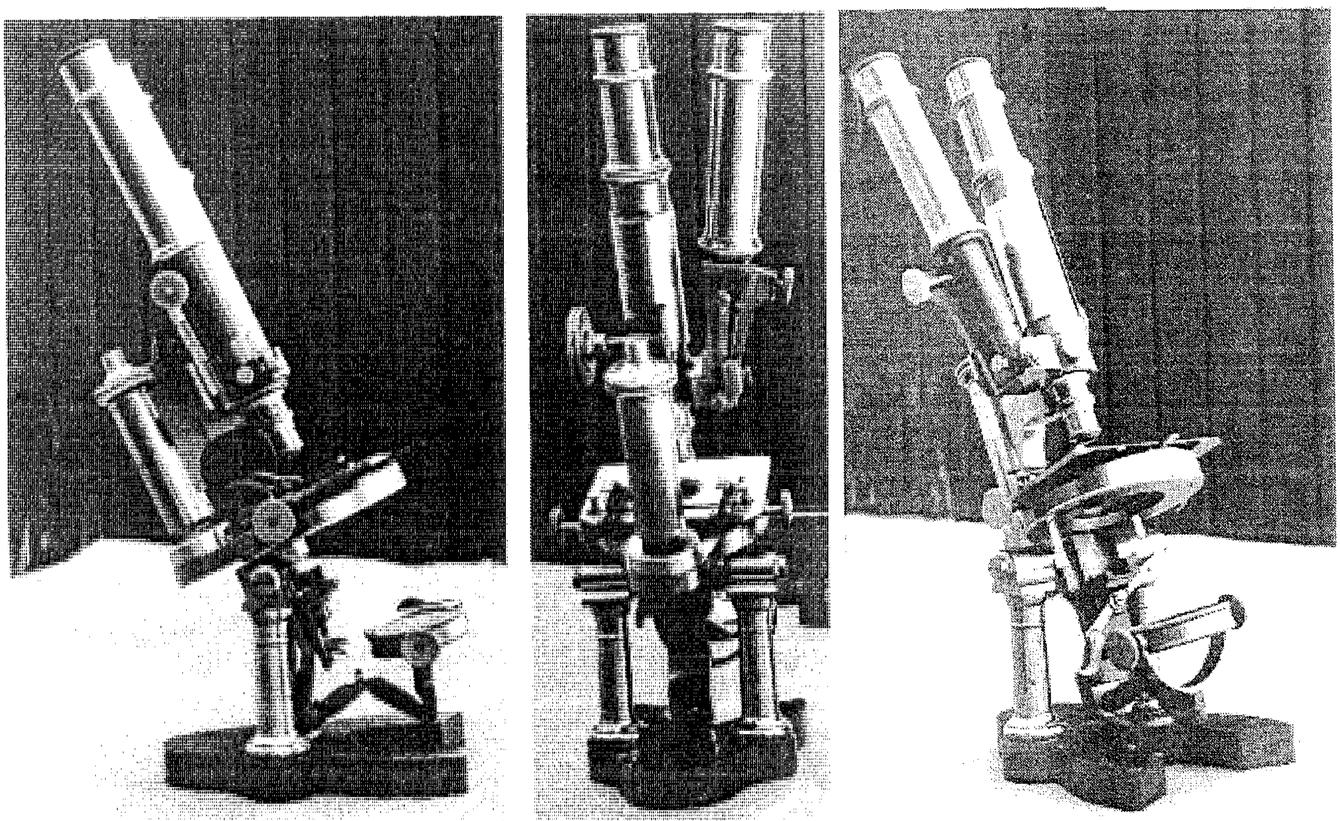
Journal of
THE MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA
Volume 2 Number 10 October 1997

NACHET MICROSCOPE GRAND MODELE

An Early 3-D Binocular Microscope

David L. Hirsch



Nachet Microscope Grand Modele

In the 18th and 19th centuries, English, French and German instrument makers produced microscopes which represented the cutting edge of technology for those periods. Brass and glass, two of the essential materials used in the making of optically oriented scientific instruments, were developed to the extent that the concepts of artistry and aesthetics embodied in instruments fabricated during earlier periods were able to be replaced by technically practical devices. The processing of glass under controlled conditions produced lenses which were of a quality much improved over those made earlier. The same held true for brass, an alloy of copper and zinc, the properties of which could now be controlled through proportioning the amount of base metals making up the brass alloy. The physical properties of the alloy could be further controlled by heat treatment. A major breakthrough in metal processing took place when techniques were developed for the manufacture of drawn tubing, which dramatically enhanced the state of the art of instrument making.

In Paris, France, within the 18th to 19th century time frame, there were four leading microscope makers: the Chevalier family; and Hartnack, Oberhauser and Nachet. In 1839, Camille Sebastien Nachet (1799-1881) was making objectives for Chevalier before he left to work on his own account. He established his shop in Paris at 16 rue Serpente. His early stands were of the Oberhauser pattern, consisting of a brass cylinder with the stage at the top, a cut-out for the light to reach the mirror and a fixed pillar holding the tube - a variation of Benjamin Martin's drum microscope. The mirror could be rotated only on an horizontal axis, so oblique pencils of light could not enter the object; a disadvantage when used with improved, wider angled objectives.

In 1862, Nachet et Fils (Nachet and Sons) was located at 17, rue Saint-Severin. In the same year, Nachet introduced the new no.1 "Microscope Grand Modele." The stand had a horseshoe foot, supporting two pillars that bore the axis on which the rest of the instrument was hung. This showed the influence of the English makers, Powell and Ross, and especially the Ross model of 1843.

Attesting to the quality of Nachet products, Henri van Huerck, in the fourth edition of his *Le Microscope*, published in Brussels in 1891 states: *"M. Nachet is, at the present time, the oldest maker in France, and thanks to the continuous progress in his factory, he maintains his position in the front rank. Indeed, with this manufacturer, it is not the maker who predominates but the microscopist, a man of research, the artiste. While holding the first place among continental makers, he has appreciated the merit of English instruments; in addition to his simple and low priced, but, nevertheless, good microscopes, he furnishes instruments, which for perfection, elegance and finish of the brass-work, rival the instruments of our (English) neighbors over the sea. Like Charles Chevalier, M. Nachet is a savant who is thoroughly conversant with all the resources of optics and mechanics. His inventions are numerous and have been much appreciated by microscopists. His microscopes are of various forms; he has unique models for special use - chemistry, petrology, college demonstrations, & c."*

Maison Nachet catalogs, from 1854 to 1910 are compiled as reprints in book form, published by Editions Alain Brieux, Paris (1879). The Maison Nachet catalogs are printed in French, with the exception of an 1889 issue printed in Russian, featuring the French exposition held in Moscow. The microscope discussed in this article, is shown and described in the June, 1881 Maison Nachet catalog: *"Catalog Descriptif des Instru-*

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ments de Micrographie". Figures 2 and 3 show the boxed Nachet microscope of Figure 1.

The following selection from the Nachet catalog: was translated from the French by Leon Stabinsky.

l. Large, Perfected (improved) Microscope Model. Complete monocular and binocular, suspended on an axis in such manner as to be able to incline it and allowing it to remain fixed in all positions between the horizontal and the vertical; of solid construction and precision for all movements and centering. Focusing adjustment is performed by the rapid movement of a rack and pinion and soft (precision) adjustments by means of a micrometric screw; the former acting on the column holding the body, the latter very delicate and specifically attached to the tube holding the objectives and situated in such a manner so as to establish constant elasticity on the objective tube in case of pressure application on the slides.

The stage can be rotated, and is equipped with a screw activated table in order to move the objects without touching them; two sections perpendicular to each other allow the determination of the coordinates so as to reestablish a given point on the prepa-

