Journal of
THE MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA
Volume 4 Number 2 February 1999

A Case in Point

David L. Hirsch

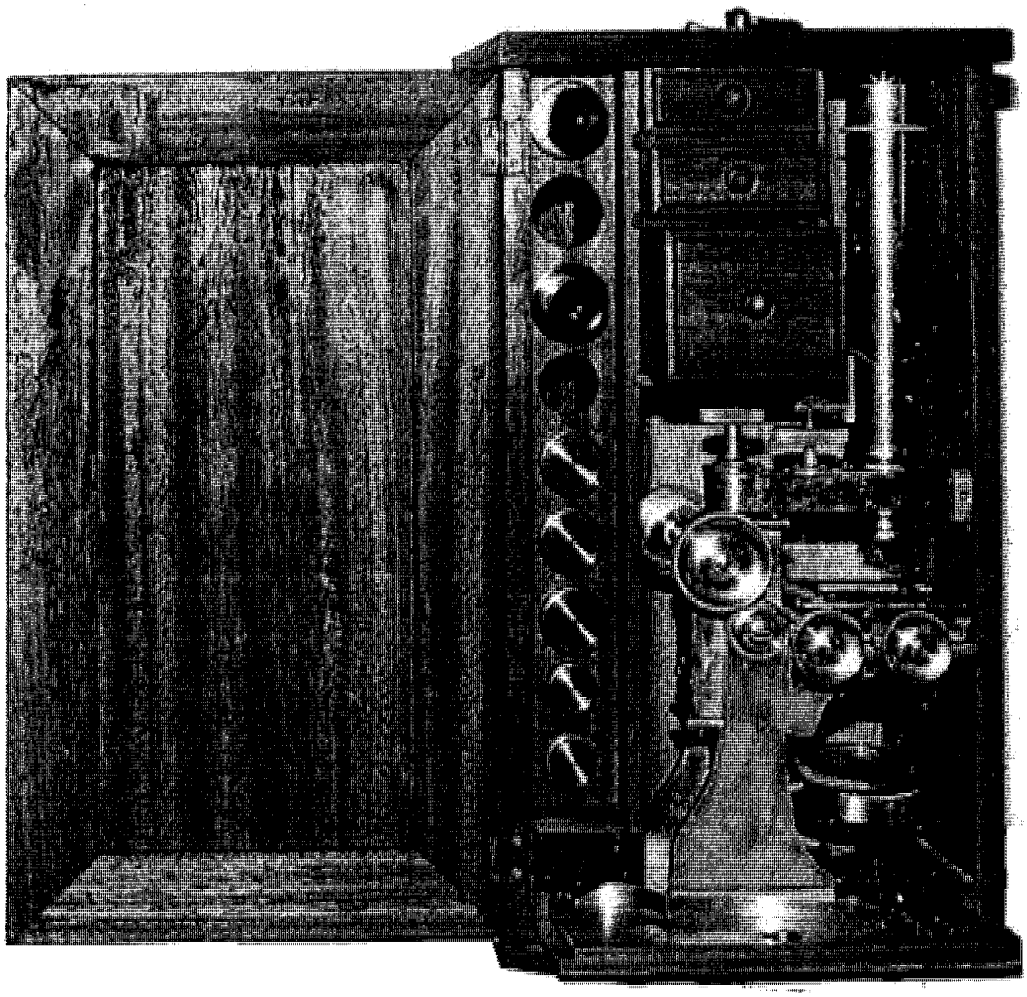


Fig. 1 Baker monocular

CASES R'US. Let's whet our appetite by looking at some homemade microscope cases. The illustrations include cases for: Baker monocular (Fig.1), Swift Petrological (Fig.2), and a Greenough derived Leitz binocular (Fig.3). The cases for these three stands were designed and built "from the ground up." Since the modus operandi for fabrication are similar for each example, the case shown in Fig. 1 will be exemplified. The design is kept functional and simple, keeping in mind the admonition: "Don't start vast projects with half-vast ideas."

RESEARCHING AN INSTRUMENT CASE. Collectors of scientific instruments will sometimes acquire microscopes or other instruments without cases. Then again, if a case is included, it may not be the original one. This brings to mind the massive mid-19th century Baker compound monocular microscope with all the 'bells and whistles.' The stand was purchased several years ago at the Golden Emporium, an antique shop in Bath, England. The low price will not be cited, because it could evoke unbridled envy among my mi-

croscopically endowed cognoscenti. The ensemble was loaded with accessories which, together with the massive microscope, were crammed into a non-original, so-called 'exhibition case' equipped with a glass fronted door. That case was well built, but my aim was to replace it with a close approximation of the original enclosure. The case with the glazed door was converted to a display cabinet (Fig. 4) for small scientific instruments such as hand held spectroscopes. Where might I find a similarly boxed Baker ensemble to use as a reference? Several museums, such as the Royal Scottish museum in Edinburgh, the Whipple Museum, Cambridge, the Science Museum, London, plus microscopes in private collections, provided much of the information. Other sources of information included reference books such as the "Billings Collection" and LE' Turner's *Great Age of the Microscope*. As the design concept for the case slowly crystallized, a thought came to mind; can a wee bit of artistic license came into play? This was mandated, in part, because of the inability to locate a similar Baker monocular stand along with its original case. It was decided to follow, albeit not to the letter, the mind set of the early case makers, by imagining it to be the middle of the 19th century, and the microscope cases were being made for Baker in his shop on High Holborn Street in London's West End. As a matter of historical interest (for whatever it is worth), 'tis said that Jack the Ripper was a frequent browser in Baker's shop.

GETTING ORGANIZED. The sizes and shapes of the microscope and its many accessories are fixed. It follows, that the enclosure will be configured by the shape and dimensions of the instrument itself, and by those of the many accessories supplied. We now get involved with 'Packing Density' which, in a prudish sense, involves the ability of "stuffing three pounds of substance into a two pound bag." Fortunately, several fellow MSSC members own cased vintage microscopes which serve as examples of various packaging schemes.

FIRST THINGS FIRST. Some guys prefer to scratch-build things. Others, like myself, do things in a military manner; we start with a plan and work 'by the num-

