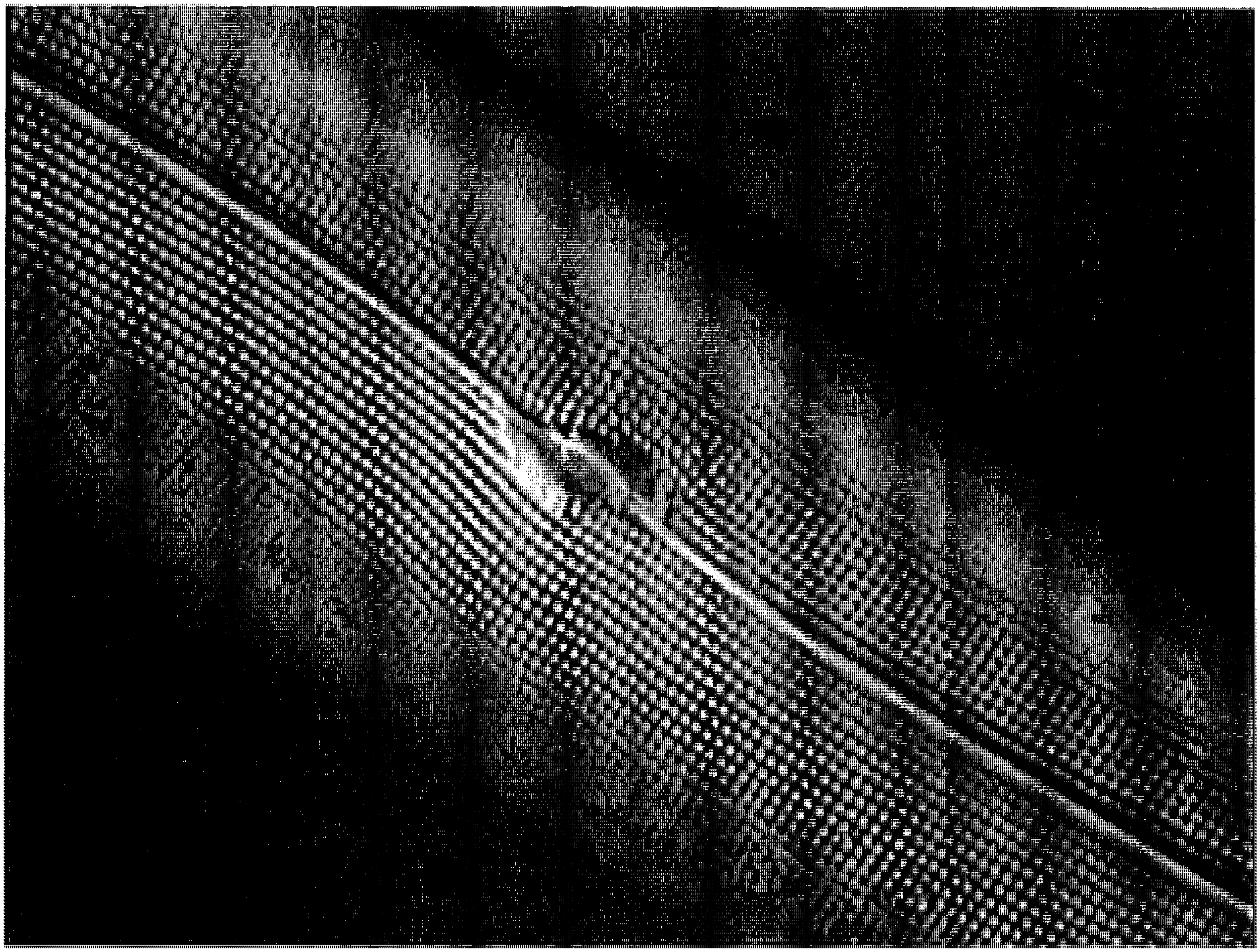


Fig. 17- Gyrosigma balticum, 1250X magnification, DIC

Suggestions for using the diatom test plate slide

If Acromatic type optics are used, there may be some color fringing along the diatom edges. With Apochromats, this shouldn't be of concern. If color fringing is a problem, simply using a green filter in the light source will help you resolve the details of the diatom that perhaps are obscured by the bothersome color fringing. The use of a blue filter may also aid in improving the contrast, as well as the use of monochromatic light source for illumination.

For the higher power magnification tests, the use of a good quality oil immersion objective, and condenser is essential, with a N.A. of 1.4. Both the condenser and the objective need to be oiled to the slide for maximum resolution. Without oiling, the condenser aperture cannot reach any higher value than a N.A. of 1.0.

A bright illumination source, such as 100 watt quartz-halogen bulb, or a 150-300 watt fiber optic system is preferred. The low power 15 and 30 watt bulbs generally don't often provide enough light output for the higher power magnifications, especially for photomicrography. Xenon and mercury vapor lights can also be used, with monochromatic filtration, but can be troublesome, and expensive, to use.

The illumination system and condenser of the microscope must be setup correctly for Kohler Illumination. The best results are obtained when the full diameter of the rear lens of the objective is illuminated. This can be checked with a focussing phase contrast telescope, or visually, by removing the eyepiece.

