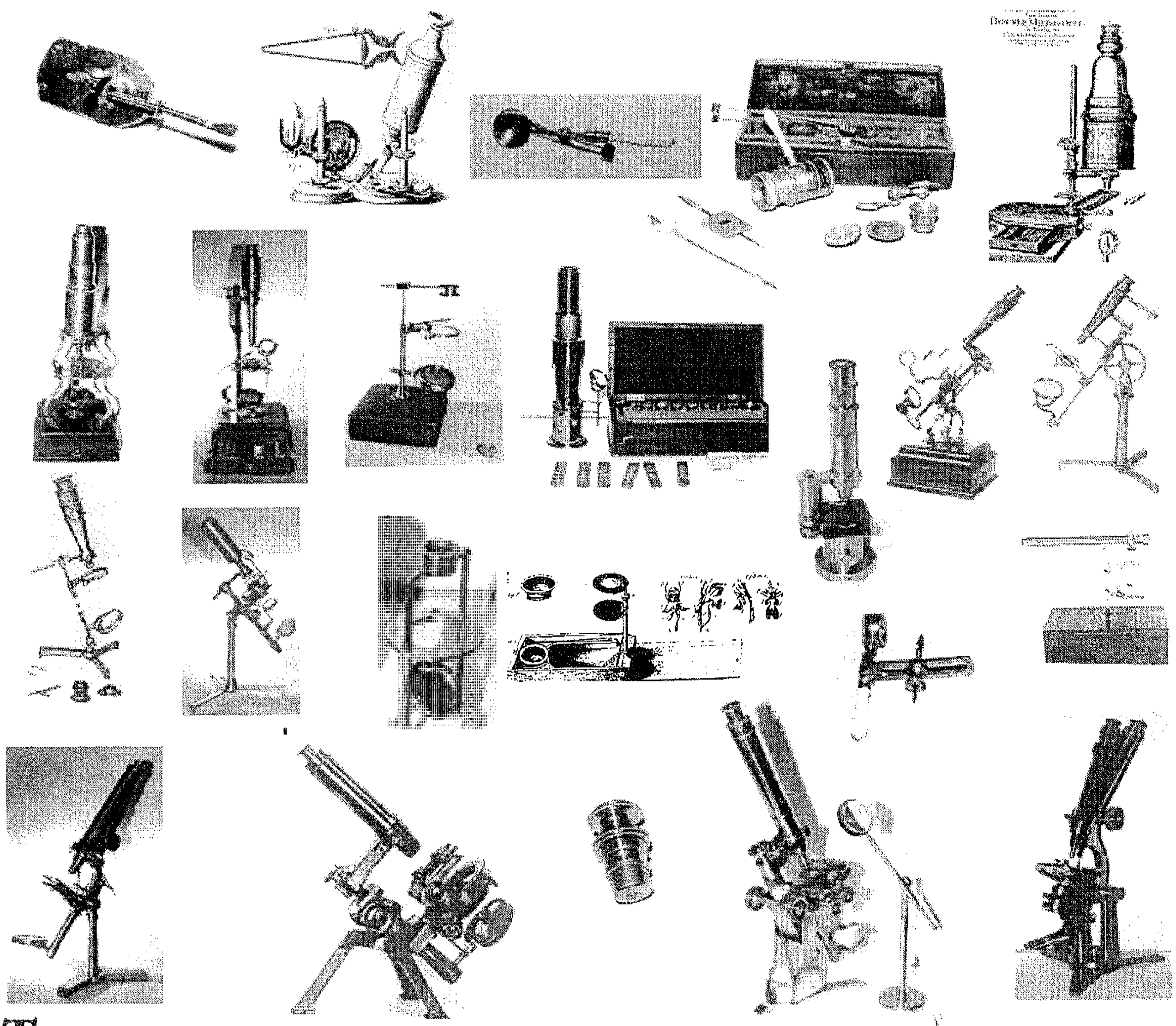
Journal of

THE MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA

Volume 2 Number 8 August 1997

A BRIEF HISTORY OF THE MICROSCOPE

Barry J. Sobel



The use of a lens to magnify small objects probably dates back to around 1500. Spectacles were the first practical use of these lenses on a wide scale and spectacle makers flourished long before microscope makers.[1] Traditionally, two Dutch spectacle makers, Hans and Zacharias Janssen have been credited with inventing both the telescope and the compound microscope about 1600,[2] although some doubt has been raised about this.[3] Furthermore, some even credit Galileo as being the first "scientific" user of the microscope in the early 1600's. The Italian Campani in the second half of the 17th century was the first to construct a microscope with a field lens,[4] based on a design by Monconys around 1660.[5] Although some minor works which may have been based on microscopic observations were published earlier, it was the Englishman Robert Hooke who published the first major book, *Micrographia*, in 1665, with illustrations of microscopic observations. Hooke used a compound microscope of his own design and concentrated on magnifying small but visible entities such as a fleas, lice, and parts of plants. He is famous for coining the term "cell." He also developed to some extent, the notions of coarse and fine focus. Antoni Van Leeuwenhoek may have been inspired by Hooke's work, and started producing "simple" (one lens) microscopes in the late 17th century. He published early works about what he found,[6] including for the first time, things which were invisible without the microscope, discovering bacteria, protozoa and other "animalcules." Even though Van Leeuwenhoek's microscopes were simple, they were far superior to the more impressive appearing compound microscopes of the time.

Since that time, microscopes have been made in ever-increasing numbers, particularly in Europe. American microscopes, on the other hand, were not produced until about 1840 when Charles Spencer, produced some which were horizontal in design, apparently copied from the designs of the Italian Amici and the Frenchman Chevallier.[7] The Spencer company continued to make microscopes well into the 20th century (most recently as American Optical), and Spencer lenses were said to be the best of their time.

Although the instrument was invented around 1600, major advances in it had to wait until the nineteenth century, when sturdier construction, and solutions to chromatic and spherical aberration were found. Leeuwenhoek's instruments were simply two flat plates between which polished glass-bead lenses were trapped (Fig 1). The instruments had a specimen holder which was moved toward or away from the lens by one screw, and up and down by another screw. Since the entire instrument was hand-held, it required practice and patience. Although it suffered from several optical problems that would have to wait until well into the nineteenth century to solve, it was nevertheless quite capable of revealing many features of the microscopic world. Simple microscopes were critical in many major discoveries and provided a useful magnification of up to 250 power.[8]

MSSC Journal
Volume 2 Number 8 August 1997

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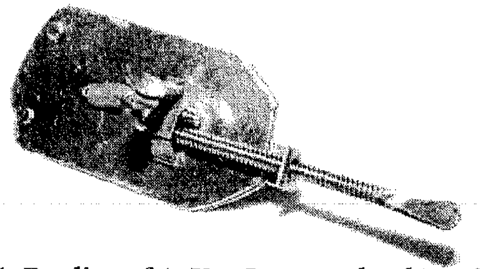


Fig. 1 Replica of A. Van Leeuwenhoek's microscope.

In 1665, Hooke published an engraving of his microscope[9] which was a wooden pillar-mounted affair with the stage and base both at the bottom (Fig. 2). He used a liquid filled glass as an amplifying lens for a flame light source, further concentrated by a bullseye condenser. The instrument was focused by rotating the coarsely threaded barrel. A single piece of wood attached the optical tube to the stand. This instrument had advantages over Leeuwenhoek's in that it: was not hand held, had a stage on which opaque objects were more easily seen, and had the convenience of not requiring the user to place their eye very close to the table. It's disadvantages included that the stand was not very steady and that the focus was crude and often shifted the direction of orientation of the lens.

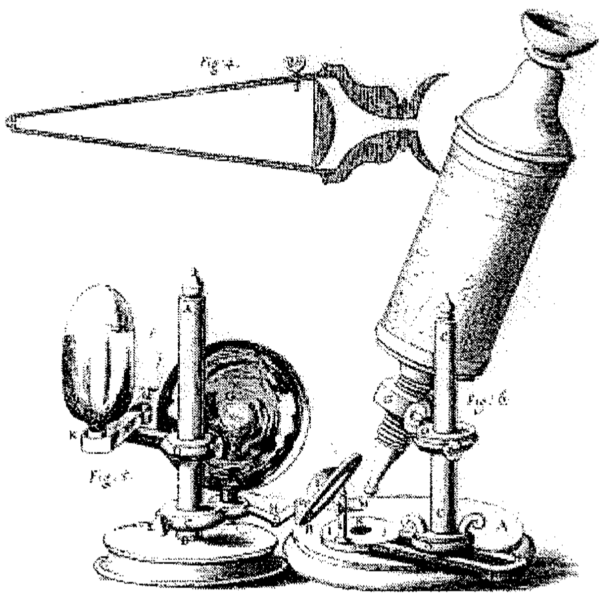


Fig. 2 Hooke's Microscope

Most importantly, though, it was optically inferior, since a nonachromatic compound microscope is inferior to any well-made simple microscope, and Leewenhoek's simple microscopes were optically far superior to the more complex-appearing compound Hooke type.[5]

For simple microscopes, high power lenses were difficult to make. About 1644, E. Torricelli discovered that by drawing a glass thread from a glass rod in a flame, and then remelting the thread, one could form a fairly good spherical bead which could serve as a lens.[10] In 1679 Hooke also described the use of glass beads as lenses.[11] In 1688, Nicolas Hartsoeker also described the use of bead lenses from melted glass threads, which he had apparently been making since about 1668.[12] He went on to develop the screw-barrel microscope. The master instrument maker Johann Van Musschenbroek developed a high power microscope from which the compass microscope was developed around 1700 (Fig 3).[13] They sometimes included a spring-loaded screw focus. Also around this time, the screw-barrel microscope invented by Hartsoeker was introduced into England by Wilson. Variations of the screw barrel microscope were made well into the nineteenth century(Fig 4).

Another Englishman, John Marshall, was the first to make major improvements in compound instruments. His first improvement was a brass support column which had a series of calibration lines, marking coarse focus for each objective; focus was achieved by sliding the tube support along the column. Fine focus remained screw type, like in Hooke's instrument. Another Marshall advance was the use of a separate stage which could swing over the edge of a table to be illuminated from below (Fig 5). Until that time, no one had thought of using an understage mirror. Hertel was

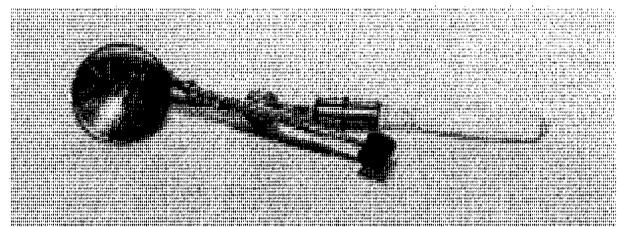


Fig. 3 Compass microscope, made from about 1700.

apparently the first to use an understage mirror, about 1716.[14] This arrangement was unsteady, however, and still another Englishman, Edmund Culpeper, came up with a two level tripod design and invented the understage concave mirror around 1725.[15] This type of microscope, initially with cardboard optical tube and brass supports, was later made entirely of brass (Fig 6).

One of the problems which plagued early high power simple microscopes was that it was extremely diffi-

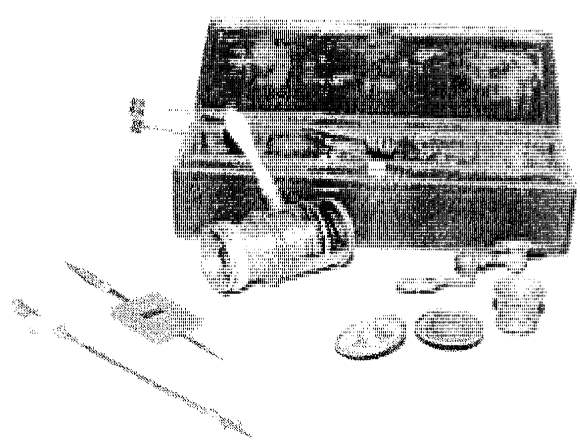


Fig. 4 Wilson Screw Barrel type microscope.

cult to illuminate opaque objects because of the short focal length. Leeuwenhoek solved this problem by using a small reflector around the lens aimed back at the object, but this technique was not widely adapted until a German, Lieberkuhn, used a polished mirror in this way about 1738. It became popular after he visited England and showed it to members of the Royal Society and also to the famous English instrument maker John Cuff who also adapted it to compound instruments, a practice that continued for over a century (see Figure 3 for a compass microscope with Lieberkuhn reflector).