MSSC Journal
Volume 4 Number 2 February 1999
CONTENTS

MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA

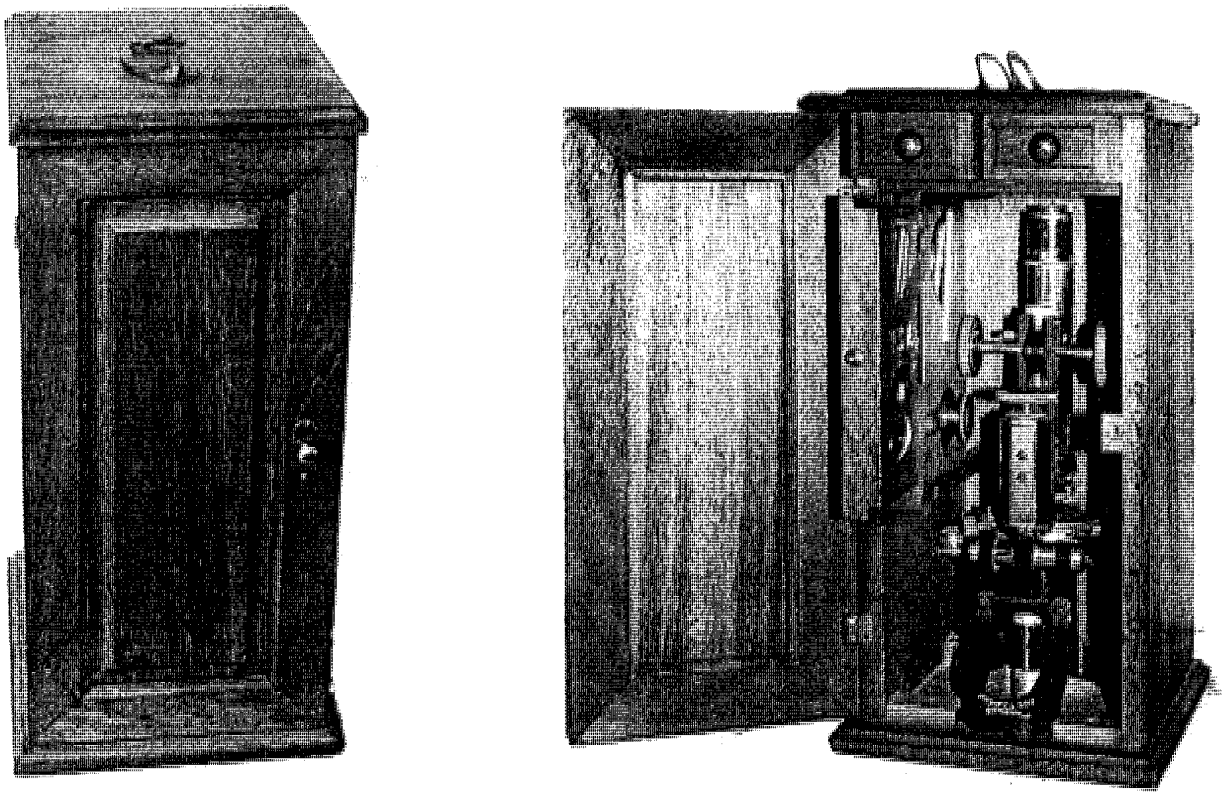


Fig. 2 Swift Petrological

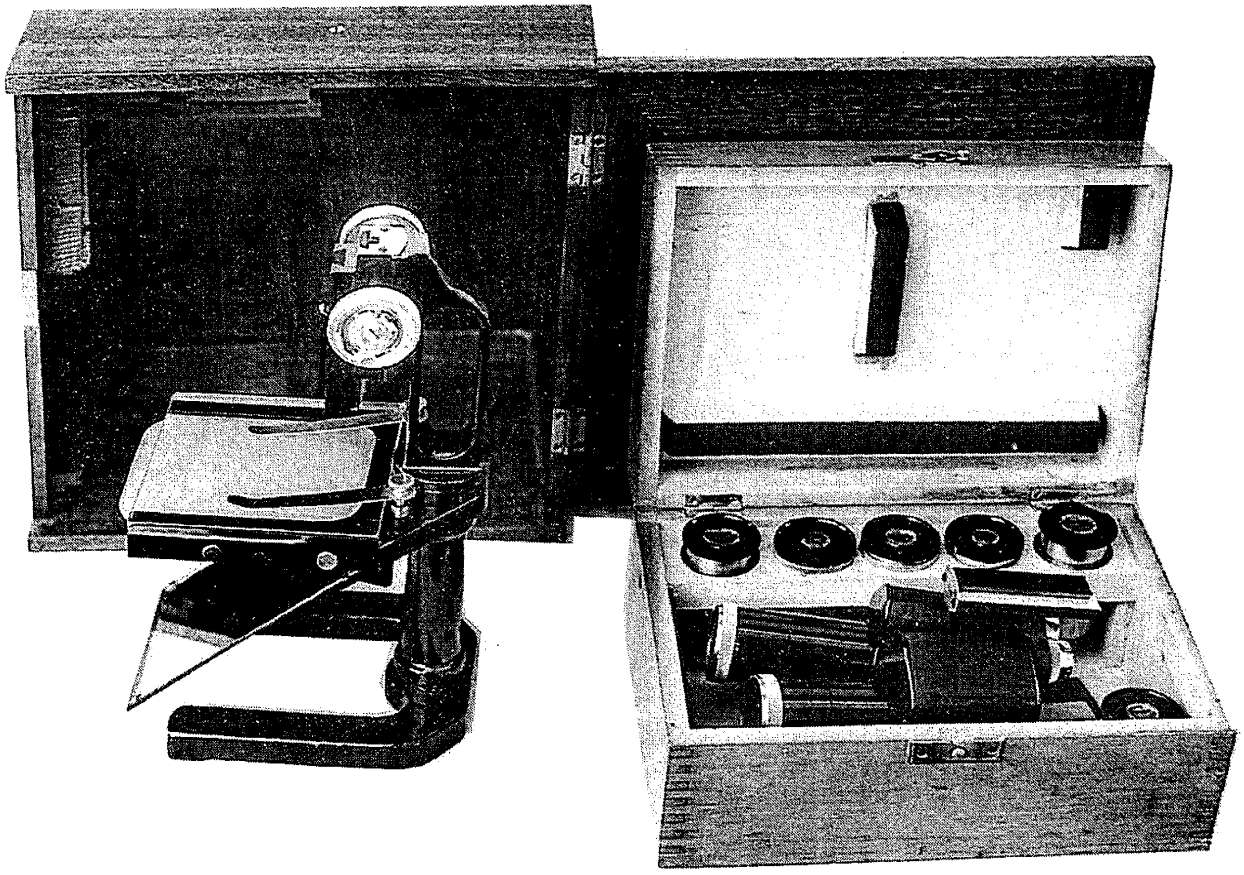


Fig. 3 Greenaugh derived Leitz

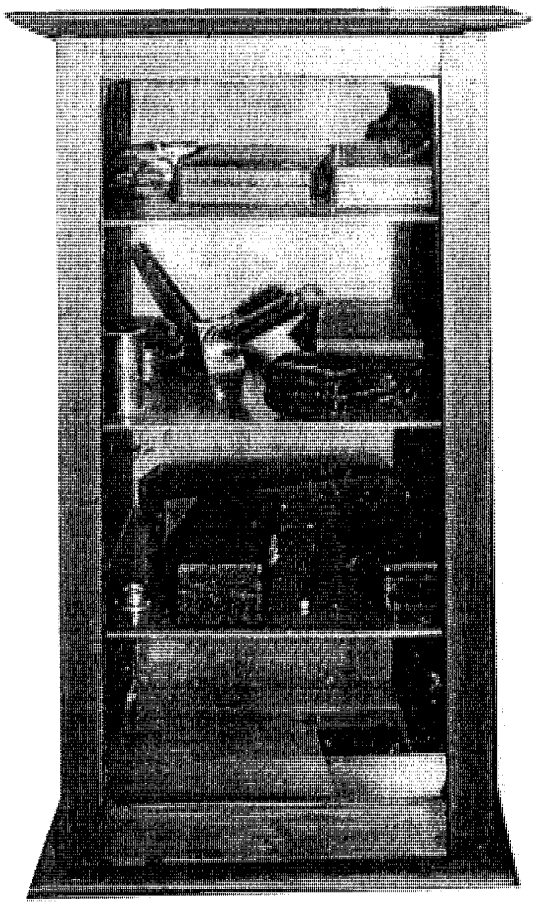


Fig. 4 Display case

bers.' If you are computer literate, you might use a CAD program to come up with a design. I prefer to jot stuff down on cross section paper. In any event, a drawing made to scale (I go full size), enables one to visualize the microscope case in its finished form. After the design is established, a bill of materials is prepared. You shop the local do-it-yourself store and your goody box for materials, and are now ready to start chopping wood. As you embark on the project, repeat after me:

"MEASURE TWICE, CUT ONCE!" CONSTRUCTION. The configurations of the microscope cases described here are unique for specified makes and models of instruments. The techniques relating to cutting and fitting of the parts described will apply in most instances. The case and other wood parts are made of Honduras mahogany. The finished top and bottom pieces are .50" thick and the sides and back panel are 0.38 " thick. The door is also 0.38" thick, featuring a recessed panel. The inside sections of the case are 0.25" thick. The external dimensions of the case are 17.5" high x 9.63" wide x 8.12" deep. The case and contents applying to the Baker stand weighed a total of 27 pounds. Inside the case, a rack on the left-hand side has openings for retaining 9 eyepieces and objectives. The upper central portion consists of an enclosed shelf with three drawers. A large lower drawer, 2.75" high x 3.25" wide X 6.5" deep is fitted to hold an analyzer and a triple objective nosepiece. The two upper drawers are each 1.25" high x 3.25" wide x 6.5" deep, and are fitted for holding slides and small accessories. All drawers are assembled with carpenter's glue, and have custom-machined brass knobs in front. A slide-out platform, which facilitates removal of the instrument from the case, rests on the floor of the case. The platform has recesses on its upper surface which fit the feet of the microscope base.

WARPS AND SPLITS - A WORD ABOUT DOORS. Wood warps when it has not been seasoned in a proper manner. Splitting occurs when wood shrinks and separates along the grain. Therefore, a door made of a single slab of wood is apt to warp. The problem of warpage can be resolved in two ways. First, the door can be made of plywood which is available with veneer, such as mahogany, on the front and rear surfaces. The edges are covered with mahogany veneer strips. The second method uses reinforced, solid lumber. The simplest reinforced door will have the center panel with the wood grain oriented in the vertical direction. The upper and lower pieces have the grain oriented horizontally, and are joined to the center panel with tongue and groove junctures. A more detailed door will have the center panel framed on all four sides as shown in Figs. 1, 2 and 3. The wooden center panel may be replaced with glass to produce an 'exhibition door' (Fig. 4).

CLOSURES. Doors on instrument cases are kept shut in different ways. Ideally, the door is equipped with a lock, which has an accompanying key. Often, the key is missing, which calls for some expeditious form of closure such as a fat rubber band or perhaps, duct tape.

WARNING! Duct tape, masking tape or anything with an adhesive coated surface is liable to pull away the varnished or lacquered finish on the case surface. If push comes to shove, stick with a fat rubber band or, as last resort, grandma's garter. Better still, head for your locksmith and have a key made. There are many old cases to which a simple hook was added to keep the door shut. Unless they are original equipment, hooks look lousy, but they will prevent your priceless microscope from crashing to the ground. Believe me, there is nothing more sickening than the sight and sound of a Powell and Lealand hitting the concrete if the door of the case should accidentally open. For the microscope case discussed here, a simple, though positive closure was designed, as shown in Figs. 1 and 2. The closure was fashioned from a brass #10-32 NF machine screw with a knurled head. It was assembled to an oval brass-detenting escutcheon which in turn, was secured to the right hand side of the door by two escutcheon pins. Held by wood screws to the inside surface on the right hand side of the case, is a brass block threaded with a #10-32 NF hole and located to mate with the end of the knurled head machine screw. A few turns of the

screw locks the door to the case wall. The screw assembly is shown in Figure 5.

ASSEMBLING AND FINISHING OF THE NEW CASE. Locate and drill all hardware mounting holes, as required, prior to assembly. Give all wood parts a final sanding (with the grain!), using #000 garnet paper. After dusting, filler was used to seal the pores of the wood. Next, following the instructions on the can, rub in a good quality wiping stain; red mahogany stain was used in this case. Allow 24 hours drying time. Per instructions, wipe on tung oil which was thinned with mineral spirits; follow with a second application at least 6 hours later. A final rubbing with a soft cloth creates a glowing finish, soft to the touch, which is further enhanced by the use of a quality paste wax.

REPAIR AND RESTORATION OF AN EXISTING CASE. When lady luck smiles down on the collector and he heads home with his prize, he might check over the case to determine if refinishing and restoration are in order. The exposed surface of the case may have flaws, such as splits and cracks, dents, scratches, cigarette burns, or perhaps, a gouge left by a slip with a screwdriver. With apologies to *Workbench* and other wood working magazines, suggestions for some down-home repair methods are given here.

FILLING HOLES. Collect wood (mahogany) dust from your sander and sift it through fine silk. Mix the sifted material with carpenter's glue to form a soft, homogeneous putty-like mass which matches the wood color. Apply to damaged wood with a palette knife to form a small mound of filler. Allow to dry and set for 24 hours, then sand smooth with #000 garnet paper until the mass is level. If the blemish is shallow, it may be filled using a putty stick. These sticks are available in various shades to match the wood. Rub the stick over the blemish until a slight mound appears, then smooth down with a cotton rag backed by a sanding block.

GRAVING STRIP. For the repair of damage to a larger area, we borrow a trick from latter day shipwrights. The damaged portion of the wood surface is chiseled away, leaving a shallow square or rectangular cavity, deep enough to remove the damaged wood. A piece of wood, matching in both grain and color, and about 1/16' thicker than the depth of the chiseled out section, is cut to the same configuration as the damaged area. Apply a small amount of carpenter's glue to the cavity and to the sides and bottom of the graving strip. Make sure that the grain of the strip is aligned with that of the wood surface. Force fit the strip into the cavity using a mallet and a block of wood placed between the mallet and the work. Allow the repaired section to dry, then plane and sand the strip flush to the surface.

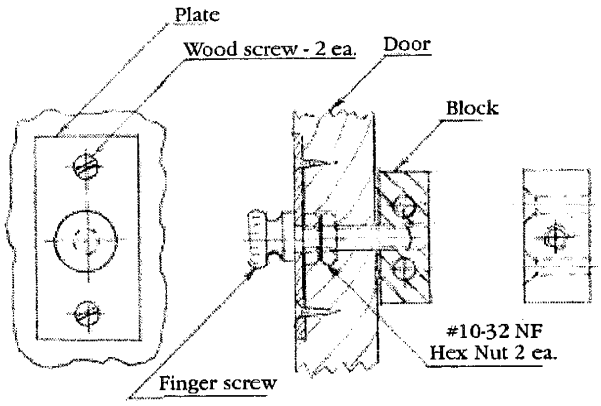


Fig. 5 Screw closure assembly

FINAL ASSEMBLY. Slotted, flathead brass woodscrews of appropriate sizes are used throughout. Assemble the case, making sure that excess adhesive is wiped away with a damp cloth before it sets. Screw heads, in countersunk holes on back of the case may be left exposed. Screws holding the back and sides to the top and bottom of the case are counterbored 0.375" dia. x 0.312" deep (max). When the screws are in place, the holes are fitted with 0.375" dia. plugs, (cut with a plug cutter beforehand) parallel to the wood grain. The plugs are cut from a scrap piece of mahogany. Coat the bottom and sides of the plug with a sparse amount of glue. When fitting the plug, make sure that the grain of the plug and the wood surface are parallel. Using a mallet and a block of wood, drive the plug into the hole. Cut and sand the plugged area until the plug is flush with the wood surface. When the case is completely assembled, retouch with stain and tung oil as required. Apply a coat of quality wax polish such as 'Antiquax' and buff to a high luster.

KEEP YOUR HARDWARE SHINING. Prior final assembly, all brass hardware should be cleaned in mineral spirits, dried, then given at least 2 coats of clear lacquer, allowing the lacquer to dry between coats.

A WORD TO THE WISE. Again I say, plan your work. If something is apt to slip your mind, as often happens when us guys slip into our dotage, keep a note pad handy and WRITE IT DOWN! I have, ever since the time I cut 12 rods at 2 inches long when I should have cut 2 rods at 12 inches long. AND FINALLY, we have gone through the conception and construction of a custom made microscope case. Your task may be harder or easier, but at least I hope that you were enriched by the foregoing hints and shortcuts deemed useful to all microscope case builders, so pick up your tools and get cutting!

WAIT! HOLD THE PRESSES! Courtesy of fellow MSSC member Herb Gold are figures 6 and 7 which show an existing case modified to hold a Leitz binocular microscope along with its binocular tube. An objective

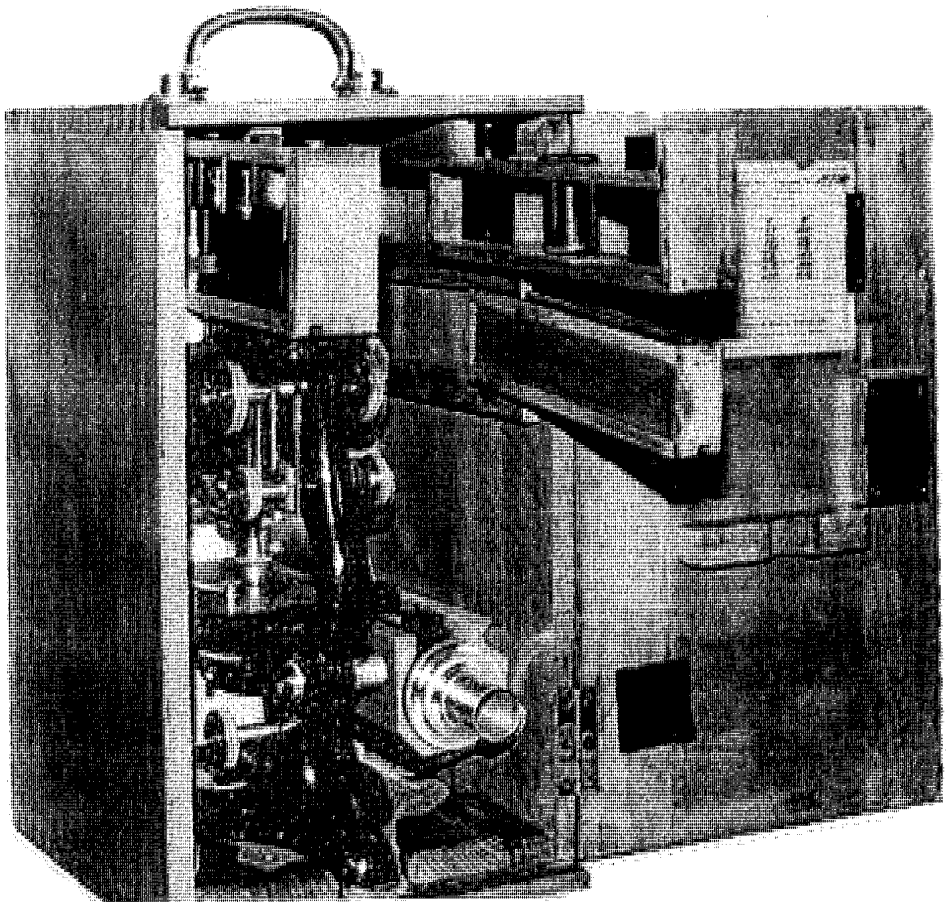


Fig. 6 Case modified for Leitz monocular-

rack was built to replace a missing rack, along with a holder for the monocular tube assembly. Extra wood pads were added for snug, positive retention of the stand.

