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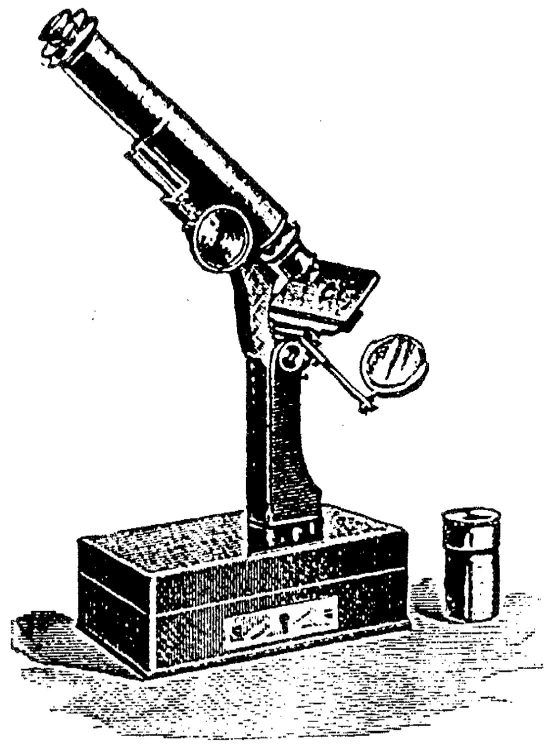
Joseph Zentmayer's Pocket Microscope

Budd J. LaRue



The article was originally written for *Rittenhouse*[1] and was slated for publication in early 1992 when Gil Mellé independently issued something remarkably similar entitled "Zentmayer's Jewel" in L.A.M.S.'s the *Objective* for March 1992.[2] I asked Deborah Jean Warner, the editor of *Rittenhouse*, to withdraw it. Jim Solliday recently persuaded me to submit it for inclusion in this new series of articles on Zentmayer's microscopes. The text owes much to Deborah Jean Warner, and I have made some additions to reflect events in the past 8 years.

Charles F. Rousselet (1854-1922), who is remembered for the Compressor of the same name, was the first Curator of the Royal Microscopical Society's "Collection of Old Microscopes." He was a noted expert on the Rotifera, pioneering in their collection and mounting.[3] Surprisingly, one of his portable microscopes was made in the United States by Joseph Zentmayer. His friend, the well known microscopist E.M. Nelson, praised it in 1895: "This instrument, while probably the smallest portable Microscope in existence, is nevertheless a thoroughly useful one for real practical work. It is not, therefore, what so many of these pocket Microscopes actually are, a toy."[4]

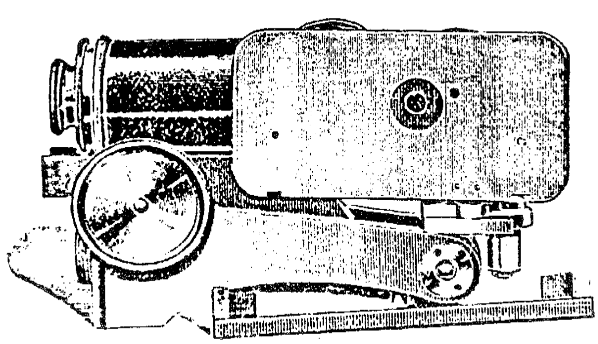


Figure 1. Charles Rousselet's pocket microscope made by Joseph Zentmayer. Above, assembled; below, folded to fit in its case. From E.M. Nelson, "A Portable Microscope by J. Zentmayer of Philadelphia," *Journal, Royal Microscopical Society* (1895): 26-28, reproduced with permission of the Royal Microscopical Society.

Mellé cited what was probably the first appearance of this microscope at a Microscopical Conversazione held while the Centennial Exhibition was ongoing in Philadelphia in 1876. The editor of the American Journal of Microscopy and Popular Science noted:"A microscope which attracted a good deal of attention from workers was the little pocket microscope of this maker.... quite equal to all ordinary requirements. As a traveling companion, it would be a little gem."

Zentmayer catalogues this instrument, unillustrated, in his Illustrated Price List, fifth edition (ca. 1878): "It is constructed on the Jackson Plan. The bar is mounted on two uprights, with joint for inclination to any angle. Coarse adjustment by fine rack and pinion; sufficiently delicate for fine adjustment. Plain stage with spring clips. Any objective from $1^1/_2$ inch up, provided with the Society Screw, can be used. It packs, including an objective, into a case of the following dimensions:- Length, $4^1/_2$ inches; width, 3 inches; height, $1^1/_2$ inches; the case forms the base, and when the instrument stands perpendicular it is ten inches high, including the height of case. No part of the instrument, not even the objective, is detached when packed, and it almost solidly fills out the little case."

With one eyepiece, this microscope cost $40. With an additional 1/5-inch objective, 75° angle of aperture, "the best adapted to that instrument," it cost $52. According to Nelson, a wheel of diaphragms is let into the stage; the body is $2^1/_2$ inches long, with a draw tube extending to $5^1/_4$ inches; the mirror has a concave side only; the case has a stout brass plate in its base providing stability and it weighs 13 oz., the instrument with objective, an additional 17 oz.

Nelson compared the Zentmayer microscope to one of his own design made for him by Powell & Lealand in 1887. The comparison seems very objective, quite a contrast to the debates over aperture which had occurred twenty years earlier pitting Tolles against Wenham. "In this summary I do not wish to make any

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invidious comparisons between Zentmayer's and my own model, but merely to point out their respective advantages and defects, so that any future designer of a portable Microscope may avoid the errors of both designs." Nelson's model survives, having been bequeathed to the Royal Microscopical Society in 1948 by his friend, A.A.C. Eliot Merlin.[5] Rousselet donated some items to the Society, but not his pocket microscope which he must have highly valued! It found its way into Gil Mellé's collection via E.P. Herlihy who purchased it from the Rousselet estate.

The $40, which would originally have bought a pocket microscope, would also have purchased a monocular American Histological microscope with a swinging substage. This was perhaps a more attractive purchase as this model abounds in the marketplace today. The 1/5 inch objective offered for an additional $12 with the pocket microscope is one of the less expensive series made for the Histological microscope, which also had a short tube. Presumably these lenses were corrected for the short tube length but Zentmayer's catalog makes no mention of this. These lenses were less expensive than Zentmayer's standard ones. Nelson's portable model did not accept objectives with the Society Screw, necessitating special lenses at additional cost.

In late 1991, when I first researched this microscope, the only Zentmayer pocket microscope known was the one in the Billings Collection, which lacked its box and mirror. The Billings catalog notes that Zentmayer's precision workmanship is readily apparent. The microscope is signed "Jos. Zentmayer, Philada.," the early form of the maker's signature. The lack of a serial number suggests that few were ever made.[6] Mellé contended that Rousselet said only three were made, however at least 4 are known today. The two that have appeared since Mellé's article have both been available to collectors. The first, signed "J. Zentmayer, Philadelphia," was sold by Richard Van Vleck on his SMMA web site, where color photos of it can still be viewed.[7] The second, signed " Jos. Zentmayer, Philadelphia," appeared at the Skinner auction in July 1997, where it fetched $3450 on its way to a Midwestern collection.[8]

Nelson's good publicity probably did little to increase the number of these instruments made, as both the Zentmayer and Powell & Lealand firms were nearing the end of their productive existences in 1895. Today it is the best reference to an interesting American microscope, which won praise from leading microscopists in England.

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3. Gerard L'E. Turner, *God Bless the Microscope* (London, 1989), pp. 67-69.

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5. G. L'E. Turner, *The Great Age of the Microscope* (Bristol, 1989), pp. 145-146, Item No. 133.

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7. http://www.americanartifacts.com/smma/index.htm

8. Skinner, Inc., Bolton, Massachusetts, Sale 1790, Science & Technology, July 19, 1997, lot 57.

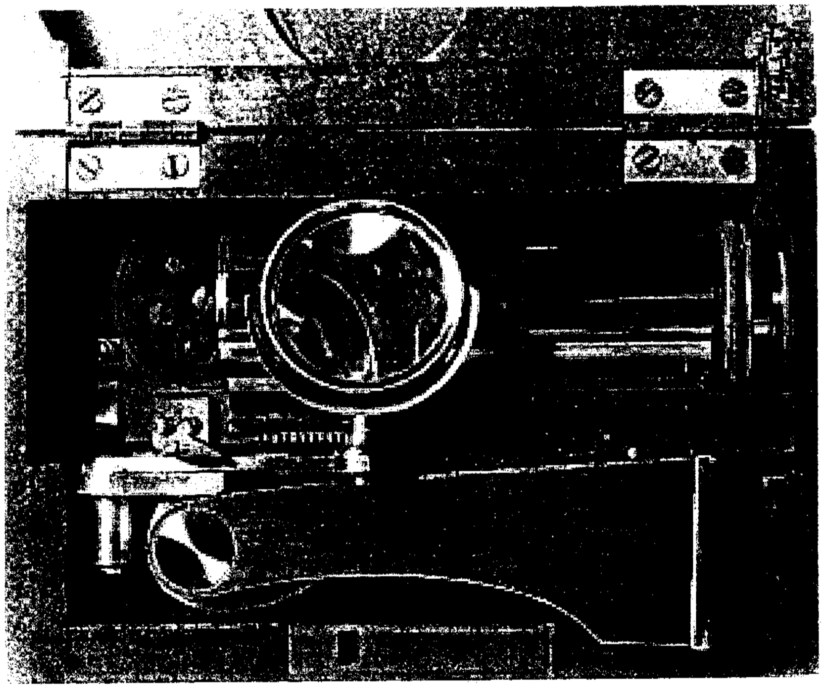

Figure 2. SMMA's "J. Zentmayer, Philadelphia" pocket microscope set into its case. Note the precise fit, and the depression in the lid for accommodating the mirror. The coarse focus knob is not visible here, but can be seen in figure 1. Photo courtesy Richard Van Vleck.