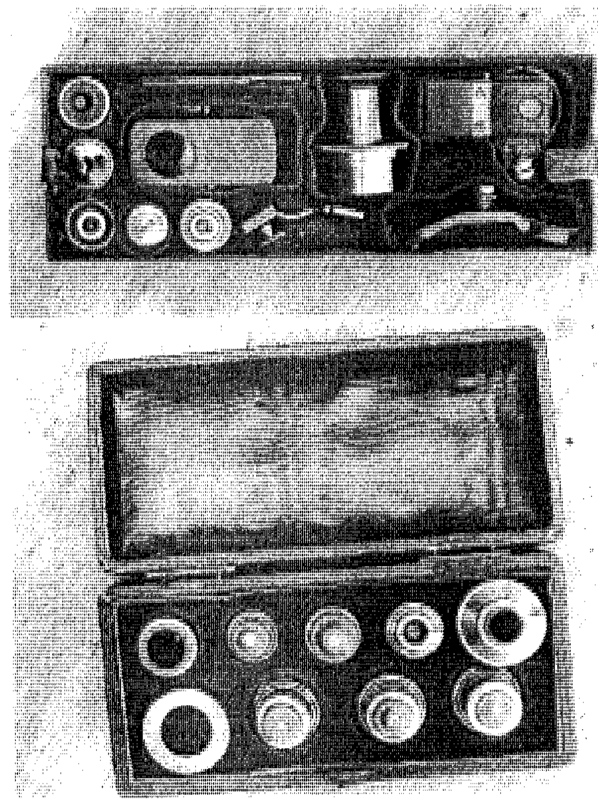


Fig. 2 Accessories from box of Fig. 3

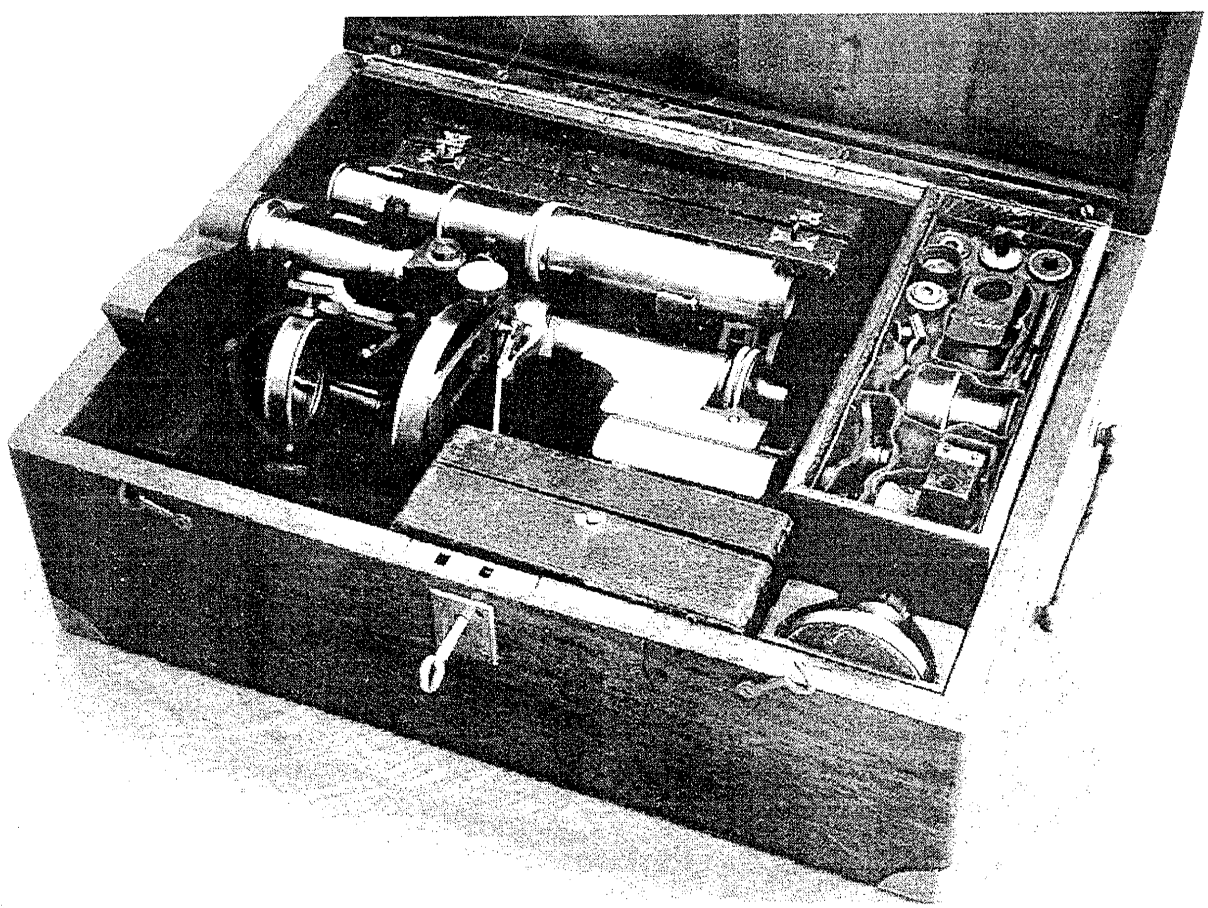


Fig. 3 Nachet microscope compendium.

ration. This stage is equipped with an inlaid glass plate to resist damage resulting from chemical reactions.

Lighting is obtained by means of a double sided mirror, flat and concave, mounted on a joint allowing it to move in all directions in order to obtain the effect of oblique lighting. A system of vertical grooves located between the mirror and the stage allows, with the aid of a lever, to move the diaphragm and to put onto focus, with the greatest precision, condensed lighting. Micrometric apparatus to allow lateral movement of the focusing micrometer in the objectives; the division can be located precisely in the eye's focus by the optional distancing of the upper lens and be located in all points in the field of vision.

Collection of ten objectives nos. 1,2,3,4,5,6,7 and 8 dry, these last three mounted with correction and nos. 9 and 11 with correction and immersion, giving 5 to 3150 diameter magnification. 4 objectives. Improved binocular apparatus. Goniometer to measure crystal angles. Clear chamber - Correcting prism. Polarization apparatus with gypsum sensitive slides (?). Direct condenser with large opening with a centering stage movable with two screws. Dark field illumination. Micrometer eyepiece. Micrometer objective (100th of a millimeter?). Long focus lens mounted on the base to illuminate opaque objects. 25mm focal length bullseye on weighted base.

Preparation accessories: glass slides, thin slides. Dissection instruments: needles, scalpels, scissors, fine tweezers, etc., etc. This instrument is contained in a strong mahogany box, the interior being velvet lined and the exterior with copper corners. The lenses are contained in a leather box, the accessories in special compartments .... 1800 Francs.

The 'Grand Modele Perfectionne' as described in the 1881 Nachet catalog mentions the binocular body tube assembly. For additional information, other books were consulted, such as the 1883 edition of *The Microscope and its Revelations*, by William B. Carpenter, from which a major portion of the following text was derived. The binocular assembly is among the most important items included with the microscope set, and for this model, is referred to as "Nachet's Stereo-pseudoscopic Microscope." Actually, Nachet had been manufacturing stereoscopic microscopes as shown in his catalogs of 1854, 1862, 1872, 1881 and on. Two versions of stereoscopic binocular assemblies are: the stereoscopic binocular from Nachet's 1862 catalog, and the pseudo-stereoscopic assembly, an improvement over the 1862 version, and first shown in the Nachet 1872 catalog.

THE THREE-DIMENSIONAL IMAGE.

An understanding of three dimensional, or stereoscopic imaging is essential in determining how a person, looking at an object with both eyes, can see the object 'in depth'. What is the rationale behind the stereoscopic effect? The unaided eyes (with or without corrective lenses) focus upon a solid object and enable that object to be seen in depth. Due to interpupillary separation, each eye sees the object from a slightly different aspect. The stereoscope, invented by Professor Wheatstone, and later refined by David Brewster," allows 'conjoint' use of both eyes in conveying to the mind a notion of the solid forms of objects, such as the use of either eye singly does not generate, with the same certainty or effectiveness."

By definition, a stereoscope is: "an optical instrument with two eye glasses for helping the observer to combine the images of two PICTURES taken from points of view a little way apart and thus to get the EFFECT of solidity or depth." Although the objects appear to 'stand out', they will not change position relative to other objects in the same scene when the eyes, the stereoscope or the pictures are moved in their respective planes of reference. By way of example, when you look at the scenery from a moving car, distant objects will not only appear in depth, but will also appear to shift position with time, relative to other nearby objects when seen from the moving vehicle.

Conversely, when looking through a modern stereo-binocular microscope at an actual object having solidity and depth, you see a TRUE, magnified image of that object. Modern stands have separate pairs of matched eyepieces and objectives, in contrast to the optically less effective dual eyepiece/single objective types developed by Stephenson, Wenham, Nachet et.al.

Binocular vision is a prerequisite for Stereoscopic, or 3-D imaging. All vision depends initially on the formation of a picture of the object upon the retina of the eye, just as a view camera forms a picture on the ground glass plate. But, the two images that are formed by the two eyes respectively, of a solid object that is placed a short distance in front of them, are far from being identical; the perspective projection of the object varying with the point of view from which it is seen. To show this, hold a thin book in such a position that its edge is at a short distance in front of the nose. Look at the book, first with one eye and then with the other. Note that the two views obtained are different, so that if you were to represent the book as actually seen with each eye, the two pictures would not correspond. On looking at the object with two eyes conjointly, there is no confusion between the images, nor does the mind dwell on either of them singly. From the blending of the two, a conception of a solid projecting body results, such as could only be otherwise acquired by the tactile sense.

Now, instead of looking at the solid object itself, we look with the right and left eyes respectively at pictures of the object, corresponding to those which would be formed by it at the retinae of the two eyes if it were placed at a short distance in front of them. When these visual pictures are brought into coincidence, the same concept of a solid projecting form is generated in the mind, as if the object itself were there.

The stereoscope simply serves to bring to the two eyes, either by reflection from mirrors, or by refraction through prisms or lenses, the two dissimilar pictures which would accurately represent the solid object as seen by the two eyes respectively; these being thrown simultaneously on the two retinae in the precise positions they would have occupied if formed there from the solid object, of which the mental image (if the pictures have been correctly taken) is the precise counterpart. This is illustrated by Figs. 4(A,B) and 4 (C,D)

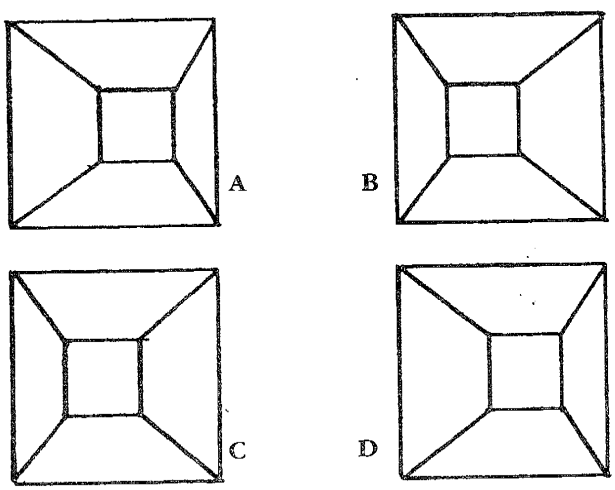


Fig 4. Stereoscopic Imaging

Stereoscopic vision is possible without the aid of a stereoscope. Each set of figures indicated in Fig. 4 constitute a stereoscopic pair (of pictures). To achieve the three dimensional effect, the following procedure applies: Relax your eyes, as if looking at a far distant object. Bring the illustration close to the eyes, then back it off slowly until a central image appears. This image will then show up in depth. Try it with figures 4(A,B) and 4(C,D).

Figure 4(A,B), when combined in the stereoscope, suggest the idea of a projecting truncated pyramid, with the small square in the center, and the four sides sloping equally away from it. Conversely, in the pair 4(C,D), (which are identical to the upper, but are transferred to opposite sides), the real conception of a 'receding' pyramid is shown, still with the small square in the center, but the four sides sloping equally towards it.

Thus, by simply 'crossing' the picture in the stereoscope, to bring before each eye the picture taken for the other, a 'conversion of relief' is produced in the resulting solid image; the projecting parts being made to recede and the receding parts brought into relief. In like manner, when several objects are combined in the same crossed pictures, their apparent relative distances are reversed; the remoter being brought nearer, and the nearer carried backwards. For example, a stereographic photograph of a person standing in front of a car will, by crossing of the picture, make the figure appear as if it were embedded in the car body. A like conversion may also be made in the case of actual solid objects by the use of the "Pseudoscope," another instrument devised by Professor Wheatstone, which has the effect of reversing the perspective projections of objects seen through it by the two eyes respectively; so that the interior of a bowl, for example, is made to appear as a projecting solid, while the exterior is made to appear hollow.

Hence, it is customary to speak of stereoscopic vision as that in which the conception of the true natural relief of an object is called-up in the mind, by the normal combination of the two perspective projections formed of it by the right and left eyes respectively. While by 'pseudoscopic vision, we mean that 'conversion of relief' which is produced by the combination of two 'reversed' perspective projections, whether these be obtained directly from the object (as by the pseudoscope), or from 'crossed' pictures (as in the stereoscope). Not every solid object, however, or every pair of stereoscopic pictures, can become the subject of this conversion. The degree of facility with which the 'converted' form can be apprehended by the mind, changes the readiness with which the change is produced, and while there are some objects - the interior of a plaster mask of a face, for example - which can always be converted (or turned inside - out) at once, there are others which resist such conversion. An interesting phenomenon that occurs when a person walks past such an inverted mask is that the eyes in the mask appear to be "following" the person.