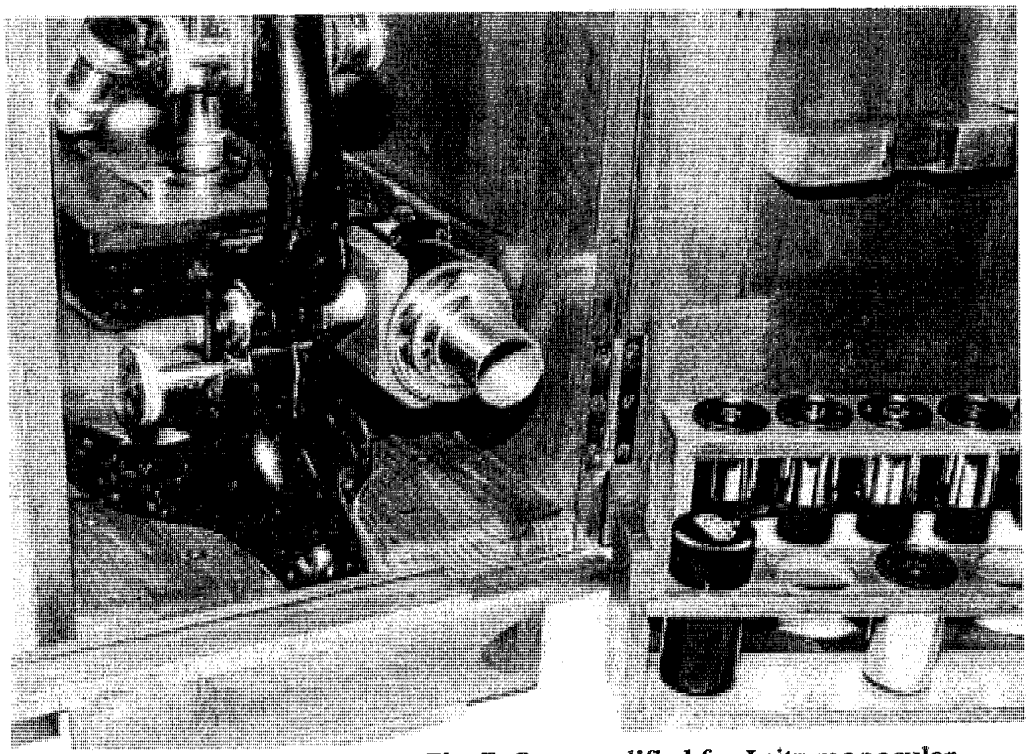


Fig. 7 Case modified for Leitz monocular-

MSSC WORKSHOP

Date: 6 February 1999 -26 persons attended
Place: Ernie Meadows' residence
George G. Vitt, Jr.

1. **Pete Teti** gave us a report on the good recuperative progress of **Steve Craig**. On February 8th. (Monday) Steve will be transferred to Sunrise Care Center, on 17th Street, Santa Monica, CA (310) 829-5411. Steve invites his friends to come for a visit, preferably bringing some show & tell goodie(s) with them!

2. **Ken Gregory** displayed a Zeiss stand (Medium) IV microscope, s/n 9060, c.1886, cased, with 6 objectives and 6 eyepieces, all in their individual brass canisters, and a separate adjustable mirror. The microscope has a rotating stage, and pillar fine focus. The entire upper part of the microscope can be rotated about a vertical axis. The original substage eccentric diaphragm disks were missing and **Jim Clark** had fabricated an exact replacement. These are on a swingout holder. There is a separate dovetail insert for a cylinder diaphragm. Ken is now on the Internet with email address: <gregory1@csulb.edu>.

3. **Jim Solliday** announced that he has a photocopy of *Working with the Microscope* by Corrington, a free copy of an instruction manual for the A/O stereo microscopes, and a formulary book for culture media *Laboratory Aids in Diagnosis* by Stephen Holt. Jim then gave a concise, short history of Ernst Gundlach, the German designer and maker of microscopes and microscope objectives. Gundlach was born in Pomerania in 1834 and, being obsessed in making optics from an early age, went to work in Kellner's workshop. During 1860-70 he made objectives on his own (which resembled those of Siebert) and established an excellent worldwide reputation. He was the first to make a 1/16" glycerin immersion objective. At the time of the Franco-Prussian war (c.1872) he moved to New Jersey, USA. About this time, B&L was called "Vulcanite Optical Co." because they made all sorts of components for optical assemblies, such as eyeglass frames, out of the then new vulcanized hard rubber. B&L started to make microscopes in 1876 and hired Gundlach, who designed their first production microscope, The "Gundlach model." Jim then exhibited two microscopes:

a) The B&L Gundlach Model: This is a cased double pillar stand with 4 cased objectives and with eyepieces, substage mirror support and the objective cans made of vulcanite (!). One of the objectives even had a vulcanite tube. Although working for B&L, Gundlach always put his signature on the objectives. The microscope has a Nikol prism polarizer, and a Gundlach-patented x-y stage and fine focus whose mechanical design leaves a lot to be desired.

b) The last model Gundlach microscope, the "Physician's Model" c.1894, similar to the B&L "Universal," draw tube, 2 objectives, cased in a hickory box with a drawer for objectives and a copy of the B&L 1893 catalog.

Dave Hirsch gave us a memory jog as to how and when the vulcanization of rubber had been discovered.

Jim later reported that Steve Gill has been working for the past 10 years compiling information on microslide mounters, and will soon come out with this most complete information on CD-ROM. Jim added that this work will extend the information that is already available.

4. **Stuart Warter** remarked that he needed some sort of protective armor, because microscopes seem to be continually falling in his lap! He displayed an excellent Ernst Gundlach microscope with the distinctive foot shaped like the Greek letter "psi." It is the first Gundlach model, patented on 21 January 1879, with a complicated fine focusing design that uses parallel linkages. Stuart then showed a "water lens" made in Belgium (?) and dates from 1840-90. It is a blown glass sphere containing water and is used to focus a candle flame into the optics of a microscope. Its focal length is approximately 3-in. The bottom of the sphere is shaped to form a hollow conical pedestal to support the sphere on a flat surface. In the center of this pedestal is a corked aperture used for filling the sphere. The glass has a gray cast, indicating that it is an early piece. **Dave Hirsch** gave some references on early glass, stating that the gray coloration might be an indication of "crystallization of glass." **Alan de Haas** described a B&L illuminator that used decinormal copper sulfate solution for spectral filtration.

5. **Allen Bishop** showed an early Zeiss stand with a glass stage. This was a Zeiss IV c.1900, with Abbe condenser mounted in a rack-pinion to decenter the condenser for oblique illumination. The microscope was cased, with 3 objectives. Allen brought **George Vitt's** mahogany case for his Spencer 39A polarizing microscope, having very expertly refinished it.

6. **Barry Sobel** showed a mint, and very rare, boxed Zeiss cover glass gauge. This is a cylindrical instrument, somewhat like a dial gauge. The cover glass is placed between two short steel arms projecting from the side of the case, and the thickness is read directly on the white glazed dial. Barry then related a horror

story concerning the destruction in shipment from England of a rare #254 Smith & Beck Student's microscope. The fault lay in atrocious "packing." He showed several photos illustrating the complete ruination of the instrument! It was stated that English insurance companies will insure anything, but will never pay because, presumably, they know that a client in America would not go to England to press his case. Barry then showed a marvelous large collection of prepared microslides obtained at a Christie's auction. This included both 19th century slides by noted makers as well as newer slides dating from the 1920s. Many were "accurate" slides made by the Accurate Co., that had been owned by Mr. Flatters. Some outstanding examples were whole-mount insect slides. This collection is now safely housed in a cabinet by James Howe, c.1883. Barry said that Brian Bracegirdle's book *Mounts and Mounters* was invaluable in identifying many of the mounters. He described a slide he has, made by Klaus Kemp, which consists of 1880 micro-mounted parts, depicting an artistic scene in 3-D! The 3-D is achieved by layering several cover slips, each of which contains part of the complete image. Barry related that Bracegirdle had stated that "Klaus Kemp is the best arranged slide maker who ever lived."

At this point, there was a most pleasant surprise! First, Barry presented a blow fly proboscis slide by Topping to **John de Haas**. Then, on behalf of the MSSC, Barry presented John with a small cased French microscope which was the same model as the very first microscope that John ever had! What was this special occasion? It was John's 80th birthday and the presentation was a means of showing the appreciation we all have toward John for the many altruistic deeds of his during his long association with our Society. Happy Birthday, John!

7. **Gaylord Moss** reported that he, **George Vitt, John Fedel** and **Tom McCormick** will soon have the capability of recording on CD-ROM (they are getting the rewritable version). He then told of the outstanding lectures that had been delivered, over a period of years at the Hughes Aircraft Co., by the renowned physicist, the late Richard Feinman. Gaylord related a humorous episode when during a lecture, Feinman wrote a complicated equation on the blackboard. He then said, "Let's check this out by plugging in some numbers." A murmer arose in the audience as he did some of the divisions to several decimal places in his head. He then explained the tricks he was using for those particular numbers. Murmers arose again as he took a cube root. He turned around again and said that this time there was no trick, he just took 1/3 of the logarithm and then took the antilog. He turned back to the blackboard and then back to the audience again with a wide grin saying, "of course, you have to know the log tables. Later, Gaylord described the compound eyes of trilobites of the early Cambrian period which were true doublets with the outside element an aspheric made of calcite with the optical axis oriented along the line of sight providing remarkable correction for spherical aberration. Gaylord praised the TV series "Life on Earth", narrated by David Attenborough which mentions trilobite eyes.

8. **John Field** displayed the "Last" Leitz Lieberkuhn of about 2-in diameter. It had been designed to collect the light transmitted through a translucent sample and reflect it onto its surface, giving simultaneously both incident and transmitted light capability.

9. **Alan de Haas** showed and described the very rare book, *Observations* by Bonanni, dated 1691. In it was a double-page engraving showing Bonanni's microscope (Lucernal), much ahead of its time, and resembling the configuration of a horizontal optical bench. Alan praised the value of the information contained in old books of this caliber. He recommended the antique book dealer, Krown & Spellman on Robertson Ave., L.A., stating that they had many fine books on the sciences at reasonable prices. He then commented on *Optical Essays* by Benjamin Martin.

10. **Jack Levi** showed an excellent, large mechanical engineering drawing that he had made of a photomicrographic apparatus that he is in the process of constructing.

11. **Larry McDavid** showed a B&L lensometer - an apparatus used for measuring both the optical power (diopters) and cylinder correction of eyeglass lenses. It is a quality control instrument for opticians, configured in the form of a rugged horizontal optical bench, and extremely well constructed. Larry then showed an unusual antique kerosene lamp, c.1863 with a long vertical cylindrical fuel tank which slides into a well fitted outer cylinder. All parts are nickel-plated and featured an on-off valve at the top of the tank. The lamp and its glass shade are on a fully adjustable stand. Larry then related his adventures in the altiplano of Bolivia where silver mining is conducted by manual labor at an altitude of 15,000-ft! Larry had gone there to photograph the total solar eclipse. He also said that Bill Gates is publishing, on CD-ROM, a book of Leonardo da Vinci. Larry, being a radio ham, also noted that the late King Hussein of Jordan was an avid radio ham and jet pilot. George Vitt told of photos he had seen many years ago of Hussein Foldboating in the whitewater of Colorado when he was a student in the US in the 50s.