Diatoms can not only be used to test the resolving power of oculars and objectives, but the fitness of the whole optical system of the microscope, including the various condensers and corrections lenses that are in the optical path, and the light source. Some microscopes can have upwards of 20 separate optical surfaces- mirrors, prisms, and intermediate lenses, all of which will collectively subtract from the overall resolution of the microscope.

Some microscopists go as far as to use a diatom test-plate to check their microscope setup before each use for critical illumination and alignment. By doing this, one insures that what one is looking at under the microscope is really there, and not an aberration of false and blurred images.

The imaging system used for the diatom photomicrographs

Many of the images that are in this article were taken with a Nomarski-DIC setup on an Olympus BHB microscope. DIC and Phase Contrast are among the best methods with an optical microscope to resolve the fine details on a diatom. I also used an Elmo hi-resolution industrial CCD color video camera, and an Olympus PM-10AD automatic 35 mm camera system.

Except for the removal of some debris, all images are as actually seen through the microscope.

The Klaus Kemp 8 Form diatom test plate, and his other magnificent hand arranged microscope slides, can be obtained from Klaus Kemp at the following address:

K.D. & S Kemp, Microlife Services, Blautannen, Wickham Way, East Brent, Somerset TA9 4JB.
Fax/ Phone 01278 760 411

e-mail <klaus@microlife44.freeserve.co.uk> or <klaus@cartons.demon.co.uk> or on Steve Gill's website at <http://www.microcat.demon.co.uk.kdk>

Also, as a convenience to those of us in the United States and to Klaus, our member in Santa Cruz, Dr. John Field generally has a stock of Klaus's slides on hand which he will mail to members which saves the postage and dollar conversion costs as well as the time to send them from England. Contact:

John Field
117 Arroyo Place
Santa Cruz, CA 95060-3139
Tel. 408-246-1383

References:

Spitta, Edmund J. *Microscopy, The Construction, Theory, and Use of the Microscope*. 1st Edition, 1907. John Murray, London.

California Academy of Sciences- *Diatom slide collection database.*

Carpenter, William B. and Dallinger, W.H. *The Microscope and it's Revelations* , 7th edition, 1891. J. & A. Churchill, London.

Nachet's Optical Illusion to Explain Diatom Hexagonal Appearance

When viewed in a microscope under certain conditions, the minute markings of some of the diatoms appear as hexagons, while under other conditions, and with a first-class objective, they appear spherical.
M. Nachet, the French microscopist has published a curious optical illusion which, he thinks, accounts for the markings on the diatoms appearing as hexagons.

The circular spots of Fig. 1 are arranged as nearly as possible like the markings on the diatom called Pleurosigma angulatum. If the figure is viewed through the eyelashes with the eyes partly closed, the circles will appear as hexagons.

In Fig. 2 is shown a negative reproduction of Fig. 1 in which the spots are white on a black ground. When these figures are compared, the white spots, on account of irradiation, appear much larger than the black ones, although they are of exactly the same size.

The foregoing text and Figs. 1 and 2 are from *Experimental Science, Elementary Practical and Experimental Physics.* George M. Hopkins, twenty fifth edition Munn & Co. 1906.

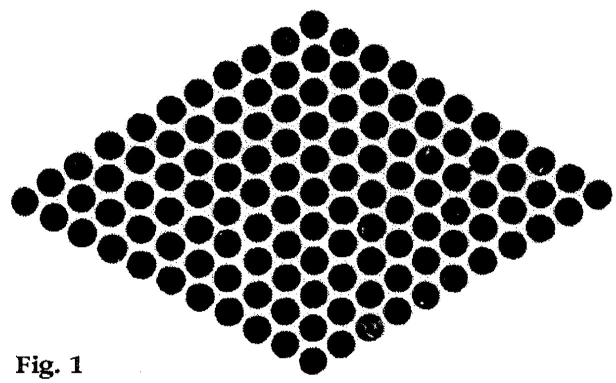


Fig. 1

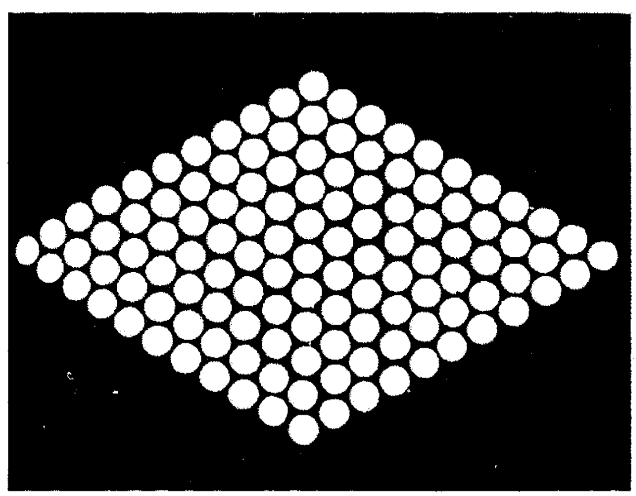


Fig. 2

Postal Microscopical Society (PMS) Slide Notes by Richard Jefts

One of the delights of being a member of the Postal Microscopical Society (PMS) is to be able to read the notes that members make on the slide sets. Each box of slides is accompanied by a little notebook as it passes around the circuit in England and abroad. Often, the notes add a great deal of information to the box as members record their observations. One of our MSSC members, Richard Jefts, regularly takes the time to make thorough commentary on the slide boxes to the great benefit of all who follow him on the slide circuit.