Up to this point, microscopes were still mostly made

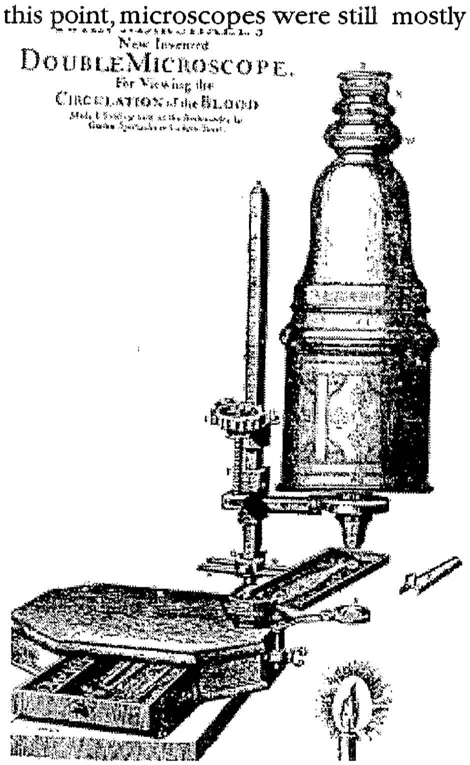


Fig. 5 Marshall Microscope.

of wood or cardboard and had crude focusing mechanisms which depended on screwing or unscrewing the optical tube. In addition, although Culpeper's design gave greater stability, the three legs on the stage limited access to it. The stage of the screw-barrel was even less accessible. This fact led Cuff, with guidance by Henry Baker,[16] to construct mostly-brass instruments which made use of coupled calibrated parallel square pillars for coarse focus and, for the first time on a widely-produced microscope,[17] a fine screw (which moved the limb holding the ocular tube) for fine focus. Thus the "Cuff type" of microscope (Fig 7) was born about 1744. Cuff also produced what has become known as the "Ellis Aquatic" simple microscope (Fig 8). This instrument was the kind used by the Swedish naturalist Linneas in his work to classify plants and animals into the now familiar genus-species format.[18] A similar instrument was also used by Robert Brown when he named the nucleus.[8] At about the same time (1738), the productive English maker Benjamin Mar-

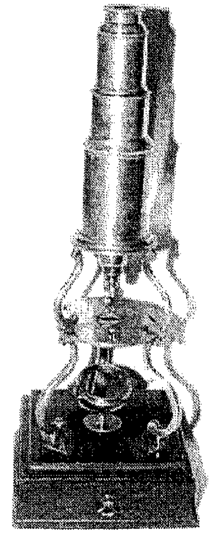


Fig. 6 Culpeper type of microscope circa 1790.

tin developed the "Drum Pocket Microscope" which used a simplified concentric tube construction initially out of cardboard but shortly thereafter out of brass. This design was inexpensive, relatively simple to make, and portable. The design was apparently not continued, however, until Fraunhofer re-introduced it in 1811. It continued to be made well into the twentieth century, though it suffered from some of the same limitations as the Culpeper type and, initially, had a cruder focusing mechanism of simple push-pull design. Nevertheless, its low cost made it very popular, and many were made. Outfits, complete with all sorts of accessories and an assortment of slides were common (Fig 9). The design was later modified, first to add a rack and pinion focus (Fig 10), and then, in the nineteenth century, into a side pillar variation by the French makers Oberhauser and Hartnack. (Fig 11). This then combined the virtues of the side-pillar with the simplicity and ease of construction of the drum microscope.

About 1746, back in England, George Adams published his book *Micrographia Illustrata*. Although mostly a plagiarism of Baker's book *The Microscope Made Easy*, in it Adams introduced the "New Universal Double Microscope," the chief advantage of which was a wheel of objectives. Although John Marshall used a ball and socket inclination joint on his microscope in 1692 (Fig.5), and Francis Watkins had produced an inclining microscope using a compass joint around 1754,[19] George Adams (whose first microscopes date to 1735) also pioneered inclining models, the first being his "Prince of Wales" microscope made around 1755[20] which inclined on Trunnions (Fig 12). He also made his famous "New Variable Microscope" circa 1770, which had a large gear and pinion to adjust the inclination (Fig 13). Adams also made a "New Compendious Pocket Microscope" first described in his *Micrographia Illustrata* of 1771 which had a compass joint at the base where it met the folding feet[21] (Fig 14) and also his two "Improved" models.

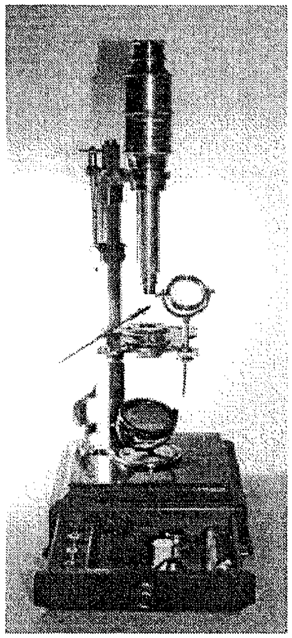


Fig. 7 Cuff Microscope signed "Dolland London"

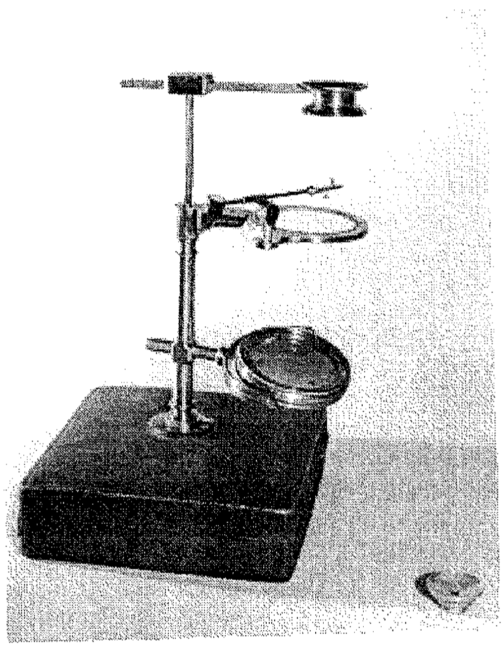


Fig. 8 Early Ellis-Aquatic Type microscope circa 1765.

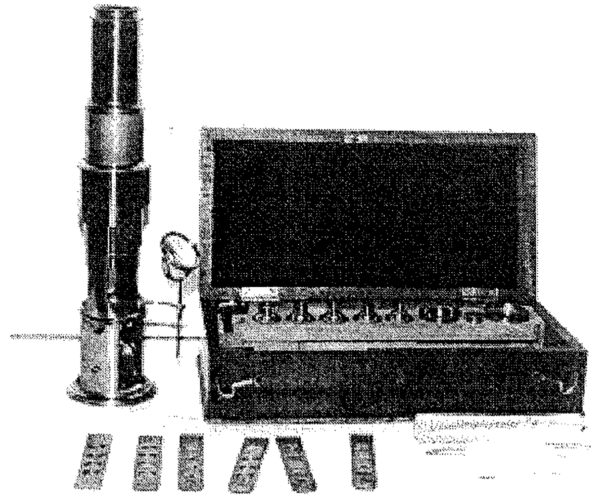


Fig. 9 A Martin-type microscope outfit complete with a full range of accessories and slides.

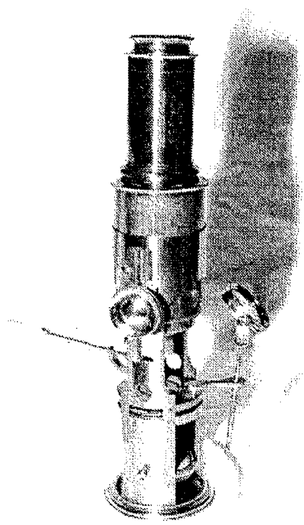


Fig. 10 Martin or Drum-Type microscope by Stewart.

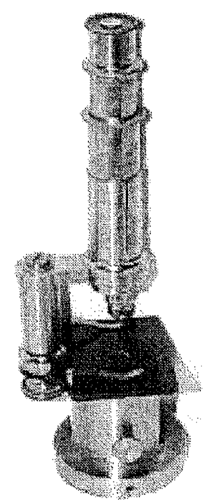


Fig. 11 Oberhauser's improvement on the drum microscope.

In the 1770's, Nairne modified the Cuff instrument by placing its base on a hinge inside a box, thereby creating the portable chest microscope.

The "Jones Improved" model did not incline, but the "Jones Most Improved" type, previously developed by George Adams in about 1790 as the "Universal Compound Microscope,"[22] did incline using a compass joint at the top of a pillar (Fig. 15). It was marketed around 1800 by W & S Jones. In the meantime, although Dollond had developed achromatic lenses for the telescope in 1758,[23] the task of grinding these for small microscope lenses was too difficult. Withering's brass botanical microscope (Fig 16) was invented around 1776, and his folding pocket botanical model (Fig 17) in 1792. About 1798, W&S Jones announced the hand held folding botanical microscope (Fig 18) which remained popular throughout the nineteenth century.

The nineteenth century was one of great progress for the microscope, in large measure due to the work of one great Englishman, J. J. Lister (father of the famous Surgeon). Prior to Lister's work however, Fraunhofer developed his own version of a more stable stand, and the famous Italian, Amici, invented a mirror reflecting microscope (Fig. 19) that eliminated chromatic aberration but was not very practical. In England, Wollaston

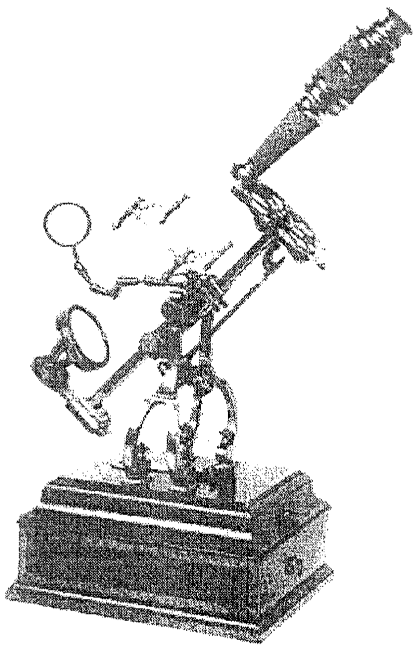


Fig. 12 Adams inclining "Prince of Wales" Microscope.

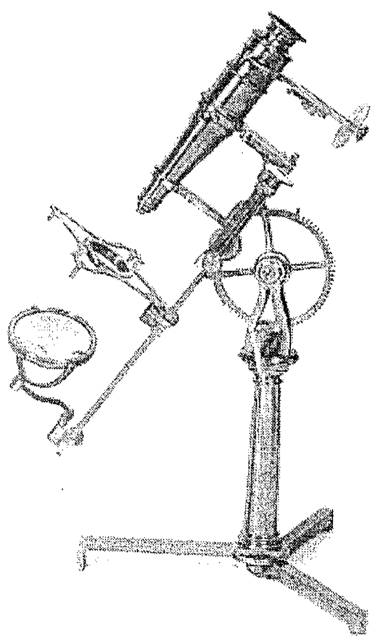


Fig. 13 Adams "New Variable Microscope"

devised a method of using stops to reduce aberration by blocking off the outermost part of the lens.