12. **Dave Hirsch**, MSSC Treasurer, gave us a glowing account of our financial state. Dave displayed and set up for demonstration a microprojector built around an Olympus compound monocular microscope. He had modified it to include a light intensity control, main switch and indicator light. It projects an image on its own integral circular screen which is shielded, or on a wall or ceiling. It can also be used as a direct

vision instrument. The microscope is fitted with a triple nosepiece with 10x and 20x objectives and a 10x eyepiece. The unit is equipped with polarizer/analyzer and a neutral density filter, and is forced air cooled. Dave is offering the microprojector for sale. Call him at (310)397-8357 or by email at: <dlhirsch@pacbell.net>.

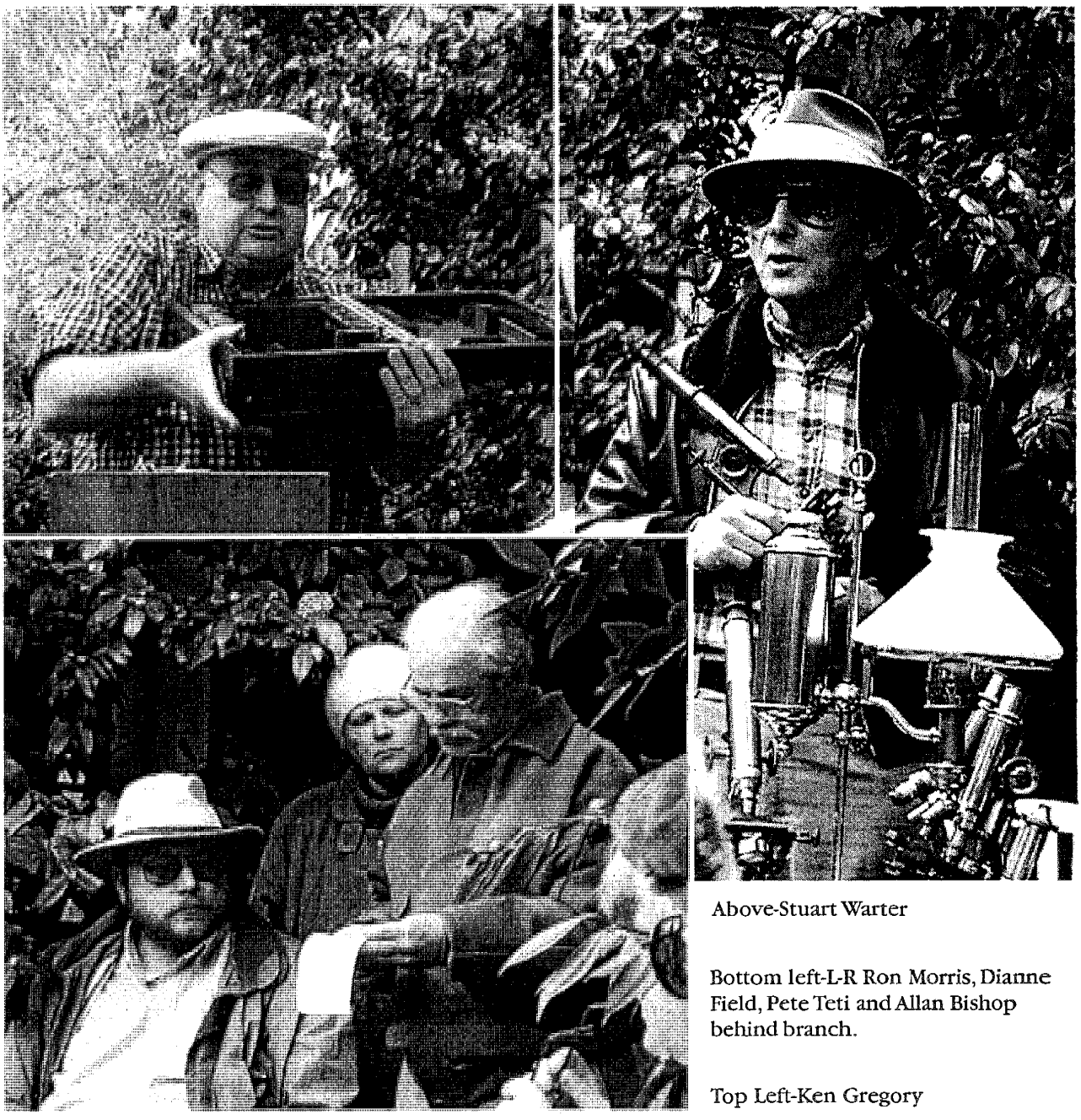
13. **Kate McDonald** told of the UCLA bookstore (Bookzone) which has periodic 25% discount sales of books.

14. **Jerry Bernstein** advised that the plastic snap covers from35mm film cans have precisely the diameter to fit the threads of objective lenses, thus providing a convenient means of keeping these lenses secure within a box container.

15. **Ed Jones** reported that Coas Co. in Las Vegas, Nevada, has a great number of books on optical crystallography and mineralogy.

The workshop was concluded at 12:20, having been enjoyed by all. We wish to thank **Mr. & Mrs. Meadows** for their fine hospitality, and also our Pete Teti for the preparation of all the refreshments, without which the Workshop undoubtedly would not be able to function properly!

February Workshop Photos by Larry Albright



Above-Stuart Warter

Bottom left-L-R Ron Morris, Dianne Field, Pete Teti and Allan Bishop behind branch.

Top Left-Ken Gregory

Longitudinal Magnification

Gaylord E. Moss

In a break from the task of developing holographic industrial systems, it once occurred to me that a magnified holographic image of a jumping spider the size of a cat would be awe inspiring, terrifying and a fun spare time project. However, as I looked at the task, I found something that I had never thought about; namely that the longitudinal magnification (that along the viewing axis) would be roughly the square of the transverse magnification. In three dimensions, my magnified spider would be distorted into a long thin shape stretching away into the distance with vastly different magnifications at each end. This nonobvious fact gets a few lines of explanation in most optics textbooks. Smith[1] gives a derivation with a "hand waving" statement that "if the thickness of the object is relatively small, then the longitudinal magnification is equal to the square of the transverse." Being curious as to the exact longitudinal magnification, I grubbed through the following derivation of the shape of the magnified three dimensional image in space. The result explains that we see such a shallow region in focus in the magnified image viewed in our microscopes because the aerial real image from the objective lens that we view with our eyepieces is immensely stretched out lengthwise in space.

Consider the side view of the optical system shown in figure 1 in which the object is a rectangle with front and back sides s and t, and with thickness w. The lens L, of focal length f, is located distance A from t and images object side t to image t* at distance B. Lens L images side s, located at distance (A+w) to s* at distance x from L. The thickness of the object is w and the thickness of the image is w*.

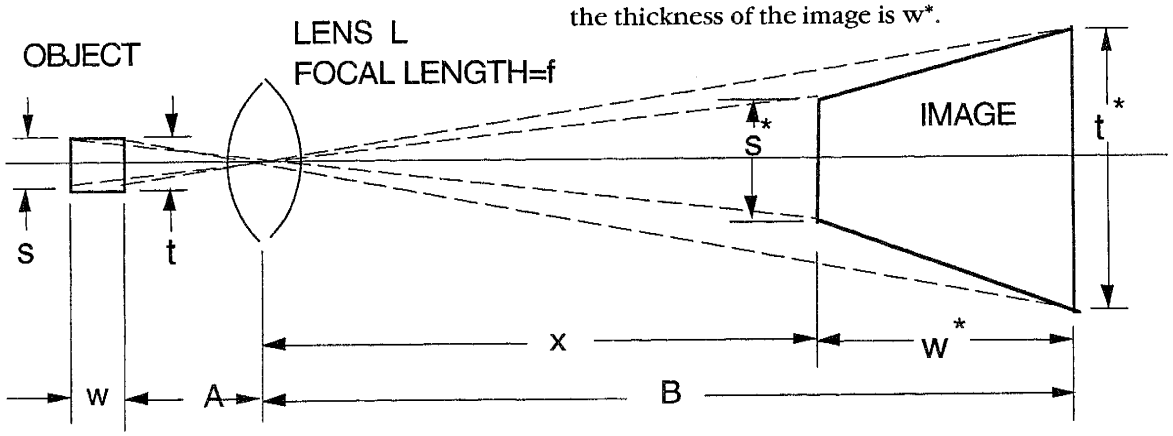


Fig. 1

By definition:

(1) The transverse magnification of side t is: $M_t = \frac{t^*}{t}$

(2) The transverse magnification of side s is: $M_s = \frac{s^*}{s}$

(3) The longitudinal magnification of side w is: $M_w = \frac{w^*}{w}$

(4) The Gaussian form of the lens equation is: $\frac{1}{A} + \frac{1}{B} = \frac{1}{f}$

Therefore from trigonometry we have the magnifications as:

(5) $M_t = \frac{t^*}{t} = \frac{B}{A} \therefore B + AM_t$

(6) $M_s = \frac{s^*}{s} = \frac{x}{A+w}$

(7) $M_w = \frac{w^*}{w} = \frac{B-x}{w}$

1. Smith WJ *Modern Optical Engineering* McGraw Hill, New York. 1966

Substituting from (5) in (4) (8)

$$\frac{1}{A}+\frac{1}{AM_t}=\frac{1}{f}\therefore\frac{1+M_t}{AM_t}=\frac{1}{f}$$

For side s, the Gaussian equation is:

$$\frac{1}{A+w}+\frac{1}{x}=\frac{1}{f}$$

Then (9)

$$\frac{x+A+w}{Ax+wx}=\frac{1}{f}$$

Substituting for 1/f into (9) from (8)

$$\frac{x+A+w}{Ax+wx}=\frac{1+M_t}{AM_t}$$

Cross multiplying

$$(x+A+w)AM_t=(1+M_t)(Ax+wx)$$

Then

$$xAM_t+A^2M_t+AwM_t=Ax+AxM_t+xM_tw+xw$$

(10)

$$x=\frac{AM_tw+A^2M_t}{A+w+M_tw}$$

Substituting (10) into (7) to find M_w

(11)

$$M_w=\frac{w'}{w}=\frac{B-x}{w}=\frac{1}{w}[AM_t-(\frac{AM_tw+A^2M_t}{A+w+M_tw})]$$

Simplifying

(12)

$$M_w=\frac{AM_t^2w}{A+w+M_tw}=\frac{M_t^2}{1+\frac{w}{A}(1+M_t)}$$

Substituting (10) into (6) to find M_s

(13)

$$M_s=\frac{x}{A+w}=\frac{AM_tw+A^2M_t}{(A+w)(A+w+M_tw)}=\frac{AM_t}{A+w+M_tw}=\frac{M_t}{1+\frac{w}{A}(1+M_t)}$$

We thus have the simple formulas for the transverse and longitudinal magnifications for a system as a function of:

1. the distance of the front surface of the object from the lens.
2. The magnification of the front surface of the object.
3. The thickness of the object.

(14) Transverse magnification of the front surface

$$M_t=\frac{B}{A}$$

(15) Transverse magnification of the back surface

$$M_s=\frac{M_t}{1+\frac{w}{A}(1+M_t)}$$

(16) Longitudinal magnification

$$M_w=\frac{M_t^2}{1+\frac{w}{A}(1+M_t)}$$

TABLE I gives calculated values using the equations of the previous page for the transverse and longitudinal magnification for objective lenses of 5, 10,20,40 and 100 power for objects varying in thickness from 1 micron to 0.64 mm.

The w column gives the object thickness in mm.The Mt column gives the stated magnification of B/A for the front surface of the object.The A column gives the object to lens distance as the tube length of 160mm divided by the magnification Mt. Ms is the calculated magnification of the distant side of the object. K is the factor in the divisor of the magnification equation for Ms and Mw. x is the distance from the lens to the image of side s.

