# MicroNews

**San Francisco Microscopical Society** Volume 4, #2 April 2009


"...I have come across among the scientists and curators that the right way to die is slumped in front of the microscope at an extremely old age. In the right hand the quill pen will just have scratched out the last description of a huge and complex group of organisms. The old boy or girl will have a vague smile upon that wrinkled but deeply distinguished face: a Job well done."(1) pp290

(1) Dry Storeroom No. 1: *The Secret Life of the Natural History Museum*, Richard Fortey, 2008. You will find several quotations in this issue from this interesting book describing this famous British Natural History museum.

***Please send to: HSchott@aol.com short accounts of what you have observed through your microscope.***

## *SFMOMA exhibit: Brought to Light:*

Photography and the Invisible, 1840-1900

By Linda Wraxall

The recent exhibit at SFMOMA called "Brought to Light - Photography and the Invisible 1840-1900" was a masterly study of the scientific spirit that pervaded those years. The power of photography to make science visible played an increasingly important role during the 19th century and contributed significantly to the development of the medical sciences. To demonstrate this, the museum had hung the walls of more than six rooms with photographic prints. They consisted of an enormous variety of subjects, ranging from the very small as seen through a microscope to the very far as seen through a telescope. There were also pictures of electricity and magnetic fields, X-rays, ghosts, and motion studies, culminating in several more rooms showing the works of early photographic pioneers like Ansel Adams, Edward Weston, Dorothea Lange and Alfred Stieglitz, to name but a few.

Science, and in particular physics, was advancing in great strides and most educated people were interested in finding out more about the world they lived in. It became commonplace by the 1860s to find microscopes in upper class homes in Europe where they were used for both entertainment and education. Once photography developed beyond the daguerreotype, people began to find ways to make images of what they could see with microscopes and telescopes.

Astronomy provided the starting point and the exhibition and discussions of pictures of the moon and the sun's surface helped to secure the interest and enthusiasm of the general public. However it was the photomicrographs of scientists like Auguste-Adolphe

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## Annual Treasurer's Report Accepted By SFMS Board

**Unlike the national economy and the travails of the banks and over-extended homeowners, the financial status of the San Francisco Microscopical Society is sound and well supervised by our four-member board. As treasurer, it is my pleasure to make this edited report to the membership.**

When distributed to the board members, this report was accompanied by the following documents:

- 2008 Guaranty Bank Account Register of Income and Expenditures
- 2008 Treasurer's Cash Expenditures

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INSIDE



## Members Participate in SFMS

The January 13th meeting of the Society occurred at the Randall Museum in the upstairs room and was, as a result of the active participation by several members, an interesting and rewarding evening. The meeting chaired by the acting president and treasurer, Henry Schott, began with the only disappointing event of the evening, the failure to lure someone into the position of president. It is not a difficult job nor is it one of overwhelming responsibilities since the board makes the decisions by majority vote, but it does provide the society with someone who can articulate the program and purpose for which this society is chartered as a non-profit organization, to function as a scientific and educational organization.

Before the election of officers occurred, each office was opened for nominations and the duties were explained to the audience. Members were invited to stand for any of the positions. The secret ballot was passed out, returned and counted by a past officer, Helmut Will. The results were a foregone conclusion. The elected were: Bill Hill, Vice President and Program Chair; Henry Schott, Treasurer; Linda Wraxall, Secretary. The position of President remains vacant and will rotate among the three officers for a four-month stint until a volunteer can be found to lead the organization, at which time the board will

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Edward Heron-Hart was an extraordinary polymath, a skilled violinmaker and Persian linguist as well as a world authority on “forams.” (Single-celled Foraminifera) (1) pp 245

PLA-

Planaria, a flat worm, Photomicrograph by Bill Gurske

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Bertsch with his amazing enlargements of diatoms, protozoa, insects and crystal structures that got the ball rolling. Jules Lirard examined cross sections of plant stems and wood while Joseph Woodward looked into skin and the veins underneath. A.W.Bawtree became famous for his stereo photos of the miniscule while Wilson Bentley spent his whole life photographing snowflakes (and never finding two the same).