In the 1820's though, Lister used scientific methods to design objectives which eliminated the majority of chromatic and spherical aberration. Along with the improved optics, came the need for a sturdier microscope. For this purpose he conceived of what became known as "Lister Limb" construction wherein the optical tube was connected to the stage via a single heavy piece of brass which was attached to a support pillar via a compass joint. In about 1830, Lister published

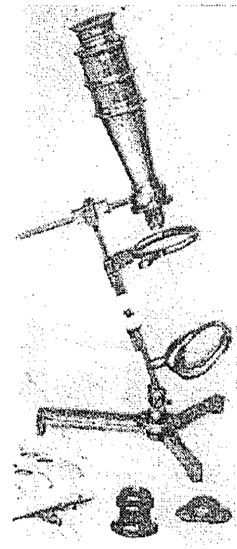


Fig. 14 Adams "New Compendious Pocket Microscope"

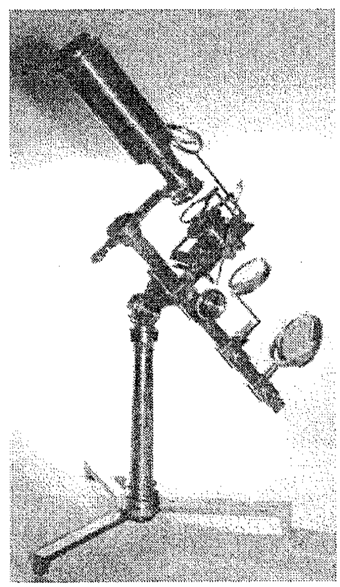


Fig. 15 The "Jones Most Improved" Microscope

his design for elimination of spherical and chromatic aberration.[24]

In the 1840's the three largest and most well known makers were Hugh Powell, Andrew Ross and James Smith. Powell, with his partner, Lealand, who joined him about 1841, became famous for their splayed-foot design and the very high quality of their workmanship. Both Smith and Ross worked closely with Lister. Smith and Ross both constructed instruments with the "Lister Limb" in 1839.[25] They both also made commercial objectives without spherical or chromatic aberration, but Ross became the major maker of objectives and also developed the "correction collar" (Fig. 22) which allowed adjustment of the objective lenses to eliminate the detrimental optical performance when

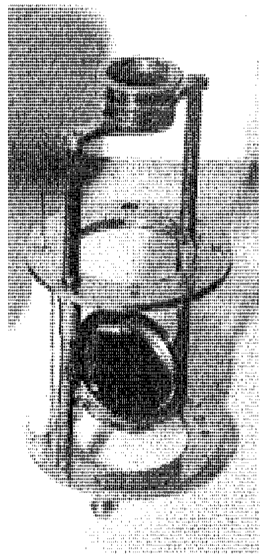


Fig. 16 Withering's Simple Brass Microscope.

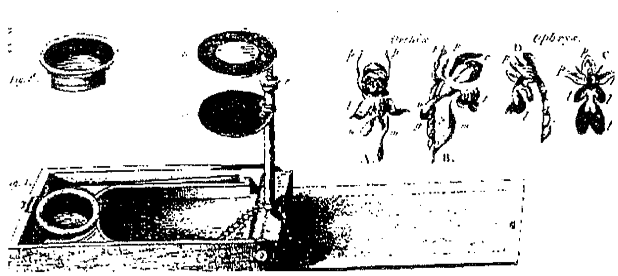


Fig. 17 Withering Folding Botanical Microscope.

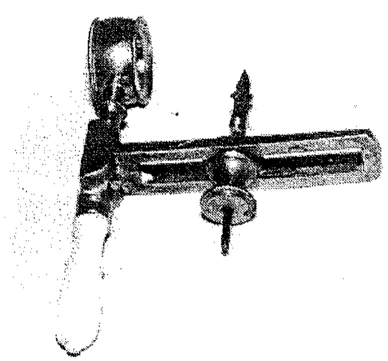


Fig. 18 W & S Jones Type Folding Botanical Microscope.

a cover slip was used. By turning a knob at the end of the objective, it could be set to "uncovered" or "covered." Smith began signing and numbering his microscopes himself, becoming primarily a retailer (as opposed to a "maker for the trade") in about 1839.[26] His twenty second signed and numbered instrument is shown in Fig. 20. When the Royal Microscopical Society was founded, the first microscope it purchased was No 43 of James Smith (virtually identical to Fig 20). Instruments by the other two major makers soon followed.

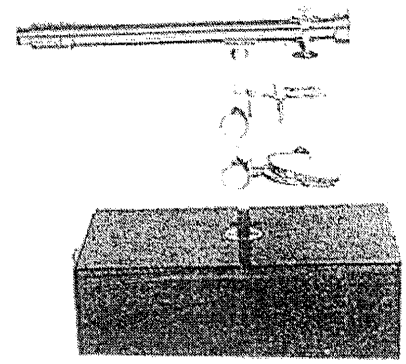


Fig. 19 Amici Reflecting Microscope.

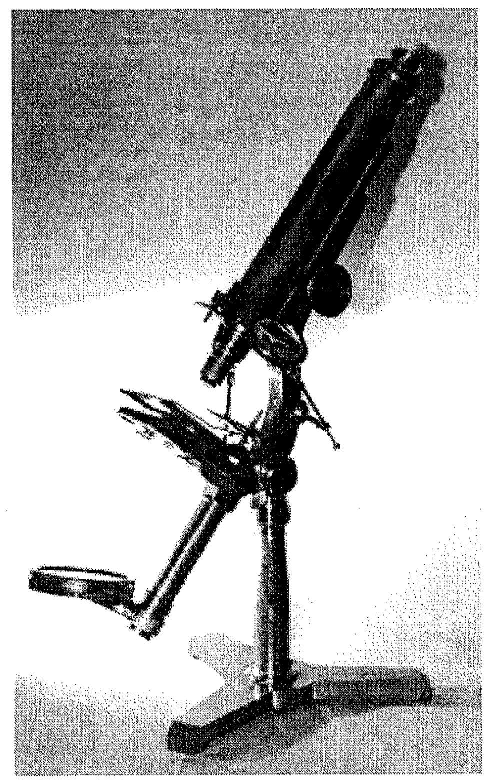
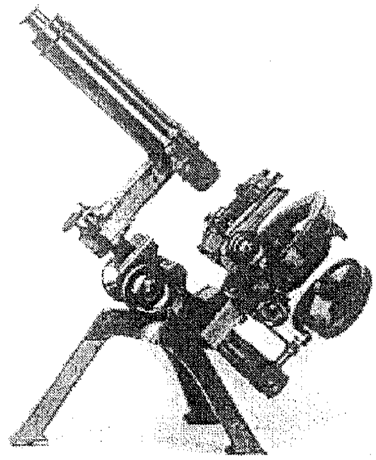


Fig. 20 James Smith Microscope No. 22.

Ross also improved his stands by lowering the center of gravity by inventing the "bar" limb construction (Fig. 23). He also became known for his Y-shaped stable foot which led later to the familiar horseshoe foot which survives to this day. It is also generally acknowledged that with Lister's help, Ross was the premier optician of the time.

The last great advance in the optical microscope was the elimination of the glass-air interface between the objective and the specimen. This was first tried by Hooke. Both David Brewster in England and Amici in Italy also worked on this technique but with little lasting results. One of the references to be found on the subject of immersion lenses is in a treatise by Charles Robin in which he alludes to finding a water immersion objective made by Amici in the Paris shop of maker



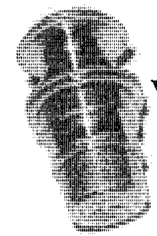


Fig. 22 Early Ross objective with correction collar.

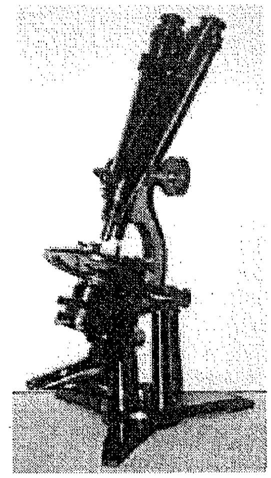


Fig. 24 Binocular Microscope in the style of Tolles with hidden signature by C.X. Dalton.

Fig. 21 Powell & Lealand Stand.

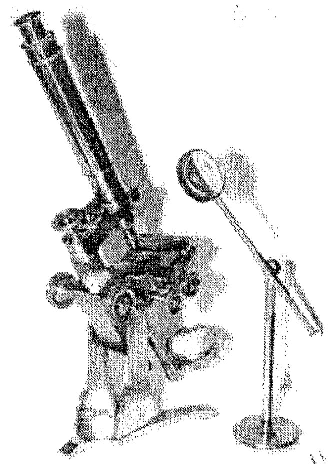


Fig. 23 Ross Bar-Limb Microscope No. 165 circa 1845.

Georges Oberhauser about 1844.[27] Edmund Hartnack, Oberhauser's partner and then his successor, was the first to develop and market immersion lenses with correction collars using water as the immersion medium. Although water gave good results, a medium with an index of refraction closer to glass was needed. In 1873, R Tolles, founder of the "Boston Optical Works," first proposed the 1/10 inch homogenous oil immersion objective, using Canada Balsam as the medium.[27] Although many have credited Tolles with the invention of the oil immersion lens, Deborah Jean Warner has pointed out that these papers addressed the numerical aperture of objectives when specimens were *cemented* with Canada Balsam to the objective lens and that he did not advertise oil immersion lenses until 1879.[28] As it turns out, this is not quite correct because Tolles used a type of Canada Balsam that did not harden. When Tolles died in 1883, he was succeeded by one of his co-workers, Charles X. Dalton. A binocular microscope closely resembling those of Tolles, with a hidden signature of C.X. Dalton, is known (Fig. 24). In 1877, acting on advice from J.W. Stephenson, treasurer of the Royal Microscopical Society, the prominent German mathematician and optician Ernst Abbe described Stephenson's oil immersion system which became readily available after about 1880. At that time, while associated with Carl Zeiss in Jena, he published his paper on microscope resolution. This led to the method which persists to this day as the means to obtain maximum possible magnification with good resolution of about 1000 for a light microscope.

Since the last years of the nineteenth century, there has been little further improvement in the light microscope. Further resolution, and therefore magnification, had to await other non-traditional developments such as the electron microscope. It is interesting to note, as pointed out by Brian Ford,[8] that in the twentieth century, the best optical microscopes are able to achieve a maximal useful magnification of only about 4 times that of Leeuwenhoek, the optical quality of which was not exceeded until the middle of the nineteenth century.

On the other hand, although the evolution of the microscope itself progressed at a steady rate during the nineteenth century, the use of the microscope to study tissues and organs lagged far behind. This was in part due to a misconception of organ structure popularized by H. Milne- Edwards.[29] Milne-Edwards, a French microscopist, had studied organs to the limits of resolution using a non-achromatic microscope. Because of the aberrations, once he reached the limit of resolution, the structure of everything looked the same. These "globules" were nothing more than artifacts of the inferior optics he was using, but nevertheless, his ideas persisted. It was not until J.J. Lister and Thomas Hodgkin published their famous paper, utilizing one of Lister's first achromatic microscopes[30] (built by Tulley and Smith) that this error was revealed. Even so, it took many more years to realize that fine structure of tissues would have bearing on diseases, and also to understand that tissues could be stained and "dead" and still reflect accurately the true and accurate structure of an organ. The latter was not a trivial idea and led to a long delay in the practice of histopathology.[31]

The author is indebted to James Solliday for providing extensive supplementary information, additional references and critical review of this manuscript.