As an example of the use of the table, consider a 40 X objective imaging an object that is 10 microns or 0.01 mm thick. Enter the table for w=0.01mm and Mt=40. From the table, we find that Ms, the magnification of the back of the object, is 36.3 with the image of the back located at 145 mm from the lens.The longitudinal magnification, Mw, is 1451. Fig. 2 shows a diagram of the example, not to scale, but with the dimensions marked.

As another example, a 0.08 mm thick object imaged by a 40x objective would have a magnification of the back side of 22, with the image located 88 mm from the lens.The transverse magnification would be 879.

Notice that, for very small objects, the longitudinal magnification approaches the exact square of the transverse. For a 1 micron or 0.001 mm thick object and a 40X magnification, the back side magnification is 39.6 and the longitudinal magnification is 1583, very close to 1600.

This analysis is, of course, only a simple approximation which assumes an infinitely thin lens and paraxial equations.

It is also interesting to note that the same equations hold for minification and may be used to describe the foreshortening of a scene viewed with a camera lens. In this case, the longitudinal magnification is still equal to the square of the transverse, but since the transverse magnification is less than one, the three dimensional image is squashed down, rather than stretched, in the longitudinal direction.

TABLE I
Longitudinal and Transverse Magnification

W	Mt	A	Ms	Mw	K	x
0.001	5	32	5.0	25.0	1.00	160
0.001	10	16	10.0	99.9	1.00	160
0.001	20	8	19.9	399.0	1.00	160
0.001	40	4	39.6	1583.8	1.01	158
0.001	100	1.6	94.1	9406.2	1.06	150
0.005	5	32	5.0	25.0	1.00	160
0.005	10	16	10.0	99.7	1.00	159
0.005	20	8	19.7	394.8	1.01	158
0.005	40	4	38.0	1522.0	1.05	152
0.005	100	1.6	76.0	7601.0	1.32	122
0.01	5	32	5.0	25.0	1.00	160
0.01	10	16	9.9	99.3	1.01	159
0.01	20	8	19.5	389.8	1.03	156
0.01	40	4	36.3	1451.2	1.10	145
0.01	100	1.6	61.3	6130.3	1.63	98
0.02	5	32	5.0	24.9	1.00	159
0.02	10	16	9.9	98.6	1.01	158
0.02	20	8	19.0	380.0	1.05	152
0.02	40	4	33.2	1327.8	1.21	133
0.02	100	1.6	44.2	4419.9	2.26	71
0.04	5	32	5.0	24.8	1.01	159
0.04	10	16	9.7	97.3	1.03	156
0.04	20	8	18.1	362.0	1.11	145
0.04	40	4	28.4	1134.8	1.41	113
0.04	100	1.6	28.4	2836.9	3.53	45
0.08	5	32	4.9	24.6	1.02	158
0.08	10	16	9.5	94.8	1.06	152
0.08	20	8	16.5	330.6	1.21	132
0.08	40	4	22.0	879.1	1.82	88
0.08	100	1.6	16.5	1652.9	6.05	26
0.16	5	32	4.9	24.3	1.03	155
0.16	10	16	9.0	90.1	1.11	144
0.16	20	8	14.1	281.7	1.42	113
0.16	40	4	15.2	606.1	2.64	61
0.16	100	1.6	9.0	900.9	11.10	14
0.32	5	32	4.7	23.6	1.06	151
0.32	10	16	8.2	82.0	1.22	131
0.32	20	8	10.9	217.4	1.84	87
0.32	40	4	9.3	373.8	4.28	37
0.32	100	1.6	4.7	471.7	21.20	8
0.64	5	32	4.5	22.3	1.12	143
0.64	10	16	6.9	69.4	1.44	111
0.64	20	8	7.5	149.3	2.68	60
0.64	40	4	5.3	211.6	7.56	21
0.64	100	1.6	2.4	241.5	41.40	4

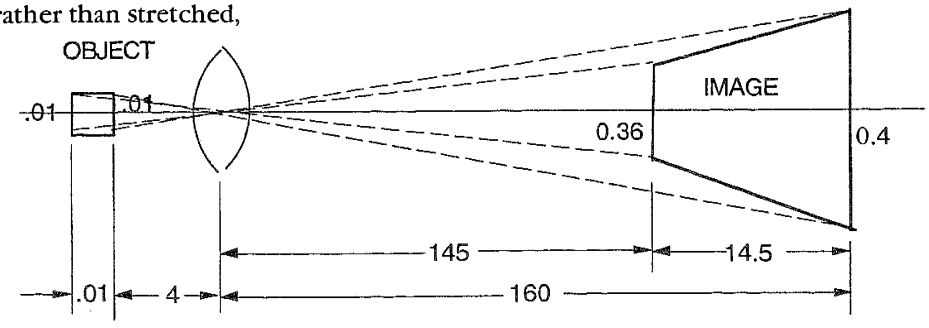


Fig. 2 Magnification Example
40x Objective lens
Object thickness is 0.01
All dimensions in mm.

THE "UNIVERSAL" MICROSCOPES OF BENJAMIN MARTIN

Barry J Sobel

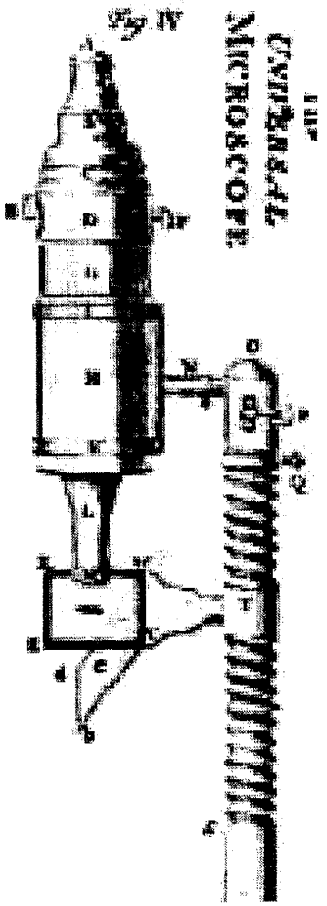


Fig. 1 First form of Martin's "Universal" Microscope

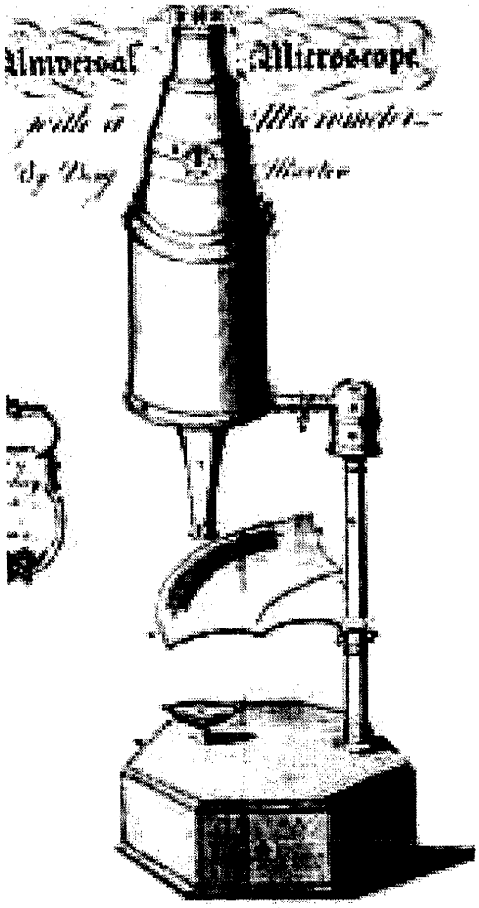


Fig. 2 Second form of Martin's "Universal" Microscope

The term "universal" implies great versatility. It is quite interesting to note how "universal" microscopes became through the centuries. Most of us would not consider a Leeuwenhoek-type microscope to be "universal." Nevertheless, Louis Joblot, designed microscopes of only slightly greater utility which he called "Universal." These instruments, still simple microscopes, had a focusing lens and a sprung slide holder but no other advance. Joblot explains in his writings that this instrument is universal in that not only can the circulation of a tadpole be visualized but that the circulation of fish can be seen as well![1]

Benjamin Martin was a self-educated man who became a schoolmaster. He went on to publish books in many fields, including a dictionary, but especially in science. He went on to become a well known lecturer and science demonstrator, as well as instrument maker. He was the first in the eighteenth century to use the term "Universal" in 1738 to describe a microscope (Fig. 1), while he was still in Sussex. Martin is well known as a maker of a variety of instruments and in many cases was an innovator. He later went on to produce a Grand orrery (for Harvard), the four lens system on the Universal Microscope after 1759, a weight driven table clock, and an instrument called the "Heliostata" which combined the functions of a heliostat and a planetary clock. In 1742, Martin published a book called *Micrographia Nova*, in which he illustrated his second version of "Universal Microscope" (Fig. 2). This instrument, was "universal" in that the arm supporting the optical tube was on a ball-and-socket joint, thus allowing the tube to be turned vertical or horizontal. He also supplied this instrument with a micrometer,

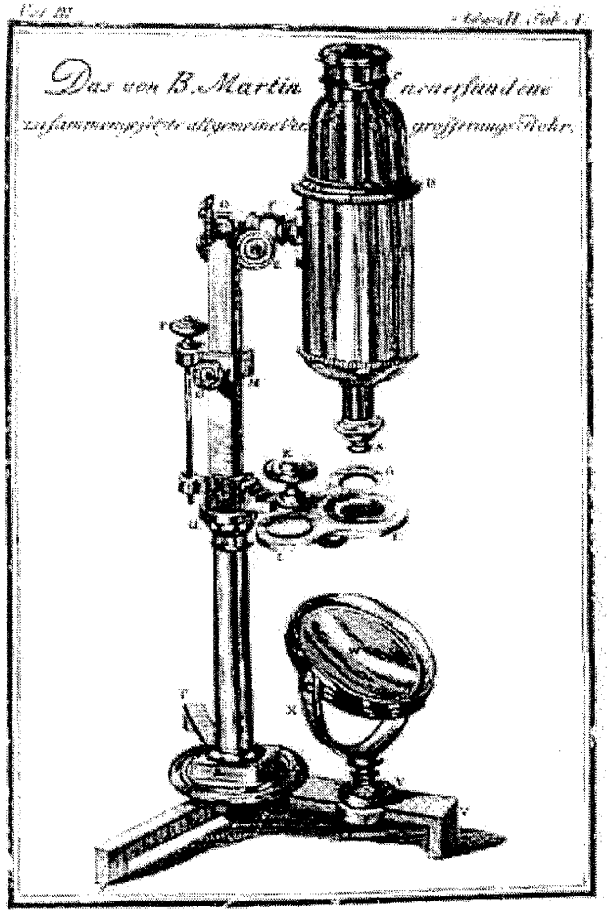


Fig. 3 Martin's all-brass "Universal Compound Microscope" of 1759.

something of a trademark on his early microscopes. By 1756, he was living in London. During his early years in London, he was apparently in fierce competition with his well-known peers not only as an instrument maker and lecturer, but also as an optician. This was particularly true in the spectacle trade where Ayscough published scathing criticisms next to Martin's own ads in newspapers of the time.[2]

He went on to produce several varieties of "Universal Microscope" which soon came to mean they could be used as simple, compound, or aquatic versions, and with both transparent and opaque objects. The "aquatic" motion allowed the arm to be moved so as to facilitate the observation of motile organisms in pond or sea water. Martin's first and second Universal microscopes were quite simplistic.

The third version of "Universal Microscope" was announced in 1752; the exact construction of this instrument is not known since no illustrations were ever published. In 1759, after moving to London, he published an engraving of his all-brass "Universal Compound Microscope" in the *Philosophia Britannica* (Fig. 3). This was his first instrument with the innovative, but, (as he admitted) not original, "between-lens." Until that time, as first described by the Italians, many

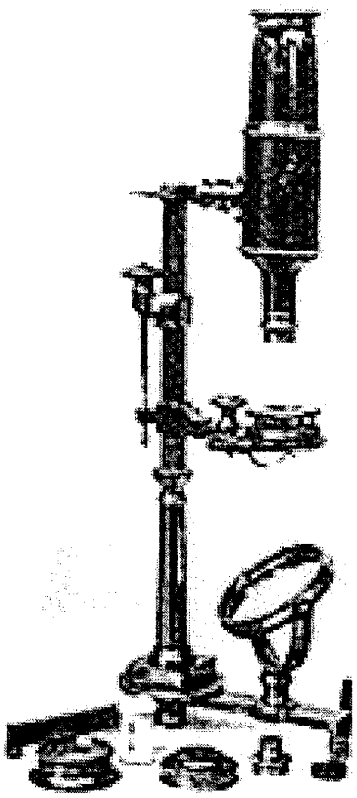


Fig. 4 Actual example of the instrument shown to the left from the Billings Collection.