What is needed to give true stereoscopic power to the microscope, is a means of so bisecting the cone of rays bisected by the objective, that of its two lateral image halves, one shall be transmitted to the right and the other to the left eye. If, however, the image thus formed by the right half of the objective of a compound microscope were seen by the right eye, and that formed by the left half were seen by the left eye, the result would not be stereoscopic but pseudoscopic, the projecting parts being made to appear receding, and vice versa. (See Fig.5A)

The reason for this is that THE MICROSCOPE ITSELF REVERSES THE PICTURE, the rays proceeding through the right and left hand halves of the objective must be made to cross to the left and right eyes respectively, in order to correspond to the direct view of the object from the two sides; if this second reversal does not take place, the effect of the first reversal of the images produced by the microscope exactly corresponds with that produced by the 'crossing' of the pictures in the stereoscope, or by that reversal of the two perspective projections formed direct from the object, which is effected by the Pseudoscope. It was from a want of due appreciation of this principle , that the earlier attempts to produce a 'Pseudoscopic Binocular Microscope tended rather to produce a 'pseudoscopic conversion' of the objects viewed by it, than to represent them in their true relief.

NACHET'S STEREOSCOPIC BINOCULAR.

The first nearly satisfactory solution of the problem of stereoscopic imaging was worked out by M.M. Nachet; whose original binocular was constructed on the method shown in figure 5A.

The cone of rays issuing from the back lens of the objective meets the flat surface of the prism (P) placed above it, whose section is an equilateral triangle; and is divided by reflection within this prism into two lateral halves, which cross each other in its interior. The rays (a,b) that form the right half of the cone, impinging very obliquely on the internal face of the prism, suffer total reflection, emerging through its left side perpendicularly to its surface, and therefore undergoing no refraction; while the rays (c,d)forming the left half of the cone, are reflected in like manner towards the right. Each of these ray bundles is received by a lateral prism, which again changes its direction, so as to render it parallel to its original course; and thus the two halves (a,b) and (c,d) of the original ray bundle are completely separated from each other, the former being received into the left-hand body of the microscope and the latter into its right hand body. These two bodies are parallel; and by means of an adjusting screw (C) at their base (Fig. 5B) which alters the distance between the central and the lateral prisms, they can be separated from, or moved towards each other, so that the distance between their axes can be brought into exact coincidence with the distance between the axes of the eyes of the individual observer, allowing for interpupillary adjustment.

This instrument gives true stereoscopic projection to the image formed by the mental fusion of the two distinct pictures; and with low powers of moderate angular aperture its performance is quite satisfactory. There are, however, certain drawbacks to its general utility. First: every ray of each bundle suffers two reflections, and has to pass through FOUR surfaces; this necessarily involves a considerable loss of light, with a further degradation of the image by the smallest inaccuracy in either of the prisms. Second: the mechanical arrangements needed for varying the distances of the prisms involve an additional liability to misalign-

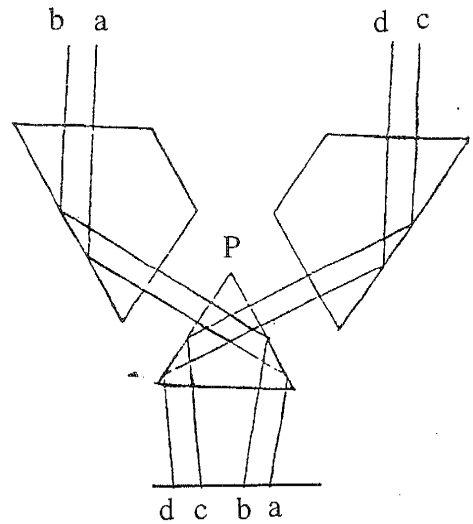


Fig. 5A Arrangement of Prisms in Nachet's Stereoscopic Binocular Microscope

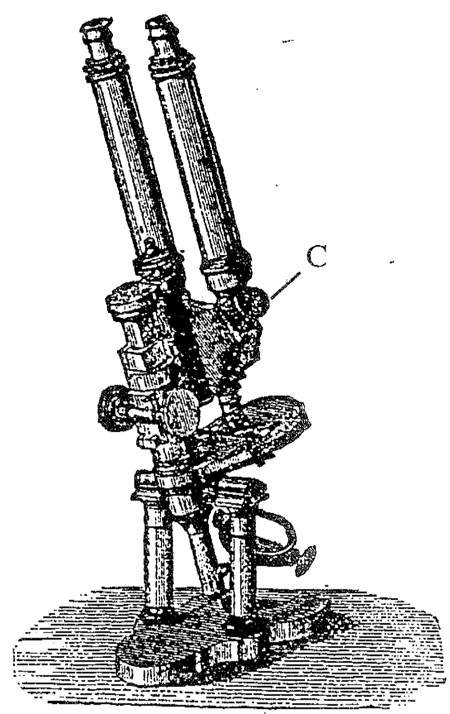


Fig. 5B Nachet's Stereoscopic Binocular Microscope

ment in the adjustment of the prisms. Third: the instrument can only be used for its own special purpose: so that the observer must also be provided with an ordinary monocular microscope, for the examination of objects unsuited to the (relatively low) powers of the Binocular. Fourth; the parallelism of the bodies involves parallelism of the axes of the observers eyes, which is fatiguing if maintained for any length of time

NACHET'S STEREO-PSEUDOSCOPIC BINOCULAR.

Nachet introduced an ingenious modification of Wenham's arrangement. It had the unusual attribute of giving to the image either its true stereoscopic projection, or a pseudoscopic 'conversion of relief', at the will of the observer. This was accomplished by the use of two prisms shown in figure 5. One of them, A, Fig.(5-1) placed over the cone of rays proceeding upward from the objective, and the other, B, Fig. (5-1) at the base of the secondary or additional body, which is here placed on the right. The prism, A, Fig.(5-1) has its upper and lower surfaces parallel; one of its lateral faces is inclined at an angle of 45 degrees, while the other is vertical. When this is placed in the position, Fig.(5-1), so that its inclined surface lies over the left half (L_1) of the cone of rays, these rays, entering the prism perpendicularly (or nearly so) to its inferior plane surface, undergo total reflection at its oblique face, and being thus turned into the horizontal direction, emerge through the vertical surface at right angles to it. They then enter the vertical face of the other prism, B, and, after undergoing reflection within it, are transmitted upwards into the right hand body as (L_2), passing out of the prism perpendicularly to the plane of exit, which has such an inclination that the right hand or secondary body Fig.(5-1) may diverge from the left or principal body at a suitable angle. a

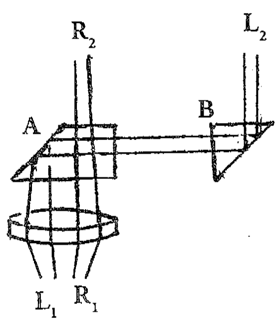


Fig. 5-1 Stereoscopic effect

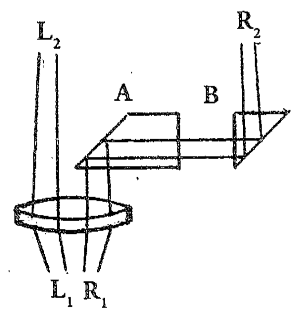


Fig. 5-2 Pseudo-stereoscopic effect

Fig. 5 Arrangement of Prisms in Nachet's Stereo-Pseudoscopic Binocular Microscope

On the other hand, the right half (R_1) of the cone of rays passes upwards, without essential interruption, through the two parallel surfaces of the prism (A), crossing beam (L) in the interior of the prism and emerging to the left as (R_2).

If the prism A, Fig. 5-1, is pushed over toward the right so as to leave the left half of the objective uncovered as shown in figure (5-2), then the left half (L_1) of the cone of rays will go on without interruption into the left-hand body as (L_2), while the right half (R_1) will be reflected by the oblique face of the prism (A), into the horizontal direction, will emerge at its vertical face and, being received by the second prism (B), will be directed by it into the right hand body as (R_2). Now, in the first position, the two halves of the cone of rays being made to cross into opposite bodies, true stereoscopic relief is given to the image formed by their recombination, as in the arrangements previously described. But when, in the second position, each half of the cone passes into the body of its own side, so that the reversal of the images produced by the microscope itself is no longer corrected by the crossing of the two beams separated by the prism (A), a pseudoscopic effect or 'conversion of relief' is produced, the projections of the surface of the object being represented by hollows, and its concavities being turned into convexities.

The suddenness with which the conversion is brought about, without any alteration in the position either of the object or of the observer, is a phenomenon which no intelligent person can witness without interest; while it has a very special value for those who study physiology and psychology of binocular vision. As originally constructed, the adjustment for distance between the eyes was made by giving a horizontal traversing motion to the prism (B) and the secondary body placed above it, by means of a screw action. But this method was open to the two objections that the focal distance of the secondary body was hereby altered, and that the traversing fittings were liable to be loosened by wear.

To meet these objections, Nachet devised the binocular construction represented in Fig.(6); in which the adjustment of the distance between the eye-pieces is effected by altering the angle of convergence between the bodies. This is done by turning the screw, (V), which is furnished with two threads of different speeds, whereby an inclination is given to the prism equal to half the angular displacement of the tube; an arrangement necessitated by the fact that the displacement of the rays reflected by a rotating surface is double the angle described by that surface.

As an ordinary working instrument, however, this improved Nachet Binocular can scarcely be equal to that of Wenham or Stephenson; while it must be regarded as inferior to the former in the following particulars: First, that as the uninterrupted cone of rays (when the interposed prism is adjusted for stereoscopic vision) has to pass through the two plane surfaces of the prism, a certain loss of light and deterioration of the picture are necessarily involved; while, as the interrupted half of the cone of rays has to pass through four surfaces, the picture formed by it is yet more unfavorably affected; second, that as power of motion must be given to both prisms - to (A), for the reversal of the images, and to (B) for the adjustment of the distance between the two bodies - there is a greater liability to derangement. It does not give the equal illumination of Mr. Stephenson's, is less free from optical error, and cannot, like his, be used with high powers.

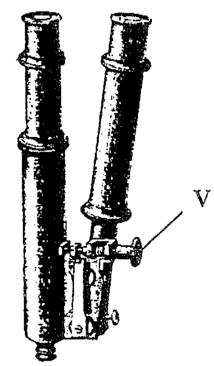


Fig.6 Nachet pseudo-stereoscopic binocular body tube assembly.

References:

1. *Maison Nachet Catalogs of Stock from 1854-1910.* Editions Alain Brieux, Paris 1979.