The following pages are a copy of one of these commentaries in which Richard has made his own notes, then copied pertinent text from a book and then added a stressed plastic distortion plate to the notebook for the use of following members.

In order to keep the flavor of the notebook, and make the text large enough to read easily, the pages are set sideways on the rest of the article. I hope this will not be too much of an inconvenience for the reader.

Thank you Richard and all the other members who with their notes add even more value to the superb boxes of slides that expert members prepare and unselfishly donate to be circulated around the world. Ed.

- First of all, it would appear that the yellow slide box has been numbered in error (95/29), or has been used to box these slides in error. The brown cardboard mailing box and the Notebook numbers are, however, in accord, both being labeled 96/3.
- As oft times in the past, I have lightly numbered the pages of the members contributions to facilitate back referencing (new word?)
- Of interest, is the slightly thicker glass slides in this box ... sort of befitting an older batch of slide preparations - see slide #10, the only one dated, April 18, 1929.
- It might be well to consider viewing a slide first without and then with polarized lighting, to better appreciate the sometimes dramatic effect of the latter. A comfortable magnification is about 50x, and widefield eyepieces will add to the pleasure of viewing.
- It is a pity that so many members (pp. 3, 14, 17) do not have even a simplified form of polarized lighting, especially when such a system can be had for the inexpensive price of two small polarizing (film) discs. A whole world of much beauty and interest is totally missed for lack of so small and simple an investment.
- Mr. Barnett asks (p. 24) why the comment was made as to the slides haveing been 'intelligently assembled.' I suspect that what might have been meant was the excellent diversity of the material, taking in examples of all three of the basic rock types - igneous, sedimentary and metamorphic.
- The making of thin rock and mineral sections is a classic example of a procedure that is simple and straight forward, both in theory and in actual execution, but demands considerable patience, is time consuming and can be somewhat tedious. Of the many methods suggested in a great many available texts, appended is one from Corringtons Working With The Microscope.
- Mr. Eric Impey (sp.?), on pp.9 & 10, asks, regarding the 'dancing inclusions.' I think what he saw was minute solid particles in liquid suspension, the dancing movement being due to their bombardment by water molecules. The phenomenon is called Brownian movement ... See any Physics text or larger, more comprehensive dictionary. These liquid filled bubbles and inclusions, by the way, are one means of determining natural gemstones from the man-made (ruby, sapphire, emerald, etc.) variety.

24

25

- Members bewailing the inability to actually identify individual crystal grains in polarized thin rock sections should not be unduly disappointed, as such identifications and comparable work demands somewhat complicated methods, procedures, optical equipment and other amenities found only on specialized petrographic microscopes. Also appended here are a couple of (older) illustrations showing some of the many bells and whistles found on such instruments and some accompanying text that gives some indication of just what is needed for such identifications - taken, arbitrarily, from Allens The Microscope. The intent here, with this box, I'm sure, is to simply acquaint members with what professionally made mineral-sectioned slides look like, and to allow simple polarized viewing, illustrating the profound and often quite spectacular color effects possible.

In this regard, note in the appended text the mention of " ... Insertion of compensators of various types ...". Many other texts, such as Burrells Microscope Technique, pp. 109-110, will define these compensators as quartz wedges, quarter-wave plates of mica, talc or selenite, etc.

A poor mans approach to adding a 'compensator' of sorts, to enhance or add spectacular color effects to an already polarized field of view, is to introduce what I call a piece of 'stressed plastic' in the optical train, after the polarizer and before the analyzer. A two inch or so disc (or whatever shape) is introduced (most simply) by laying it on top of the slide and rotating it, moving it about, up, down, left and right. Many polarized fields of view, perhaps still somewhat drab, can often be markedly enhanced, colorwise, with such a 'compensator'. To a polarized field, already brightly colored, the plate can add and make astonishing color changes of spectacular brilliance, shades and tones to the mineral grains themselves and to the often present open and clear background areas. Try experimenting with various types of flat plastic from sheets, containers, etc. The best I have found are discs cut from the tops or bottoms of Falcon brand, plastic, disposable Petri dishes. To perhaps get some member started, I lastly append a glued-in pocket with an approximate two and a quarter inch disc of such a piece of 'stressed' plastic plate. Remember that the plate is not used alone, but in conjunction with an already polarized field.

26

Please be sure to return the disc to the envelope before passing the box and Notebook on to the next member. For a stamped, self-addressed envelope, I will be happy to send any member a comparable disc, should nothing suitable be available in your area.

Use the plate with good effect on less than spectacular polarized fields, on slides 4, 6, 10 and 11. For truly spectacular, constantly changing, brilliant color effects, (with already colored polarized fields), use the plate on slides 5, 7, 9 and 12.

Many thanks to A.D.M. for making such a well prepared and totally different contribution for us all.

Richard M. Jefts / Microscopical Society of Southern California / July, 1999.
P.O. Box 2437
Fallbrook, CA 92088 U.S.A. Circuit G.

Chemical and Petrographic Microscopes

Despite the elaborateness of research models, there are some kinds of work for which neither they nor the simplified stands are suited. Chief of these are chemical and petrographic examinations. It is not merely that these require polarized light equipment, for that is usually provided in the form of accessories for occasional use with almost any type of stand, but in order to work expeditiously in chemical microscopy and petrography, means must be provided for quick changes from plain to polarized light, conoscopic vision with Bertrand lens, and various other devices never required for general microscopical purposes.