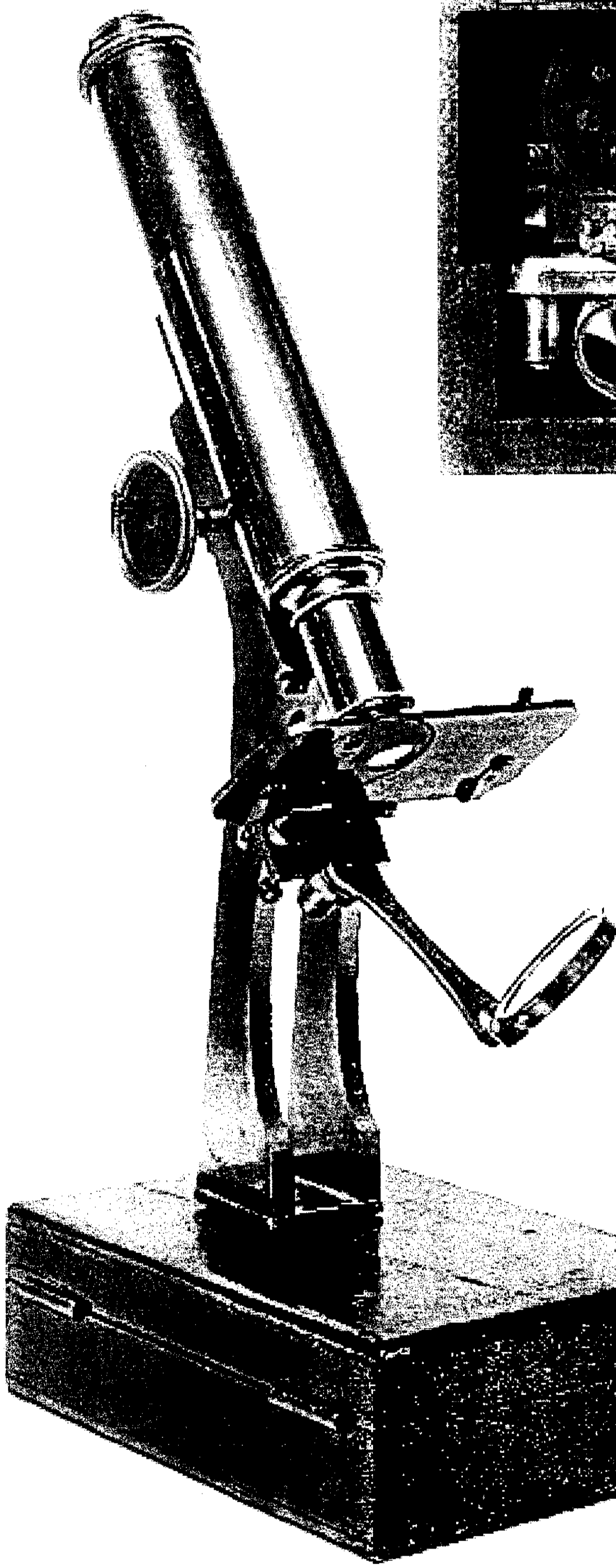

Figure 3. The microscope assembled on its case. Photo courtesy Richard Van Vleck.

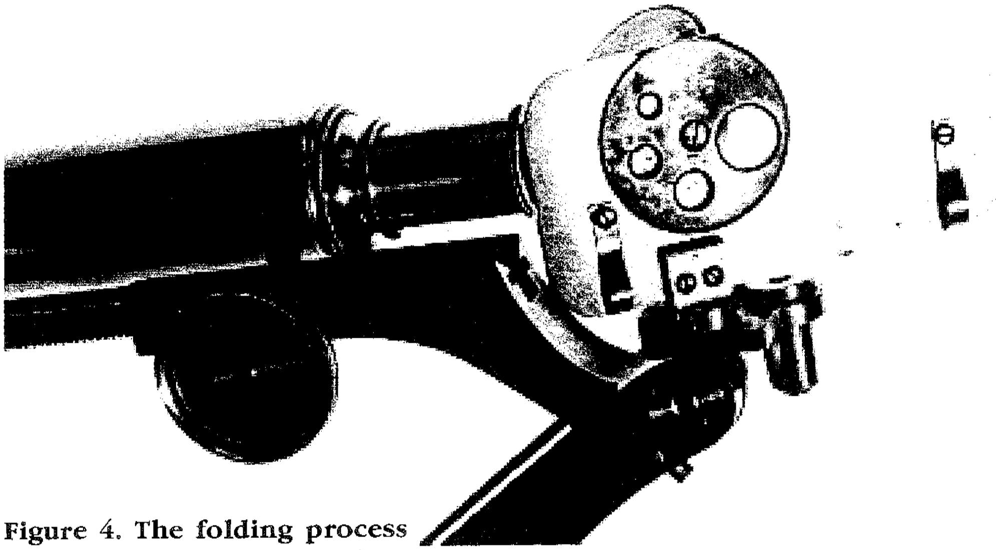

Figure 4. The folding process begins when the stand is unscrewed from the case, and the limb folded back, and the mirror and stage are folded on opposite sides of the limb. As Nelson noted, it is not necessary to remove the objective, there is a notch in the case to accommodate even it. Photo courtesy Richard Van Vleck.

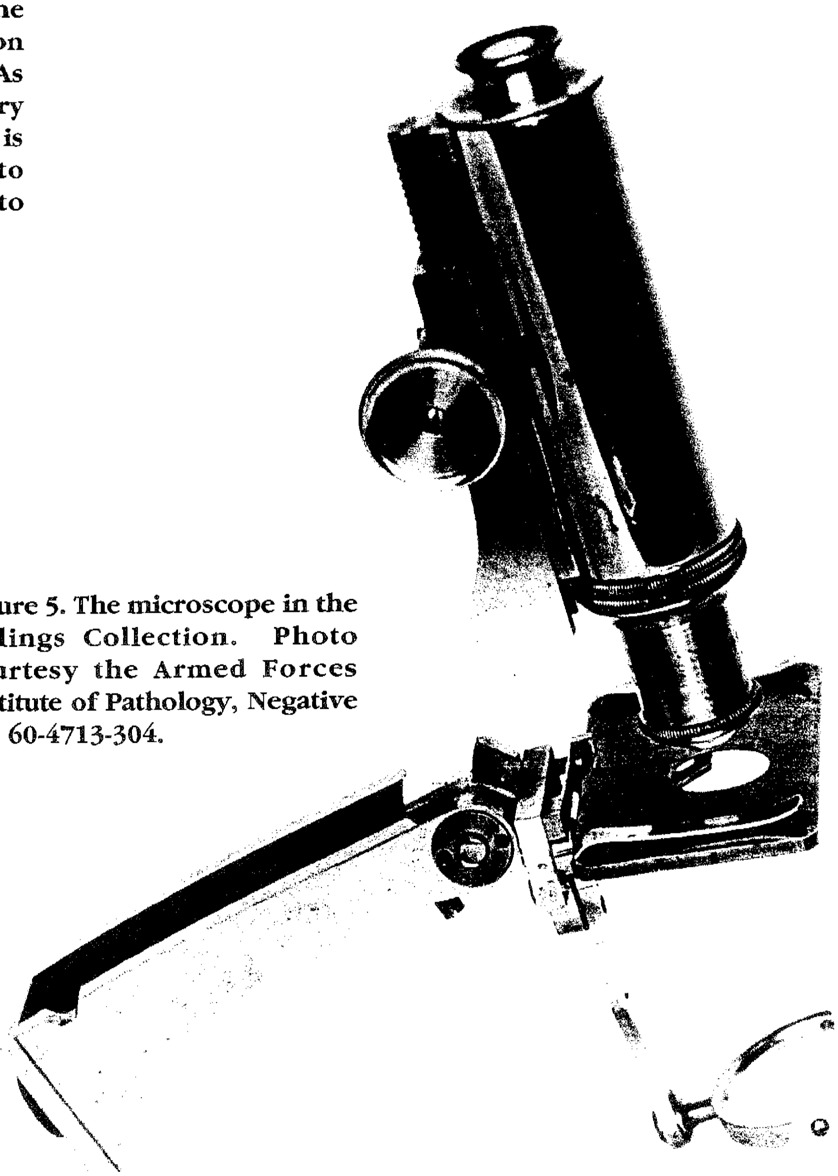

Figure 5. The microscope in the Billings Collection. Photo courtesy the Armed Forces Institute of Pathology, Negative No. 60-4713-304.

An Improved Smoke Cell Design for the Video Display of Brownian Motion

Bill Davies

Abstract

A simple smoke cell, for the display of Brownian Motion is described. The cell may be constructed from readily available materials and it can be used together with a video camera and monitor to provide stable displays for demonstration to groups.With slight modifications, the cell may also be used with conventional microscopes.

Introduction

Almost everyone who has experience with microscopes has heard of, or is familiar with Brownian Motion. The phenomenon is named for Robert Brown, the English botanist who observed and described the effect in 1827 whilst using a microscope to study samples of pollen seeds suspended in water. Brown noticed a continuous motion of tiny particles among his pollen samples. The effect was visible even within pollen seed samples which had been dead for many years.

Upon further investigation,Brown was able to observe the same "activity" in a wide variety of suspensions of small particles. This mysterious motion had already been reported by other researchers in previous years. Brown was unable to explain the motion but theorized that the effect could be due to thermal, or diffusion processes within the aqueous solutions. Other explanations had been suggested including evaporation effects (and even bacterial activity).

It was not until 1910 that acceptable theories were put forward by Einstein, Smoluchowski and Maxwell who, independently, provided logical explanations for this apparent "perpetual motion", based on the molecular theory of matter. Einstein, who provided a very comprehensive mathematical treatment, was awarded a Nobel prize for this work.

The molecular theory explanation is now almost universally accepted and it is basically as follows :

1) Liquid or gas molecules under ambient conditions are in constant motion
2) Particles suspended in a liquid or a gas are bombarded by the surrounding molecules
3) If the suspended particles are very small (in the range of a few microns) the result is erratic random motion of the particles which can be seen with the aid of a microscope.
4) With larger particles the bombardment is distributed over the larger surface area of the particle and the molecular energy is dissipated more uniformly, hence the movement tends to be damped.

Brown's original publication was criticized by some of his peers who claimed that Brown's experimental or observational methods were questionable. In a second paper, published in 1829 titled " Additional remarks on active molecules," Brown answers some of these criticisms.

The contents and even the title of this paper suggest Brown's considerable insight. Part of this paper is reprinted below.

Practical Observations

Brownian Motion may easily be studied using a basic microscope and common household materials, such as, milk, wood glue, some inks, etc. The main requirements are a microscope capable of 200 - 600 times magnification, some slides and cover slips.

Experiments similar to the following may be found in Physics textbooks :

Place a small drop of milk (1 mm) on a slide. Mix with a similar size drop of water.
Place a cover slip over the mixture. Using 400 to 600 times magnification, jiggling of the fat globules can be seen after the streaming effects have ceased.
The jiggling is due to the bombardment of the fat particles by the water molecules.

If the guidelines above are followed, good images are readily obtained. By further experimenting with the illumination and trying materials having different particle size, quite spectacular displays can be produced. Following the above procedure will give the experimenter a feel for the various conditions and adjustments necessary to obtain and recognize " Brownian" images before attempting to view smoke particles.

Smoke Cells

Using a simple optical " smoke cell " and a suitable illuminator it is possible to observe the effects of Brownian movement of air molecules upon smoke particles.