ENDNOTES

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2. See for example: Clay RS and Court TH: *The History of the Microscope.* 1932 reprinted by Holland Press Ltd. London. pp 7-10 (1975).
3. Hans, Zacharias' father, was probably the originator, though Zacharias probably carried on his father's work.
4. In this context, a lens between the ocular and objective which increases the size of the field of view.
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13. Lieberkuhn's microscope. *J. Royal Microscopical Soc.* 7:806 (1887).
14. See: *J of Applied Microscopy.* Bausch & Lomb Optical Company pp 1621 (1898-1903).
15. As reported by McCormick J: *Eighteenth Century Microscopes*, Synopsis of History and Workbook. Science Heritage Ltd. Lincolnwood Illinois. p 39 (1987).
16. Baker H: *Employment of the Microscope.* (1753).
17. This type of fine adjustment screw was apparently invented by the German astronomer Johanne Havelius in 1673.
18. Linnaeus and the use of the microscope. *J. Royal Microscopical Soc.* 25:253(1905).
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20. See page 174 and Figure 126 in: Clay RS and Court TH: *The History of the Microscope*. 1932. Reprint Holland Press London (1975).
21. Fig 135, page 190, in: Clay RS and Court TH: *The History of the Microscope*. 1932. Reprint Hol land Press London (1975).
22. Clay RS.and Court TH: *The History of the Microscope*. 1932 reprinted by Holland Press Ltd. London. pp 199-200 (1975).
23. Actually it was Hall who first invented the achromatic telescope objective; he never mass- produced it nor patented the idea however and it was Dollond who further developed and patented it.
24. Lister JJ: On some properties in achromatic object-glasses applicable to the improvement of the microscope. *Phil Trans* 130: 187-200 (1829).
25. See Fig 71 in Hansen JL, et al: *The Billings Micro scope Collection of the Medical Museum of the Armed Forces Institute of Pathology* 2nd ed. Washington published by Armed Forces Institute of Pathology (1974).
26. Apparently a signed James Smith Microscope which dates to about 1826 is known to exist in a private collection (personal communication, J. Solliday).
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MINUTES OF THE 16 JULY 1997 MSSC MEETING

David L. Hirsch

GREETINGS! MSSC began the new fiscal year on 1 July, 1997. We have a healthy start toward the replenishment of our Treasury and to date, we are ahead of the same period last year in terms of membership renewals and new member sign-ups.We must be doing something right!

Among the "right" things, is the ability shown by Program Chairman LARRY ALBRIGHT in securing speakers of merit. Our speaker for the evening, Mr. GARY GREENBERG, of the Edge Scientific Instrument Company LLC, Santa Monica, California, gave an excellent presentation on High Definition Direct-View 3D Microscopes and related microscopical techniques.

Mr. Greenberg supplied technical literature to the MSSC members along with viewer spectacles in which each of the Polaroid foils was oriented 90 degrees from the other, and secured in the viewer frame. Looking at the image pairs, which were projected on the screen in color, elements of the objects "appeared" to be in three dimensions. Actually, the in-depth appearance of images derived from photographs which exist only in an x-y plane, is illusory. Although the image has in-depth appearance, we cannot readily measure distances in the "x", "y" or "z" axes. By contrast, distances between points in solid (in depth) objects viewed under a stereo binocular microscope are measureable in all planes. Stereoscopic imaging goes back to the days of Brewster, Nachet and Wenham. It goes without saying, this interesting phenomenon will be addressed "in depth" by our membership at future meetings.

WORKSHOP. The crisp air and sparkling repartee of our members stimulate the creative juices of all in attendance. The MSSC Workshop, which takes place on the first Saturday of each month, is drawing an ever increasing number of members and guests to the patio of STEVE and MILLIE CRAIG. VP GAYLORD MOSS, with your Treasurers blessing, purchased several strong low-cost plastic chairs to accommodate the increasing number of attending members and guests.

WORKSHOP PROGRAMS. PETE TETI spoke on the development and implementation of workshop programs. This included training sessions in the various aspects of slide preparation, specimen gathering, handling of the microscope and the accompanying accessories, and other practical aspects relative to conducting an effective and successful workshop. Laboratory facilities are on hand, and much of the necessary expertise exists within our membership, giving us a readily available teaching staff.

PROGRESS. We marvel at the dramatic positive changes that are sweeping MSSC since we launched the reorganized Society. Membership and attendance are on the rise. Our quality house organ, THE JOURNAL OF THE MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA has more relevant content, and is based principally on the input of our members and that of sister Societies. The graphics are of the best quality and, most important, MSSC members receive the Journal on time!

VP GAYLORD MOSS donned his Editor's hat and described the use of the Page Maker software program in formatting the Journal. Photos and other pictorials are scanned at 400 DPI on our new scanner. The master sheets are prepared using a 600 DPI HP printer prior to xerographic reproduction, collation and stapling.A cumulative index of articles will be published at year end, so keep your copies of the MSSC Journal. You will be glad that you did!

SHOW AND TELL. As always, the submissions of the evening drew a lot of interest from the meeting attendees. A wide range of microscopiana (?) was shown, including the Edge Model 160 True-view 3-D Head mounted on the Edge R-400 base as described by speaker Greenberg. We marveled at the sparkling, in-depth images produced by this instrument. Gary gave a concise and detailed description of the Edge 3-D microscope along with the fundamentals of its operation. For additional information, contact Mr. Greenberg at: The Edge Scientific Instrument Company, LLC, located at: 1630 Seventeenth Street, Santa Monica, CA 90404, Phone: (310) 396-9333; Fax:(310) 396-9003.

LEON STABINSKY prefers to collect smaller instruments; "anything that can be carried in the pocket," compared to the likes of massive Victorian binocular microscopes. Leon showed a newly purchased, circa 1910 Bausch and Lomb hand held microscope. The objective is mounted behind a truncated metal reflecting surface with a hole in its mid-section for admitting light. The objective end of the microscope rests immediately adjacent to the specimen. Magnification is adjusted by means of a sliding tube, secured with a locking ring. The finish on the tube surface, at one time gloss black, had been buffed away.Leon is seeking advice on restoring the original finish.

Like Motherhood and Apple Pie, to polish or not to polish is a very sensitive topic. Look for articles in future issues which will illuminate (or possibly inflame) this perplexing dilemma.

STUART WARTER showed his Pillischer Binocular Microscope described as a "No.1 microscope with a Turrell mechanical stage and Wenham prism for stereoscopic imaging." The original stand was made in 1857 and the binocular body was reworked in 1861. An interesting feature is the construction of the eyepiece assemblies which, in the forms presented, serve two functions. First, they are removable to allow the collapsed stand to fit into the case, and second, to effect an increase in the interpupillary distance with the accompanying rack and pinion adjustment.

BARRY SOBEL brought in three interesting microscopical items. First, he showed a pristine cased nickel plated thread counter made by Leitz Wetzlar. In use, the counter is placed on top of the fabric and lined up with threads oriented perpendicular with respect to the graduated edge of the base. A threaded rod, similar to the feed screw on a lathe, is rotated by means of a hand wheel. This action moves a "carriage" with an indicator point which moves across a scale. The distance traversed by the pointer is observed through the magnifying lens. This distance, measured in inches, is divided by the separation between threads, giving the number of threads per inch.

Barry's second item was a projection microscope accessory made by Bausch and Lomb, circa 1880. The unit, for showing prepared slides, had a sliding tube focus and a sleeved end which fitted over the projection lens of a 'magic lantern' projector..

The third device, made by Philip Harris & Co., Birmingham, England, was an unusual and probably rare optically oriented device used in either a shop or a laboratory. The massive cast iron base had machined foot pads on two of the adjoining surfaces, allowing the optical assembly, which was mounted in the direction of the longer surface, to be oriented either horizontally or vertically. The design of the instrument allowed accurate, and by means of a vernier scale, measurable positioning of the optical assembly body.

JOHN FIELD also displayed three instruments. First, was a polarizing binocular microscope signed: "J. Swift & Son, 81 Tottenham Court Road, London, W." Made circa 1910, this instrument was equipped with many adjusting features. The lower end of the principal tube contained a polarizer located above a Wenham prism. Both elements were mounted on slide-out blocks. It appears that a 'Bermondsey Burnisher' did a number on the stand, removing the black finish which originally covered the arm and the base of this fine microscope.

John's second offering was a Bausch and Lomb Chamot Chemical Microscope, circa 1930, in pristine condition. Primarily intended for chemical microscopy, this stand is so designed that it can easily be applied to general work including metallurgy. Several accessories were included such as compensators, short mount objectives, an auxiliary stage and a magnifying lens for observing interference figures. TOM McCORMICK is now the proud owner of this exemplary instrument.

The third item displayed, was an optical comparator, of high quality manufacture. The instrument enables one to precisely compare two similar items, such as documents.

IMPORTANT! Membership dues are due and payable as of 1 July, 1997. If you pay by check, PLEASE make the check out to: DAVID L. HIRSCH. Regrettably, at this time, CHECKS MADE OUT TO MSSC CANNOT BE DEPOSITED and must be returned to the sender for reissue with the payee as designated. Dues are $50 for regular members and $40 for corresponding.

FOR SALE Ortholux Microscope. Call or write for details. (714) 870-0439. Gary Legel 1306 Sheppard Drive. Fullerton, CA 92831.

WANTED:

1. Wild Plan-Fluotar Objectives, 40X and 100X, for the Wild M-20.
2. Instructions/catalog for Zeiss Photoscope 1 and Leitz Laborlux 12 (will pay for cost of copying).

Ron Morris (714) 557-6567.

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The demand for our MICROSCOPES and other SCIENTIFIC INSTRUMENTS in America during the past seven years, has been so satisfactory, and so steadily increasing, that we have opened a BRANCH HOUSE in Philadelphia, in order to meet more fully the advancing demand, under the management of Mr. W. H. WALMSLEY, who has hitherto conducted our agency as a member of the firm of JAMES W. QUEEN & Co.

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W. H. WALMSLEY, (Late of J. W. Queen & Co.,) Manager.

R. & J. BECK, 921 Chestnut Street, Philadelphia.

Advertisement from the American Journal of Microscopy, 1876.
Courtesy of Richard M. Jefts.

MEMBER PROFILE

Norman H. Blitch

Norm Blitch 1953

Norm Blitch 1993

Prologue

When I was in the fifth grade, a very long time ago, I was given a small drum microscope, brand unknown, complete with a couple of prepared slides. I discovered that it was great fun lining up the other kids at recess and bossing them around in exchange for a look. It still is.

In the late 1930's, I was given, by a retired dentist, a small pillar microscope with a ball-joint base and button objectives. Many years later, I learned from Nuttall's catalog of the Frank collection that it was probably made before 1870 by Nachet. It served well as my introduction to the pleasures of microscopy, and I still have it. Along with a friend, I also discovered chemistry. My friend's mother was willing to sign the required forms for us (we were both minors) to purchase any chemicals we could think of. We equipped our home laboratories with everything from metallic sodium to cyanide. Our efforts to produce thermite did only minor damage to the floor. We survived our early experiments without permanent injury. The kids of today are not allowed to have such fun.

Prewar Europe

I entered the School of Engineering at Tulane University in the Fall of 1936, intending to graduate as a chemical engineer in 1940, but plans changed and I found myself in Europe for two years just before the beginning of World War II. I had always been interested in drawing and painting and now became a serious art student. Among many other places, I lived for six months in Ghent, near the Cathedral of Saint Bavon. I was strongly influenced by the great Van Eyck altar piece of the Cathedral, and sometimes like to claim that I studied the basics of color and perspective under the Van Eyck brothers! My art teacher in Ghent was a talented and accomplished artist whose husband, an expert swordsman, was the old world Maitre d'Armes of the City of Ghent. During my two-year sojourn abroad I was to become familiar with much of Europe, from prewar Paris to brown-shirted Freiburg, for the times a rare kind of education. But, war in Europe drew closer. I left from Amsterdam in the summer of 1939 on a freighter, heading for Pensacola. Everywhere there was a state of massive confusion, and my belongings were lost enroute. Almost 50 years later, my brother, while on a trip to Europe, visited The Hague. By amazing coincidence, he was shown a small unframed pastel drawing of a dog, unquestionably mine because my full signature was on it. At least there is minor detritus remaining there of my prewar stay in Europe.