The initial goal of photomicrography was to eliminate the tedious task of drawing by hand what could be seen under the microscope. It also avoided the “editing” of the background features by the illustrator for the sake of clarity. Now everything in the microscopic field could be seen and, despite the challenges of lighting, focus and

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PLANARIA

When it comes to being flat, Planaria meet all expectations, They are flat from stem to stern although in other regards they demonstrates utter disregard for conventional organization. Shaped somewhat like an arrow, albeit a fat one, the anterior does not contain a mouth, nor does there appear to be a posterior anus. Yet eat it must since it is not photosynthetic and this they do by an extendable tube that projects from the midsection. Lacking a heart and circulatory system to distribute nutrients to various parts of its body, they nevertheless succeed because the digestive system is ramified into all parts including the head and tail. The gut is a bag without exit so what enters by the tube must also, if indigestible, exit thereby. HS

(Continued from page 1)

- 2008 Income and Expenses and Life Member’s Account with line ID #
- Year to year Comparison of All Funds
- Yearly Summary of Financial Transactions 2008

Members of the Society are entitled to inspect these documents if they wish.

***How Funds are Held:*** The Society’s funds are held in three categories. The first is our checking account where we had a balance of $3,104.99 on January 1, 2009. All funds received by the Society are deposited into the checking account. The second category is a CD (certificate of deposit) that was purchased on May 9, 2008. Comingled in, the CD is the third category, the Life Membership funds, that are set aside as an endowment from which only the interest is used for operating expenses. The Life Membership account grew from $2, 989.84 to $3,710.84 as five new life members enlisted. There is no need to calculate exactly how much interest is earned by the Life Membership account since we are financially secure. The bank will report the interest that the CD earns and that will appear in the 2009 report. What is important is to track the amount that has accumulated in the Life Membership account and to identify all life members.

***Major 2008 Expenditures:*** The Ford dinner, shared with the California Association of Criminalists, represented the greatest optional expenditure. Besides our $300.00 share of the honorarium, SFMS provided some support to student members who wished to attend. The cost of meals was $570.00 while we collected $530.00 from attending members. The actual cost to the Society for this event was therefore $340.00.

***Ultraphot Microscope Expenses:*** An agreement reached with Peter Barnett houses the Ultraphot Microscope at the Richmond Laboratory of Forensic Science Associates (FSA) at no rental cost to the Society. A rented truck and a helper moved all the material to the new location from Oakland for $180.09; One training session, held for members by Helmut Will, prepared a few members to use this instrument. Members who complete the training may use the microscope by arranging access through Peter Barnett.

***Micro News Expenses:*** The third major expenditure is associated with the production of *Micro News*, the Society’s quarterly news and information letter. To facilitate production we purchased Microsoft Publisher software for $184.86.

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## January Meeting (cont.)

(Continued from page 1)

appoint the individual to the position until an election is held in January, 2010.

Two new members were made welcome in the society. Bill Gurske, a chemist, brought with him a CD of the photomicrographs he has taken of protozoa and other specimens collected in the field. Reproduced in this issue are a few of his excellent images. We hope to have more of them available on our web site, www.SFMicroSoc.org (capitals not needed) where pictures from other members are already available. Niel Straus, whose wife also attended the meeting, is a biologist (see brief professional history elsewhere in this issue) and brought one of his microscopes. It was used to see several slides as well as view the text on a plastic NCR Microform, 5 centimeters square, that contained the entire bible. It was brought by Henry Schott. Mike Kan then demonstrated how, using a hand held digital camera, it was possible to photograph the text. Henry's first efforts to do so produced an unclear image.

Linda Wraxall attended the MOMA (museum of modern art) exhibit *Brought To Light: Photography and the Invisible 1840-1900.* Her talk and the pictures she circulated provided a clear view of this multifaceted exhibit that ended on January 4th. With the advent of photography and improved optics, experiments were performed in recording images taken through microscopes, telescopes, sequentially tripped cameras to study motion, the phenomena associated with electricity and magnetism, the discovery of x-rays and the fad of having hands x-rayed, and "spirit" photography. Examples of these early efforts were displayed including some that were published in books. Recall that before the recording by photography, images were made with India ink drawings and sometimes by non-scientists who were skilled in drawing but not in