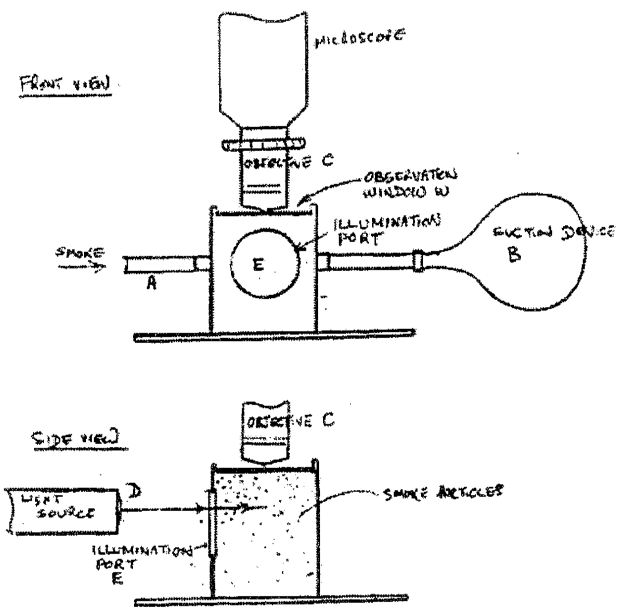

Fig. 1

Several different types of smoke cell are documented. (See references).The main requirements are:

1) A small chamber (with observation and illumination windows) to contain the smoke
2) A light source of sufficient intensity to illuminate the smoke particles
3) Some means of observation, (magnifying and focusing on the smoke particles)
4) A source of smoke

A typical smoke cell consists of a small, cylindrical chamber, which can be mounted on a microscope stage. (See Figure 1).

An observation window (W) is located at the top of the chamber. Smoke is drawn into the chamber through the tube on the left side (A) using a suction Bulb (B). The microscope objective (C) is focused through the window (W) on the smoke particles which are illuminated by the light source (D), the beam of which passes horizontally through the cell via an illumination port (E).

There are several different designs of smoke cell based on these features. One popular commercial version was sold by the Welch Scientific Company.

A convenient way to produce the smoke is by lighting a twisted paper towel, blowing out the flame and allowing the paper to smolder for a few seconds. Various demonstration setups are described in the relevant scientific literature. Some of these are rather elaborate, utilizing high intensity lamps and optical projection systems.

Different configurations of smoke cells similar to the design in figure (1) were tested, together with various light sources (including a laser source). Some of these setups proved to be difficult to use and adjust, and they are not really suitable for live demonstration to groups.

Smoke cells appear to suffer from the following problems depending on the particular application :

1) There is often insufficient clearance to place the cell on the stages of some microscopes
2) The working distance of the objective and the high magnification necessary, make focusing difficult.
3) Heating by a high intensity light source may produce turbulence in the smoke cell.This masks the distinctive Brownian jiggling.

It was decided to try various modifications in order to produce a simpler, easy to use design. Most of the testing was carried out using a microscope objective directly attached to a small video camera together with a 17 inch video monitor as described in the notes below.

A major improvement was made by eliminating the observation window and mounting the objective directly into the top of the cell, so that the objective front lens is directly immersed in the smoke sample. This modification eliminated the need for focusing and excellent images were obtained. (It is advisable to use a low-cost objective for this application as repeated exposure to smoke may eventually cause contamination of the objective components.)

Because of the high magnifications involved, any disturbance of the smoke sample due to convection currents within the cell will cause the image to appear as a "snowstorm " and the familiar Brownian jiggling motion is not visible.

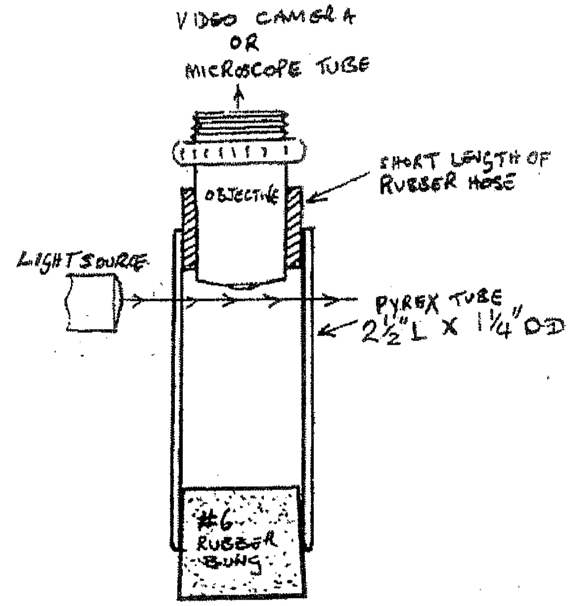

Fig. 2 Outline drawing of cell.

Convection currents within the cell can be caused by heat from the light source, so it is helpful to provide an optical "exit port" for the light beam in order to minimize heating of the cell walls. Also air leaks in the cell can produce swirling of the smoke particles as the air in the cell heats up. Some smoke cells appear to work best as sealed systems.
To minimize these effects, further modifications were tried, and the final design is shown in Fig 2.

This version is extremely simple and it consists of a short length of glass tube with the microscope objective mounted at one end, and a rubber bung seal at the bottom.
The cell is shown in Fig 3, together with a standard (10 watt) microscope illuminator.
Smoke is introduced into the cell by removing the rubber bung and inserting a smoldering twisted-paper taper into the bottom of the tube for 3-4 seconds. The bung is replaced, and when the smoke has stabilized after a few seconds the light source can be adjusted to provide the best images.
Brownian movement is visible for several minutes. The demonstration may be carried out under normal room lighting conditions and no shielding from ambient light is necessary.
This cell was primarily designed to be attached to a video camera, but it may be used with some types of conventional microscopes by removing the stage, and associated components.
Variations of the above design have been tried using different light sources and tube lengths etc..
These all appear to work well and the dimensions are not critical.

Notes:

In this application, the smoke cell together with the microscope objective is directly attached to the video camera using an adapter, in place of the normal TV lens. Using this "generic" adapter device as described below, objective magnification specifications are not strictly valid.

The overall magnification obtained actually depends upon the following:
1) The video camera scaling factor, ie., the magnification of the objective primary image at the plane of the camera optical detector (CCD chip). Ideally, the magnified primary image should fill the area of the camera detector chip,
2) A second scaling factor which is the ratio of the size of the video monitor screen in relation to the video camera CCD detector chip size.

For practical purposes, using a standard 40X objective mounted directly on a camera with a 0.3 inch square CCD chip, overall magnifications of approximately 600-700 times are typically obtainable using a 14 inch video monitor (magnifications were checked using a stage micrometer). The field of view will vary according to the particular characteristics of the objective used.

It is not possible to focus on individual smoke particles in this particular application. The smoke particles in the cell are in constant motion and are seen rather as points of light as they pass through the focal plane of the objective.

Construction of the above cell is extremely simple and a list of materials is given below. Components such as small video cameras are low cost and are readily available. Various objectives may be tried to produce the best results.

Components list

1) Length of Pyrex tube. approx. $1\ ^{1}/_{8}$ inch inside diameter, x $2\ ^{1}/_{2}$ inches long .
2) One # 6 rubber bung
3) Short length of plastic or rubber tube (1 inch long x _ inch ID) or suitable size to adapt the objective OD to Pyrex tube ID
4) Microscope objective (20 x - 45 x)
5) Video camera (CCD type) and monitor. A medium resolution monochrome or color camera is adequate.
6) Adapter ring : Objective thread , 36 TPI , to Video camera "C" mount thread (Edmunds J03-627).
7) Microscope illuminator (Conventional 10 Watt Tungsten lamp type -similar to Edmunds J35-237).

Assembly and operation

Insert the microscope objective into the Pyrex tube

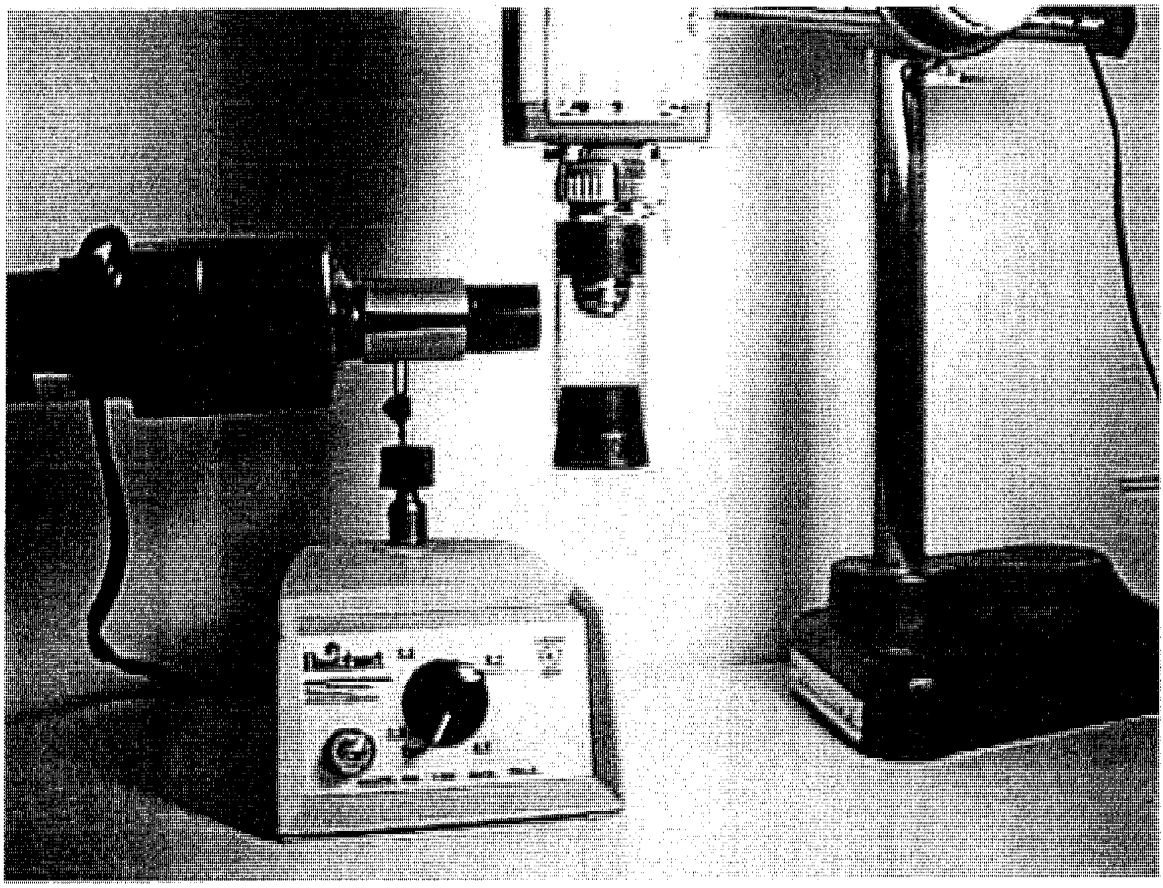

Fig. 3 Photo of cell and illuminator

using the short rubber sleeve as a bushing. Use a few layers of plastic electrical tape wound around the objective and/or the sleeve, if necessary, to produce a snug fit. This task is simplified if the ends of the Pyrex tube have been "flame" polished beforehand.
Place the rubber bung into the open end of the tube.

Use the adapter ring to attach the microscope objective to the video camera "C" mount thread, ensuring that the rear of the objective is clear of the camera CCD element.