2. Carpenter, WB: *The Microscope and its Revelations.* 6th Ed. Wm Wood & Co. New York 1883.

3. van Huerck, H: *Le Microscope* 4th Ed. 1891

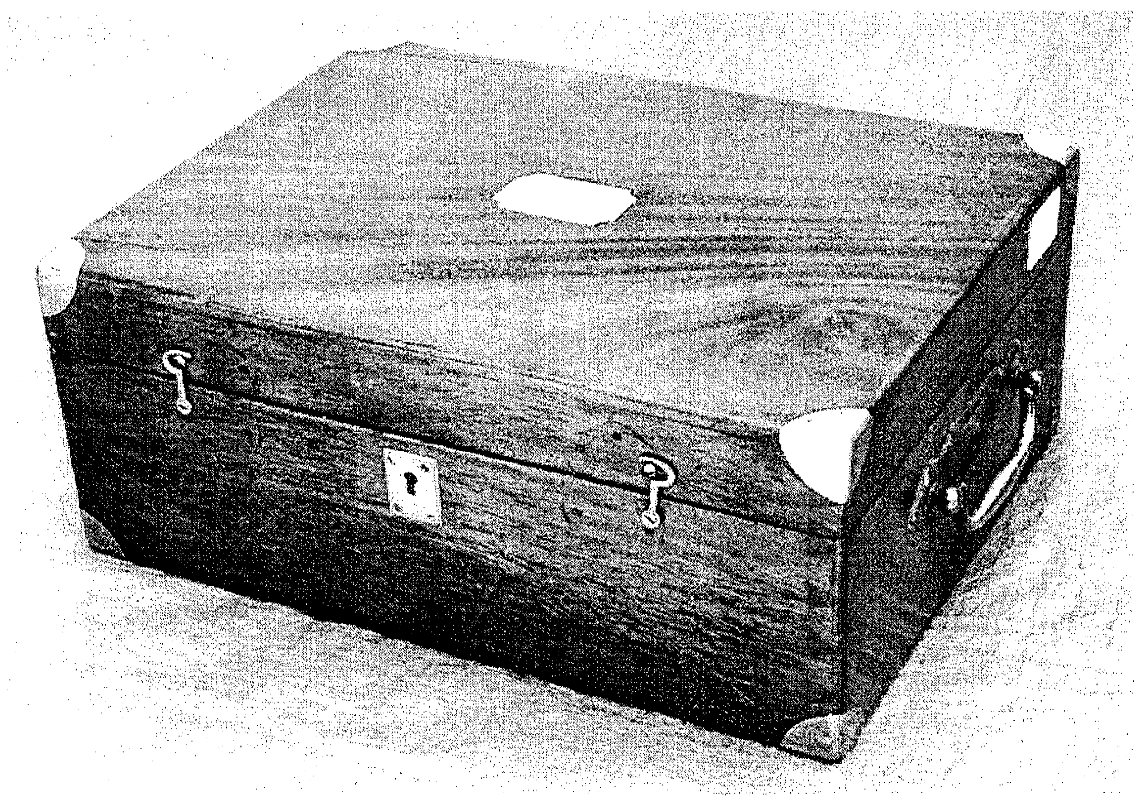


Fig. 7 The elegant mahogany case of the Nachet microscope of Fig. 1

GOODS GEAR AND GADGETS

Richard M. Jefts

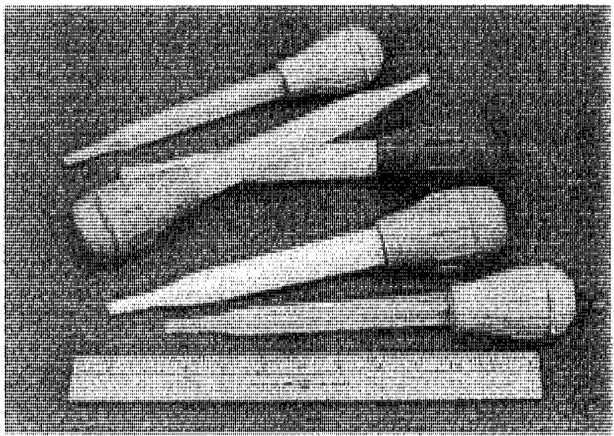


Fig. 1 Current supply of "turkey basters".

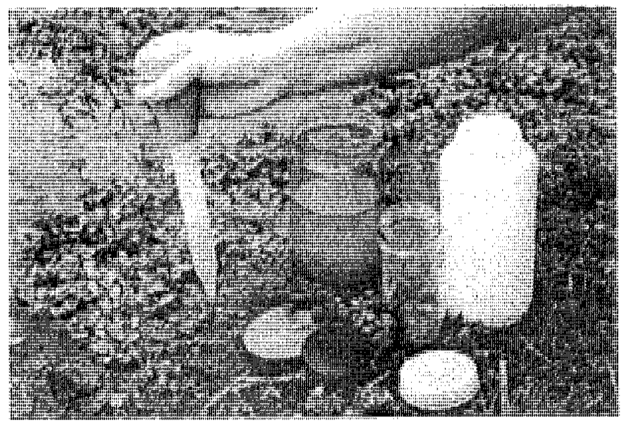


Fig. 2 Sample collecting in the field.

By our own definition, this is a pretty good gadget - something we adopt for our own use, but was made for a somewhat different purpose.This is what is generally called a 'turkey baster' - sort of an overgrown medicine dropper and used by the housewife to baste the bird with the natural juices while it is cooking. With a plastic barrel and a plastic or rubber bulb, it is seldom over a foot in length, is inexpensive enough if purchased new in a super market, and may run fifty cents to a dollar in a local thrift shop. For use in the field, they can be almost indispensable for collecting single and multi-celled aquatic wildlife.

With considerable control, one can selectively draw up larger or smaller quantities of water by skimming the surface, or at various depths below in a stream, lake, pond or pool.With finesse, one can clean off and collect from the surface of submerged leaves, twigs and rocks, and pull up heavier sand, dirt and decomposed bottom material. It is this ability to select an area, depth or isolated spot, plus its moderate length to aid in reaching out, across and down, that makes the 'dropper' such a valuable tool. Fig.1 shows the current supply of these multi-colored bulbed meat or turkey basters. Fig.2 shows a scene in the field with selected samples being transferred to glass and plastic bottles. At the lab bench or work table (Fig.3), the dropper plays a similar role - selecting and transferring samples from bottles, jars and larger aquaria for further handling.

Fig. 3 Transferring samples in the lab.

Like other kitchen and household items that we can adopt for our own use, it is perhaps best to play it safe and have your own supply. Although, with Thanksgiving coming up, it may not be a bad idea to have a couple of clean spares on hand - just in case the lady of the house wants to borrow one.

Member Profile

ZANE H. PRICE

Zane Price with Douglas SNJ Navy Trainer Feb 2, 1943.

Zane Price with his Zeiss Microscope at a science exhibition in high school 1937.

In the beginning was Gilbert of erector, chemistry and microscope kit fame.The model of Gilbert microscope kit I received as a Christmas gift has long ago faded from my memory banks, but the pleasure of microscopy lingers on. In due course, a Zeiss monocular, model ESC, a gift from my mother, followed the Gilbert.The Zeiss was purchased in 1937 from Erb and Grey on south Figueroa, where in addition to the acquisition of the microscope, I learned of the Los Angeles Microscopical Society.

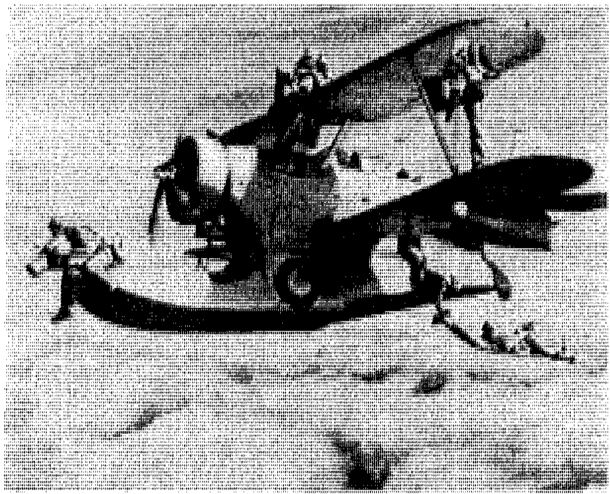
The Zeiss stayed with me through high school, and during summers as a lab assistant at the Cal Tech corn genetics farm in Arcadia. I became expert at bagging tassels and silks, and preparing pollen smears for cytology.The basics of photography were acquired as a by product of micrographing pollen smears.

Julian Corrington's column on microscopy in *Popular Science* attracted my attention, and I became a charter member of the American Society of Amateur Microscopists. I still have the charter member certificate signed by Corrington and Simon Henry Gage.

The good Zeiss accompanied me through my first year of college, and ably assisted my performance as lab instructor indoctrinating a class of 30 prenursing students on the fine points of bacteriology. Microbiology as a word had not achieved popularity in 1939.

A brief experience as freshman yearbook photographer contributed to a chance meeting with Dick Farrel of the L.A. Daily News. His tales of experiences during the Clifford Clinton reform campaign for mayor of L.A., and the concurrent gambling ship expose' intrigued me. He used a specially designed hidden vest button camera to photograph activities on the gambling ships. I decided that press photography was much more exciting than college. Clifford Clinton, founder of the Clifton Cafeteria Chain, was unsuccessful as candidate for mayor, but he did light a fire of reform under City Hall.

College failed to interest me, and I left in the summer of 1940 to pursue a career as a press photographer. I worked for the L.A. Chemical Company by day and a photographer for Downey - Allen News Service at night to get experience.They provided photography for the Pasadena Star News and other papers.This continued until the spring of 1942, when hints of potential greetings from the draft board drifted my way. I decided to enlist, hoping that doing so would enable me to continue as a photographer. The Marine Corps was the



OSU "Duck" Zane on nose. (Simulation)

Zane and Maxine Price 1990

only service that displayed interest, and I was told that I would be accepted as a combat photographer with a rating of sergeant. Oh! Gullible me. I raised my right hand only to discover too late that the recruiter had lied to me.

A series of being in the right place at the right time (a better situation than being in the wrong place at any time), during and after boot camp, found me in Marine Air at North Island, San Diego. Then in late '42, it was on to the Naval School of Photography at Pensacola, Florida. Training included still, movie and aerial photography in B&W and color, plus wide ranging laboratory experience, but no photomicrography. I made a couple of training films on PBY sub patrol over the Gulf of Mexico. Among my classmates were Doyle Nave, who threw a last second winning pass for USC in the Rose Bowl of 1942 and Leif Erickson, who went on to star in movies and TV.