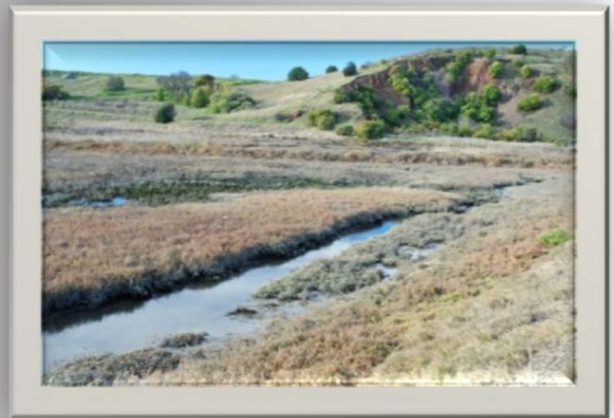
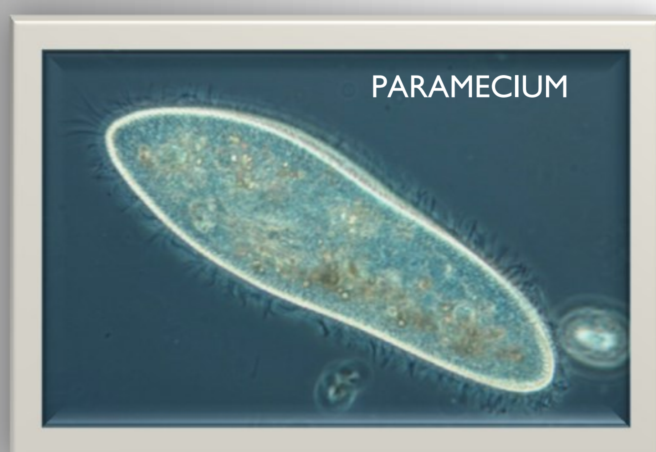


*Fig. 1 View of Don Edward's Slue, a collecting site.*


Three photomicrographs by Bill Gurske, a new member of SFMS

## Mineralogy and Modern Microanalysis

From a recent book: (see pg 1) "Mineralogy came from this ancient tradition, and the modern science gradually shed the esoteric baggage of its forebears. One of the earliest no-nonsense science* books was Georgius Agricola's *De rerum metallica* (1555), a practical guide to mineralogy and the art of mining. It remained useful for several centuries. As knowledge of chemistry and the elements developed, the old furnaces of the alchemists were replaced by the blowpipes of the assayers, and then by the batteries of reagents — strong acids, solvents and poisonous cyanides — used by "wet" chemists, the men and women who used test tubes and titration to identify the composition of minerals. Even today there is still a "wet lab" in the Natural History Museum used to identify certain light

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"Not everything is as blameless as we might like. But the sum total of that deep archive (the psyche) is what makes us who we are. … There are histories that deal with the decisions fo the mighty, and there are histories that are concerned with the ways of ordinary people." (1) pp 3.

DARWIN

Darwin was born 200 years ago on February 12, 1809, the same day that Lincoln was born. "The theory of evolution provides humankind with more than just a scientific narrative of life's origins and progression. It also yields invaluable technologies." *Scientific American, January 2009, pp 82*

Examples: molecular clocks; accelerated evolution in labs to improve vaccines.

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"On the eve of Darwin's birthday last Thursday, a new Gallup Poll was released showing that 39% of Americans believed in evolution, with 25% not believing in it and 36% holding no opinion. Among weekly churchgoers, 24% believed in evolution and 41% do not."
*SF Chronicle 2/14/09*
*Charles Burress pp A8*

Go to :
http://evolution.berkeley.edu
for more information on Understanding Evolution.


*(Continued from page 3)*

elements. But most of the routine work assessing chemical composition of the majority of minerals is now entrusted to high-tech equipment: electron probe microanalysis and ion probes can work on tiny quantities of material, even a sample only five microns across, that is, five-thousandths of a millimeter, plucking out and sorting its atoms to an accuracy of picagrams (that is, a million millionth of a gram). There is something almost mystical about these kinds of figures, something that should inspire in the ordinary person a feeling not unlike the awe felt by the initiate wandering into the alchemist's lair. But as the figures are derived from machines, faced with dials and plasma screens that are familiar from a hundred films featuring the scientist at work, somehow the achievement of such accuracy can be taken on the nod. It is remarkable how the remarkable has become unremarked." (1) pp229

## Concentrated light, The Abbe Condenser

The word "condenser" has been known for a long time. It must have been used by alchemists when they distilled liquids and then condensed the gasses. Distillers who condensed spirits knew it. That the word could be applied to light must have been of more recent origin since light, particularly in microscopy, needed to be concentrated rather than changed from a gaseous form to one that is liquid. But to name the structure below the microscope stage a concentrator would have introduced a word that was not familiar to the general public while 'condenser' derived from the bringing together of moisture (or condensation) was a frequently observed phenomenon on windows and mirrors.