Mount the complete assembly vertically with the rubber bung at the bottom, using a laboratory stand or a small tripod to support the video camera. Set up the light source close to the smoke cell so that the beam passes horizontally through the Pyrex tube, approximately 2mm below the center of the objective. Introduce the smoke as described above and adjust the light to produce the best images.

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Reprint of Brown's second "Additional remarks Paper "

Remarks on Active Molecules
By Robert Brown from "Additional Remarks on Active Molecules" (1829)

About twelve months ago I printed an account of Microscopical Observations made in the summer of 1827, on the particles contained in the Pollen of Plants; and on the general Existence of active Molecules in Organic and Inorganic Bodies.

In the present Supplement to that account, my objects are, to explain and modify a few of its statements, to advert to some of the remarks that have been made, either on the correctness or originality of the observations, and to the causes that have been considered sufficient for the explanation of the phenomena.

In the first place, I have to notice an erroneous assertion of more than one writer, namely, that I have stated the active Molecules to be animated. This mistake has probably arisen from my having communicated the facts in the same order in which they occurred, accompanied by the views which presented themselves in the different stages of the investigation; and in one case, from my having adopted the language, in referring to the opinion, of another inquirer into the first branch of the subject.

Although I endeavored strictly to confine myself to the statement of the facts observed, yet in speaking of the active Molecules I have not been able, in all cases, to avoid the introduction of hypothesis; for such is the supposition, that the equally active particles of greater size, and frequently of very different form, are primary compounds of these Molecules,— a supposition which, though professedly conjectural, I regret having so much insisted on, especially as it may seem connected with the opinion of the absolute identity of the Molecules, from whatever source derived.

On this latter subject the only two points that I endeavored to ascertain, were their size and figure: and although I was, upon the whole, inclined to think that in these respects the Molecules were similar from whatever substances obtained, yet the evidence then adduced in support of the supposition was far from satisfactory; and I may add, that I am still less satisfied now that such is the fact. But even had the uniformity of the Molecules in those two points been absolutely established, it did not necessarily follow, nor have I any where stated, as has been imputed to me, that they also agreed in all their other properties and functions.

I have remarked, that certain substances, namely, sulphur, resin, and wax, did not yield active particles, which, however, proceeded merely from defective manipulation; for I have since readily obtained them from all these bodies: at the same time I ought to notice that their existence in sulphur was previously mentioned to me by my friend Mr. Lister.

In prosecuting the inquiry subsequent to the publication of my Observations, I have chiefly employed the simple microscope mentioned in the Pamphlet, as having been made for me by Mr. Dolland, and of which the three lenses that I have generally used, are of a 40th, 60th, and 70th of an inch focus.

Many of the observations have been repeated and confirmed with other simple microscopes having lenses of similar powers, and also with the best achromatic compound microscopes, either in my own possession or belonging to my friends.

The result of the inquiry at present essentially agrees with that which may be collected from my printed account, and may be here briefly stated in the following terms: namely,

That extremely minute particles of solid matter, whether obtained from organic or inorganic substances, when suspended in pure water, or in some other aqueous fluids, exhibit motions for which I am unable to account, and which from their irregularity and seeming independence resemble in a remarkable degree the less rapid motions of some of the simplest animalcules of infusions. That the smallest moving particles observed, and which I have termed Active Molecules, appear to be spherical, or nearly so, and to be between 1-20,000dth and 1-30,000dth of an inch in diameter; and that other particles of considerably greater and various size, and either of similar or of very different figure, also present analogous motions in like circumstances.

I have formerly stated my belief that these motions of the particles neither arose from currents in the fluid containing them, nor depended on that intestine motion which may be supposed to accompany its evaporation.

These causes of motion, however, either singly or combined with others,— as, the attractions and repulsions among the particles themselves, their unstable equilibrium in the fluid in which they are suspended, their hygrometrical or capillary action, and in some cases the disengagement of volatile matter, or of minute air bubbles, — have been considered by several writers as sufficiently accounting for the appearances. Some of the alleged causes here stated, with others which I have considered it unnecessary to mention, are not likely to be overlooked or to deceive observers of any experience in microscopical researches: and the insufficiency of the most important of those enumerated, may, I think, be satisfactorily shown by means of a very simple experiment.

This experiment consists in reducing the drop of water containing the particles to microscopic minuteness, and prolonging its existence by immersing it in a transparent fluid of inferior specific gravity, with which it is not miscible, and in which evaporation is extremely slow. If to almond-oil, which is a fluid having these properties, a considerably smaller proportion of water, duly impregnated with particles, be added, and the two fluids shaken or triturated together, drops of water of various sizes, from 1-50th to 1-2000dth of an inch in diameter, will be immediately produced. Of these, the most minute necessarily contain but few particles, and some may be occasionally observed with one particle only. In this manner minute drops, which if exposed to the air would be dissipated in less than a minute, may be retained for more than an hour. But in all the drops thus formed and protected, the motion of the particles takes place with undiminished activity, while the principal causes assigned for that motion, namely, evaporation, and their mutual attraction and repulsion, are either materially reduced or absolutely null.

It may here be remarked, that those currents from centre to circumference, at first hardly perceptible, then more obvious, and at last very rapid, which constantly exist in drops exposed to the air, and disturb or entirely overcome the proper motion of the particles, are wholly prevented in drops of small size immersed in oil, — a fact which, however is only apparent in those drops that are flattened, in consequence of being nearly or absolutely in contact with the stage of the microscope.

That the motion of the particles is not produced by any cause acting on the surface of the drop, may be proved by an inversion of the experiment; for by mixing a very small proportion of oil with water containing the particles, microscopic drops of oil of extreme minuteness, some of them not exceeding in size the particles themselves, will be found on the surface of the drop of water, and nearly or altogether at rest; while the particles in the centre or towards the bottom of the drop continue to move with their usual degree of activity.

By means of the contrivance now described for reducing the size and prolonging the existence of the drops containing the particles, which, simple as it is, did not till very lately occur to me, a greater command of the subject is obtained, sufficient perhaps to enable us to ascertain the real cause of the motions in question.

Of the few experiments which I have made since this manner of observing was adopted, some appear to me so curious, that I do not venture to state them until they are verified by frequent and careful repetition.

I shall conclude these supplementary remarks to my former Observations, by noticing the degree in which I consider those observations to have been anticipated.

That molecular was sometimes confounded with animalcular motion by several of the earlier microscopical observers, appears extremely probable from various passages in the writings of Leeuwenhoek, as well as from a very remarkable Paper by Stephen Gray, published in the 19th volume of the Philosophical Transactions.

Needham also, and Buffon, with whom the hypothesis of organic particles originated, seem to have not unfrequently fallen into the same mistake. And I am inclined to believe that Spallanzani, notwithstanding one of his statements respecting them, has under the head of Animaletti d'ultimo ordine included the active Molecules as well as true Animalcules.

I may next mention that Gleichen, the discoverer of the motions of the Particles of the Pollen, also observed similar motions in the particles of the ovulum of Zea Mays.

Wrisberg and Muller, who adopted in part Buffon's hypothesis, state the globules, of which they supose all organic bodies formed, to be capable of motion; and Muller distinguishes these moving organic globules from real Animalcules, with which, he adds, they have been confounded by some very respectable observers.

In 1814 Dr. James Drummond, of Belfast, published in the 7th volume of the Transactions of the Royal Society of Edinburgh, a valuable Paper, entitled "On certain Appearances observed in the Dissection of the Eyes of Fishes."

In this Essay, which I regret I was entirely unacquainted with when I printed the account of my Observations, the author gives an account of the very remarkable motions of the spicula which form the silvery part of the choroid coat of the eyes of fishes.

These spicula were examined with a simple microscope, and as opake objects, a strong light being thrown upon the drop of water in which they were suspended. The appearances are minutely described, and very ingenious reasoning employed to show that, to account for the motions, the least improbable conjecture is to suppose the spicula animated.

As these bodies were seen by reflected and not by transmitted light, a very correct idea of their actual motions could hardly be obtained; and with the low magnifying powers necessarily employed with the instrument and in the manner described, the more minute nearly spherical particles or active Molecules which, when higher powers were used, I have always found in abundance along with the spicula, entirely escaped observation.

Dr. Drummond's researches were strictly limited to the spicula of the eyes and scales of fishes; and as he does not appear to have suspected that particles having analogous motions might exist in other organized bodies, and far less in inorganic matter, I consider myself anticipated by this acute observer only to the same extent as by Gleichen, and in a much less degree than by Muller, whose statements have already been alluded to.

All observers now mentioned have confined themselves to the examination of the particles of organic bodies. In 1819, however, Mr. Bywater, of Liverpool, published an account of Microscopical Observations, in which it is stated that not only organic tissues, but also inorganic substances, consist of what he terms animated or irritable particles.

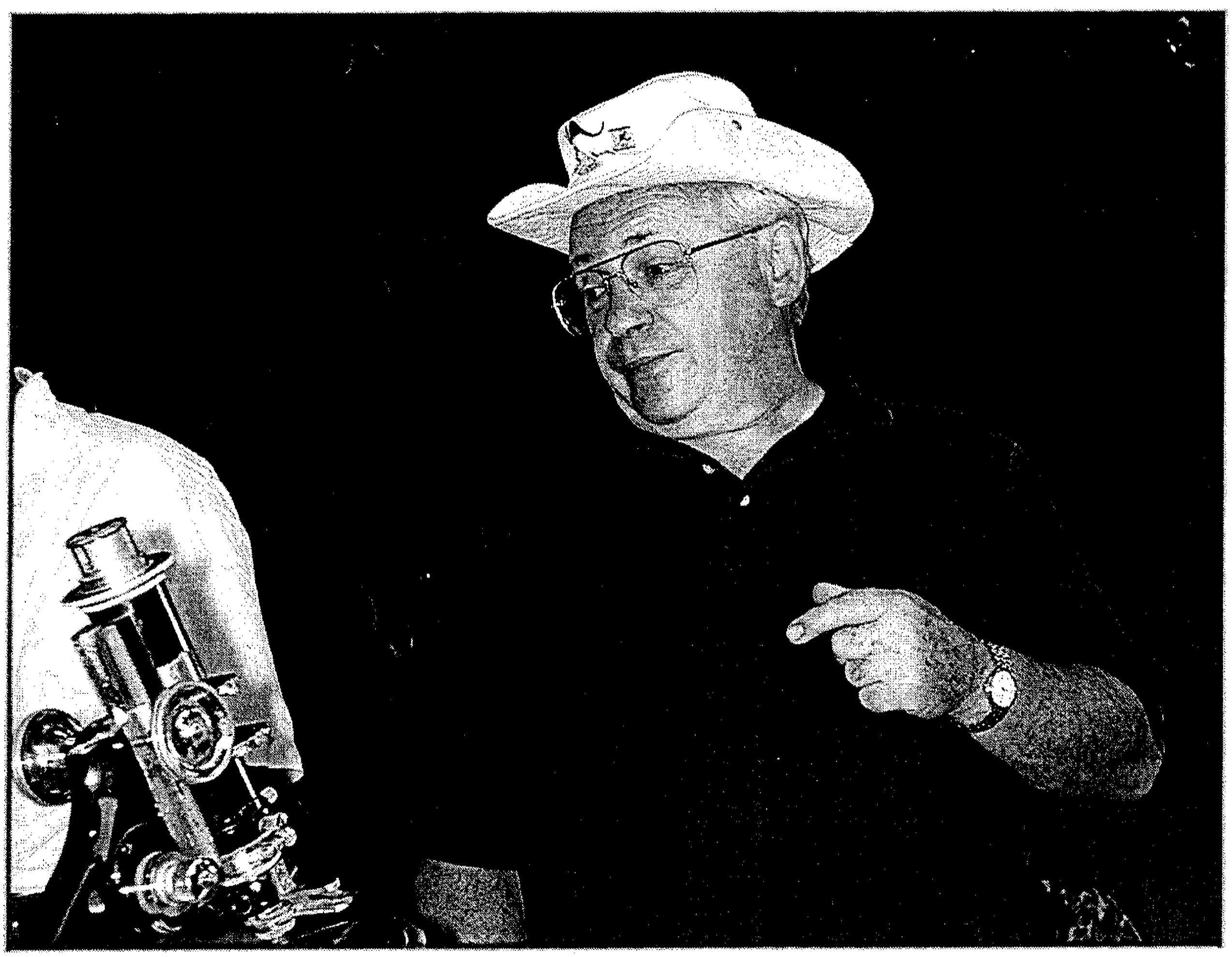
A second edition of this Essay appeared in 1828, probably altered in some points, but it may be supposed agreeing essentially in its statements with the edition of 1819, which I have never seen, and of the existence of which I was ignorant when I published by pamphlet.