In the petrographic stands (used also for chemical work) we find another series of models, extending from the simplest possible form up to very elaborate types, equal to the research models in the regular series. Present in all, however, are certain essentials which differentiate them from the corresponding stands of the ordinary type. These are: They must be fitted with a polarizer beneath the substage condenser and an analyzer in the tube above the objective, the latter capable of being quickly withdrawn or pushed into position as required; the stage must be circular, rotating and graduated for determining the degrees of rotation; a slot must be provided between the objective and analyzer for the insertion of compensators of various types, and another between the analyzer and eyepiece for the insertion of a Bertrand lens for observing interference figures; the top lens of the condenser must be capable of being quickly inserted in or withdrawn from the optic axis; the objectives must be provided with some means for centering them relative to each other and must be specially selected for freedom from polarization; and the eyepieces must be provided with cross-hairs and capable of being inserted into the tube in a fixed position with relation to the vibration directions of the polarizing prisms.

All of these are essentials, but the ways in which they have been worked out for the various models differ materially. As with microscopes in the regular series, the more elaborate petrographic stands are larger, heavier, and capable of accommodating larger objects. Further, they are provided with more expensive polarizing prisms and more highly corrected condensing systems. Many additional adjustments are provided, such as rotation of the analyzer, with graduated circle; means for sliding the polarizer, as well as the analyzer, out of the optic axis; a centering Bertrand lens with iris diaphragm, mounted on a slide for quick insertion in the tube, and a separate rack and pinion for focusing the Bertrand lens for various oculars, and raising and lowering of the stage by rack and pinion. One of these elaborate petrographic models is shown in Figure 37.

In addition to this conventional form of stand, most manufacturers also provide models with synchronic rotation of the polarizer and analyzer. In the former, the specimen under examination is rotated with reference to the vibration directions of the prisms through rotation of the stage; in the latter, the specimen can remain stationary and the same result be accomplished by simultaneous rotation of the polarizer and analyzer, which are coupled together for this purpose by bars working around the stage. Such a stand is shown in Figure 38.

30

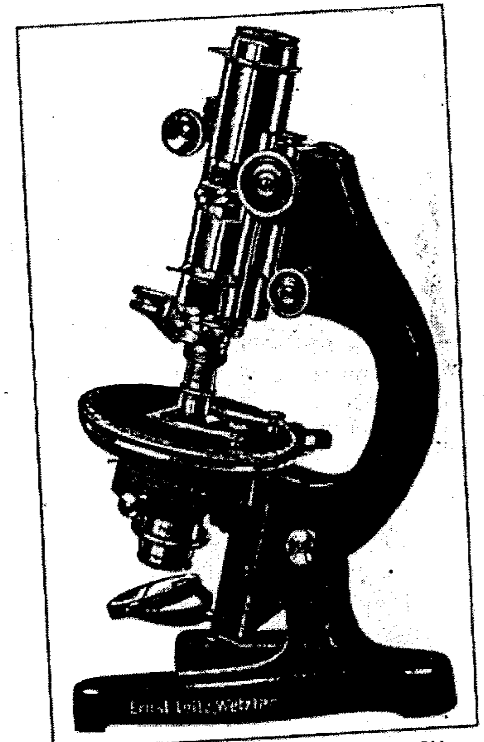


FIG. 37. Leitz Petrographic Microscope — CM

31

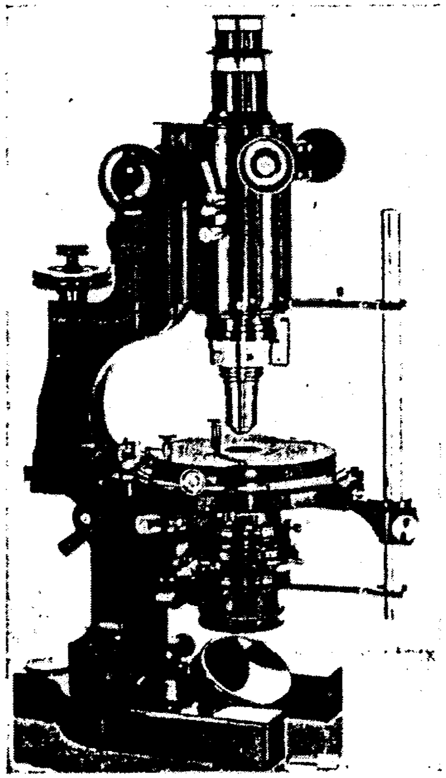


FIG. 38. Bausch and Lomb Petrographic Microscope (Synchronic Rotation of Prisms)

32

Hard Rocks and Minerals.—Preparation of sections of these hard objects is somewhat similar in method to that used for bone, though the preliminary cutting is more difficult and laborious without special equipment. An old sewing machine may be rigged up by substituting a thin plate of soft iron for the flywheel, plus some sort of clamp to hold the rock specimen while cutting. Any form of lathe can be adapted. It is not difficult to hook up a shaft to a small motor and thus get revolution for a horizontal iron plate, mounted within a box or trough to take care of the mess created. Slices are cut wet, the abrasive being diamond dust by preference, though carborundum will serve. If a water faucet is available to deliver a slow trickle during the work, so much the better.