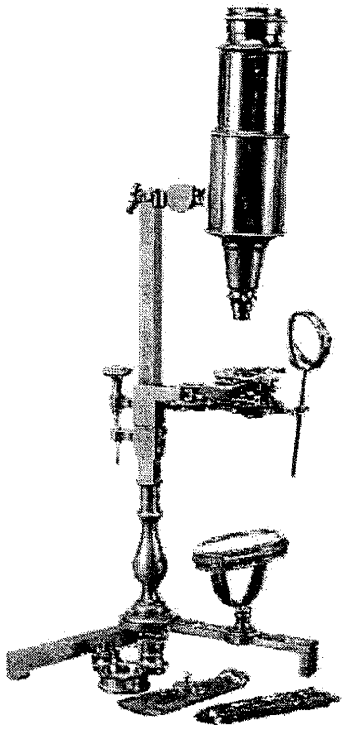


Fig. 5 The popular second all-brass version of the Martin Universal Microscope (c. 1759-67) with a between-lens, but still focusing by Helvelius'screw. Both signed and unsigned examples are known, and examples with a conical or a cylindrical shaped snout were sold.

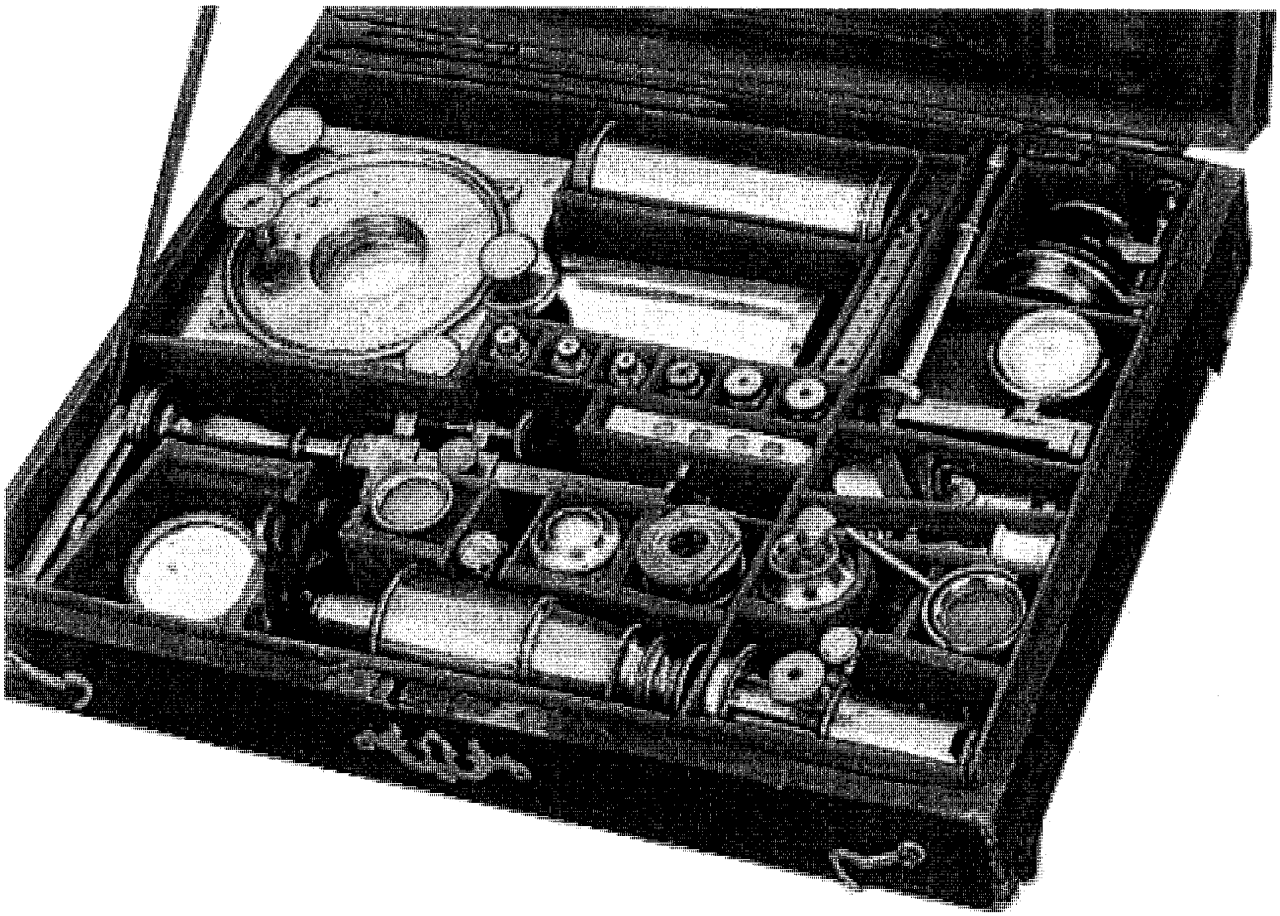


Fig. 6 Benjamin Martin compendium with compound, simple and solar microscope including the identical microscope of Figure 5.

makers used a field lens to create a larger field of view, but Martin was the first in the eighteenth century to revive the use of a "between lens." It is a planoconvex lens of long (4-5 inches) focal length which essentially forms the rear element of all the objectives. It was placed at the top of the snout which came to be known as "Martin's Pipe" because of its cylindrical form. The microscope featured a Hevelius screw-type of fine focus (as in the Cuff model of 1744), and featured a winged stage which could swivel in an arc, preserving a function found in his second universal microscope.

The next instrument (Fig.5) was a transitional one which had only minor changes, but set the stage for models to follow. Produced for sometime after 1759 and before 1768, it is virtually identical to the well documented and signed instrument sold to the famous scientist, Joseph Priestly, in 1767.[3] The compound tube could be moved fore and aft or removed completely to allow it to be packed into its relatively compact sharkskin-covered case. It could also be tilted so as to be aimed horizontally. The stage swivels and a Bonani type of slide-holder was provided which fit in the center. A fish plate fits through the keyhole to one side and a small black and white disc for opaque objects on the other side. It also accepted a bullseye condenser in front, a stage forceps on the side keyhole, and, like the Culpeper type, a vial under the stage. Like the 1759 model, it has the Cuff-type focusing using a Hevelius screw. Coarse focusing is achieved by loosening the set screw, and sliding the stage up or down, with graduations on the pillar to guide the user to a close starting point for focusing the various objectives. Once clamped at that location, the Hevelius screw is used to achieve fine focus. This instrument has a relatively short draw tube featuring a planoconvex field lens and an eyepiece with planoconvex lens and integral sliding dust cover. The between-lens, as is typical, has a long focal length and appears planoconvex with the convex side towards the eyepiece. The plano concave mirror is mounted to one of the folding feet. This instrument must date from after 1759 when Martin first started producing instruments with the between-lens. It probably dates from before 1768 when he started to use rack and pinion focusing on a regular basis. It differs from the 1759 version. Therefore, the best estimate for a date of production is circa 1760-67. Features which differentiate it from the previous instrument include the baluster-turned pillar, the round rather than square pillar base, and the fact that the knob holding the stage in place was, this time, identical to the ones which clamped the coarse focus and

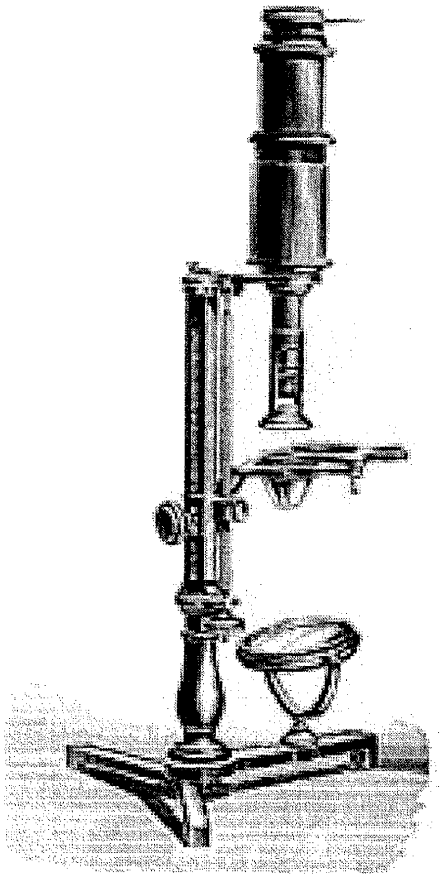


Fig. 7 Martin's "New Universal" microscope of about 1770.

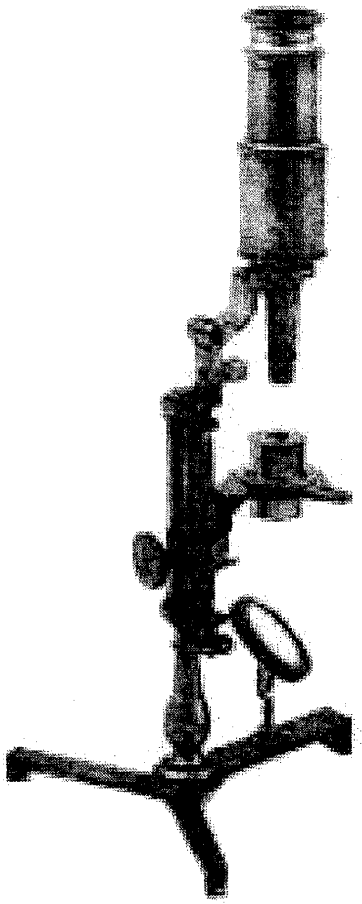


Fig. 8 Martin's "New Universal" microscope found in later optical cabinets after 1770.

held the tube assembly on the arm.[4] As can be seen in the prior instrument, this knob was different from the other two, being raised rather than relatively even with the stage after tightening. Finally, some examples of the instrument shown in Figure 5 have conical snouts, while others have cylindrical ones which accept a lieberkuhn. The former may relate to Martin's development of a lieberkuhn holder which would attach to the front of the stage, a feature found frequently in his successive "Universal" instruments and later, on the Jones "Most Improved" model. The microscope shown in Figure 5 was often supplied with his biggest and most expensive "optical cabinet" which he actually called "a portable optical apparatus." It was described at an auction after his death as "magazine case of optical instruments containing a solar microscope, a best compound ditto, a single ditto, and apparatus in a large fishskin case." An example of one of these cases is shown in Figure 6. There is a separate stand for the compound universal and another for the simple microscope. Earlier versions were supplied with a scioptic ball type solar microscope and some versions were supplied with a drum microscope instead of a Universal. Martin also made a small Culpeper type of microscope and it is possible that some compendiums were supplied with one of these but the author is unaware of such an example.

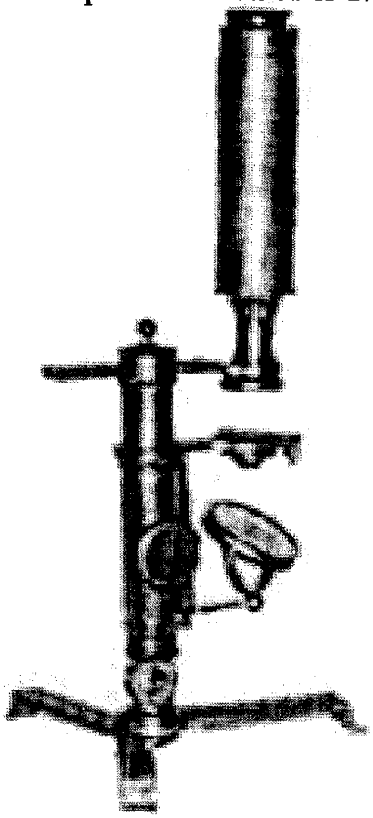


Fig. 9 Martin's "New Universal" microscope c. 1776.