From the edition of 1828, which I have but lately met with, it appears that Mr. Bywater employed a compound microscope of the construction called Culpeper's, that the object was examined in a bright sunshine, and the light from the mirror thrown so obliquely on the stage as to give a blue colour to the infusion.

The first experiment I here subjoin in his own words.

"A small portion of flour must be placed on a slip of glass, and mixed with a drop of water, then instantly applied to the microscope; and if stirred and viewed by a bright sun, as already described, it will appear evidently filled with innumerable small linear bodies, writhing and twisting about with extreme activity." Similar bodies, and equally in motion, were obtained from animal and vegetable tissues, from vegetable mould, from sandstone after being made red hot, from coal, ashes, and other inorganic bodies.

I believe that in thus stating the manner in which Mr. Bywater's experiments were conducted, I have enabled microscopical observers to judge of the extent and kind of optical illusion to which he was liable, and of which he does not seem to have been aware. I have only to add, that it is not here a question of priority; for if his observations are to be depended on, mine must be entirely set aside.



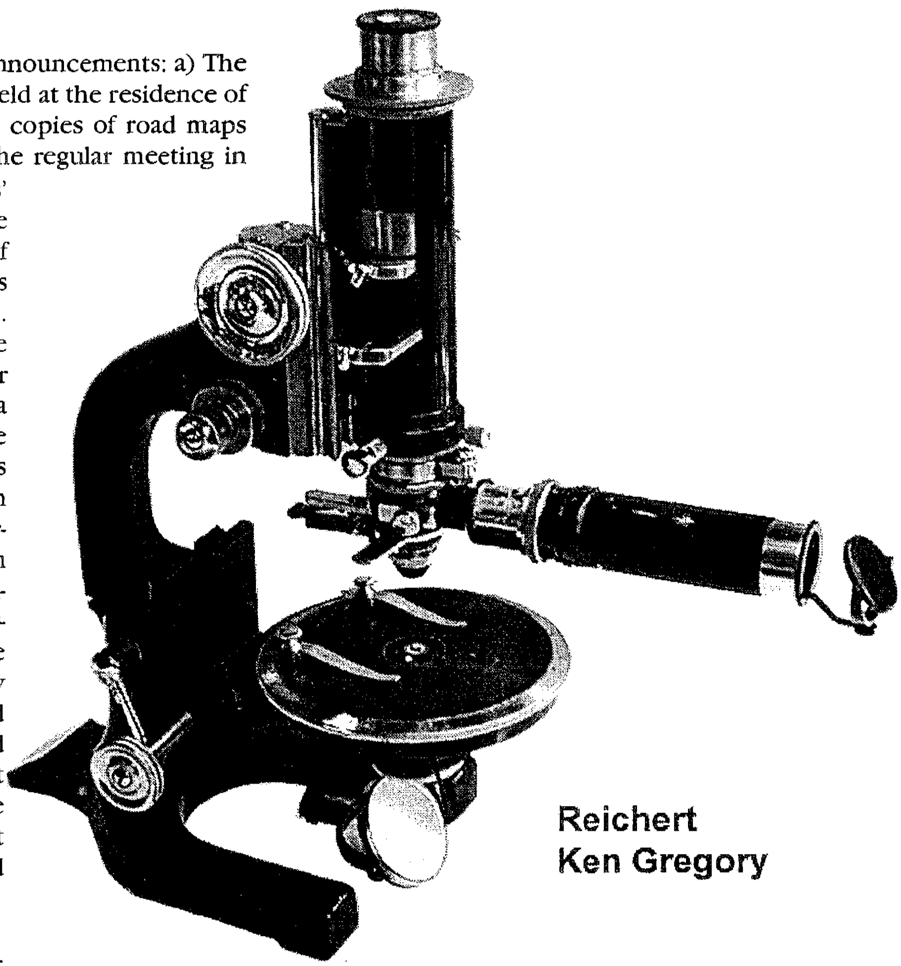
"The Collector's Look" Leon Stabinsky - MSSC Workshop - 5 August 2000

WORKSHOP of the Microscopical Society of Southern California

George G. Vitt, Jr.

Date: Saturday, 5 August 2000
Location: The Lieberman's residence

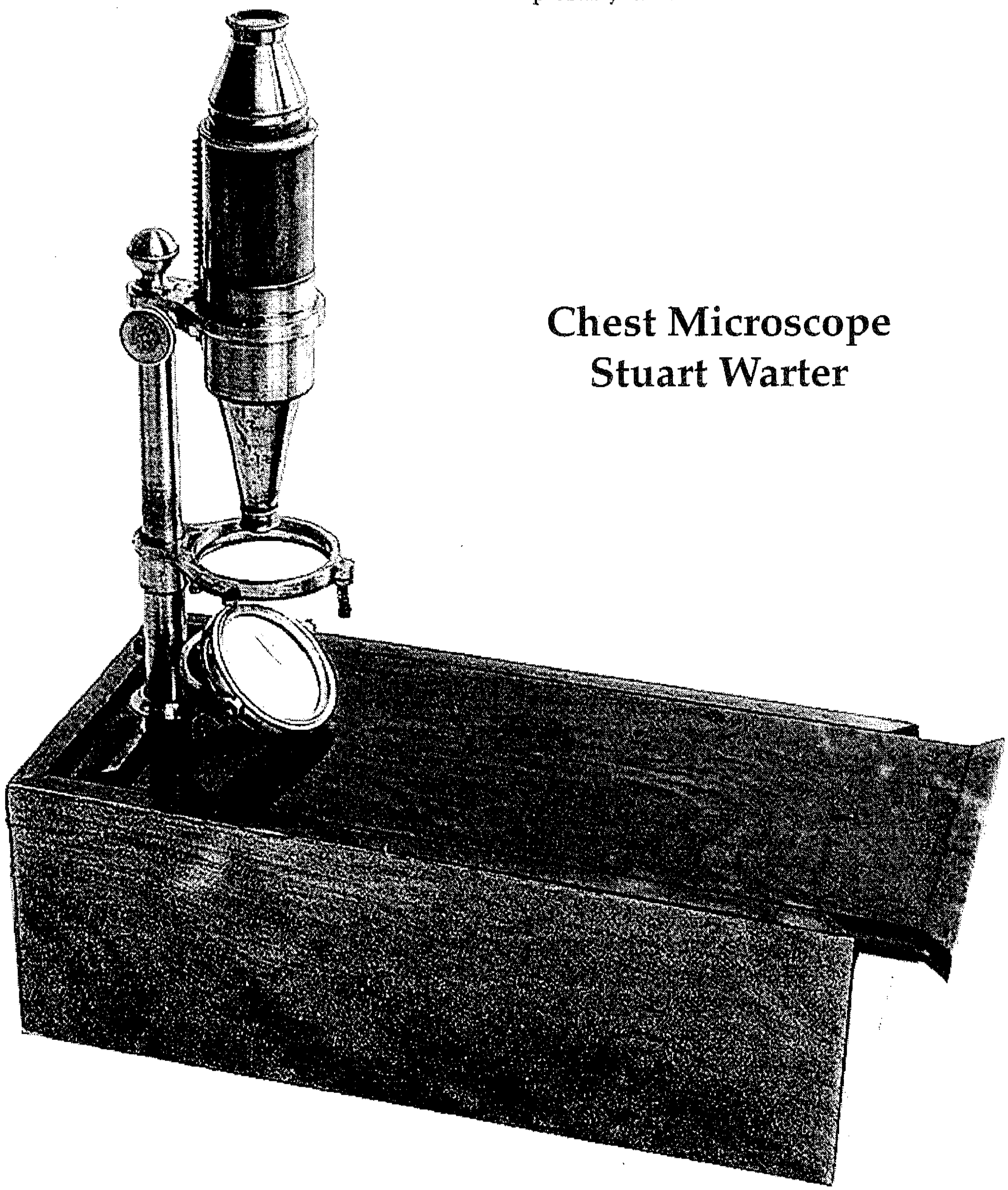
1. **Jim Solliday** made two announcements: a) The September Workshop will be held at the residence of Ken Gregory. Jim handed out copies of road maps indicating the way there; b) The regular meeting in September will feature Ed Jones' hands-on demonstration of the making of microslides, each of which contains many specimens about the size of a grain of sand. For this, he urged us to bring fine needle-nose tweezers, one or two stereo microscopes and a light source. Jim then raised the question as to the whereabouts of some 200 botanical section microslides, that MSSC had purchased several years ago from John Wells, which have mysteriously disappeared. He asked everyone to check his storehouse of equipment to see if they may have been 'put in a safe place' and forgotten. Jim then described our collection of excellent microslides prepared by Lee Gonzales, and proposed that these should be circulated among the membership.