After cutting as thin a slice of rock as possible in this way, the two surfaces are ground, preferably by machine, otherwise by hand. Steel plates make the most durable grinding surfaces, though plate glass is entirely satisfactory. For very hard and fine-grained rocks, a coarse carborundum or emery powder may be employed first, followed by medium and then fine. With other rocks, omit the coarse and start with the medium. Rub with a rotary motion.

Another method of obtaining specimens for slide preparations is to chip off thin flakes with a cold chisel and hammer, then grind as just described until fairly thin. In either case, most technicians prefer to mount the section or flake before the final grinding. To do so, place a blank slide and the rock slice on a hot plate where the temperature can be somewhat controlled. Start at 50° C. and slowly increase the heat, either by moving the bunsen burner or lamp under the hot plate, or by placing a screw clamp on the rubber tubing of the burner, gradually admitting a greater volume of gas. At 60° C. put some balsam on the slide and some 10 to 15 min. later, with a temperature in the neighborhood

33

of 115° C., test the balsam by drawing out a thin thread of it with a fine forceps. The balsam is not ready until such a thread is brittle, which will occur between 115° and 120° C., whereupon the rock section is mounted by pressing it down firmly into the balsam; then put the slide away to cool and harden.

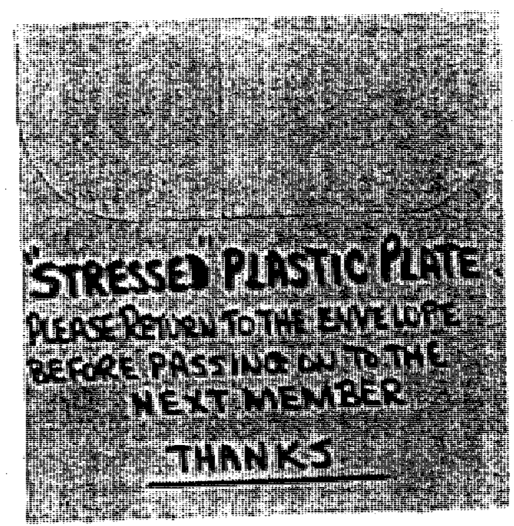
Grinding now continues, with the section mounted in this temporary manner, and must continue until the slice is exceedingly thin. It should be tested from time to time under the microscope; if intended for use with a polarizing microscope, it should be tested with crossed nicols until satisfactory. Increasingly fine abrasives are used as the work progresses. When completed, the slide is washed well and then dried. Heat until the balsam melts, then with an orangewood stick or a matchstick that has been sharpened to a chisel edge, gently and carefully push the rock section off of the temporary slide and into some fresh balsam on a clean slide for final mounting, governed by the same temperature regulations as given for the first mounting. The cover glass should be heated also before applying it to the balsamed section, and should be pressed down evenly and carefully.

Between each of the grinding operations, it is important to wash the specimen and scrub the hands well with soap and water. This will prevent carrying over coarse abrasive particles to mixtures of finer ones, and getting any of them into the final mounting. An extra step, which will assist with this point, is to push the finished section off the temporary slide mount into xylene and let it soak until freed of all balsam, to avoid carrying over any of the old balsam; then transfer it to fresh xylene for a short time and proceed with the final mounting.

Soft Rocks, Coals, Fossils.—The foregoing methods apply to hard rocks. When soft, friable, or porous rocks, coals and other fossils, or porous fossiliferous rocks are dealt with, the material needs reinforcing in order not to

34

go to pieces during the grinding, especially in the later stages. After the sawing, sections are soaked in xylene to impregnate them and fill up all spaces, then transferred to a mixture of xylene and balsam which is gradually heated to drive off the xylene. Some workers add a little shellac to the mixture; still others find that imbedding in plaster of Paris before impregnation works well. Chamberlain (*Methods in Plant Histology*) gives two interesting procedures known as *peels* for the taking off of a thin layer of organic material from petrified fossils onto a thin sheet of celloidin or gelatin, which is then mounted on a slide.



35

Minutes for the MSSC Meeting of Wednesday October 13, 1999

David L. Hirsch

Logistics being what they are, we were bumped from our spacious meeting hall this evening, and sent to hold forth in one of the classrooms.The ambiance was cozy, but it soon became apparent, especially among us senior citizen types, how the school desks had shrunk over the years.

The meeting was called to order at 1930 hours. Program Chairman LARRY ALBRIGHT introduced our speaker of the evening, BRIAN FORD. Mr. Ford spoke for 35 minutes on " Brownian Movement", and showed a dramatic video illustrating Brownian motion inside pollen as shown with the very type of instrument that had been used by Brown. The presentation was historical in context and related how Brown was a careful enough scientist that he refrained from ascribing the movement to life until he had tested all other possibilities, eventually finding that it was an effect of nonliving small particles as well. I believe that enough interest was generated in the group to elicit further investigation, for example, in the construction of associated apparatus.

As usual, the sales table literally groaned under the weight of of the scientific 'treasures' that were offered. Thanks to ALAN deHAAS, a veritable bonanza of new chemical glassware and other intriguing items were made available at give-away prices. Proceeds of the sale were generously donated to the MSSC Treasury by Alan. I wish there was some way for Corresponding Members to participate in such sales. Any suggestions?