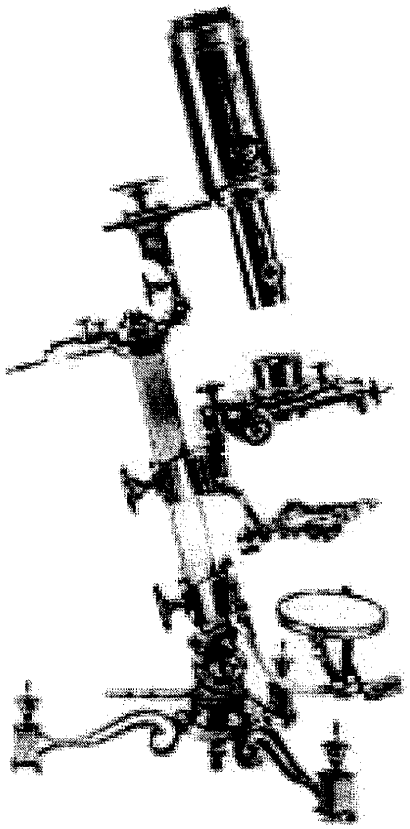


Fig.10 Martin's "Grand Universal Microscope" of about 1780.

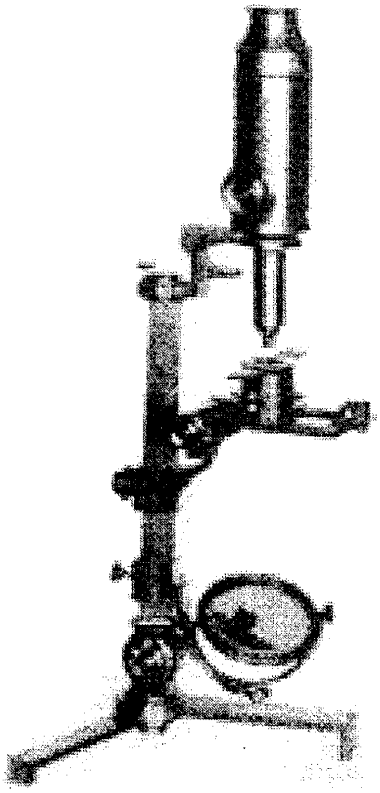


Fig. 11 Final form of "Martin's Universal Microscope" c. 1880.

Sometime before 1771, Martin claims he had invented a rack and pinion focus for his New Universal model (Fig. 7) with the rack cut in a slot inside the pillar. When it was included in a compendium, it was slightly modified and, in contrast to the earlier model, could accept a simple microscope to the same stand (Fig. 8); in the earlier compendium (Fig. 6), the cabinet included a separate stand for the simple microscope. By 1776 Martin's Universal began to resemble what would later be known as the Adams Universal, except that it inclined at the foot rather at the top of the round pillar(Fig. 9). Following this, an even more sophisticated, if not ornate version was his "Grand Universal" (Fig. 10) of about 1780, with many adjustments in different planes and direct rack and pinion focusing of the optical tube. Instead of a simple compass joint at the foot, this instrument had a worm-gear type adjustment at the bottom to control inclination. It also not only had rack and pinion adjustment to the optical tube, but also separate rack and pinion adjustments to the snout, the stage, and, riding in the same slot as the stage, the substage condenser. Even the mirror was moved up and down by rack and pinion! It was fitted with the usual aquatic movement as well. The substage condenser had two lenses. A less ornate but similar model of the "Grand Universal" type was also produced (Fig. 11). As he developed ill-health, Martin's business was turned over to others and, incredibly, by the time he died he was a poor man.

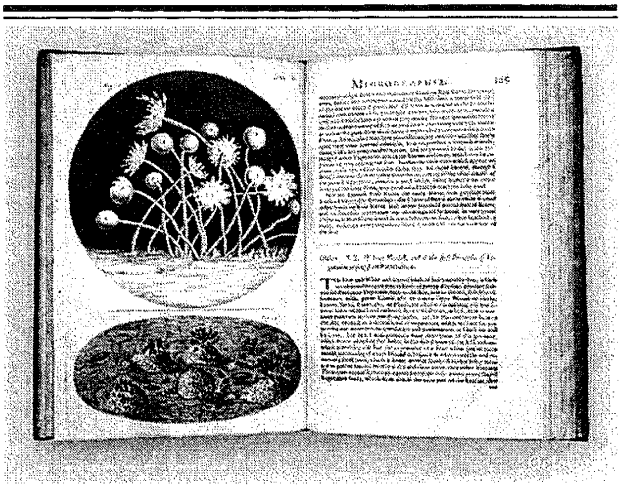
REFERENCES

1 Joblot L: *Descriptions et usages de pluseurs nouveaux microscopes, tant simples que composez...* Paris, 1718. As quoted in: Disney, A, ed: *Origin and Development of the Microscope*. Royal Microscope Standard of care. London. 1928.

2 Millburn, JR: *Benjamin Martin: Author, Instrument Maker and Country Showman*. Supplement. Vade Mecum Press, London. 1986.

3 Millburn, JR: *Retailer of the Sciences: Benjamin Martin's Scientific Instrument Catalogs*, 1756-82. Vade-Mecum Press, London. 1986, p 70.

4 This is evident when one closely examines the several extant examples of each instrument.



Micrographia on CD ROM Octavo Corp.

Member Profile

John Field

First birthday - preparing to do ? to clock.

A small town kid

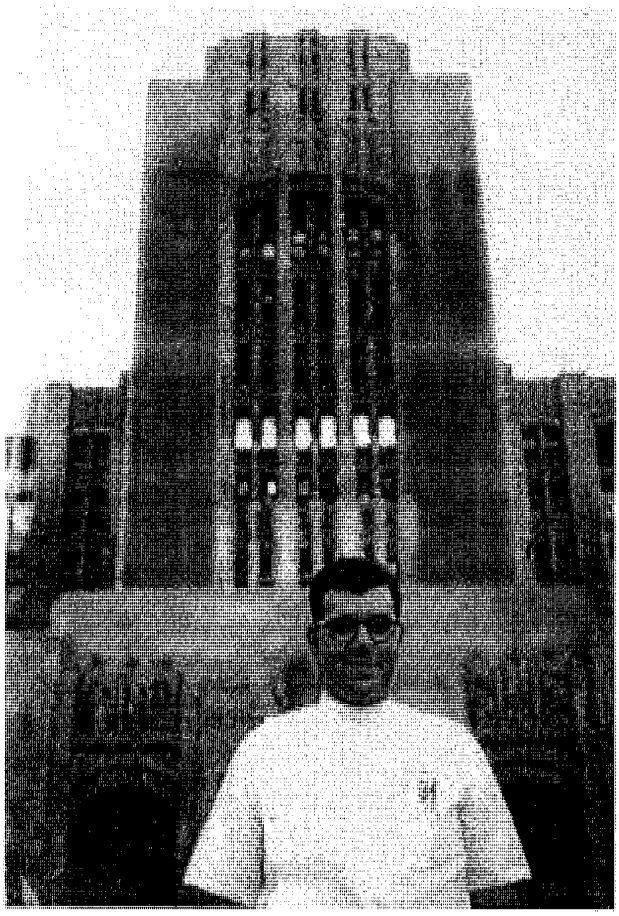
I was born in San Francisco, in the midst of the depression. In honor of my birth, my Father bought a Lionel toy electric train, which he would occasionally set up and operate for me. He gave it to me on my fifth Christmas. I believe this was my favorite toy, ever, and even today, the sight of a nice Lionel item, or even a red and blue Lionel carton gives me pleasure. I still have that train, though somewhat augmented.

I also still have my Erector set and my Stanlo construction set, for I just loved to build things and to take things apart. I was given discarded vacuum cleaners, old radios and phonographs to take apart. I remember I would make them into as many discrete parts as I could (without breaking anything), and sort the parts into various cigar boxes. Then, if I could, I would make other things from these parts; for example, I remember making a one tube radio using an O1A tube, with "A", "B" and "C" batteries; however, I had taken apart many much more elegant radios. I liked the things that I made. Of course, I had no idea, nor, I suspect, did my parents, that the discarded items I disassembled would be valued again one day by sensible people.

When I was in the fourth grade, I, with the boy and girl next door (John and Valery White) co-edited "The Hilltop Magazine." It was a very modest publication, featuring articles on our cats, simple adventure stories, and bits about World War II. The first edition of this, now rare, newspaper is particularly scarce, for each copy was individually typed. By the time we printed the second edition, we had a post-card size mimeograph, which dictated our 3" x 5" format. Illustrations were often hand water-colored, and our masthead was a red ink stamp. Many of the little old ladies in our area were willing to part with 2¢ to keep up with our news. This biweekly publication ran for over a year until the Whites moved away.

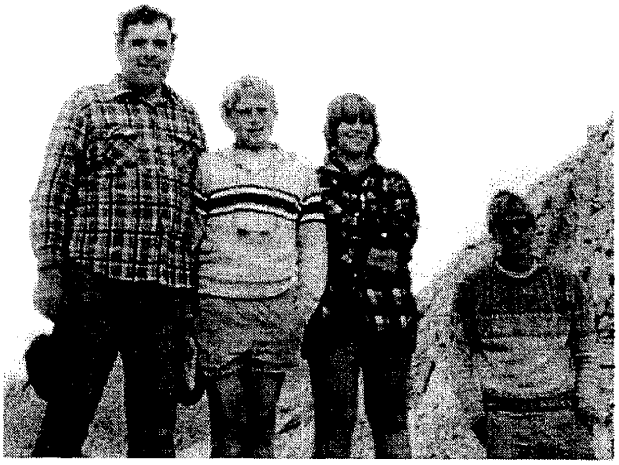
My Father grew up in Philadelphia; however, when he was 17 years old, his mother moved to Palo Alto, so that he and his sister could attend Stanford and she could keep an eye on them. They had not been enrolled in school in Philadelphia, but were taught by home schooling which turned out well. Dad read the Britannica (the 11th edition) from A to Z, straight through, and remembered much of it all his life. Once, his mother entered him in a contest, similar to what is now called an Academic Decathlon, and we still have a newspaper clipping from the Philadelphia Inquirer announcing that this contest, to which most schools had sent their best students, had been won by one John Field who had never been to school for a single day.

I remember my Father telling me about the unrest in the Stanford Student Body in the early 20's, when the tuition was raised from $15 per quarter to $20 per quarter. Of course, it is true that $20 was a lot harder to earn then. Originally, the University was free, but the endowment was not sufficient to keep it thus, and it has crept up over the years. It was not, however, the Stanfords' intent to make it expensive, but rather to attract good and serious students as a memorial to their son, who was a good and serious student.



New intern.

With children David, Johnny, Cara and first wife Wilma.



David, Cara and Johnny when children were still growing.

My Mother grew up in Porterville, California, and met and married my Father at Stanford where they were both Phi Beta Kappa. After I was born, my mother spent most of her time as a wife and mother, with little intellectual career for herself, though she was very active within the academic community. She was the most loving, kind, good and bright person, doing far more for others than she ever did for herself. She even found a new car and a bit more track for the Lionel Train during World War II. This was no mean feat, for it was completely out of production during the War.

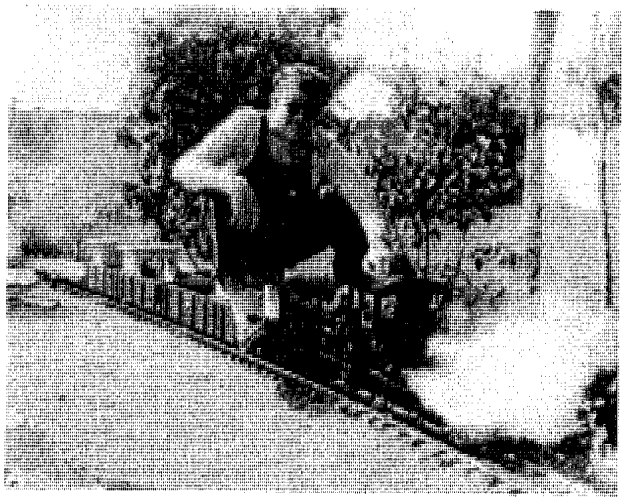
My family stayed at Stanford until 1949. It was a lovely place to grow up, though I had no idea how lucky I was until much later. I remember toddling to see the Hoover Tower being built. Then, in 1949, our family moved to Washington D.C. (Before that, I'd thought Reno was pretty far East!). This move came as I began High School, so I had the privilege of attending the Sidwell Friends School - a truly fine Quaker school (Chelsea Clinton went there, just a little after I left). Then, as I was about to start college, we moved to Los Angeles, so I enrolled in Electrical Engineering at UCLA. I still loved electrical things, and I saw some really big things to take apart there.