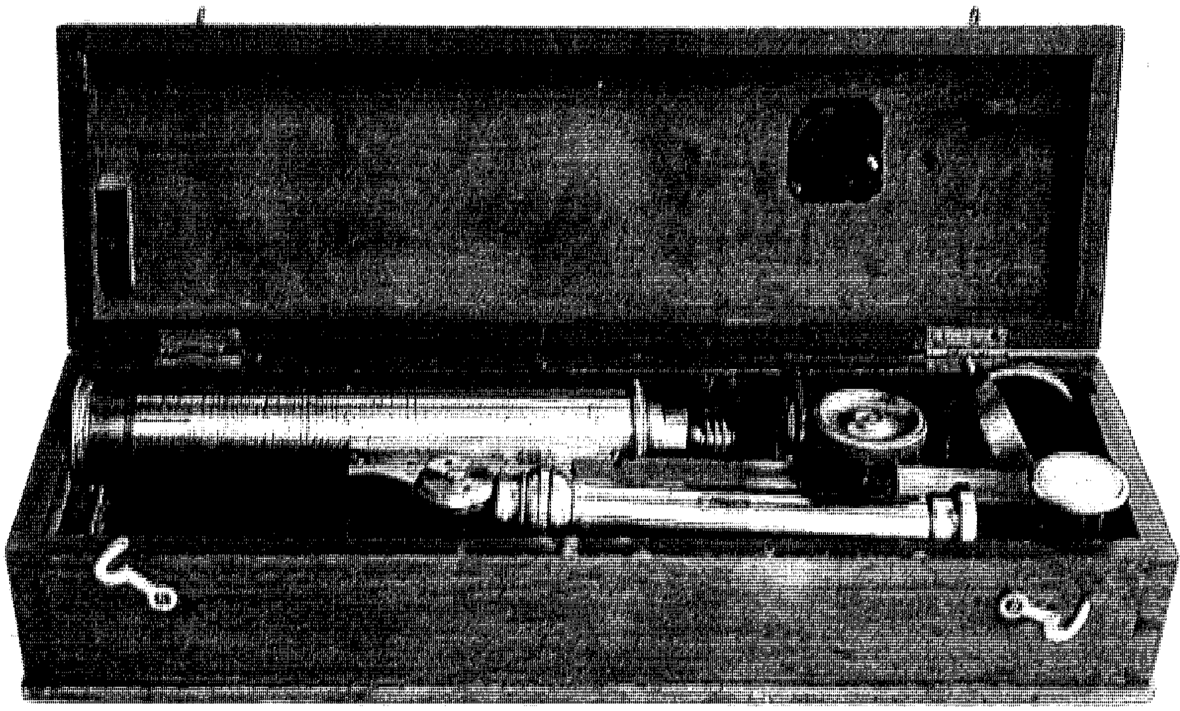
Reichert
Ken Gregory

2. **Ken Gregory** showed an excellent 1926 cased Reichert petrographic polarizing microscope (see photo) with a set of 6 slip-in objectives, several eyepieces, graduated (angle, and x-y) rotating stage and epi-illumination capability. The epi-illumination optical tube fits above the objective, pivots on a vertical axis, and can be locked at any desired azimuth angle by means of a ball detent and locking collar. A gimbaled mirror at the outer end of this tube directs the light from the substage mirror (clearing the stage) down the axis of the tube and into a conventional prism beam splitter above the objective. This is a very convenient and practical epi lighting arrangement which is not often encountered. The microscope is equipped with Ahrens calcite prism polarizer and analyzer and a focusable Bertrand lens in a slide mount which also has a clear aperture, as is standard practice in most polarizing microscopes. The substage condenser has a swing-out high numerical aperture top lens for use with high power objectives - the whole assembly being removable by virtue of the lockable dovetail slide. The design of the substage optics and the method of mounting and removal is practically the same as that on the Reichert Zetopan microscope The stage can be moved downward to allow the inspection of thick specimens such as those encountered in geological work.

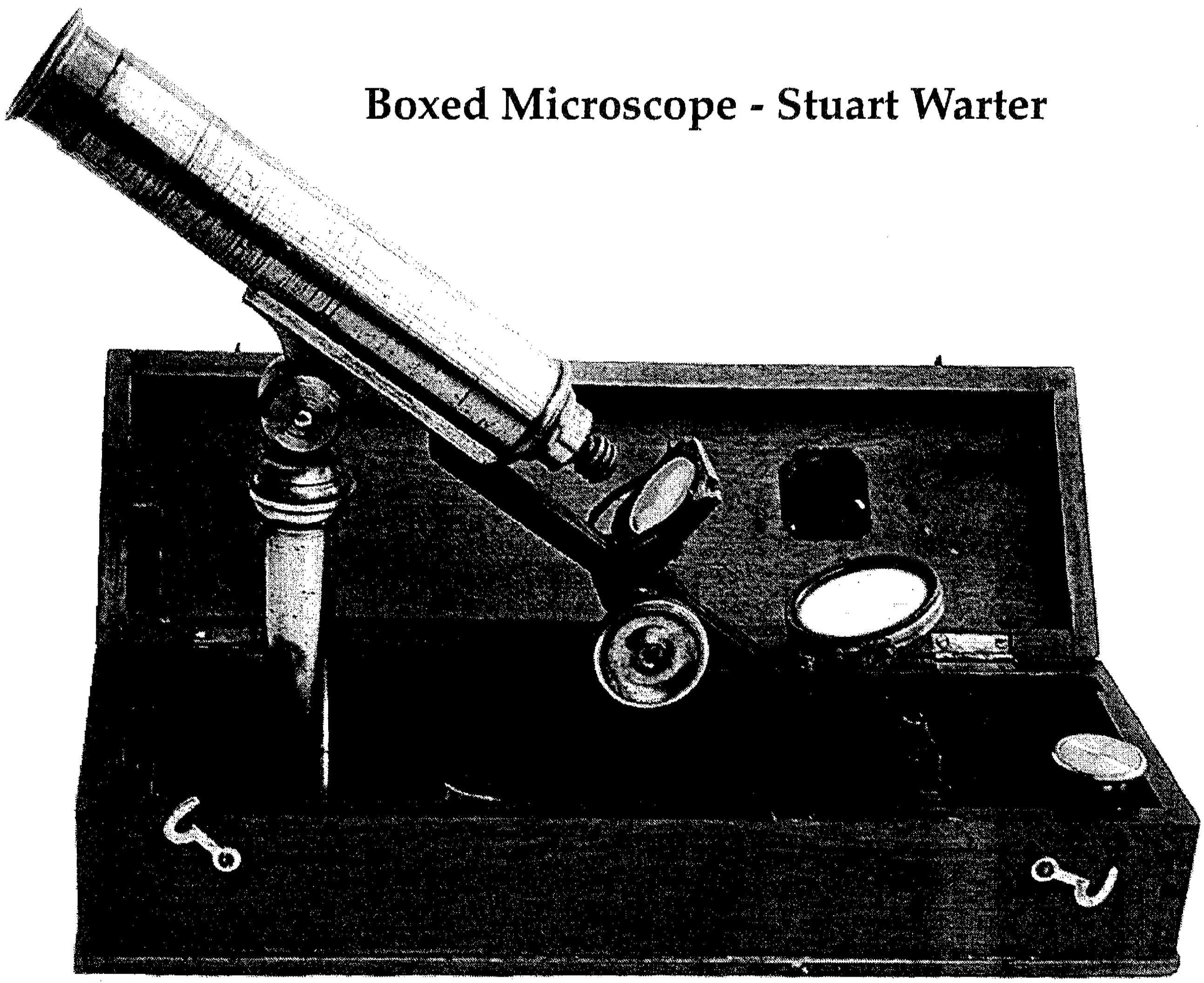
3. **Stuart Warter** showed two brass 'chest' microscopes (see photos). The smaller microscope, which appears to be of early English make, mounts on top of its mahogany case which has a sliding dovetailed lid. The larger boxed microscope is mounted inside the box in a way that makes it impossible to use it in any other but the horizontal position! Upon closer examination, Stuart came to the conclusion that it was originally made as a chest microscope, but was later altered to fit the needs of a previous owner. In Stuart's words, "The larger of the two "chest" microscopes turned out not to have been manufactured in that ill conceived configuration after all. On examining it closely, I discovered three well camouflaged filled holes on one corner of the box lid, where the mounting boss had originally been attached. Probably a previous owner found it unstable in that configuration and moved the attachment inside. When mounted on the outside corner as originally intended, it could be used in a vertical position, as well as an inclined one. A good rule: when something doesn't look right, it probably isn't."



Chest Microscope
Stuart Warter



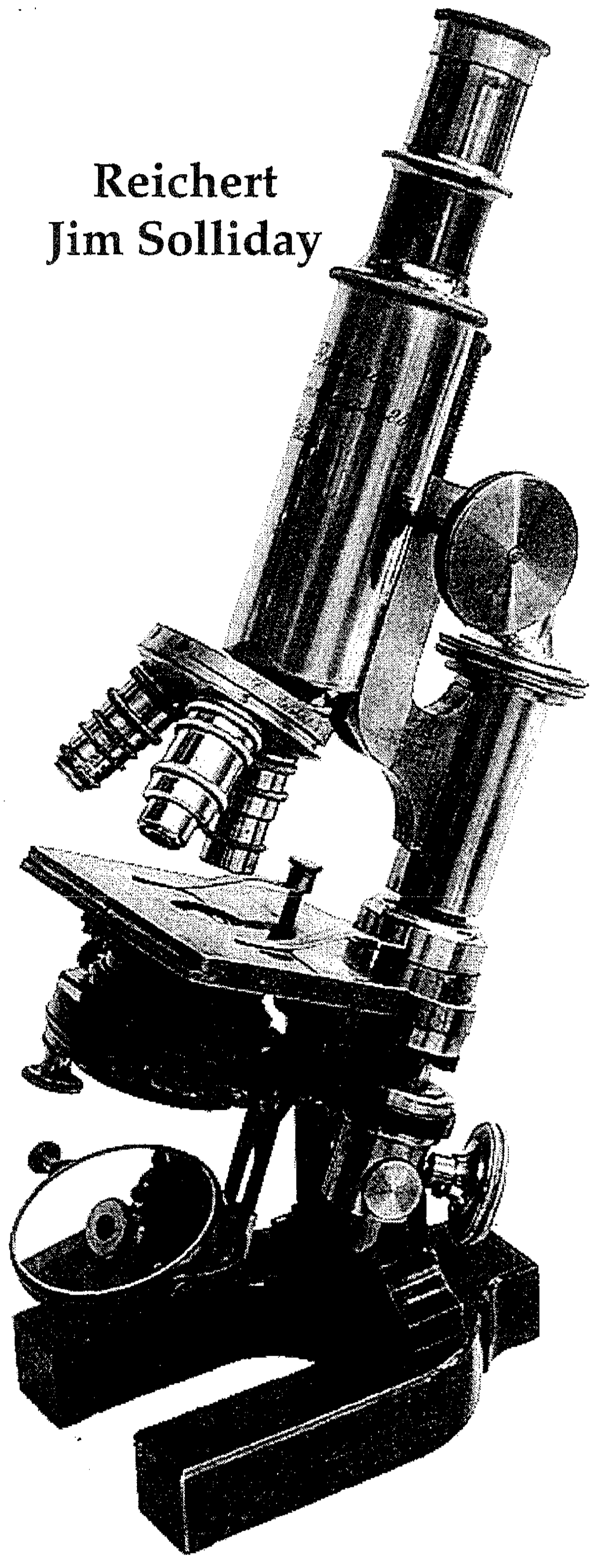
Boxed Microscope - Stuart Warter



4. **Jim Solliday** showed a Reichert stand No.2, c.1887, with a 3-objective turret, contained in a 'magazine style' portable case, where the instrument lies on its side. The substage optics are raised and lowered by a lockable rack & pinion attached to the rear-left of the stage. The swing-out substage condenser on its dovetail slide can be interchanged with a stop tube. Here is Jim's description:

Carl Reichert Stand Ko.Ii, 1887. This instrument is signed, C. Reichert, VIII Bennogasse 26, Wien (26, Bennogasse, Vienna) . Serial No.5289. Stativ Nr.II. Constructed like the No.1, only somewhat smaller with a less sophisticated stage-plate. Carl Reichert (1851-1922) was a pupil of Dr. Hartnack (van Heurck, 1893) and had joined the firm of Ernst Leitz before establishing his own workshop. In 1874 he married the sister of Frau Leitz but did not successfully establish a partnership with the Leitz firm. However, Reichert established his own firm in 1876 providing stands very similar to those of Leitz.The stand on exhibit is one of Reichert's larger Continental models which has the ability to be inclined; the course -movement is by rack and pinion, and the fine is by a micrometer screw mounted at the top of the limb. It has a drawtube, which is divided into millimeters. It stands on a very heavy horseshoe foot filled with lead providing great stability. The illumination apparatus is comprised of a plane and concave mirror, an Abbe condenser with a numerical aperture of 1.40. The condenser is fitted to the substage on a sliding dovetail, it can be removed and replaced with a standard simple cylindrical condenser holding waterhouse stops (in this case 2). The arrangement of the Abbe optical condenser is quite special. It is raised and lowered the length of a side bar by means of a milled head and rack & pinion. A steel pin working in a hole in the condenser plate maintains the centering during its movement. The pin is shorter then the downward movement of the hole so that when the condenser goes beyond the pin it can be turned aside. Included is a set of iris stops, which fit into the diaphragm plate. There is also a dark-field stop. The diaphragm plate has an eccentric movement, enabling oblique illumination in both directions. The objectives are mounted to the stand on Reichert's triple sprung circular nosepiece. The objectives include a No. 2, No. 4, No. 6, No. 7a and a 1/15th inch Homog. All lenses use Reichert's proprietary thread mount. Also there are 2 objective adapters and one extension tube (brass). The lenses can be stored in a small leatherette box, marked "C. REICHERT, WIEN". There are 4 eyepieces (Huygens). The instrument is stored in an elegant travelling mahogany case, with lock and key. The overall condition is very good including the original lacquer.

Reichert
Jim Solliday



5. **George Vitt** described some measurements he made on a sectioned shell of a chambered Nautilus. He showed a full-size scanned image of the shell where he had laid out radial lines from its center, spaced by 45 degree increments. Going outward along the spiral he measured the length of each line from the center to its intersection with the spiral. The number of revolutions of the spiral and its intersection with each of these radial lines yielded 25 data points. On semi-log paper he plotted the line lengths as a function of rotation angle. Results: From 'zero' size to a radius of 6mm, this Nautilus exhibited a very rapid rate of

growth. Beyond 6mm radius, the rate decreased abruptly and the data plotted as a straight line on the semi-log paper, as expected. The shell geometry bore no relation to the Fibonacci series. George had emailed these results to Gaylord Moss who then derived the equation of the curve and plotted the results using Excel software.

6. **Ed Jones** showed the book "Medical Parasitology", 5th edition, where 60% of the photomicrographs (and those from an SEM) had been taken by MSSC member Zane Price. Ed then gave his recommendations as to what members should bring to the Sept. Meeting where he will demonstrate and provide material for some hands-on slide making of tiny specimens which he will supply.

7. **Gaylord Moss** discussed how the Nautilus grows and explained the Fibonacci series and spiral, noting the 'Golden Mean" ratio it produces. He then described some ingenious tactics that parasites employ to propagate themselves - some examples being both shocking and ghastly! Gaylord mentioned that Larry Albright had found some Linux shareware that allows computer control of Nikon 950 and 990 digital cameras.

8. **Steve Craig** showed photos at 10X, 60x and 200X taken with his Intel/Mattel video camera microscope. Steve plans to use its time lapse feature in his photography.

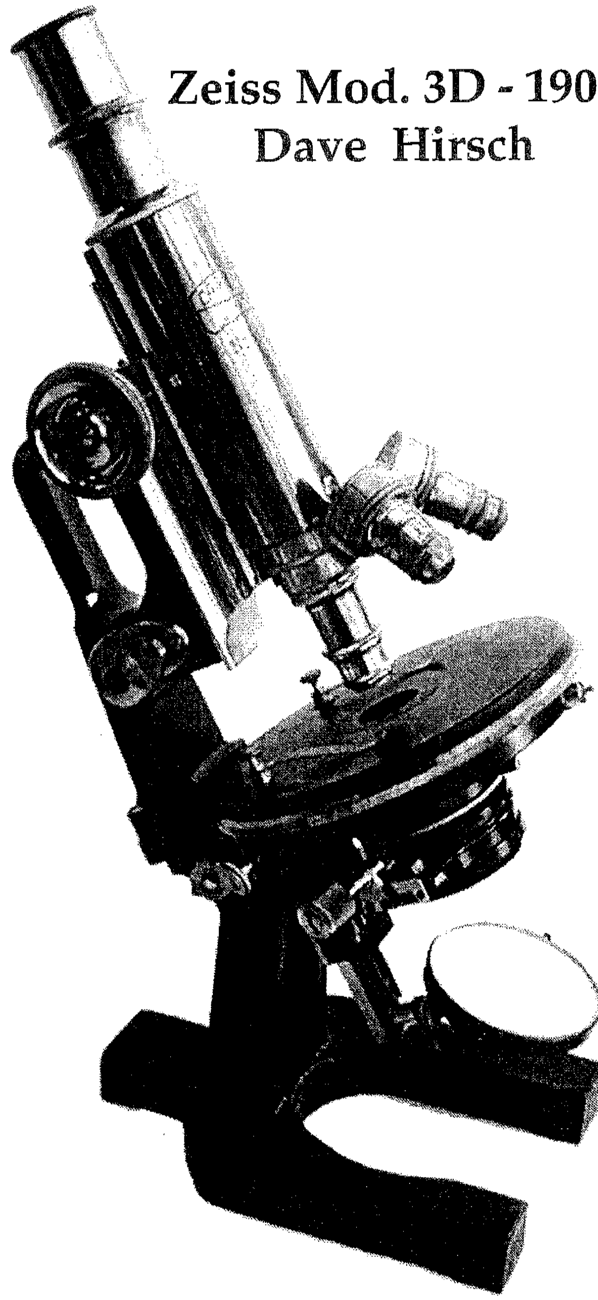
9. **Larry Albright** showed some Chinese "Magic Mirrors" that he had diligently located while on a recent trip to China. With the reflected light of the sun, they cast an image onto a projection surface. Such mirrors were made as early as the Han Dynasty (200BC) and were also made in Japan and the Middle East. Larry then showed a handy small Radio Shack pocket microscope., with built-in epi illumination and a specimen holder, which he had for sale at $5 each!

10. **Pete Teti** described his visit to the San Francisco Science Exploratorium and suggested the possibility of MSSC establishing some sort of relationship with a local Science Museum.

11. **Dario Solares** showed some photos of the new laboratory he is constructing on his property. It looks like it will be an elegant place.

12. **Stuart Ziff** described the scientific film of Charles Eames that is being shown at the L.A. County Museum.

13. **Dave Hirsch** showed a Zeiss Jena microscopeMod.3D, c.1903 (see photo). On the top of its mahogany case is a metal trade label of Rosenthal, a Prague firm, bearing also the double-eagle of the Austro-Hungarian Empire. There was the original instruction book in excellent condition.



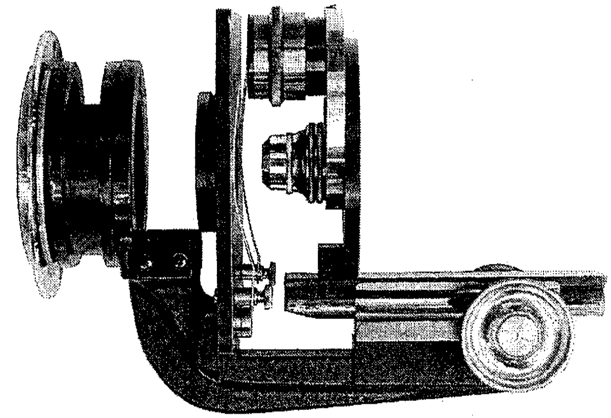
Zeiss Mod. 3D - 1903
Dave Hirsch

14. **Tom Boulger** showed his model of an Egyptian pyramid, from which he drew certain conclusions as to its method of construction.

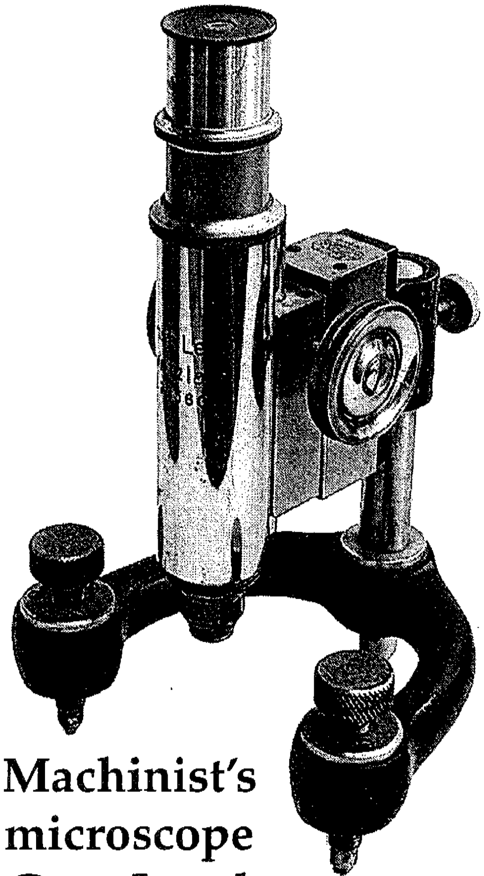
15. **Larry McDavid** described his cruise to Catalina Island, out of Long Beach, aboard the only remaining "Victory Ship", the "Lane Victory". He then showed a 6-slide rule (a Moon Stick) to display the phases of the moon for any date between 7,000BC and 11,000AD - with 1.5-hour accuracy! He then showed a sample of an adjustable book jacket cover made by Brodart Library Supply (http://www.brodart.com).

16. **John de Haas** showed an excellent monocular biological stand by Officine Galileo (Italy), c.1950, with a 3-lens turret and a sub-stage light source which he had installed. This is for sale at $250.