World War II

In due course, Pearl Harbor intervened, and I had to postpone again my plans for completing my education. I became an Aviation Cadet in March of 1942 and went to San Antonio for pre-flight training, including mastery of Morse Code, which I never used again. Flight training began in the open-cockpit Fairchild PT-19, which had no radio or intercom. Communication between instructor and student was via a "Gosport Tube". This consisted of a rubber tube running between the two open cockpits, one end of which was hooked into your cloth helmet and the other to a microphone. The best part of student flying is the sheer joy of aerobatics: the rolls and loops and spins in small aircraft. So, I was able to endure being yelled at by that piece of rubber tubing, and finally went on to more serious flying.

Shortly after graduation from flying school, I was invited to join a nice all-expenses-paid ocean cruise, complete with real teutonic entertainment. Naturally I accepted, and in 1943, along with 21 other pilots, I traveled in the commodious cargo hold of a Liberty ship to North Africa.

Once aboard, we were told to tread lightly, as the hold just below ours was full of a large shipment of hand grenades. However, a naturally curious shipmate discovered a hatch that gave us easy access to the real cargo: case after case of beer. Enroute, our 30-ship convoy was subjected to bombing and torpedo attacks, by JU-88's, and submarine torpedo attacks. The din was deafening as we pilots watched from the deck, warm beer in hand.

Our trip ended in Algeria, where we were cast ashore to join our B-25 Squadrons. The B-25 bomber, which we were destined to fly in combat, had been used by Jimmie Doolittle to bomb Tokyo the year before. It was the most heavily armed aircraft in the world, carrying up to fourteen .50-cal machine guns and, in one model, no less than a 75 millimeter cannon. The cannon was mounted in the tunnel leading forward from the navigator's compartment, its breech extending awkwardly back into the compartment. The bombardier loaded a shell into the breech and slammed it home. The pilot fired the piece by pressing a button mounted on the wheel under his right thumb. Three rounds could be fired against a ground target on one gunnery run. At the moment of firing, the sensation was as if the whole airplane had come to a complete stop in mid-air, and then instantaneously resumed flight. The cannon was tested in flight off the coast of Southern California, west of Laguna Beach, I believe. It was never really useful, in Italy or in India, but perhaps had some success against shipping In the Pacific. Generally, we flew the cannon models in- the wing position in formation, since they had no bombsights.

Our first combat missions were from a captured base in Sicily, whence we shortly moved to Italy. There we used "PSP" (Pierced Steel Planking) laid on the ground as runways With bomb loads up to 5,200 pounds per aircraft, we could barely lift off the steel plates. As the Germans retreated up the west coast of Italy, the flak became concentrated in smaller and smaller areas and we were forced to fly through the heaviest anti-aircraft barrages in any theatre of the entire war, at our usual lower altitudes. Our planes seldom returned from missions without damage, often significant, and many never returned. The ground crews did a remarkable job patching us up to fly again. In one of a series of crash landings resulting from control damage caused by flak, I sustained a back injury which still plagues me from time to time.

In Sicily, our flight path was often near enough to Mt. Etna, which was erupting, to see the lava flows, especially beautiful at night, as the mountain glowed with bright red fingers of lava. In Italy, Mt. Vesuvius was also erupting, and at least one B-25 Squadron was put out of action for a while as volcanic dust covered its airplanes.

I flew 25 combat missions in the Mediterranean Theatre. The last two were in support of the Anzio beachhead, after which we moved to India, where our Group was assigned to aid the British in recapturing Burma from the Japanese. Our targets were to be in West China near the Salween River as well as in Burma, hitting bridges, railroads and troop concentrations. After a long stop in Cairo enroute, we landed by coastal steamer in Bombay, proceeded three days by train across India to Calcutta, thence by riverboat and truck to Dacca, and then to Feni. We were now about two hundred miles east of Calcutta in an area sometimes referred to as "The Armpit of Asia." We began operations from Feni, finding that the Japanese anti-aircraft gunners were not as accurate as the Germans, and their fighter pilots, though daring and aggressive, were less well trained. Our biggest fear was of engine failure above the infested jungles. I flew another 32 combat missions, for a total of 57.

What does all this have to do with microscopy? Well, we had plenty of time between flights, and the flora and fauna of the exotic environments we lived in encouraged us to develop interests in the natural sciences, perhaps as compensation for time spent where we didn't especially want to be. Sicily and Italy offered only the occasional monstrous centipede (8-10 inches long and as big around as a cigar) and a few other specimens that tend to live on man. India, on the other hand, was a different story. The jungle areas teemed with microscopic as well as visible life. It is a part of the world in which the people do not tolerate the disturbance of anything living. Insects were prolific, and many came in strange forms. There were always small magnifiers available (in the Pacific, fellow MSSC member Dave Hirsch was ingenious enough actually to construct a microscope), and we all became natural scientists of a sort. Snakes were plentiful, including cobras, as were monkeys and hawks. The large monitor lizards (close relatives of the Komodo Dragons of Indonesia) strolled through our squadron area as if we didn't exist. Jackals fought over food scraps. All living things were sacrosanct by religious fiat, and they prospered mightily.

Pilot Training Research

Around Christmas-time in 1944, I left India for the United States, completed B-25 instructor training and was assigned to Douglas, Arizona, where I met my wife, Florence. We were married in June, 1945, fifty two years ago. After the war ended, we decided to remain in the Air Force. I became a regular officer, completed a degree in psychology and did several years of research in the field of human engineering.

In 1953, I was sent to found and direct the Air Force Interceptor Pilot Research Laboratory at Panama City, Florida, becoming jet-qualified in the process. A single-engine jet is a totally responsive machine, and flying alone (you can't be more alone) at 30,000 feet is a powerful stimulant, altogether a thrilling experience. The laboratory mission was to conduct research in pilot training methods and to develop techniques for the use of the new flight simulators as pilot training devices. I was given an F86-D flight simulator to be used solely for our research purposes, together with a staff of research pilots and training psychologists.

I think we did some good work and the laboratory was a thriving concern when I was reassigned to Washington, D. C. to prepare for assignments in still another teeming zoological milieu: Intelligence.

Intelligence

After completing the Defense Department's Strategic Intelligence School, I entered the State Department's Foreign Service Institute, where I labored for nine months, with a native Greek tutor and an occasional professional linguist, learning to speak Greek and studying Greek history and culture. I then attended Air Force and other agency schools for another year or so. I had been an amateur photographer for some years, but was sent to two schools of photography, with complete darkroom training as well as practice with cameras of all sizes from miniatures to those used for aerial photography. In 1956 I was appointed Assistant United States Air Attache to Greece. With my wife and four children I moved to Athens. At that particular moment in history, it turned out to be an exciting assignment.

There was the Suez business, our invasion of Lebanon, and, of course, the troubles in Cyprus, all of which had an impact on my duties in Athens. The Russians made things uncomfortable, as did the Bulgarians along their small part of the Iron Curtain. The region was full of Cold War intrigue and contention. There were even reverberations of World War II, which as far as the Greeks and Albanians were concerned had not yet ended; they were still banging away at each other along their mutual border. The U. S. was having difficulty, too, trying to convince the Greeks that they should point their radars toward the communists rather than toward the Turks. And, there was a lot of real action going on in Cyprus, with reverberations in Athens.

On our return to the United States in 1959, we were sent to Albuquerque, New Mexico, to join the Air Force Special Weapons Center. I went through nuclear weapons training then was made Director of Foreign Technology and later Chief of the Analysis Division, responsible for staying abreast of Soviet nuclear development. It was a heavy period of nuclear testing, in which the Russians were very active, and I was often called to Washington to help evaluate Russian developments.

In 1963, I received an offer from North American Aviation that I couldn't refuse, and, with great regret, retired from the Air Force. I had the good fortune over the next 19 years to be associated successively with three of Rockwell International's largest projects: Apollo, the B-1 Bomber and the Space Shuttle. Usually, I served as an engineering manager in advanced systems, sometimes locked up in a vault, but somehow the industrial experience could never quite compare with life in the military service. Frankly, it was boring. Along the way, I finished my Masters in an administrative field. After forty years in aviation and aerospace pursuits, I retired from Rockwell International in 1982.

A couple of years before retiring, my wife found in an antique store a 1920's vintage B & L microscope. I proceeded to take it apart to find out how everything worked. I got it all back together, but decided to look for a manual or textbook on microscopes. Then I met Jake Zeitlin of La Cieniga Avenue, and one thing led to another. I became interested in the literature for its own sake, and began to buy books on the subject. From one dealer I learned that a man named Maurice Greeson had just bought a book I wanted. I called him, got to know him, and it was Maurice who steered me to the merry band of the microscopical society. I became a member and attended a series of workshops started by John deHaas at the Page Museum, learning a little more at each meeting, with the assistance of members like Jim Solliday. I have stayed an enthusiastic member and thank all of the great circle of friends I still enjoy in MSSC. Meanwhile, I have built a reasonably good library of works on microscopy and related subjects. Florence has a significant collection of childrens' books, both recent and antiquarian, so between us we require a lot of cubic footage in shelves. My collection of antique microscopes is relatively small, mostly acquired more or less by chance. I enjoy working with my Ortholux, particularly in photomicrography, and have my own darkroom, small but equipped with a Leitz Focomat enlarger. Drop by when you're in the neighborhood.

CRYSTALS ARE FUN

Leo J. Milan

Do you like abstract art? If so, you can make unique pictures with low-melting organic crystals. You need only a a small amount of crystal powder heated to its melting point and allowed to recrystalize. The crystal, when viewed through cross polarization, will yield various unique, colorful patterns. These can be enjoyed and photographed.

The attached list are most of my favorite chemicals. If desired, one can have two chemicals melted together, such as Resorcinol and Urea. We have an electric stove and I use it to melt the crystals. The vented hood protects me from the fumes which are obnoxious and perhaps a dangerous health hazard. It is best to make five or more of each melt to allow for discards.

A pinch of the chemical is placed on a slide which is held by a clothes pin and melted over the burner. After melting, the slide is moved to a hot plate. The hot plate temperature is somewhat below the melting point. Slower cooling seems to enhance the resulting recrystallization.

Generally, my pictures are made at low magnification with an objective of 2X and a flat field eyepiece of 7X. These are mounted in the microscope with a bellows, which permits further adjustments. The net magnification is around 25X. When more magnification is desired, I use a 6.3X or 10X objective.

The pictures make excellent slides. If you wish, they can also be prints of optional size. An enlargement to 20 or 30 inches makes an excellent wall decoration.

Some chemicals burn when heated, decompose or have too high a melting point. Table sugar and Epson salts make excellent crystals if they are dissolved in water and recrystallized. I tried to dissolve Tylenol in water without success. However, when I used alcohol, I was successful.

I am indebted to John Chesluk who sharpened my skills at these abstract art procedures. Also I'm indebted to William Sokol who introduced me to microscopic photography

HAVE SOME FUN AS AN EXPERT IN ABSTRACT ART!

Some of my favorite birefringent chemicals.

Subject	Chemical	Melting Point	Benzine Ring	Molecular Wt.	Crystals
Acetanilide Item 42	C_8H_9NO	113-115	Yes	135.16	Orthorhomic Plates
Adipic Acid Item 152	$C_6H_{10}O_4$	152	No	146.14	Monoclinic Prisms
Benzoic Acid Item 1052	$C_{15}H_{16}N_2O$	105	Yes-2	240.29	?
Citric Acid Item 2328	$C_6H_8O_7$	153	No	192.12	Monoclinic
Hippuric Acid Item 4636	$C_9H_9NO_3$	187-188	Yes	179.17	?
Resorcinol Item 8158	$C_6H_6O_2$	109-111	Yes	110.11	Needle-Like
Salicylic Acid Aspirin Item 8301	$C_7H_6O_3$	157-159	Yes	138.12	Acicular
Terpin Hydrate Item 9101	$C_{10}H_{20}O_2$	104-105	Yes	172.27	Rhombic
Urea Item 9781	CH_4N_2O	132.7	No	60.06	Tetragonal

Source: Centennial Edition, Merck Index, Eleventh Edition.