RON MORRIS offered two sophisticated microscopical items for sale; a Leitz Ortholux research microscope and an Aristophot 4x5 large format camera system. If anyone is interested, please contact Ron by Email at: tronm@earthlink.net, or by phone at:(714) 557-6567.

Joe Wise, our Crossroads School contact, announced a Millenium Day Program to be held at the school toward the end of this year. Our Society was invited to participate in the activities. Joe suggested a microscopically oriented exhibit featuring the photomicrographs produced by our MSSC members, and shown at a recent exhibit in Palos Verdes.

The Show and Tell segment of our regular meetings always brings forth an intriguing assortment of instrumentation and accessories. In the body of our main speakers discourse on the Brownian Movement, Mr. Ford mentioned that Robert Brown used a 'dissecting microscope' in the pursuit of his experiments on the movement of particles due to thermal agitation of molecular bodies.The subject microscope, by Blaispal, featured coarse rack and pinion columnar focus, and fine focus by means of a screw mechanism integral with the column.

Accordingly, members possessing related microscopes displayed their goodies. In evidence, were Withering's, botanical and aquatic microscopes, and others contemporary to that previously mentioned.These small, pocket sized stands satisfied the need for portable instruments of moderate power, and relieved compleat 18th and 19th century microscopists of the necessity of shlepping around cumbersome Culpepers or Powell & Lealands.

For the 'microscopist who has everything', have you seen the "Credit Card Companion", by Tool Logic? It contains an eight power magnifying lens, a pair of forceps and a probe, a magnetic compass, a blade capable of dissection or defense, a screwdriver, bottle opener, etc.A newer model also contains scissors. Check it out at Home Depot or any cutlery shop. Several MSSC members are building noteworthy collections of historically significant microscopes, accessories and relevant literature. This is in keeping with an growing interest in microscopes and other scientific instruments related to historical technology. It follows, that the laws of supply and demand kick in, as evidenced by the escalating prices set for related objects of virtue. Look forward to interesting discussions relating to the hows, whys and wherefores of collection, restoration, display, valuation, etc. of scientific instruments.

Would you believe that almost a year has passed since out last Christmas party? This years' party, with the Millenium just around the corner, is in the planning stage.T'would be nice if MSSC members world wide could attend. How about it, you lads and lassies way up North, Down Under, or from Across the Pond?

RESTORING OBJECTIVES
by Sydney Harvey

Some time ago I obtained a Zeiss x6.3 variable phase objectives for use on my Laboval 11. At home I first looked through it with a watchmaker's eye loupe, and could see that it was quite cloudy. When fitted to the turret the view through the oculars was like looking through an old time London fog.

All the books and fellow microscopists say 'Don't try to dismantle an objective, you will ruin it'. With that in mind I wrote to Zeiss to see if they would repair it. Their quote of just over £100 was a bit too rich for me. So, what had I got? A useless objective which could not be made much worse. Why not ignore all that good advice and 'have a go? I had nothing to lose and the experience would be beneficial.

In order to unscrew the internal threaded collar, which has two slots cut into its upper edge, I fashioned a tool. From a piece of 15mm copper tube, which I cut open and flattened out, It was a simple matter to file away the edges of the copper until it fitted inside the objective tube, and down into the two slots. I tried to count the turns out so that I could use the same number of turns in. Somehow, because of interruption, I lost the count so I just took care with reassembly.

When removing the threaded collar BE CAREFUL Keep the objective upright. Make sure you know the way that the components MUST go back.

The first element is the phase ring, followed by a very thin washer. Next is the first magnifying element which sits on the end of a tubular distance piece. At the other end of this distance piece is the final element. The part of the lens which we clean. When I assembled the elements and distance piece outside of the body tube I noticed that the makers had scratched a mark down the edges of the top elements, down the long distance piece and across the final element edges. By examining this scratch one can see if the assembly is correct. I cleaned both sides of each element with an alcohol damped cotton bud and set them aside under a Petri dish to keep them clean. With a watchmaker's puffer I removed all dust from the inside of the lens body tube.

Now for the tricky bit. The re-assembly. Gently push the components down the body tube. It is very easy to get them off square, as I did, and have them jam in the tube. I carefully pushed them out and had another try. This time they slid in easily. I think the makers use a lubricant. I as too scared as I did not want to mess up my cautious cleaning with oil smears. I then fixed the locking collar back in place, assembled the outer shell and screwed the objective into the turret. BINGO!!! What a relief. A slide of the 'tongue' of a blowfly showed all was sharp and crystal clear.

As each element is mounted in a metal cage, these relatively modem lenses are much easier to work with than their balsam mounted predecessors. Careful cleaning, avoiding all dust and very careful assembly is absolutely essential, and not too difficult to achieve. Please note that it was a simple x6.3 objective not a multi element x100 that I worked on. I am more than satisfied with the result of my efforts. My gamble paid off. As I said at the beginning I had nothing to lose and the gain, a fine variable phase objective which now gives excellent results. So that I can get some more practice, I am keeping my eyes skinned for defective objectives.