Cherry Point, North Carolina Marine Air Station was the next stop. This was a replacement, and training center for marine squadrons. I was subsequently given the choice of Life Magazine school in New York, or Vectography 3D school at Polaroid in Boston. The grapevine had alerted me that a choice of Vectography would be cause for reassignment to the West Coast. I chose Boston. Vectography employed a system of right and left pictures, but the two pictures were printed on polaroid material of opposite polarization. The two photos were then mounted on top of each other slightly out of register. The final result was viewed with polaroid spectacles. The system was useful for making 3D aerial mosaic maps. Vectography was an amazing system at the time, but it was never widely used.

El Toro Marine Air Station was the next stop, and I spent two years getting acquainted with the rear seat of a Douglas SBD dive bomber. Fortunately, I never had to use the twin 30's or 50's for any purpose other than target practice over San Clemente Island. Cameras were more to my liking. I took many oblique aerial photos with the hand held K-20, and vertical mapping with the K-24. An old OSU "Duck" aircraft was used as the camera platform because it was slow. The camera and operator peered through a hole in the bottom of the pontoon - a most uncomfortable position for the cameraman. Pilots were less than enthusiastic about flying the thing. It was nothing like an F4U fighter.

Another fortuitous circumstance of being in the right place resulted in my reacquaintance with a pert Irish lass and high-school classmate who, to my pleasant surprise, lived near ElToro. Circumstances rapidly went from "Out of Nowhere," to "Easy to Love," to "All The Things You Are," to "I Only Have Eyes for You," to "Sunday Monday or Always," to commuted rations. Maxine Fitzgerald and I were married in the summer of 1943.

A damaged knee put me in the Norco Naval hospital for three months in the spring of '45, and I was mediced out in July of that year.

Clinical photography supported me for a year or so after separation from the Corps, and I became active in both the National and L.A. Chapter of the Biological Photographic Association. The L.A. Chapter included a number of members of the Microscopical Society, Lloyd Matlovsky and Ed Hamilton among others. The clinical photo department was a unit of Loma Linda University medical school and hospital. Preparation of teaching material was a significant part of its activities, and microscopy and photomicrography were essential tools. I welcomed back the Zeiss.

I decided to take advantage of the G.I. Bill, and completed college with a major in biology. I attended Walla Walla College in southeastern Washington, because the

Biology Department had an active field training program from their field station on the shore of Pugent Sound. That gave me the opportunity to do a fair amount of wild life filming in the area.

The Cal Tech corn genetic farm employed me during summers to film corn seedlings grown from seeds exposed to the Bikini Bomb explosions - weird plants. The Bikini experiments involved people from the physics department, and I discovered, they had assembled a Transmission Electron Microscope from brass plumbing components, modeled on the Toronto scope of Hillier, et al. Unfortunately, high voltage electronics and vacuum technology were not what they are today. Images were disappointing to say the least. However, continuing fascination with electron microscopy resulted in a career change.

I joined the Department of Infectious Diseases of the UCLA School of Medicine in 1950, first as a graduate student, and then as a staff researcher, and director of the department Electron Microscopy Lab for the next 40 years. The department chairman had spent time in Japan at war's end, and he became acquainted with a number of Japanese medical and scientific people. This resulted in the Department of Infectious Diseases receiving a gift of a Hitachi HU-9 transmission electron microscope (TEM} in 1954. This was the first electron microscope to enter the US from foreign sources. I suspect the gift was due, in part, to Hitachi's desire to get an opening to the US market. Two Japanese scientists came with the scope, and stayed in my lab for a year. We had some interesting conversations. One of them, an M.D., had been forced to become a Kamikaze pilot, and given six weeks to learn to fly. This was indicative of the desperation of the Japanese military. He completed his first mission, not as a suicide bomber, but by landing behind American lines to finish the war as an American captive. He commented that he was not stupid.

I became a member of the American Society for Electron Microscopy in 1954, and assisted in forming the Southern California Society for Electron Microscopy the same year. The Royal Microscopical Society accepted me as a Fellow in 1963.

In the mid sixties, I was invited by the National Polytechnical Institute, the Latin American Center of UCLA and AID to participate in a faculty exchange program for the purpose of establishing an EM lab and research program in the Microbiology Department of the Institute. Members of that department also spent time in my lab at UCLA. Mexico City and central Mexico were the locale for a couple of rewarding years.

I came in on the ground floor of electron microscopy and retired as use of the technology in medicine and biology began to decline. Surprisingly, confocal, fluorescent and atomic force /scanning tunneling microscopy, along with video and the computer, has resurrected light microscopy for research.

Pigeon Post in the 1870 Siege of Paris

To the microscope, the art of photography has lent its valuable aid, so that all the revelations of the microscope are susceptible of preservation in permanent records, as photomicrographs. A curious, but very practical use of the microscope was made in the establishment of the pigeon-post during the siege of Paris in 1870 -71. Shut in from the outside world, the resourceful Frenchmen photographed the news of the day to such microscopic dimensions that a single pigeon could carry 50,000 messages, which weighed less than a gramme. These messages were placed on delicate films, rolled up, and packed in quills. The pigeons were sent out in balloons, and flying back to Paris from the outer world, carried these messages back and forth, and the messages, when reaching their destination, were enlarged to legible dimensions and interpreted by the microscope. It is said that two and a half million messages were in this way transmitted.

from *The Progress of Invention in the Nineteenth Century*
Byrne EW, Munn & Co. New York 1900
Courtesy of Stewart Warter

Editor's Notes

Members who have joined after the first of the year are entitled to a full set of the MSSC Journals for that year. If anyone has joined after January 1997 and did not get the back issues for 1997 please let me know so that I can send them a completion set of Vol 2.

Also, if anyone would like to have a full set going back to the first of the new issues in September of 1996, we still have stock of all of the four 1996 Vol. 1 issues which can be purchased individually.

As was done in 1996, the December 1997 issue will contain a full index by article and author so that the year's issues can be easily referenced.

I continue to solicit articles on the variety of microscopical interests that are represented in our diverse group and to thank those who have contributed so splendidly to our publication.

Gaylord E. Moss

WORKSHOP of the Microscopical Society of Southern California

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

Date: **Saturday, 6 September 1997**

Location: **Steve Craig's Lab**, 20 persons attended.

1. **Steve Craig** discussed the upcoming art exhibit at the Palos Verdes Art Center, as first announced by MSSC member, Philip Lohmann, and MSSC participation therein. Steve also announced that <u>the workshop on the second Saturday of October will not be held</u>, because Steve will be out of town.

2. **George Vitt** mentioned the fine botanical sections that are being made by Mr. John Wells of England. George also brought up an image degrading problem discovered while scanning 35mm slides (unfortunately on an unidentifiable film). This manifests itself in producing what can best be described as a 7-day old beard which appears in the dark shades of grey (darker shadows) of the image. He intends to inspect these particular slides under the microscope to see if the film grain structure has anything to do with it. It was suggested that the compression algorithm (JPEG) may also be at the root of the problem.

3. **Richard Jefts** said that he has for sale the book *British Diatomaceae* by L. Harding.

4. **Gary Legel** described his interest in looking at pond animals and that he needs a book to identify them. It was suggested that Bioquip Corp. (Gardena, CA) has the book *How to Know the Protozoa* for $14.95 which would meet his requirements. **Larry Albright** suggested that he look for the older edition which was spiral bound and could be laid open flat, and that it would be quite as valid as the new edition, since the protozoans have not changed very much in the interim. (This was another 'micro-albright' **!)

5. **Pete Teti** showed a c.1930 Leitz microscope for which he needs a condenser and mirror. He also showed an A/O stand without a body tube, which he intends to fix and give to his nephews for Christmas. He then asked all to bring a stereo microscope to the 2nd. Sept. workshop where **John de Haas** will provide materials and instructions on the preparation and mounting of micro mineral specimens. It was suggested that suitable small plastic boxes are available from Bourget Bros., Plastic Mart, and Hastings Plastics (all in Santa Monica, CA).

6. **Jim Solliday** showed an extremely rare book by **Joseph Burke**, Trustee of the Staten Island Museum where he had his own lab in which he made a thorough study of diatoms, creating the finest collection of diatoms of the state of New York. Only 12 copies of his book exist! **James Smith**, the first president of the Southern California Microscopical Society (1938-40), and an avid diatomist of note, helped write this book. The photo plates were from specimens mounted by our member **Al Brigger**. Jim noted that this is a good example of how our Society has contributed to microscopy. Jim elaborated on the requirements for submission of photos to the above-mentioned exhibition: Photomicrographs and photoMACROgraphs are OK; NO crystal slides (why not?); SEMs photos are OK; color or B&W; and that 24 total aesthetically pleasing photos are needed. 600-700 people will attend the opening of the show and the photos can be sold to the collecting public after the show closes. **Steve Craig** commented on the salon work being done by the BPA.

7. **Ed Jones** is back from a 5-week vacation on the east coast. He visited the McCrone Institute where he obtained reprints by our **John Delly** and a reprint of Industrial Research, Oct 1973 plus a Michel-Levy Color Chart (from C.Zeiss, Oberkochen). Ed then showed the book *Discover Hidden Worlds* - a Golden Book, NYC - Western Pub. Co., Racine, WI, printed in Italy.

8. **Dave Hirsch** showed a water-drop microscope which he had designed and expertly constructed of brass, and housed in a beautifully adapted wood cigar box! Its mirror has a 6-degrees of freedom adjustment capability. Dave then described the method of its use. **George Vitt** described an article on the water-drop lens microscope in a 1970s Russian Popular Science type magazine. It seems that gold miners in the Urals and Siberia used a hot needle to burn a hole in a playing card, and applied a water drop to the under-side of the card, the hole acting like a limiting aperture to reduce inherent aberrations.

9. **Norm Blitch** showed a 1992 offprint of a description of the Carey microscope which is still on display in Darwin's study. On p. 608, there is a picture of the very microscope we discussed at a past workshop.

10. **Leo Milan** reported on the 25 lots of **Bill Sokol's** crystal slides, stating that they were all taken on Kodachrome 40.

11. **Chris Brunt** reported on the availability of 20mm diameter high quality Polaroid filters at $1.00 each!

12. **John de Haas** described his binocular Japanese Tiyoda microscope with rotating stage and 4 objectives. He said that at the end of WWII, Tiyoda made exact copies of the revolutionary Zeiss "L" stand which Zeiss introduced in 1932. This type of stand was the first to implement focusing by moving the stage, rather than the body tube, and to have integral illumination. In the period 1950-1960, Tiyoda made the best microscopes in Japan, all of which were precise copies of Zeiss microscope and lens designs. John related how, to repair a Zeiss fluorite objective; he had removed the 3rd element from the equivalent Tiyoda lens and installed it in the Zeiss lens. The repaired lens worked perfectly!