CLEANING METHOD FOR FOSSIL DIATOMS

James D. Solliday

One of the most interesting activities requiring the use of the microscope is the study of diatoms. Collecting diatoms can take the student to diverse and challenging locations such as old desert lake beds, steep sea cliffs, rocky streams, mountain lakes, still ponds and coastal wet lands. Acquiring the samples can be an adventure all on its own. What to do with the sample once you get it to the lab is another adventure requiring the application of a little chemistry. For a number of years, I have experimented with the cleaning methods found in the available literature. I discovered that, in most cases, they were inadequate and I was often disappointed. The methods that did seem to work were long and labor intensive. The method described below was developed as a result of my own experiments. This method is intended primarily for fossil material but some of the techniques can also be applied to the processing of any diatom sample. Fresh material that was collected alive does not require the aggressive treatment needed for the fossil sample. There are even cold methods that do not require the application of heat when processing the fresh sample. It should be understood that different types of collections require different methods of cleaning. A basic understanding of chemistry should help the student decide how to treat his individual sample. In future articles, methods of cleaning fresh material will be addressed. The reason for beginning with the fossil material is that it represents the greatest challenge and the techniques once understood can be applied to other samples. The literature is full of imaginative and dangerous cleaning methods, but developing a simple and effective system was the goal. The following cleaning process is presented in hopes of encouraging the inquisitive microscopist.

Cleaning diatoms requires the use of acids and corrosive chemicals. The use of eye protection throughout the process is a requirement. Boiling acids produce fumes and they also must be controlled. I do all my cleaning outside and my advice is that anyone working in this field should do the same. The exception is if you have access to a lab with a fume hood. For the amateur microscopist, however, a simple and affordable system is needed. The condensing apparatus shown in either Figs. 1 or 2 below can be used to control the fumes. In the setup of Fig. 1, the acid vapors recondense on the bottom of the flask so that no acid need be added for hours of boiling. The disadvantage is that some vapor escapes from the edge of the beaker, making it advisable to use this only outdoors or in a good fume hood. In the setup of Fig. 2, all fumes are removed through the water drain so that no fumes escape into the air. The disadvantage is that the acid is consumed in a short time, typically 15 minutes for a 5/8 inch liquid layer. The scheme does, however, offer a method for operating with poor ventilation.

For either method the flask must be of the heavy walled type and eye protection, preferably a full face shield, must be used.

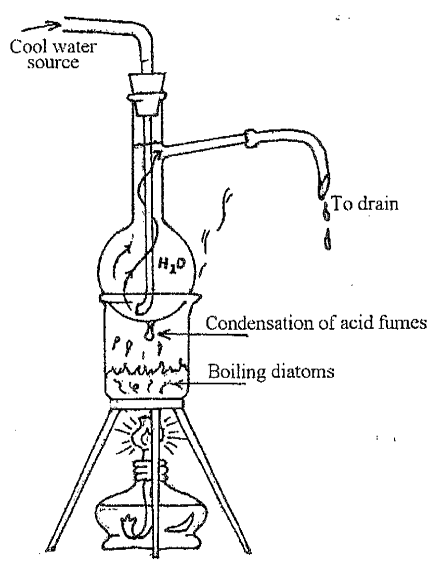


Fig. 1 Apparatus to recondense fumes on flask.

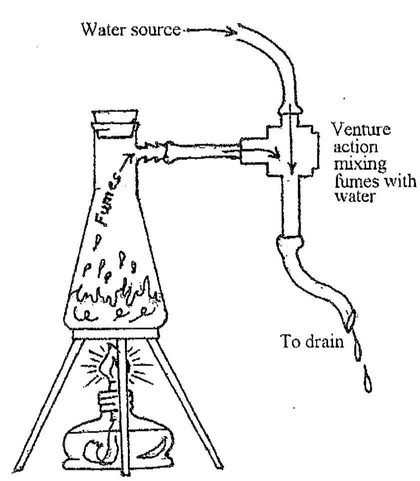


Fig. 2 Apparatus to take fumes down drain in water solution.

If the material you are working with is from a saline source, such as ocean dredging, it should first be boiled in distilled (Dist.) water, then decanted. This will remove most of the soluble minerals. The method that I will be describing below is primarily for fossil material. Fossil material is usually chalk-like and can be very soft to quite hard. The color may be white to very dark gray and its composition may be laminated to solid. Remember that all collections must be labeled with the date, location and stratification level of the deposit.

1. **Mechanical Treatment.** Your sample should be broken down into as small pieces as possible. I usually use a little ice pick to chip off small flakes from the sample.

2. **Boil in Distilled water** as described above, then decant. This step may be skipped if the material is not calciferous nor from a saline source.

3. **Boil in Hydrochloric acid** for at least 15 minutes, then decant. Hydrocholoric acid helps break up the calciferous solids.

4. **Boil in Hydrogen peroxide,** (at least 37%) for 15 minutes. Then add Hydrochloric acid as the reaction continues. Boil 15 additional minutes, allow to settle then decant and rinse with distilled water. I have found that you only need to apply two changes (rinses) if you bring the rinse water to a boil. What consumes the time is allowing the diatoms to settle after each rinsing (30-40 minutes).

5. **Boil in Hydrochloric acid** a second time if needed, but this is only required for resistant samples. If applied, you must rinse again.

6. **Boil in Sulfuric acid**. If your sample contains a sufficient amount of organic material, you must boil for 15-20 minutes in Sulfuric acid (or boil until white fumes appear). Then add a small amount of Nitric acid (oxidizer). Be extremely careful at this point: always run the Nitric acid down the side of the beaker and not directly into the hot sulfuric acid. (Always use eye protection.) For this step I normally use a long pipette. A second option, instead of the Nitric acid, is to use a few flakes of Sodium nitrate. Either way, you should decant out the acids and (rinse/boil) in distilled water several times.

7. **Boil in Sodium hydroxide** if the samples contain much volcanic ash or have remained resistant to the above process. Care must be used as the diatoms can be damaged or even *dissolved* if the following is over used. Bring your remaining material to a boil (in the distilled water). Then apply 3 or 4 flakes of Sodium hydroxide to the boiling water. After about 5-10 seconds, dilute with cold water and **quickly** check the sample under the microscope to see if it has been cleaned sufficiently. You may need to do this several times with stubborn material. Sometimes just 5 seconds is enough. **When the cemented conglomerates of diatomite have broken up, you must add a 15% solution of Hydrochloric acid to stop the action of the Sodium hydroxide.** Remember that the diatoms can dissolve very quickly under the influence of Sodium hydroxide.

8. If your material contains a great deal of heavy sand the following method can help separate the sand from the diatoms. Add about 1 to 1-1/2 inch of distilled water over the sample and place the beaker on a flat table. Swirl the water by rotating the beaker as you hold it flat on the table top.The heavier material will form a small pile in the center of the beaker. After you stop the swirling action wait 10 to 15 seconds and then decant the suspended diatoms. You should repeat this step as many times as needed to remove the heavy waste material. Check your suspensions with the microscope. By the way, I use a 400 ml beaker. If you do not have a problem with sand you may continue to the next step.

9. At this point the material must be thoroughly rinsed. I find the best thing to do is to run the sample through a number 400 mesh sieve. The material that remains on the sieve should be quite beautiful. Remember to keep the material that passed through the sieve because it contains the very small diatoms. Having two vials representing what passed through and what was trapped by the sieve can be very useful. If your material was subjected to the above sand removal treatment you should continue with the sieving process. Use of the sieve is the only way one can remove the very tiny debris. Without sieving, the material will almost always remain cluttered. When using a fine sieve you can either wait for the debris to drain through or you can use a spray bottle with distilled water to help the material through the sieve. Store the sample in distilled water with one or two drops of formaldehyde added. If the diatoms are to be used for arrangements, you may then allow the sample to dry completely and then store it in vials or envelopes.

I hope I have encouraged some of you to take on the challenge of working with diatoms. I trust that I have imparted enough useful information to establish a solid starting point.

To obtain the proper sieves contact: **Gilson Company, Inc.**, P.O. Box 677, Worthington, OH 43085., (800) 444-1508.

WORKSHOP of the Microscopical Society of Southern California

by: **George G. Vitt, Jr.**

Date: **Saturday, 5 July 1997**

Location: **Steve Craig's Lab,** 34 persons attended.

This has been another record-breaking attendance of the MSSC Workshop, exceeding even that of the previous month. This meeting might well be called the "The Smith & Beck Extravaganza." Present as guests were Katherine, the niece of George Vitt, and her husband Alex. Katherine is a biophysicist at UC San Francisco, and Alex is a polymer chemist.

1. **Steve Craig** stated that a decision must be made as to the disposition of MSSC-owned equipment, all of which had been displayed at the workshop. It was decided to sell the items to members in attendance. A fair price was established for each item, and the winning buyer's name was picked at random from a box of slips. These sales were accomplished to everyone's satisfaction at the end of the show-and-tell portion of the Workshop. Proceeds went to the MSSC treasury.

2. **George Vitt** distributed a variety of microscope related literature.

3. **Barry Sobel** gave a brief history of the Smith and Beck enterprises and also exhibited a panoply of 6 excellent vintage microscopes:

(1). James Smith "Best" model, 1840, s/n 22: this is the first commercial model of the achromatic microscope which formerly belonged to Dr.Thomas Hodgkin; single pillar on flat tripod leg signed on the foot; white universal lever stage (a later addition); fine focus to the nosepiece; Smith's combination objectives (further described in a prior article in the Journal).
(2). Smith & Beck First Class, Improved Small Best or No.2 stand, 1853, s/n 764: Single pillar; understage controlled vertically oriented knobs for mechanical stage; side of nosepiece screw fine focus; rack and pinion adjustment to substage and parabolic condenser; 3 oculars, polarizer & analyzer; bench condenser; side arm hemi-Lieberkuhn, stage forceps, bench condenser.
(3). Smith & Beck First Class Improved Small Best Portable, 1858, s/n 1899: folding legs; horizontally oriented understage knobs control mechanical stage; double nose piece, bench condenser, substage rack and pinion condenser assembly; rack and pinion coarse in front of nosepiece screw fine focusing; single pillar.
(4). R&J Beck "Pathological", 1890, s/n 16949: mint condition; glass stage; triple turret with 3 objectives; substage with achromatic condenser assembly controlled by rack and pinion iris diaphragm; rack and pinion coarse focus; screw lever focus at rear of stage; short pillar; original case.
(5). R&J Beck Seaside type Folding Microscope, 1915.
(6). R&J Beck "Universal" Household Microscope, 1880: the foot is formed of the company letters R&J and is green; signed with both London and Philadelphia addresses, but was actually made in France.

4. **Jim Solliday** gave a detailed chronology of Smith & Beck, stressing that in the 1880s there was a proliferation of microscope makers in England, due to the great competition, and that R&J Beck started advertising in 1864. Jim exhibited four R&J Beck microscopes:

(1). A very rare "Lankester's Dissecting Microscope," 1863, which had been designed by Dr. Lankester, then President of the Royal Microscopical Society. It has a large circular glass working surface, the spring-loaded free-sliding stage being movable in all directions. Four brass pillars extend up from the mahogany base and support the stage. There is a Coddington ocular, a bullseye, and substage mirror. An interesting accessory is the 'mounting stage' which allows specimens to be mounted 'dead center' on the slide, and also helps keep reagents off the stage. There was also included a dissecting kit with ivory handled tools. This instrument has to be seen to be fully appreciated! It puts many of our 'modern' dissecting microscopes to shame.
(2). "Darwin's Single Microscope," 1865: dissecting type; single pillar on a mahogany base; box with all accessories; substage mirror; circular stage (R&J Beck, 1864) designed for use with Petri dish; the eyepiece is actuated by a rack and pinion and is movable in X,Y, Ø. Factory manufacturing started in the 1850s.
(3). R&J Beck "Popular Microscope", 1872, s/n 6935.
(4). Box of accessories (Smith's quarters), 1861.