Last but not least; the cause of the 'fog' was a greyish deposit which had formed on the adjacent sides of the phase ring component and the next magnifying element. It took a good deal of careful cleaning to remove it. I have very little idea of what the deposit was or how it was formed but I suspect that the lens was not kept in its box, in an open area which was subject to damp or chemical contamination. Has anyone a better idea as to what the deposit was, or its cause? Since I prepared this article I have cleaned up a Baker x10 and a Baker x40, successfully. The down side is that I have messed up a x100 Hi Dry. Well, you can't win 'em all, can you?

Editors Note, The advice to leave well alone is sound, But, if the lens is useless then the treatment described seems the only course of action. I have been singularly unsuccessful in my attempts so far! My only success applies to a x50 Watson, an unusual lens which I wanted to save. Careful examination with a x10 glass revealed a deposit on the outer surface of the front element, which responded to careful treatment with Xylene and the ever useful Cotton bud. A classic simple fault often written about but never seen till now.. Certainly a case of 'look before you leap'.

The foregoing article is reprinted from the July 1999 issue of the *Balsam Post*, the Newsletter of the Postal Microscopical Society with their kind permission. The note above is from PMS Editor, Fred Loxton.

WORKSHOP of the Microscopical Society of Southern California

by: George G. Vitt, Jr.

Date: Saturday, 2 October 1999
Location: Ernie Meadows' residence - 19 persons attended

The topic of this workshop was English Student Microscopes.

1. **Larry Albright** announced that, on 13 October, Brian Ford will give us a talk on Brownian Motion. Larry reminded us that we will need contributions to defray the cost of this presentation.

2. **Jim Solliday** reported that member Herb Layfield had informed him that he has for sale a Flatters & Garnett microtome. This is the very same model that had been donated to MSSC by Colin Lamb and auctioned at a previous workshop.

3. **Larry McDavid** described how one can obtain the exact magnetic deviation for any geographical location via the Internet at the address: <http://www.ngdc.noaa.gov/cgi-bin/seg/gmag/fldsnth2.pl>. He then showed a model of the Apollo II spacecraft, fully equipped with acoustics! Larry then displayed a c.1903 cased brass Spinthariscope with focus adjustment, by W.Crookes, in perfect condition. It uses a zinc sulfide screen to display the scintillation activated by a radium-tipped needle which emits 0.6 milli-roentgens/hr. Alan de Haas reported that Russian manufactured optics of the 1970s and 1980s were made of high uranium content glass and that this was a waste problem for them at the time. (Note: the highly touted Voightlander Apo-Lanthar and the Kodak f/2.0 Aero Ektar lenses were also a 'bit on the hot side' due to the incorporation of lanthanum glass for optical correction. GV)

4. **George Vitt** described some recent PowerPC computer problems he has been experiencing due to improper operation of the SCSI-2 chain. This problem has temporarily made it impossible to access his flatbed and 35mm scanners.

5. **Ken Gregory** displayed a c.1877 R&J Beck dissecting microscope which he had obtained on ebay and which he had restored beautifully. The microscope lacks the 1.5" mirror. Does anyone have a spare mirror?

6. **Jim Solliday** displayed a Fields 'Society of Arts' microscope, also called the "Students' Microscope". This was an affordable instrument with 1/4" and 1" f.l. divisible objectives. Jim then displayed a microscope by Collins, who made the best of the Students' Microscopes in the 1860s, with very wide body tube, achromatic doublet condenser (N.A. around 0.5), 1/4" objective and wide FOV eyepieces. All parts of the microscope are on an optical bench arrangement, moving on a common way. It has a short-lever fine focus adjustment with the screw supported at both ends. It uses Smith & Beck objectives and comes with a live box. Jim then showed a students' microscope by Charles Baker, who made a microscope to compete with the 1880-90 German Hartnach units being imported in large quantities from Europe.

7. **Stuart Warter** showed Pillischer's version of the Students' Microscope. It has a nested rectangular cross section column (as in most Pillischers) and breaks down completely into a very small case. Stuart then displayed an R&J Beck c.1913 binocular microscope based on a 1903 patent by the American Frederick Ives which uses the 'swan cube' prism beam splitter. This superbly constructed microscope, in mint condition, was "the last gasp of an adaptation of the Wenham system", and was the first successful high-power binocular microscope. It must be seen to be appreciated!

8. **George Vitt** described the important turn of the century contributions of Frederick Ives of Philadelphia to the fields of optics and photography, and his many interesting US Patents. Ives made his own glass-plate panchromatic emulsions and made stereoscopic, sequential RGB exposures of three plates, behind appropriate color filters. Reversing these plates, they were attached to one another by means of flexible cloth runners at the edges, and spaced to fit over the apertures of his "Kromscop", which allowed viewing the subject in full additive color and in stereo! The Kromscop was a large oak box incorporating filters, glass plate beam splitters and oculars, enabling the additive combination of the three primary colors. George had such an instrument years ago (Eastman colletion) and reports that the Ives photo of an iridescent Brazilian butterfly was as vivid as the day it was taken. Ives also did pioneering work in the encoding of color photo information, for subsequent color-additive projection on a screen, through the use of bichromated-gelatin diffraction gratings of selected spatial frequencies. Anyone interested in this fascinating field of optics is urged to explore the patents of Ives and Wood, who were contemporaries, and worked along similar paths.

9. **Ron Morris** discussed the use of the USB computer interface, in preference to the SCSI or parallel interfaces, to circumvent the problems of erratic SCSI operation. There ensued a general discussion on the manufacturing of CDs, with Alan de Haas describing the microscopes and highly refined long working distance objectives being used for inspecting them.