One of the most successful innovations of 19th century microscope was the development of the Abbe condenser. In addition to the flat and concave mirror used to direct light from the sky into the microscope, the need to create an evenly illuminated small disc of concentrated light required optics that could focus the light and one or more diaphragms that could reduce stray light beams from being directed onto the observed specimen. Ernst Abbe perfected such a system. Who was he?

Ernst Abbe was born on January 3, 1840 in Eisenach, Grand Duchy of Saxe-Weimar-Eisenach. Germany was not united in 1840 and was composed of many divisions, some large but others quite small. While his father worked long hours, his father's employer helped young Ernst with his studies. He won scholarships for he demonstrated perseverance and intelligence. He studied at Jena and Göttingen Universities and earned in 1861 a doctorate in physics from Göttingen with a dissertation on thermodynamics. At age 23 he started teaching at the University of Jena. He rose in rank to professor of physics and mathematics in 1870. Eight years later, he was appointed director of the astronomical observatory at Jena. He continued at Jena until his resignation in 1891.

Carl Zeiss approached Herr Professor Ernst Abbe, for that is how he would have been addressed, in 1866 with various optical problems. In the same year, Abbe was made research director at Zeiss optical works. This work stimulated his interest in astronomy and optics that resulted in his invention of the apochromatic lens system for microscopes in 1886, another major advance in microscope construction.

Chromatic aberration results when light passes through a lens. The light is broken up into its component colors with violet being bent the most and red the least so that they do not come to the same focus. If uncorrected (by properly combining lenses of different types of glass with dispersive power but similar refractive power) chromatic aberration causes the image of the observed object to be bordered by a colored halo. In achromatic objectives only two colors of the spectrum have been accurately corrected and brought to one focus. The uncorrected colors form a defect called the *secondary spectrum*. In the apochromatic objective three colors are brought to one focus leaving only a slight tertiary spec-

*(Continued on page 6)*

## Where the Money Went

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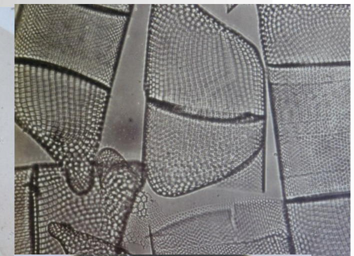
Production and mailing costs were $411.55 for four issues of the four pages, 125 copies newsletter. This expense also includes the printing and distribution of the *Directory of Members*. All costs associated with recruitment of new members and collection of dues was included in the cost of postage and printing. The software cost could be prorated over three to five years if it is to be included as an expense associated with the production of Micro News. The board allocated $380.00 to the production of *Micro News* and directory.

A simple comparison of income to expenditures shows a deficit of ($206.53). This amount, however, does not reflect that *Life Membership* funds are sequestered into a separate account. The actual deficit is thus $206.53 plus $721.00 giving $931.53. From this amount must be subtracted the interest earned by the CD during 2008 which is estimated at $175 resulting in a deficit of $756.53. Little is gained by such detailed accounting since the Society could comfortably support such a deficit for years. The growth of the Life Membership account is desirable because it creates an endowment and reduces the burden of collecting dues at the end of each fiscal year. Members are encouraged to purchase Life Memberships by making four equal payments of $36 or four equal payments of $33 prior to October 1 of the fiscal year if the current year's dues of $12 have been paid.

*The Web Site:* The Society's web site (www.sfmicrosco.org) is housed by Microdataware, a company owned by Steve Shaffer, a former member. The treasurer contacted Steve two times to get a bill for his service but has not received a response. The last time we paid for this service was on 2/24/2006 ($403.20). The treasurer requested that a yearly bill be presented covering a specific time-period such as a fiscal year so that we can budget for this service. It is not clear what the yearly cost is for this service. A member, Michelle Caisse, maintains the site for us.

***Recommendation:*** The Society's fiscal health is best served by a board-approved budget for the fiscal year. Properly designed, a budget provides funds allocated to conduct the business of the society (the fixed costs) and for a successful way to implement the aims and functions of the Society (the variable costs). To build a budget the board needs to formulate and implement a program for the fiscal year.