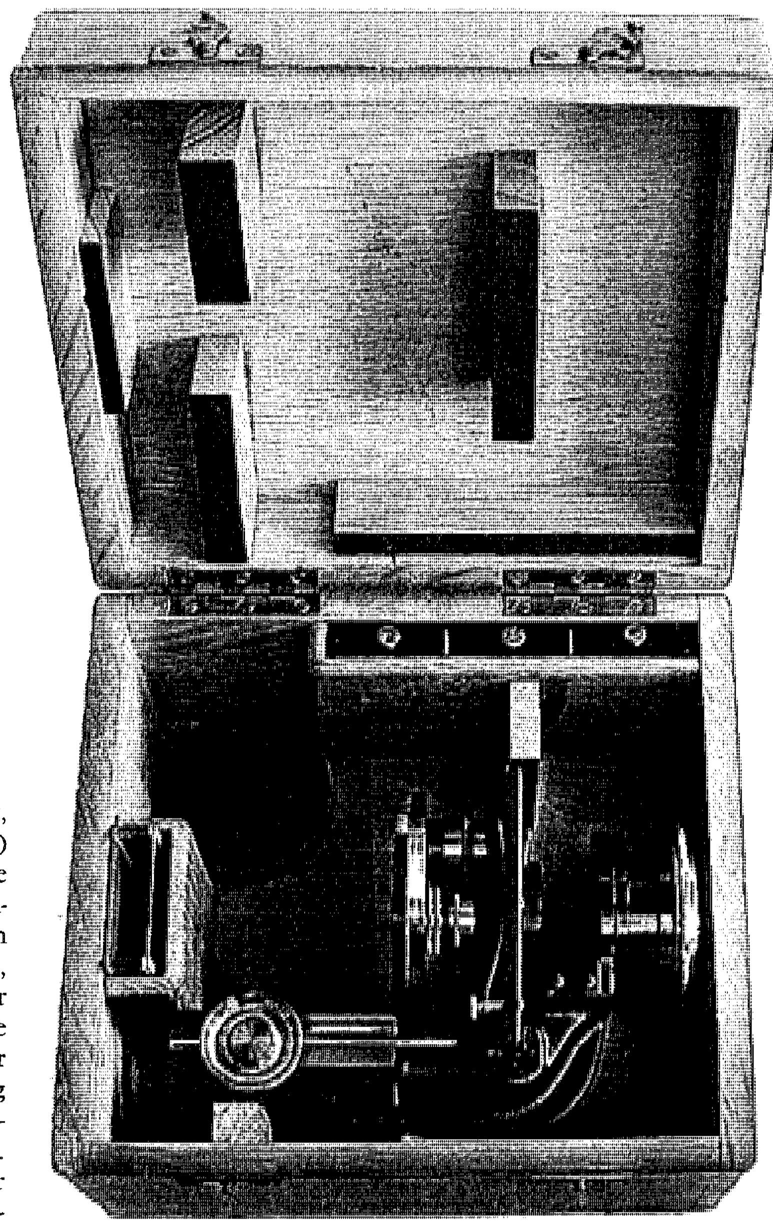
17. **Gary Legel** showed an interesting Ernst Leitz machinist's microscope (see photo), tripod mounted, the two front legs being screw adjustable for height. This microscope is for sale. Gary then showed some microslide labels that he had printed on self-adhesive 8.5"x11" paper.



Busch Micro-projector
Alan deHaas



Machinist's microscope
Gary Legel



18. **Alan de Haas** showed an excellent, cased, Busch microprojector (see photo) with two turret mounted lenses, one being a 3.5cm Glyptar - a rare and excellent macro lens with iris adjustable down to f/6.3. A glass parallel plate cuvette, for holding copper sulfate solution for light filtration and cooling, fits into the unit. There are 3 insertable condenser lenses, calibrated in diopters. A ring flange at one end is intended for mounting the unit to some sort of light source. The flange is typical of the type used for mounting lenses on view and press cameras.

MINUTES OF THE MSSC MEETING OF 19 JULY, 2000

David L. Hirsch

There was a murmur of anticipation in the air as President GEORGE VITT rapped his official gavel to establish order and decorum.Among old and new business was an announcement by LEO MILAN, our beloved curator of prepared slides and orchid grower extraordinare. Leo has an accumulation of prepared slides going back to the early days of our society; slides that need sorting, classifying and in some instances, dumping. Leo would like to have a member or members assist him in this task. If you are so inclined, please contact Leo at: (310) 391-9654.

Integrate the light microscope with a computer system and you have hardware at the cutting edge of technology. LAYLA GAUSODDIN, Senior Area Sales Manager, Keypence Corporation of America, demonstrated several pieces of equipment whereby various specimens were examined. Under the light microscope, minute objects are magnified optically. Integrating the optical source with an electronic device, the optical image is translate into pixels. Utilizing a 1.5 million pixel HD CCD, ultra high resolution of 1434 x 1050 dots can be obtained!

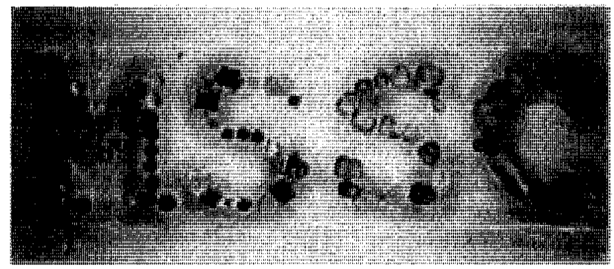
The equipment demonstrated included a 13 inch HD TFT LCD monitor attached to a controller and a VH hand held or mountable microscope. Product catalogs were distributed. To obtain a catalog, contact Layla at: (310)851-8681, ext. 603, or by email at: laylag.la@keyence.com.

ED JONES has created an art form which bears mention. Using micro size shells, bones, rock particles, etc., Ed creates prepared slides showing words and various planar geometric configurations. Many members have expressed interest in preparing their own slides. At the coming August meeting Ed will conduct a workshop to introduce our members to his technique.

Through the courtesy of JIM SOLLIDAY we were treated to the showing of a fine film titled: "Microbiology", prepared by Biomedia Associates. we watched wee waterborne beasties such as rotifers, etc. along with a very accurate discussion of the workings of the light microscope.

Following the film, JOHN FEDEL showed slides that he had taken of bacteria, diatoms and crystalline structures with his superb Olympus system recently acquired from Ron Morris. GARY LEGEL showed excellent slides of several varieties of mosses and lichens that he took while on vacation.

ALLAN DeHAAS presented one of his ongoing minilectures. The admonition laced title of his discourse was: "Don't throw your (photographic) film away yet!



Ed Jones' microslide

There may be ultraconservative blokes around who refuse to part with their Kodak Brownies. Contrarywise, there is a massive effort afoot by the camera folks to have you dump your film loaded cameras and join the digital camera aficianados. Not a had idea, as several MSSC members will attest. BUT, pixel-wise, for equivalency to a single frame from 35mm film we are looking for an excess of EIGHT MILLION pixels! (keeping in mind that pixels are 5 microns wide and 1-2 microns apart).

Mattel once marketed a baby doll named: "Kissy Tenderlove". You squeezed her belly and Kissy tilted her head, puckered up and made a kissing sound. At the other end of the toymakers spectrum, Mattel got academic and, working with Intel, produced a microscopically oriented device which hooked into a computer to produce magnified images on the monitor. RON MORRIS told us about the development of "InterPlay" as this device is known. GAYLORD MOSS displayed the device and mentioned that Toys R Us are selling InterPlays at about $70.00 a copy and a number are on Ebay for about $35.

JIM CLARK donned his official symbolic hat as Interlocutor of the eagerly anticipated Show and Tell portion of our meetings. STUART WARTER displayed a Swift London monocular stand with legs that rotated to afford compact storage. The microscope featured 2 objectives, a circular rotating stage and polarizing attachments. In anticipation of his forthcoming workshop, ED JONES demonstrated the setup for producing his micro slides.

JOHN deHAAS showed, and offered for sale, two microscopes; A Zeiss monocular stand for $175.00 and an Italian "Oficina Galileo", triple objective monocular stand for $250.00. Violating the "Microscopes only" edict, your intrepid Treasurer, DAVE HIRSCH, showed a massive John Browning spectrometer, circa 1870.

Our Editor, GAYLORD MOSS had included dues reminders in the last Journal. If you are among those who for whatever reason have not crossed your Treasurers palm with silver, please do so and you will be thrice blessed.

MSSC August Meeting

Wednesday, August 16 at 7 PM.
Crossroads School, 1714 21st Street
Santa Monica, CA.

Make Your Own Microslides

Ed Jones

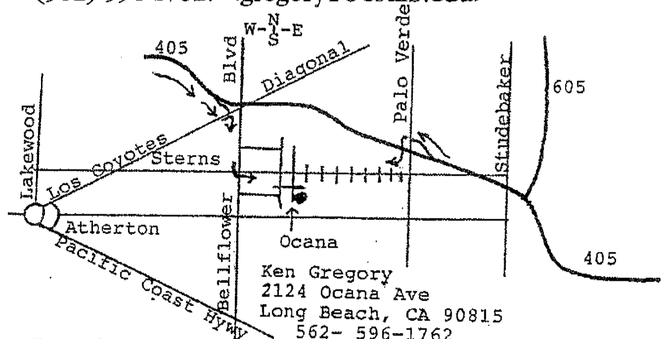
Ed Jones will provide kits of materials and will guide us in making our own arranged microslides of various materials like those which he has shown at meetings. Ed has spent several hours assembling each of 35 kits, which contain 2 slides in slide mailers and an assortment of micro-materials such as foraminifera sand, glass microspheres, seeds, iron shot, several types of gunpowder, and 13 different electronic microchips. Ed will use a video camera and monitor to demonstrate his techniques for sorting and arranging these items as we work along with our own microscopes.

In order to participate, bring a stereo microscope, a light source and a **good** pair of tweezers. Ed stresses that good tweezers (capable of picking up a single grain of salt or sugar) are essential. If you have a second stereo scope, please bring it for someone who does not have one.

Page 161 shows one of Ed's microslides viewed through the Keypence light microscope at the last Wednesday meeting. This is a unique opportunity to learn from a master how to arrange such slides. "First come, first served" on the 35 kits, so don't be late.

Next Saturday Workshop at the Home of Ken Gregory

The next workshop on September 2, 2000 will be held at Ken Gregory's home in Long Beach. The plan is to alternate by holding every third workshop at Ken's which will be easier for members down south as well as giving another interesting venue. See map below.
Ken Gregory, 2124 Ocana Ave., Long Beach, CA 90815
(562) 596-1762. <gregory1@csulb.edu>



From 405 West, take the Bellflower Blvd Exit which ends on the Diagonal. Jog left, then Right onto Bellflower Blvd. Go to Sterns, turn Left, thru the Mall, turn Rt. on Ocana (2nd street). From 405 E or 605, exit at Palo Verde, Lt. on Palo Verde, then Rt. on Sterns, then left on Ocana Ave.