13. **Gaylord Moss** discussed SEMs and the manner of their operation. There was a general discussion on SEM design and principles.

14. **Larry Albright** said that Mr. Brian Ford is coming here in October and the meeting will take place on Tuesday, 28 Oct. Larry then showed a thermostatically controlled hot stage he had made from a 200 watt, $45 ring heater and a compact surplus TRW temperature controller. He is using this device to melt and cool crystals while watching the crystallization process (forming & deforming) through the microscope Larry then showed a high power x-ray tube.

15. **Alan de Haas** described a consulting job he had where the identification of the manufacturer of defective connector pins had to be identified. Alan described his methods and showed several excellent photomicrographs he had taken which showed the maker's logo imprinted on the tiny pins. Embossed logos were much easier to read than inked ones. For the photography, he used an Aristophot with an 8 cm Summar lens and only one lamp (to simulate what an inspector would use), and 100 ASA 2 1/4 x 2 3/4" film.

16. **Larry McDavid** described the consulting work analysis he had done on quality of teflon-filled anodized coatings on aluminum and also on the perfection and integrity of crimped connections in automotive cables (where reliability under adverse conditions is paramount). He showed many fine photomicrographs of cross-sections of crimps, illustrating perfect gas-tight and also non-gas-tight crimps. Specimen preparation follows the general rules of metallographic sample preparation. Larry stressed that the surface preparation and its special etching (to bring out the color contrast between inter-grain regions of the plastically deformed metal) was both a science and an art. Multiple layer plating of copper wire (brass>nickel> gold to prevent migration was discussed. Larry then introduced a guest to the workshop: **Julian S. Pulido**, owner and operator of "Cross Sections Unlimited", 11619 Cozumel Street, Cypress, CA 90630; Home/FAX: (714) 897-8756). Julian is a professional metallographer of wide experience and great skill. He was the one who prepared and photomicrographed all of the crimp connector specimens that were being analyzed and on which Larry was reporting. This project was a very specialized application of metallography, and Julian had done an extremely fine job.

(Note: After the Workshop, **George Vitt** had an opportunity to speak with Julian at some length concerning his work and techniques. Julian was asked if he would be willing to give us a presentation on his metallographic techniques at some future MSSC meeting, and Julian replied that he would be quite pleased to do so. Metallography is one subject that has been sadly neglected by all of us over the years. It is time that we 'got up to speed'! I suggest that we solicit Julian to join MSSC. It looks like a perfect 'fit'.)

17. **Ron Morris** discussed the bonding process in microcircuit technology.

(**) micro-albright= the largest practical unit of punsterism.

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MSSC's "Second Monthly Workshop" took place on 13 Sept 1997 at Steve Craig's lab., where 10 persons attended. All the time (9 am to 11:30 am) was devoted to the preparation of micro-mineral samples. To this end, John de Haas first gave an introductory talk on the subject. John had brought a very large quantity of various types of minerals and crystal-bearing rocks, miniature lidded plastic boxes, plasticene, and other materials which he had donated to the group. To split the larger specimen into small, mountable specimens where the mineral and/or crystal structure would be shown to best advantage, John provided a special "rock splitter". This device used two v-shaped (about 30 deg. included angle) opposing chisel-like points which are slowly wedged into the rock specimen, eventually splitting it at the desired point. The points are advanced by a 0.5" diameter screw rotated manually via a small handle, working somewhat on the principle of a vise. Many specimens were prepared and observed through several stereo microscopes There was a general feeling of enthusiasm and the workshop was pronounced a total success.

Minutes of the September 27, 1997 MSSC Meeting

David L. Hirsch

The customary meeting room at the Crossroads School was pre-empted this evening by an assembly of Crossroads School Alumni. As an alternative location for our meeting, Mr. **Joe Wise**, of the Crossroads School staff, had made arrangements for us to use their very large Crossroads Theatre, a facility eminently suited for the type of superb audio-visual presentation we were to witness that evening, as presented by our **Jim Solliday**. With the walls and ceiling of a black matte color, a huge ceiling-mounted projection screen, tiered seating, and a projection room (which we did not use), there was nothing else to be desired.

Jim Solliday gave us a magnificent audio-visual presentation entitled "Inner Space." Here, we were given a feast for the eyes and ears of Jim's superlative artistic and technical abilities. He used a pair of aligned dissolve 35mm projectors which were synchronized by an audio tape which contained a carefully selected orchestral musical compositions that set the mood for the spectacular imagery that Jim had created with his microscope and photomicrographic equipment. Starting with scenes of a beautiful wilderness pond, he zoomed in on its insect and amphibian denizens, then to drops of water on the grass leaves and, finally to within the drop to explore the world of the diatom and of crystals. Jim noted that he had created this presentation in 1980, and that it was the first such show that he had undertaken. (Since then, he had produced many such excellent programs on various aspects of the micro-world). His imagery reflected the use of multiple exposures, dark field, polarization, Nomarski DIC, Rheinberg and, for that matter, every imaginable type of specimen illumination. Jim's presentation was on such a high esthetic level that it was truly an emotional experience! We all look forward to seeing all the other shows that he had prepared and which we had not seen in a long time.

After the presentation there followed an animated discussion on many important aspects of photomicrography, covering techniques, materials, and instrumentation.

MSSC has a video library of presentations recorded in the past by various **Steve Craig**. If you are interested in reviewing any of the tapes, contact **Steve** . Members are invited to bring their cameras and camcorders to meetings and other MSSC activities.

On behalf of the MSSC membership, and in sincere gratitude for his salutary efforts in preparing and distributing the MSSC Journal, Pres. **George Vitt** presented VP **Gaylord Moss** with a copy of a book on Adobe Photoshop 4.0. The software is recognized as the world standard photo design and production tool for images used in print, multimedia and on the Web.

SHOW TIME! Look forward to the scientific instrument show to be held on 31 January, 1998 at the Los Angeles Airport Hilton. Dealers will offer a wide range of goods, from abaci to zogroscopes. For information, contact **Al Roberts** at: (310) 476-6277

Our Treasury derives its income from three sources; the main source being annual dues. Alternate sources are from advertising in the Journal and donations made by members to MSSC. Donations offered to the Society under the banner of MSSC are far in excess of any made in the past. Thank you, fellow members, for your appreciation and support for our noble cause.

SHOW AND TELL. **John deHaas** showed a Zeiss photographic attachment consisting of a side viewing telescope mounted on a connecting tube. An Ihagee (Dresden) 35mm camera with a focal plane shutter completed the array. Vibration introduced into the system when the focal plane shutter is activated, can be sufficient to affect clarity of the reproduced image. In Johns' photographic attachment, this deleterious effect is minimized by mechanically isolating the vibration at the lens .

Notes: Through the exchange of journals, MSSC is well on the way of becoming recognized world wide, as an outstanding microscopical society. The editorial, appearing in the September, 1997 issue of the Scientific Instrument Society Bulletin, credits and describes our own MSSC Journal. Four of our members were mentioned, including: **Gaylord Moss, Stuart Warter, Barry Sobel, and yours truly**.

Brian Ford, the author of: *The Single Lens*, is scheduled to speak at our October 28, 1997 meeting. Through a fortunate coincidence, the series of 6 articles on "Single Lens Magnifiers," by Allan A. Mills began with the first article: "Part I: The Reading glass." This article appeared in the above mentioned issue of the SIS Bulletin.

It is worth noting that several of our members are also members of the Scientific Instrument Society. **Leon Stabinsky**, a long time MSSC member, is their West Coast Representative. If you wish to join the SIS or seek further information on the Society, please contact Leon at: 9610 Quartz Avenue, Chatsworth, CA 91311, phone: (818) 886-1979.

DIATOMS AND DENTIFRICES

or

The Tooth, The Whole Tooth and Nothing but the Tooth

Richard M. Jefts

The seeker the world over for rare gems and minerals is no more avid in his or her zest for collecting than the seeker of diatoms, those both living and fossil microscopic gems of the marine and fresh water world. Familiar to most students of microscopy, these unicellular algae, with their silica impregnated cell walls or frustules of incredibly intricate patterns and designs, are among the most beautiful of all objects that can pass under the questing lens of the active microscopist.

The botanical sciences tell us the life history, variety and construction of these one celled wonders and of their place, function and significance in the aquatic world they inhabit. We learn, too, of their fossilized remains - vast beds formed by the slow accumulation of these silica cells, raining down from the sunlit surface to the dark bottom depths of fresh and salt water seas and oceans of the world. When these thick and watery beds become geologically exposed, the amassed diatoms, making up the greater bulk of the mined material, now called diatomite or diatomaceous earth, can be both aesthetically and commercially useful. Aesthetically, single cells please the eye and inspire the mind of microscopists whose superb lenses are designed to reveal that same world of the very small, and, interestingly, certain species of diatoms are used to test the degree of excellence of those same lenses that are used to view them. Commercially, bulk volume provides some of the more prosaic but important uses, such as filters for various beverages, as insulation, as a base for cosmetics, in cement and bricks and as a scouring agent and polishing powder. This latter piece of information was long buried away and through a recent chance remark, the question slowly surfaced as to whether any of the modern day brand name toothpastes might possibly utilize diatomaceous earth as a polishing agent in their formulas. And so began a sideline project that will not only keep me in toothpaste for years to come, but has also afforded many slightly off-beat but pleasant and instructive hours at the lab bench and microscope.

In short, from supermarkets, grocery and drug stores, twenty four brands of toothpaste were accumulated and examined. These samples, arbitrarily kept to an even two dozen (at least for the time being), are a good cross section of commercial brand toothpastes currently and locally available. Fig.1 shows the array of all twenty four samples. As a quick aside, the boxed sample on the extreme left is of interest, as it is "Manufactured in U.S.A. for Bausch & Lomb Oral Care Division..." The two small glass vials, center, are typical of each of the final twenty four blended and suspended preparations. Initially, however, a small dab of each sample, plus a drop of distilled water, was puddled around on a microscope slide, a #1 coverslip lowered in place and each slide methodically swept out at 150x, checking details at 625x, high dry. Standardized mixtures were then made for each sample by blending, in small glass vials, 1.0 gram of toothpaste in 4.0 mls of distilled water. To eliminate frothing, the blend was stirred, not shaken. The resulting suspensions showed varied settling times which allowed for the examination of the heavier bottom material separately as well as the various levels of the cloudy supernate, to note the presence or absence of any diatomaceous material, no matter how small.