Prepared by: Henry Schott, Treasurer.



***Early Photomicrographs***

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speed, the medical sciences began to use lantern slides to teach students. In fact, bacteriology was being taught in both American and European medical schools by the 1890s. Once the gelatin dry plate was invented in the 1870s, vision itself became an object of study. One experiment, using a firefly's eye, discovered that not only could the insect's mosaic eye combine the separate images into one but it was seen right side up.

In 1885, photographers like William Jennings made images of the various forms of lightning and, a few years later, Etienne Trouvelot's work revealed what a direct electric spark looked like on film. Nikola Tesla, the original "mad scientist" and father of physics, was actually born during an electrical storm. He went to work for Edison but soon split to work on his own discovery of alternate electrical current. In 1893, the World Exposition in Chicago used his invention to light the whole exhibition. Lord Kelvin of England, who at that time was working with G.Westinghouse to build a power station at Niagara Falls, was so impressed with it that he changed the power station's design to accommodate this new technology.

Soon after that, in 1895, Rontgen discovered X-rays and they became a source of general fascination. Within a year, a thousand books and articles had been written about them

"But despite all the recent advances in basic research and its practical achievements, American science — and the funding for it — is lagging.

The public's understanding of science as the key to a productive and healthy future remains woefully limited, and our public schools, with slashed budgets, have been facing critical shortages of science teachers, science labs and lab tools." *(2) The SF Chronicle, Feb 3, 2009 B3 David* Perlman

Continued

### *SFMOMA exhibit: Brought to Light:*

Photography and the Invisible, 1840-1900

By Linda Wraxall

and it became fashionable to have one's hands x-rayed for show. We could even see the bones of the hands of the last Czar and Czarina of Russia, x-rayed by Henri van Heurck complete with rings! Victor Chambaud used X-rays to photograph the delicate skeletons of fish and Joseph Jungla became known for his X-rays of the human body.

During this same period, spiritism became popular; people who had lost loved ones would try to reconnect with them using a medium and photography became a means of both revealing and recording the invisible spirit world. Many attempts were made by reputable scientists to photograph the ghosts of the dear departed during séances, and even the hands of the medium could show a magnetic type of aura when photographed.

Motion studies also attracted photographers' attention and, in 1878, Eadweard Muybridge demonstrated the sequence of movement in a galloping horse by using a bank of cameras and trip wires. The series of photos produced settled a long argument as to whether the horse's hooves kept contact with the ground at speed. He also made sequential photos of boxers fighting, cougars running and so-called "aesthetic" photos of plump naked ladies bathing, dressing or even spanking a small child (also naked). In 1883, Etienne-Jules Marey made a photographic series of birds flying, hens running, and fish swimming. Much later, in 1938, when film and camera technology was much more developed, it was possible to see the swing of a golf club and a baseball bat in sequence. By 1964, it was possible to freeze the flight of a bullet leaving a gun barrel, passing through a banana and cutting a playing card in two on film. Who does not remember seeing for the first time the photo of a drop of milk splashing, which revealed the symmetrical corona of droplets?

As long ago as 1858, it was predicted by Thomas Skaife, a very early high speed photographer, that a camera

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"But within the Natural History Museum (Peter) Mattingly was famous for being the most absent-minded of all scientific staff, and this in a profession where absent-mindedness is regarded as part of the job description. He was quite bent over, particularly at the top of his back—not I believe because of any congenital deformity, but as a consequence of many years peering down a microscope. The condition is known as "microscopist's hump." So when he walked about the place it was with his head leading the way, glasses perched somewhere near the tip of his nose. When he left work in the evening he took off down the front steps of the Museum at a terrific lick and marched straight across the Cromwell road, briefcase dangling from one hand. The Cromwell Road is one of the busiest thoroughfares in London, so how Mattingly managed to escape being run over was a mystery. Possibly thinking about mosquitoes protected him, … (1) pp207.

*(Continued from page 4)*

trum. Compensating oculars used with apochromatic objectives give the best results and generate very little chromatic aberration.

The success of the development of apochromatic objectives hinged greatly on the glass chemist Otto Schott who had a doctorate from Jena. They met in 1881 and by 1884, Schott, Abbe and Zeiss formed a new company known as Schott and Sons in Jena. Their experiments included new formulas for making glass, new techniques of mixing and annealing the glass to eliminate internal defects, resulted in high quality optical glass. This made the apochomats possible with primary and secondary color distortion eliminated.