I always loved the steam railroads my father traveled on, though I did feel they were deficient in not having a third central rail, like my Lionel. Thus, I was happy to see that the trolley cars they had in D.C. during my high school years had a third rail with a power conductor beneath the surface, like the cable cars. So you can see why I was just as happy as I could be when, for my sixtieth birthday, Dianne arranged for me to be guest engineer on a steam railway for a day.

I was quite happy in electrical engineering and was invited to work during the summers in the Radiology Department at their, then, new Medical School. I was building instruments, and doing some simple research projects. Upon graduation, I had an invitation to join the U.S. Army, and another to stay on in Engineering to earn an M.S. degree; however, the people I worked for in Radiology suggested I consider the M.D. degree because it is very versatile - it can lead to teaching, research in many areas, public health, medical practice of all sorts, or even the military. Well, I had not thought I'd like this career previously. I remember rather disliking the apparent grade point fixation I had sensed in some pre-med's I had known. I felt that in Engineering we were much less affected by that, and also in Engineering, no one much appreciated a correct answer without the reasoning behind it. But, I had a long talk with my Father, who supported the idea of an M.D degree, and said he'd help me with finances and advice, so I went so far as to apply to two Medical Schools (U.C.L.A., and Stanford). I remember thinking that if I wasn't accepted, I could tour the world in luxury cour-

With David (6' 8") and Cara.

tesy of the U.S. Army. Well, I was accepted by both schools, so I stayed on at U.C.L.A. where I was happy, and had a tiny but warm little cottage on a lot probably now worth $1,000,000 or so. Medical School was a lot of work and I was awfully busy, but I remember being quite happy there. During those summers, I worked in an Orthopedic Research lab, again building instruments and doing simple research, and before you know it, I graduated. Now, after all these years at this academic center, I felt I ought to have a change of scene, and so I did a rotating internship at L.A. County General Hospital. Those of you in Los Angeles have all seen this monolith, though I doubt many of you have been inside it. I was very very depressed the day I walked in - big, dark, strange, and with many suffering people, often with unhappy lives. However, I quickly learned that we did quite a good job for major injuries, diabetic coma, and all sorts of medical catastrophes. I think we did a less satisfactory job on minor chronic ailments, but overall, I believe it to be a fine institution. Half way through my internship, I was not sure what I wanted to do next, but it was time to apply for a residency, if one wanted to be considered for next year. I had made a friend of the Chief Orthopedic Surgeon, who urged my to apply for his program. So, liking him a lot, I did (with the knowledge that it was no shame to leave after one year if I was unhappy). I did enjoy this program, however, and so stayed on at, and lived in L.A. County General Hospital for five years. My room was on the 12th floor, just beneath the jail, which was the entire 13th floor. During my Medical student days, I had done a project involving micro-densitometry of bone, involving a lot of microscopy, and my first experience at photography through a microscope. As a resident, I did a somewhat similar project studying viability of femoral heads after femoral neck fractures, labeling living bone with tetracycline which is a common antibiotic that fluoresces under u.v. illumination.

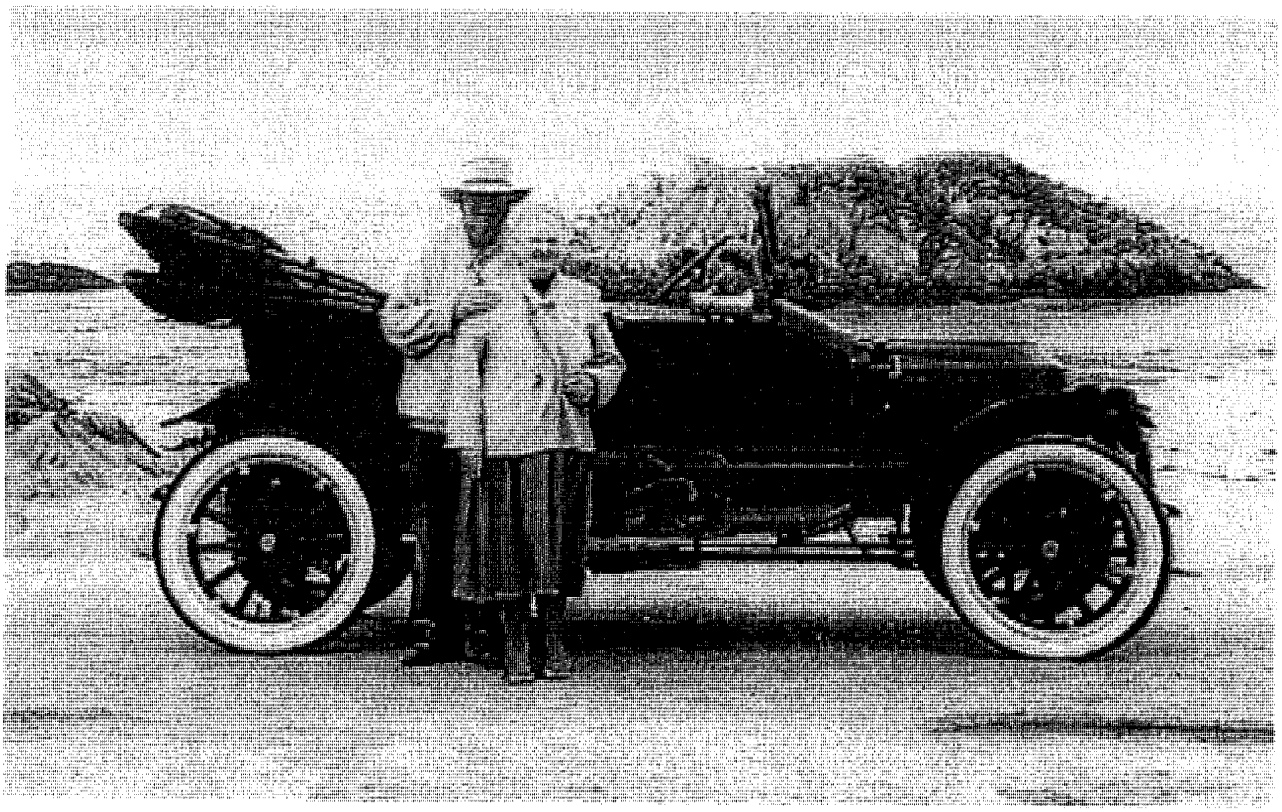


Always loved steam.

I finished my Residency at the height of the Viet Nam war and was given a definite invitation to join the U.S. Army; whereupon, I was promptly sent to Korea. I spent over a year at the 121 Evacuation Hospital, between Seoul and Inchon, practicing Orthopedic Surgery - a very good experience. I often rode in helicopters in Korea and we could hear combat radio conversations from Viet Nam on our helicopter radios when we were in the air. We did not have many real war injuries there, but with 50,000 U.S. troops then in Korea, we had lots to keep us busy, including occasional gunshot injuries, and an abundance of land mine injuries and vehicle accidents. I have never been back, but it would be very interesting to see the Far East again.

Well, after two years with the U.S. Army, I was discharged, newly married, and free to go wherever we wished. We arbitrarily picked Santa Cruz, California, believing it to be a lovely town, with a fine climate, and thinking they needed one more Orthopedic Surgeon. I have never regretted that choice, and my three fine children-all now grown, away, and independent-are very fond of their home town. I think that they, like I, grew up in a very nice environment.

Microscopy has been a small part of my life for a long time. In fact, when I was quite small, my Father bought a used Leitz microscope so that we children could all study the micro world. We all did, to some degree, and I had my own box of slides, which I built up. For some reason, the one I remember best was a bit of red cloth, nicely mounted, and I would admire how well it was woven, and how each thread was woven of so many smaller strands. When I began Medical School, I bought a new Zeiss Junior which was easy to carry about. It served me well for those years; however, upon graduation, I sold it to an incoming freshman. I could always use instruments at the hospital whenever I wanted, and had no need for an instrument of my own, nor did I have any thoughts or time for non-medical microscopy.



Always loved steam. John and Dianne and 1914 Stanley.

Probably fifteen or so years ago, while browsing through a "Silicon Valley" "surplus joint" I saw a Leitz Ortholux microscope and it reminded me that I had enjoyed very much using this model instrument during my fellowship one summer at the Argonne Laboratory. Well, as a youth, I built a Heathkit oscilloscope, never dreaming I might later afford Tektronix instruments, so until that day I never even thought I might own something such as an Ortholux. Seeing my admiration for this instrument, the proprietor lowered the price to compensate for the fact that it was down to just two objectives, the other two having left the store in peoples' pockets, he said. I brought it home, not realizing at first that it had an odd Zeiss stage which was held in place with 6-32 screws! It had no condenser, nor the (hard to find) condenser bracket. It was rather sad, actually. I began to visit, and make friends with, several local used microscope dealers, who helped me, and even came down to Southern California for some parts, and literature. Gradually, I learned much more about this instrument, and as I gathered parts and literature, began to realize what a fantastic "compendium" of equipment Leitz had made for this instrument, during its catalogue lifespan of 1937 through 1972. I added whatever I could, as I found them, until I had most of the phase contrast, interference contrast, spectral, polarizing, photographic, and other attachments they had offered for the Ortholux. As my contacts grew wider, I found items I initially never dreamed I might own.

Slowly, I was not just making a good outfit for microscopy, I was assembling a museum of just about all Leitz ever made for the Ortholux and its associated literature. Then, slowly, beginning with one magnificent "SY" Pol scope, I began to add other Leitz instruments, and, products other than just microscopes, and associated literature. It is quite an undertaking and I have had a good deal of success. I have been able to keep myself restricted to just Leitz, for there must be some limit to the breadth, bulk, and expense of this collection. I have been good about this limitation, with just a very few exceptions, such as another instrument from Wetzlar, or items made to go with Leitz equipment.

My parents spent the rest of their lives in Southern California (Brentwood and then Pacific Palisades), and my siblings are still there. As I learned more about general microscopy and learned of, and attended our club meetings, I would plan family visits to coincide with meetings. I am very grateful to this group, for many of you have become among my best friends; you have taught me so much about microscopy, and, most important of all, it was at our club that I met my beloved second wife, Dianne, and, as most of you older members remember we were married in conjunction with the Club's 1993 Christmas Party. Thus I can most truthfully say that this hobby, and this Club, have been a very major source of my life's happiness.

My parents have passed on, and though one brother still lives in the Palisades, we get South less than we did in years past. However, Dianne has now retired, and I am retiring June 29, 1999 and so we do hope, after that date, to be down South much more during MSSC activities. We plan to move back to Santa Cruz, as of June 30, 1999, and to finally get organized. I am hoping to write a history of the Leitz Microscope, at least during the period of Leitz family ownership (up until about 1972).

MSSC March Meeting

Wednesday, March 17 at 7 PM
Crossroads School
1714 21st Street
Santa Monica, CA

Microscopical Swap Meet

We have been besieged with requests for a mechanism for ridding ourselves of
items and belongings, somewhat microscopical, or not, with the possibility of
fungible compensation.
In short....A swap meet!
Yes! Bring items to trade, sell, brag about, EBaY mistakes? What a chance to pass them on to a needy person. We will get tables and some price labels! Just bring the stuff, and don't be bashful..we won't ask why you paid good money
for such a silly item. "er...how much is it? The first half of our Wednesday meeting
will be the <swap meet>. The second half will provide an opportunity to show
slides by members. Bring anything you would like to share..

Preview Notice
May 19
Annual Pond Life Meeting

This is one of the most exciting evenings of the year. Last time, we had over 40 microscopes set up including one with a video camera. Bring your own and your favorite scummy water. See what animicules others have brought. Check out other microscope systems in action. Plan ahead so as not to miss this evening.

Editor's Notes

I would like to thank those who have responded to the plea for articles and profiles for our Journal. Please keep them coming. Special thanks to John Field this month for taking the time to do the difficult task of writing a profile. Also, to Dave Hirsch and Barry Sobel who have contributed heroically far beyond the call of duty. Also, the pictures in this issue and for several past owe their quality to George Vitt's exceptional skill with Photoshop and ability to go nights without sleep to make astounding improvements on weak images. Thanks all.

Gaylord Moss

Saturday Workshop - April 3 9AM

At the home of
Marj and Ernie Meadows
707 Greentree Rd.
Pacific Palisades, CA 90292
310-459-4788