Once the general nature of all the solids were determined, a few specific samples were chosen to represent and illustrate any major morphological differences in the solid particulate material. From these select few, semi-permanent slides were prepared as follows: with a large drop of the suspended material in the center of a clean microscope slide, a 24 x 60mm, #1 coverslip was taken and a thin ridge formed along all four edges, by scraping lightly with a finger thinly coated with vaseline. The coverslip was then inverted onto the drop and gentle pressure applied. This results in a thin wet film of uniformly suspended solids, representative of its sample type, and sealed from the atmosphere, keeping evaporation to the very minimum and allowing long term, uninterrupted observation. Except for some point size Brownian movement, all particles are now completely static and representative fields were chosen for final leisurely viewing, note-taking and photography. All photomicrographs (see note at end), were taken at 625x - a magnification adequate to show all particles, their shapes and significant details, allow a standardized comparison of their relative sizes and still retain a moderately large field of view.

This admittedly cursory survey shows that of the twenty four samples of toothpaste taken, two, or about 8%, were found to list and contain diatomaceous earth.

Fig. 1 The twenty four toothpaste samples examined for this article

One sample lists both calcium carbonate and sodium bicarbonate as a "mild abrasive..." and the remaining twenty one list either "silica" or "hydrated silica." Except for size, no structural difference was seen between these latter two components, and these essentially featureless, highly refractile appearing shards were not further identified. Figs.2 and 3 show the marked extremes in particle size found in the "silica" samples, while Figs. 4 and 5 show the less dramatic extremes found in those samples having "hydrated silica."These photos are included to indicate that from what we have seen here, the silica contents do not appear to be derived from a diatomaceous source. Our main interests, of course, are those two product samples actually containing diatomaceous earth. They are, for those who may wish to seek them out, KEEP and CAFFREE. Figures 6 through 12 show typical, although less abundant, whole diatom frustules and the more prevalent scattered shreds of yet still identifiable diatom remains.

Of the two products, KEEP appears to have a higher concentration of this identifiable diatomaceous material. Although it is tempting to try to identify some of the more prominent diatoms found here, less than ideal conditions, ie., clean, unobscured and well defined specimens make such identification risky and uncertain. Figures 5 and 7 do show radially symmetrical or centric types and Fig.8 another of the same with a broken edge, plus two possible Pinnularia. Fig.9 has a long pennate type with a small, centric jewel on the left and with two large broken shreds on the right - these latter showing pore patterns. Fig.10 shows a complete structure, a valve view of what appears to be a Navicula, while Figs. 11 and 12 show broken shards, the latter having one piece with a relatively large hexagon pattern and two smaller pieces with extremely fine pore or dot designs. Beyond these tentative speculations, the specialist could venture more safely and more accurately. Also of interest were many of the wet films when viewed with crossed polars alone or with a wave/retardation or stressed plate added. Not all particles show birefringence, but those that do, are quite handsome, and with darkfield illumination, many of the structures can be effectively displayed.

This then, is one of those open-ended projects, for other toothpastes with diatomaceous earth can be sought out with continued interest. Candidly though, it must be admitted that as a new or even ready source of diatoms, the toothpaste tube will never compete with such world class deposits as found in Ireland, New Zealand or Lompoc, California. However, for an hour or an evening of simple pleasure, delving into diatomaceous dentifrices can be novel, inexpensive and fun, and may be no further than just around the corner, or, perhaps, even closer - no further than your bathroom medicine cabinet.

Notes:
Microscope - Leitz tri-head Ortholux
Objective - Leitz 40x Apo with correction collar
Film - 35mm Kodak Gold, ASA/ISO 400
Camera - Olympus PM6