10. **Allen Bishop** noted that the Antique Trader newspaper reports that the collecting of antique scientific instruments is bringing the highest prices.

11. **Walter Coulson** displayed an elegant cased James Smith c.1844-7 microscope, a presentation instrument. It is equipped with a Wenham prism system, an X-Y stage, turret disk diaphragm apertures substage, adjustable stage plate and stage forceps, Nicol prisms, a rotating stage, and objectives by Edwin Swift. The substage dovetails enable the convenient interchange of substage accessories. Various accessories were housed in a separate excellent accessory case.

12. **John de Haas** gave an excellent demonstration of his technique for nickel plating which he is using for the restoration of microscope objectives. After a careful polishing and thorough degreasing of the piece, John suspended it part way by a nickel wire into a glass beaker containing the plating solution. Using a pure nickel anode plate and a regulated 5-volt DC power supply, he allowed the reaction to proceed for a minute or so, at which point a fine layer of nickel has been deposited on all the exposed metal portions of the objective. The piece was removed and, after a careful rinse, hand polished with a soft cloth impregnated with cerium oxide polishing powder. The results were spectacular, to say the least. John noted that the plating solution had no adverse effect on the exposed surface of the outer lens of the objective, nor on the balsam sealing medium. After the demonstration, Alan de Haas gave some pure nickel wire to those who could put it to use as a plating anode.

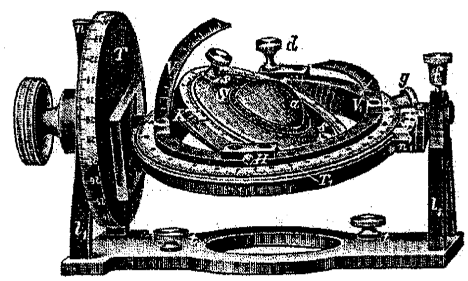
13. **Jack Levy** showed some excellent books: 1) *Morphology of Moth Eggs (Zur Morphologie Der Schmetterlingseier*, Academie-Verlag-Berlin, 1955.) 2) A magnificent book, *Le Monde du Papillon*, by M. Saud, Paris, J. Rothschild, Editeur, 1867.

14. **Alan de Haas** showed a small, cleverly designed and rare 'goody' made by B&L for microscopical inspection of surfaces by incident illumination. A small, black metal frame (about 1x1") supports another frame at 45degrees, into which one slides a cover glass which is held in place, at the rim, by two leaf springs. The piece is placed over the specimen and a beam of light is directed horizontally at the cover glass beam splitter which illuminates the specimen and allows the viewing of it from above. By moving the cover glass against the friction of the springs, one can position it so that the specimen is illuminated partially by vertical and partially by epi illumination. Alan then produced his 'piece de resistance' - a cased 4-axis Universal Stage, with two hemispheres, by Feuss, Berlin. c.1910 - in mint condition. This exquisite piece of mechanism was fully discussed and the mode of its use described. It was noted that, for inspecting the mineral specimen through the hemisphere, one needs to use "UM" or "UK" objectives, at around 10-20X, that have a long working distance and an iris diaphragm.

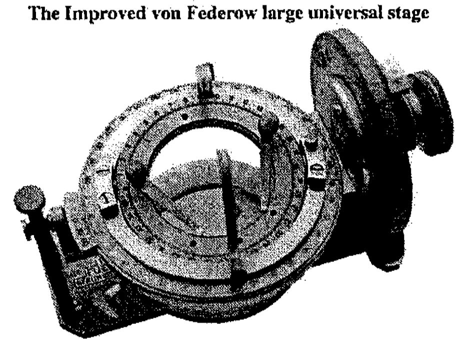
15. **Gary Legel** distributed Xerox copies illustrating a metallurgical photo setup by Leitz, which is available from a camera shop owner friend of his in Torrance. Gary had a Leitz Focomat 1A enlarger and a B&L illuminator for sale.

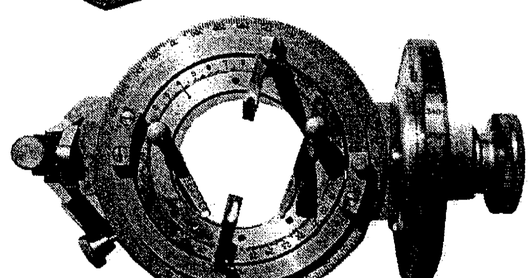
16. **Ron Morris** reported that a 35mm digital plug-in sensor is being developed for use with current 35mm film cameras.

The Workshop adjourned at noon and a number of members went to Coco's for lunch and more conversation. We wish to thank **Mr. & Mrs. Meadows** for their fine hospitality in hosting our Workshops at their home.



The Improved von Federow large universal stage





Universal stage similar to that shown by Alan deHaas.

IMPORTANT NOTICE

January Workshop Delayed to the Second Saturday

Since the first Saturday falls on January 1, in order to allow members to recover from New Year's festivities. the workshop will be delayed until the following Saturday,

January Workshop
Saturday, January 8, 9:00 AM
The Meadows Residence
707 Greentree Road
Pacific Palisades, CA 90292
310-459-4788

Wednesday Meeting
January 19, 2000: 7 PM
Speaker to be announced.