5. **Stuart Warter** exhibited and described three of his R&J Beck microscopes and a fourth that had been brought by **Ken Gregory**:

(1). "Histological," 1880: compound/simple (converts).
(2). "Star," 1895: a low cost compound microscope.
(3). "Economic," 1877: horseshoe base.
(4). **Ken Gregory's** "Economic," 1879: tripod base.

6. **Dave Hirsch** exhibited two Smith & Beck microscopes:

(1). Large compound binocular microscope, 1865: full box of accessories.
(2). Large compound microscope, 1870, with box case and accessories.

7. **Larry Albright** showed an R&J Beck, 1865, with Crouch lenses.

8. **Norm Blitch** showed an exceptional SEM photo of a microfossil insect (about the size of a small midge) that had been collected and prepared by Fred Hantsch c.1980. The photo was made during a visit to the Hughes Research Labs, Malibu, CA in 1982, which **George Vitt** had arranged. The young lady in charge of the SEM facility had generously devoted her entire Saturday to being host to our group. In recognition of this, we wrote her the following commendation:

"On behalf of the Microscopical Society, we wish to express our appreciation and thanks to Merry Nell Colborn of the Hughes Research Laboratories for giving us a most instructive, thorough, and fascinating demonstration of the Scanning Electron Microscope on Saturday, August 12, 1982. The time and effort expended by her on our behalf not only bespeaks her knowledge and dedication to the art and science of the SEM, but also her laudable desire to impart her experience to others."

Norm then described the story of the New York Microscopical Society, written by Mr.Bowser of the Smithsonian Institution; He then showed a book of insects, published in 1773 by Hill (inventor of the mechanical microtome), which contained colored plates of the creatures and the announcement, "Ladies who want to color their insects can get extra plates (which are printed pale)". Norm then described a collection of books on microscopy that he had inspected at a Glendale book dealer's, who also had a mint Ortholux microscope and phase equipment available. (It has since been bought by a person unknown!)

9. **Dave Hirsch** described the book *Optrix* devoted to optical illusions, and referred to 'Mason's disk' experiment.

10. **Richard Jefts** described his longitudinal sectioning and showed his photos of Eocene period Turitella fossilized agate specimens from Wyoming. He told of the Del Mar reef outcropping of conditioned sandstone, as a source of fossils, which is now bulldozed flat! George Vitt described extensive Turitella deposits immediately adjacent to Old Topanga Canyon Road that he had explored in the 1960s, and Alan de Haas stated that this deposit has now been virtually decimated.

11. **Ed Jones** showed 1986-9 issues of the magazine "American Laboratory" which contained articles on microscopy by well known authors. He then described the process of cleaning fossilized nodules (from Barstow, CA) with hydrochloric acid, which dissolves the calcium carbonate, leaving the silica intact.

12. **Don Battle** explained how Christie's auction house had photographed the microscopes and other scientific instruments for their catalogs: for a background, they used variegated paper, i.e, colored paper whose hue and/or reflective density varied smoothly from top to bottom. The paper is draped so that it forms a smooth curved surface, below and behind the instruments, thus removing any visual distractions from the background, and giving a fine color contrast to the "brass and glass". Christie's seems to prefer the orange-reds and blues as a background. Lighting is from large diffuse sources of the correct color temperature. Don also said that by calling 1-800-336-8868 ext. 95, one can get data on a new C-41 process color film.

13. **Myron Lind**, our newest member, displayed an "Agriculturist's Microscope" by B&L. He showed the book, Carpenter's 1st edition, 1856, "The Microscope and Its Revelations" which had been owned by Mr. Cox, the first president of the American Microscopical Society, established in 1872. Myron then showed a Cary type "Box" microscope, c.1820, which screws into the lid of its carrying case; bone slides of wood sections; and a slide making kit by W.S. Stanley, 1860-70, London, in its mahogany box containing slides by various English makers, mounting media and alcohol lamp.

14. **Gaylord Moss** announced that Bill Krause, English book dealer, is taking out a 1/3-page advertisement in our Journal for the next 3 months.

15. **Larry Albright** announced that Brian Ford, well known author on microscopy, will be our featured speaker in September 1997.

16. **Leo Milan** said that he has all of Bill Sokol's diatom slides (200!). There ensued a general discussion of the method John Chesluk had used to clean the diatoms he had collected live in the local kelp beds and shoreline. He boiled them in Clorox, outdoors. Other methods were also described. Undeterred by the fact that this was a microscopical workshop, Leo told of how Jupiter was "observed by gravitational wobbulation of stars." Announcement!: Mr.& Mrs. Milan are celebrating their 60th wedding anniversary! Our heartiest congratulations!

17. **Larry McDaniel** described life detection instruments on spacecrafts Viking 1 and 2 (gas chromatographs, etc.), capable of measurement with 1 part in

ten to the 13th background! He then showed an interesting globe of Mars (about 12" in diameter) and showed where these craft had landed, pointing out that the most recent craft (July 1997) had landed close-by. Larry told of the NASA Sojourner Web site, a "mirror" site, <kcs.nasa.gov>, which mirrored him back to JPL. (Note: Al Herman recently told the writer that <http://www.nasa.jpl.com> is an excellent site to obtain startling photos of Mars' surface, especially the 360 degree panoramic view, which is a 10Mb file.)

18. **John de Haas** showed a three ring binder containing 8x10 photomicrographs and lab notes on the research he had done on anomalies in magnetic tape coatings, while he was with Hughes Aircraft Co. These photos showed transversely microtomed sections through the tape.

19. **Ron Morris** gave a report on the SEM at the Crossroads school, stating that it works OK, and that the school has a grant to support its maintenance. All power supply problems have been solved, and that interconnections ought not to present a problem. Ron described his current work in the development of a DVD system, and that the Saturn photos were spectacular!

20. **Peter Fischer** distributed Zeiss and Leitz literature and exhibited a WILD comparison tube, to be used atop 2 microscopes to observe simultaneously the surfaces of two objects. It is for sale.

21. **Jerry Bernstein** said that he would put in an advertisement into the Journal.

22. **Steve Craig** said that he is lining up a speaker for MSSC, an astronaut, whose subject will be crystal growth in zero gravity.

23. **Tom McCormick** related that UCLA is interested in using the Crossroads School SEM; that the school has installed a high-speed fiber connection, allowing any school computer to download the images; and that the SEM maintenance man has volunteered to give the school a 2-day course.

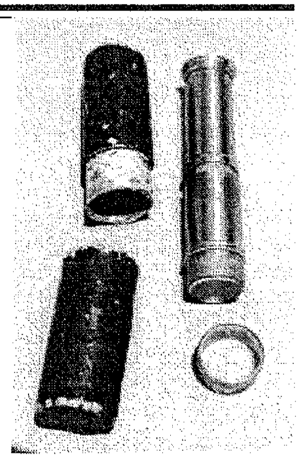
24. **Pete Teti** has volunteered to put together plans for alternate workshops which would allow more hands-on experience in the use of the microscope and slide preparation. John de Haas offered his assistance. Ken Gregory, our inveterate collector, and a Professor at Cal State Long Beach, is looking into the very real possibility of our having workshops in one of their labs - perhaps every other month. It is possible that our first such Workshop could occur on the second Saturday of August 1997 at Long Beach.

25. **Leon Stabinsky** displayed a "Simple, or Demonstration" microscope, pocket size, by Edgar & F.Newton. It is contained in its cylindrical case with friction lid. Would that some enterprising manufacturer make this type of microscope today! They would sell like hotcakes. Perhaps some of our enterprising members, who are blessed with full metal working machinery, might undertake such a project.

We thank **Steve Craig** and his wife **Millie** for their hospitality and the tasty pastries and coffee served during the Workshop. A large group joined at Coco's for food and talk.

July 14. 97

Dear Leon: Today the newest issue of the Journal of the MSSC arrived and I note your article with photo of a Newton pocket microscope. I sold this very exampl. to Delahar at the last Fair, the first Fair I attended & also exhibited at. It came to me from a collector in Canada. I would call it, therefore: "A travelling pocket microscope." Best, Ray.



GOODS, GEAR AND GADGETS

Richard M. Jefts

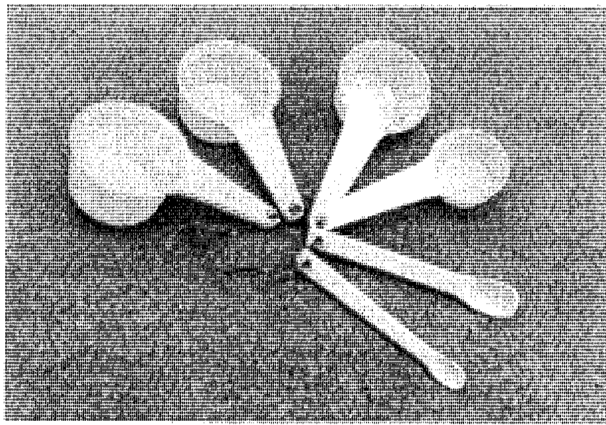


Fig. 1 Plastic measuring spoons

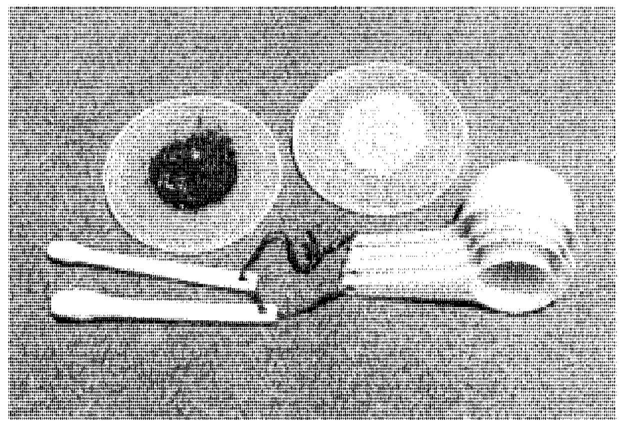


Fig. 2 Spoons and "winnowed" sand

The simplicity of the gadgets this time around, belies their general usefulness.They are nothing more than a set of six brightly colored plastic measuring spoons, from 1/8 teaspoon to 1/2 cup, and strung together on a ring or cord. See Fig. 1. Not especially needed when sampling something, lets say, like a sand dune, the spoons become handy gadgets when used to sample smaller, more selected areas. In Fig. 2, the left hand pile was reclaimed using one of the smaller spoons, from a thin strata of dark, decomposed material sandwiched between a lighter and friable sandstone. Careful scooping kept the sample pure and uncontaminated.And although the predominantly dark grains are not too evident, the pile to the right is another example of a selective recovery - from very thin, winnowed strands of dark or "black" beach sands, using one of the larger spoons, and skimming the surface very lightly. One can also scoop up crawling critters to be transferred to a collecting jar, poke in cracks and crevices and by noting the lengths or scratching marks, a spoon can be used as a rough measuring rule in the field.The teaspoon, with a total length of exactly 5", has had such quarter inch marks scratched in place. (I have cheated, however, for I've since drilled a hole in a 6"/150 mm plastic ruler and strung it on the cord, along with the six spoons.All's fair in love, war and accumulated gadgetry.) The spoons, being a bright yellow color, are less apt to be misplaced, but if lost, are easily and inexpensively replaced. My first set was "borrowed" from our kitchen odds and ends drawer, but I now carry a set of my own. It seems that no matter how well cleaned, utensils that have been dragged through dirt, mud and slimy pond bottoms, are somehow not always seen fit to measure flour, salt or baking powder. So if not exactly caveat emptor, then perhaps let the user beware!

A last minute aside: a recent trip to a large, home-do-it-yourself type emporium, called my attention to something many of you may already be aware of - the off the shelf availability of at least three popular solvents used in microscopy.They, and their prices per gallon were:Acetone @ $8.48 / Toluol(Toluene) @ $7.99 and Xylol (Xylene) @ $9.97. Although no information is given as to purity, the availability is there and the prices are in line, so perhaps now is the time to consider laying in a supply, just in case any changes are made in rules and regulations. If nothing else, buying from a local store makes it a lot easier to come by. However, I haven't yet tried any of these reagents on a sample or slide preparation, so here again, we have another example of not so much a caveat emptor, but another and perhaps even better example of a let the user beware.