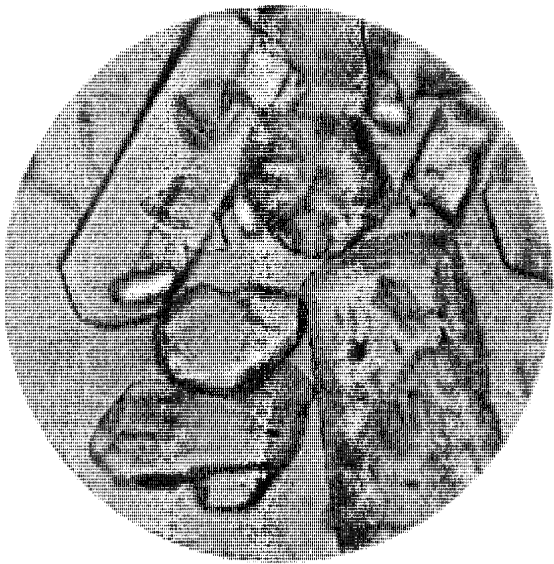

Fig. 2

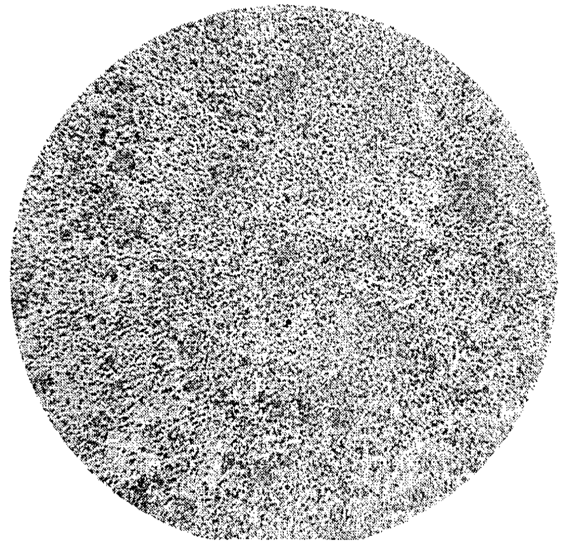

Fig. 3

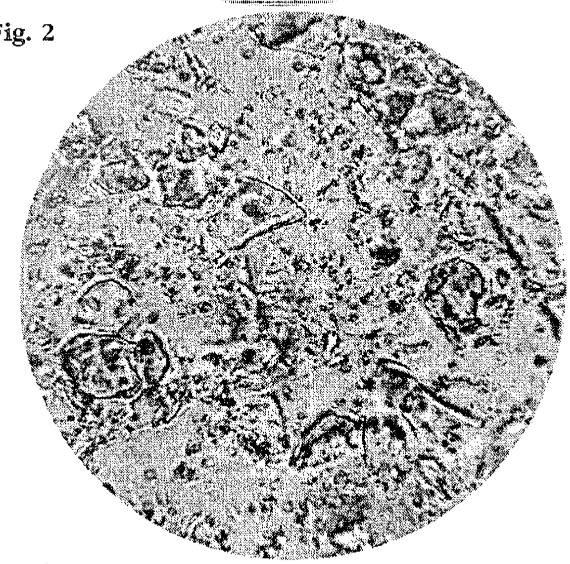

Fig. 4

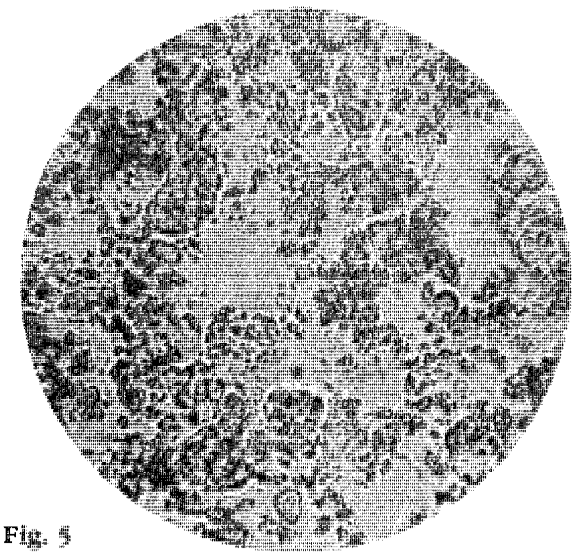

Fig. 5

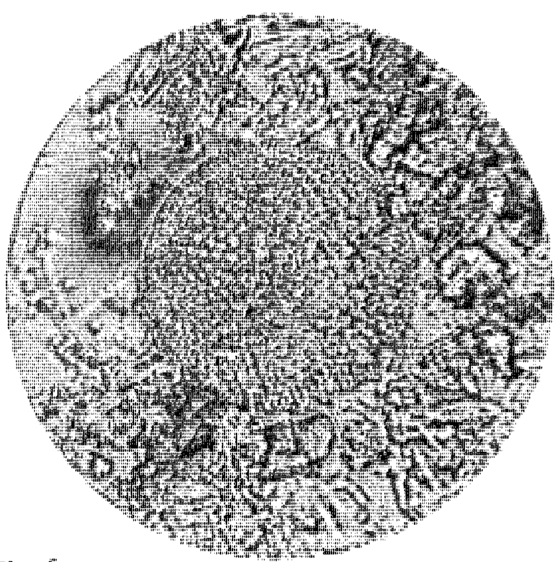

Fig. 6

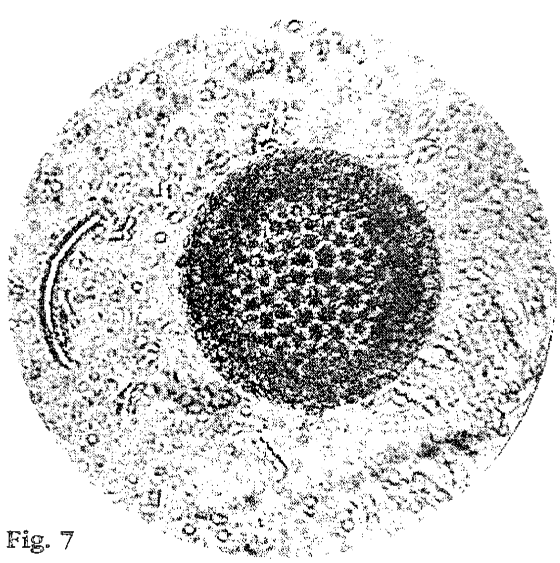

Fig. 7

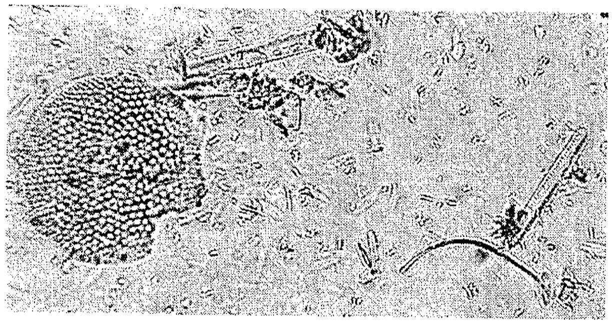

Fig. 8

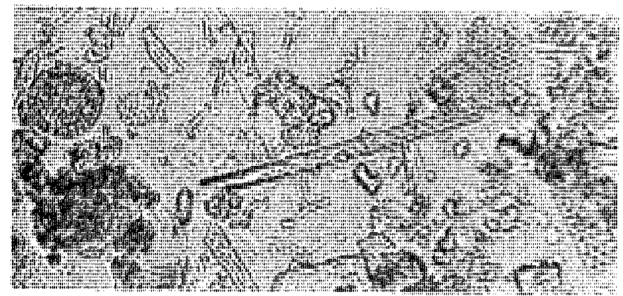

Fig. 9

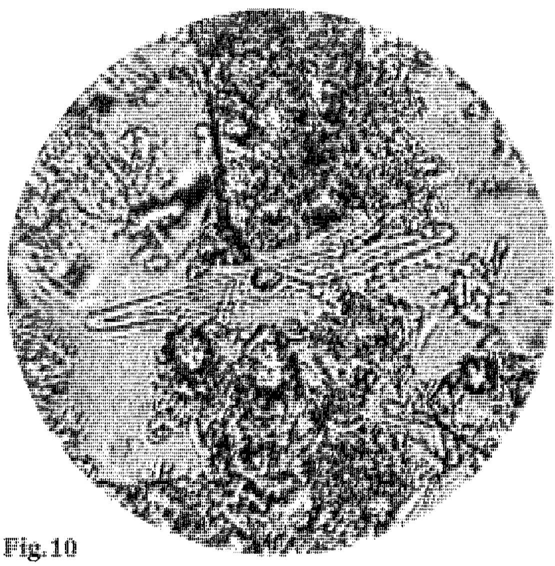

Fig.10

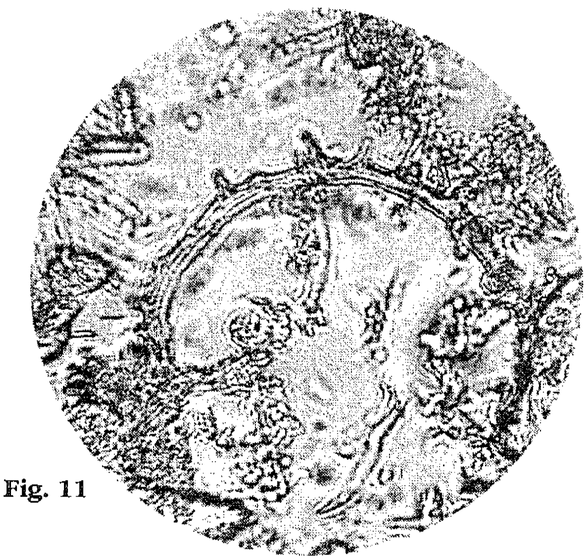

Fig. 11

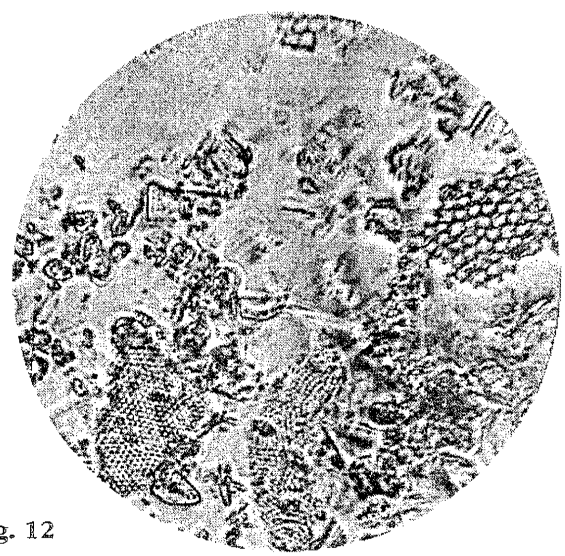

Fig. 12

THE STEREO IMAGE - A DEFINITION

Alan deHaas

This brief description is an addendum to a beautiful demonstration at the July 1997 meeting at which Dr. Greenberg of the Edge Corporation showed a stereo microscope of his own invention. For those who did not attend, I will only state that several of his slides were greeted with oohs and aahs and even applause.

What constitutes a stereo image? Or perhaps a better phrasing, what mathematical constraints must be fulfilled for the eye-brain combination to assume that sufficient data has been presented to produce a three dimensional view?

There are only three constraints.The first is "obvious." Each eye must be presented with different information about the same scene.

The second constraint is that the left and right homologous points lie on the same horizontal axis. The third is that the scene's right and left vertical axiis are parallel. If these two constraints are not met, either no stereo image can be formed, or one gets eyestrain and a headache from trying to fuse similar but improperly oriented images. It is this misorientation that one notices in an misaligned binocular head. The homologous points of a stereo image are those two points, one left, one right, which suffer no displacement.They are the reference points to which all measurements are made. This set of constraints must be satisfied whether one is looking at a scene unaided, through a microscope or at a stereo photograph pair.

In order for different data to reach each eye, there must be a difference in the linear displacement of a point with respect to the homologous points (Fig. 1).That is, some (X_L - X_H) must be different than the corresponding (X_R - X_H) . The greater the difference in these two distances, the more accentuated will be the stereo effect. If there is too great a displacement, the brain will have trouble fusing the images into a stereo pair.

A question was raised at the July meeting as to whether or not a Wenham binocular microscope does indeed provide a stereo image. The specimen being viewed does not alter only one ray of light. The rays of light occupy not just the center of the objective, but the entire front element. One can sample the left and right halves of the image-forming bundle and find that the data content is indeed different. Since the Wenham prism divides the rear of the objective, different data arrives at each eye. The problem is that as one increases the objective power, the prism is no longer sufficiently well positioned with respect to the rear plane of the lens to provide a true division of the information into left and right halves . Of course, even with low power, it is not at exactly the right plane, but it is close enough to realize beautiful stereo images. Dr. Greenberg's invention includes an optical relaying of the objective's rear aperture into a plane in which it can be utilized to provide a correct stereo image with any objective.

As an aside, the objective's effective rear aperture is an optically interesting and from design considerations, a very important zone. By examining this plane one sees all of what the objective is doing, how it is relaying the information about the subject and how it and the specimen are handling the cone of light provided by the condenser. The successful use of phase, petrological and interference microscopy depend to a large extent on the ability to observe and correctly manipulate the data provided in this plane.

Along with the pleasing view that a stereo image provides, there is an important benefit for the microscopical analysis of structure. Given the basic parameters of the system, linear displacements measured between details in the specimen can be used to derive z-axis data. A computer with the appropriate software and frame grabber can quickly provide topographic maps of the specimen, surface roughness, volume etc. without the need for raster scanning and acquisition of point by point focus data.

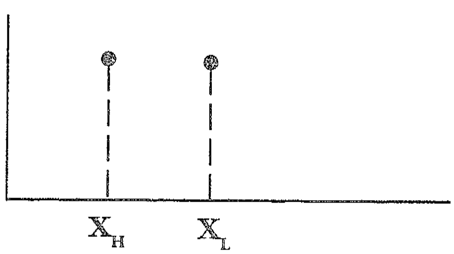

Fig. 1A Left eye view

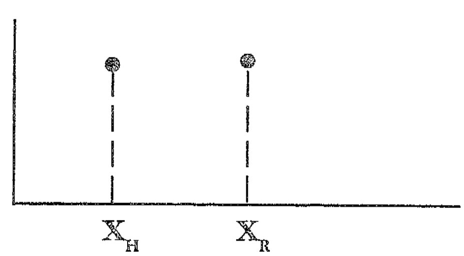

Fig. 1B Right eye view

Advertisement from The American Journal of Microscopy July 1976 Courtesy of Richard M. Jefts

October Meeting
Note Corrected Date
Tuesday October 28

Brian J. Ford

A Spectacular Event

We are most fortunate to have an evening with Brian J. Ford who will speak on one of his many subjects of expertise. His contributions to the historyof microscopy are legendary and he has published a number of books since *The Single Lens* from the dust cover of which the following information was extracted.

Don't miss this exceptional night.

Tuesday, October 28 at 7 PM
Crossroads School
1714 21st Street
Santa Monica, CA

Excerpted from the dust cover of, *The Single Lens.*

Brian J. Ford is an authority on the microscope, a biologist, and is also well-known as an author, lecturer and broadcaster on science. He read biology as an undergraduate at the University College, Cardiff, where he is now visiting research scientist in the Department of Zoology and a scientist in the Department of Zoology and a Member of the Court of Governors. He is a Member of the Institute of Biology, a Fellow of the Linnean Society, the Royal Microscopical Society , and of many other specialist organizations. His papers have been published in many scientific journals world-wide (including New Scientist, Nature and the British Medical Journal). He has also contributed to the Times, illustrated London News, and Guardian, and broadcast on radio and television for nearly 25 years. His textbooks include *Microbiology and Food*, *The Revealing Lens*, and *Optical Microscope Manual*, and among his general books are *Microbe power*, *The Earth Watchers*, and his influential *Cult of the Expert*.

The textbooks of science are being rewritten following the extraordinary disclosures described in this book. It has long been taught that no specimens survive from the early days of the microscope, but Brian J. Ford found nine specimen packets prepared three centuries ago by the 'father of the microscope' Antony van Leeuwenhock, at a time when the foundations of modern biology were being laid. His research has revealed how the specimens were prepared and how the first sections were cut. He has identified the species Leeuwenhock examined and even found some of the great man's cells adherent to the sections. he then recreated the pioneering experiments which gave us such fundamental concepts as the 'cell nucleus' and showed that many neglected early microscopes- formerly described as 'low power dissecting instruments' - were actually capable of generating images of the highest quality. His story outlines a prolific and intense programme of research carried out in several countries. It is a vivid first-hand account of scientific investigation which brings alive the origins of the modern era of biology.

In July 1981, Sir Robin Day interviewed Brian J. Ford about his discovery of the oldest specimens in the history of the microscope. Details appeared next day in New Scientist and Nature and were widely reported in the USA and abroad. Later that year Ford marked the 150th anniversary of the naming of the cell nucleus by recreating the original experiments at an extraordinary General Meeting organised by the Linnean Society at Burlington House, London. He showed to a crowded lecture theatre of distinguished scientists how a range of instruments thought to be 'dissecting microscopes' were capable of high magnifications, matching modern microscopes. Standard textbooks state that no early specimens have survived, that they would have been of poor quality, and that the images produced by early simple microscopes were distorted and indistinct. In each case Ford has disproved their traditional view. His research has involved many institutes throughout Europe, and the cooperation on leading scientists in Britain, Europe and the USA. The specialist findings which have won several awards have been published in the major science journals and many textbooks are currently being revised to incorporate these important discoveries, the story of which is told in full for the first time.