Leon Stabinski's Travelling Pocket Microscope

The letter on the facing page describes the wanderings of the pocket microscope that Leon Stabinski recently purchased in England, showed at the MSSC workshop and described in his article on page 129 of the July 1997 MSSC Journal. Ray Giordano, of "The Antiquarian Scientist" in Acton Massachusetts writes that he had acquired it from a collector in Canada, brought it to Massachusetts and then sold it; whence it went to England where Leon found it and brought it to California-all in a very short time. Ray Giordano has a good name for it as it certainly is "A Travelling Pocket Microscope." And a very nice one at that.

EXPLORING WITH THE MICROSCOPE - WERNER NACHTIGALL

BOOK REVIEW

Edwin L. Jones, Jr.

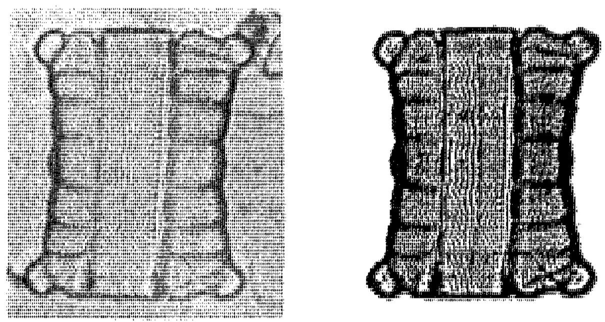


Fig. 1 Left: Photomicrograph of marine diatom Biddulphia, made under very simple conditions. Right: Double Xerographic copy. *Nachtigall p. 69.*

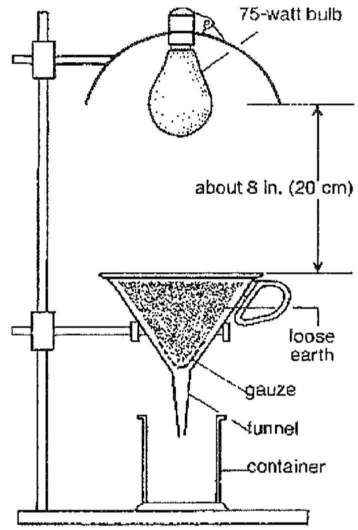


Fig. 2 Berlese apparatus used for catching very tiny soil fauna. *Nachtigall p. 91.*

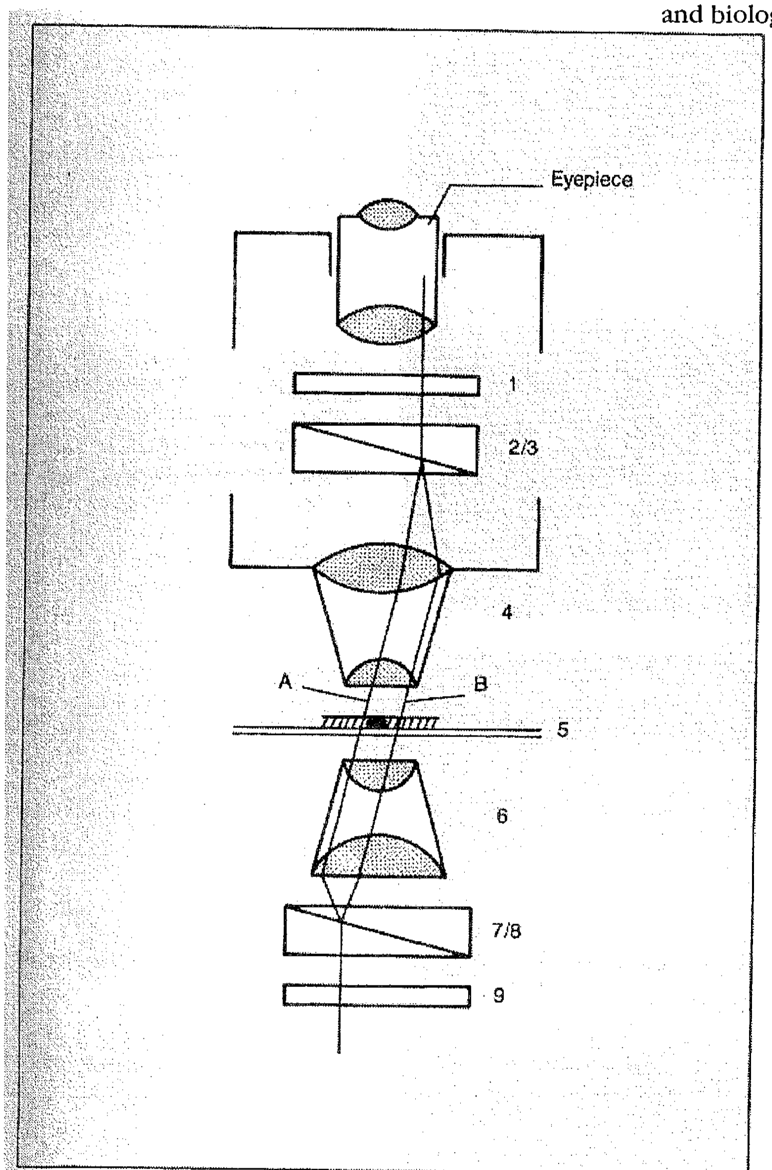
Werner Nachtigall's 1995 paperback book *Exploring With The Microscope* was found by my wife in the children's section of Dutton's Books in Burbank, California. It is published by Sterling Publishing Co., Inc., New York and cost $14.95. To say that this book is heavily illustrated is an understatement as the following numbers will show: 160 pages, 150 color photomicrographs, 35 black and white photomicrographs, 32 sketches showing light paths through optical components and microscope construction, 40 photographs showing microscopes or microscope parts and accessories, 79 sketches of microorganisms and preparation techniques. Believe it or not there are 17 pages with no illustrations. This book was originally published in German in 1994, the translation and proofing of this book is excellent.

Exploring With The Microscope is divided into the following chapters:The Microscope, Optics, Illumination, Photomicrography, Drawing and Measuring, The World of Plants, The Animal Kingdom, Inorganic Structures, and Aquatic Microorganisms. The first chapter is aimed at the person trying to buy a microscope for his hobby. The components, styles and types of microscopes are clearly laid out in words and illustrations. Optics shows the difference between good and bad lenses along with 12 sketches displaying the interaction of light with lenses. Objectives, oculars, cover glass thickness, polarization, phase contrast, interference contrast, fluorescence, working distance, contrast and resolution are covered in this chapter. Fig. 3 opposite is a sample of the quality, depth and clarity of the illustrations.

Illumination covers various light sources, condensers, Kohler illumination, brightfield, oblique, darkfield, filters, Rheinberg, mixed light and incident illumination. Photomicrography covers cameras, extension tubes, focusing, exposure, vibration, micro-flash, film, filters and video recording. The illustration of Bidulphia being transformed from a photograph to a 'sketch'. using a double xerographic copy is shown (Fig. 1). Drawing and measuring includes drawing accessories, measuring magnification, stage micrometers and ocular micrometers. The World of Plants covers the following topics: microtomes, permanent slides, diatoms, algae, fungi, lichens, bryophytes, ferns, seed bearing plants, leaves, wood, roots, starch, pollen and seeds with all techniques and subjects richly illustrated.

The Animal Kingdom moves from capturing very tiny soil fauna with a "Berlese apparatus" (Fig. 2) to staining an earthworm with ink. Several techniques and subjects are illustrated with photographs and sketches. Inorganic Structures is four pages long and does not show a crystal with crossed polars. Microfossils, crystals and minerals are covered in this chapter. Aquatic microorganisms is the longest and the best chapter in this book. It is easy to tell from this chapter that the author is a professional biologist who has made his profession into his hobby or more likely vice versa. This chapter covers: where to find them, how to capture them, how to keep them in aquariums of all sizes, how to examine them and finally how to identify the most common freshwater microflora and microfauna with sketches and photographs.

I did figure out why this book was in the children's section of the bookstore. Under the heading: Library of Congress Cataloging-in-Publication Data appears: 1 MicroscopesJuvenile literature. 2. Microscopy-Juvenile literature. Even though this book ends with an appendix titled: Microscopy with Children and Teenagers, it is my opinion that the book is aimed more at the amateur microscopist than at children. My only criticism of this book is that the illustrations are not numbered. I recommend this book without reservation to anyone regardless of age who is interested in microscopy and biology.



Above: Main features of interference contrast. The individual elements are numbered and discussed in the text. The paths of the rays are illustrated schematically; in reality the distance between both partial rays, A and B, is only part of 1/1000 mm.

Right: example of interference-contrast photos.
Top: mounting medium hardened in layers.
Middle: joint of the leg of a mite, with delicate muscle tissue.
Bottom: cross-section of a piece of wood with color transitions. The dots are particularly well contrasted (green against red).

Fig. 3 Phase contrast illustrations *Nachtigall p. 39.*

August Meeting

The Crystal Slides of Bill Sokol and a China Adventure

by Leo Milan

Wednesday, August 20 at 7 PM
Crossroads School
1714 21st Street
Santa Monica, CA

Bill Sokol was one of the early members of the MSSC, back when it was called the Southern California Microscopical Society. He made a wide range of slides of various chemical materials crystallized under the microscope. About 200 of these slides are in the collection of the MSSC under the care of Leo Milan who has catalogued them and loans them out to individual members for study. Leo has also taken a number of color slides of the Sokol collection and will show about 45 minutes of these slides at this meeting. Bill Sokol was a talented slide maker and these slides show a wide range of remarkable colors and patterns when viewed under polarized light.Anyone who likes modern art should not miss the spectacular slides that will be shown.

Leo has made a number of slides of his own and is an accomplished photomicrographer as shown by the examples that he has brought to several workshops. An article describing his methods is on page 57of this issue.

As an added treat, Leo will briefly share highlights of the recent trip to China that he took with his wife Dorie, with whom he recently celebrated their 60th wedding anniversary. He has some interesting photo notebooks of the trip for perusal by interested members.

Editor's Notes

A number of members have asked about the equipment that I use to produce the MSSC Journal. The list for computer buffs is as follows:

Computer: Until this month I used a Macintosh 7100 66 MHz power computer which has just been replaced with a Power Computing Power Tower Pro 200 MHz 604e Mac clone with 144 megs of RAM , a 4 gig hard drive, 1 meg cache and 8 megs of VRAM.
Printer: HP LaserJet 6MP 600 dpi laser printer.
Scanner: HP Scanjet IICX 400 dpi.
Word processor:Wordperfect 3.5 and Word 6.1.
Page layout: Pagemaker 6.5.
Graphics:Adobe Photoshop 4.0.
Text recognition: Omnipage Pro 6.0.

Omnipage does a good job of scanning any reasonable quality printed matter and converting it to computer language.Photoshop allows me to crop and adjust the brightness and contrast of pictures that are scanned with the Scanjet IICX. I can lay out the complete document in Pagemaker and put in the pictures,resize them and then flow text around them.The 6MP printer's 600 dpi images are good enough quality that they can be used as masters for photocopying the final Journals.

The amazing power of the personal computer makes it possible to assemble the Journal in a small fraction of the time than that required by the old cut-and-paste method. Although word processing programs such as Wordperfect and Word tout their ability to assemble complex documents with text and pictures, they are miserably clumsy and difficult as compared to a real page layout program such as Pagemaker or Quark. For anyone doing much document work, a true layout program is well worth its cost.

In the Mac vs. Windows PC wars, I still prefer the Macintosh which,in spite of Apple's internal problems, is still used by most print and graphics houses as well as most graphic artists.

Part of the pleasure in putting out the Journal is being continually astounded by the almost magic capability of these computer programs.

Gaylord E. Moss