*"One year after beginning the manufacture of the Carl Zeiss compound microscope, in 1873, Herr Abbe released a scientific paper describing the mathematics leading to the perfection of this wonderful invention. For the first time in optical design, aberration, diffraction and coma were described and understood. Abbe described the optical process so well that this paper has become the foundation upon which much of our understanding of optical science rests today. As a reward for his efforts Carl Zeiss made Abbe a partner in his burgeoning business in 1876." (1)* ***Article*** *by: J J O'Connor and E F Robertson from the Internet: Abbe's work as described by* The Carl Zeiss Foundation.

There were several other remarkable achievements, Abbe had calculated the limit of resolving power of lenses using visible light, no matter what refinement in shape or glass composition, would exceed the theoretical limit which is about one-half micron. *(2) Pioneers in Optics: Ernst Abbe (1840-1905) by Michael W. Davidson, Microscopy Today, January 2009*. He formulated what is now known as the *Abbe sine condition* that defines the correct construction of lenses and was a breakthrough in microscope design.

Abbe's association with Zeiss made him wealthy and gave him time to study sociology and law. He set up and endowed the Carl Zeiss Foundation for research in science and social improvement. The direct beneficiaries of the foundation were the Jena University and the employees of the Zeiss company. Abbe introduced in 1896 benefits that today are widespread including the eight hour day, sick and holiday pay and pensions. It is reassuring that behind the bearded face we now associate with Abbe was a mind that not only focused on physics but also on the wellbeing and happiness of those who had helped make him wealthy. HS

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# Nomarski Microscopes by Helen Gourley

When it's too small for a stereo scope and too large for a scanning electron microscope (SEM) we use an ordinary high-power instrument, typically up to 400X magnification. When it's flat, opaque and reflective, we can get spectacular results from a Nomarski microscope, also known as a DIC – differential interference contrast. Invented more than 50 years ago, it has grown into a key tool of the Semiconductor industry for several decades. It also serves aerospace in analyzing super-smooth surfaces like the Hubbell telescope and spectral- sensitive thin film coatings on glass.

Figure 1 (a and b) shows a diagram of the optical paths that generate a false-color image representing the contour of the target. An OSA Publication (1) explains it like this:

"Light from the illuminator passes through a polarizer and then through a Wollaston prism, where it is split into two beams polarized at right angles to each other. The microscope lens focuses this light into two spots [ typically centered about 1 micron from each other]. Any small defects or slope variations on the surface will introduce a relative phase difference between the beams. The reflected beams again pass through the microscope objective and the Wollaston prism, interfering in the image plane. Each color in the image is associated with a specific phase change between the two beams."

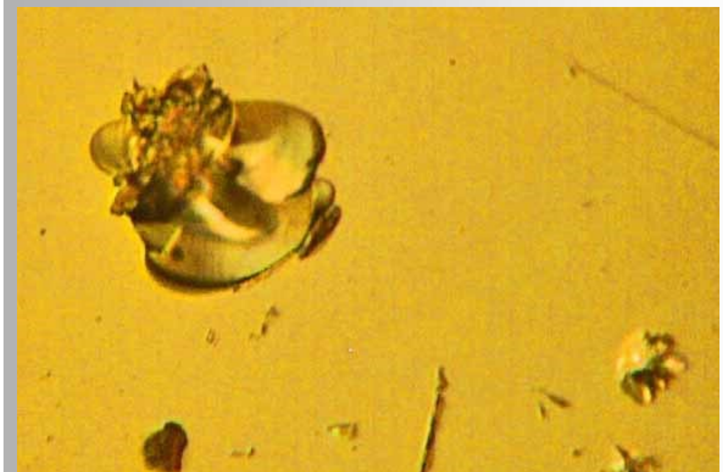

***Figure 2 Glass, see text.***

This works best on metallic surfaces, which are very opaque, and very reflective. But with a little patience you can make the contour of other objects visible in color, and even get a hint about their material. A recent forensic problem was to show that tiny fragments of glass were trapped in a solid white plastic panel. Because it was white, it scattered incident light, obscuring all fine detail. The question we asked was "Can we see very small bits of clear glass in the field of a bright white background?"

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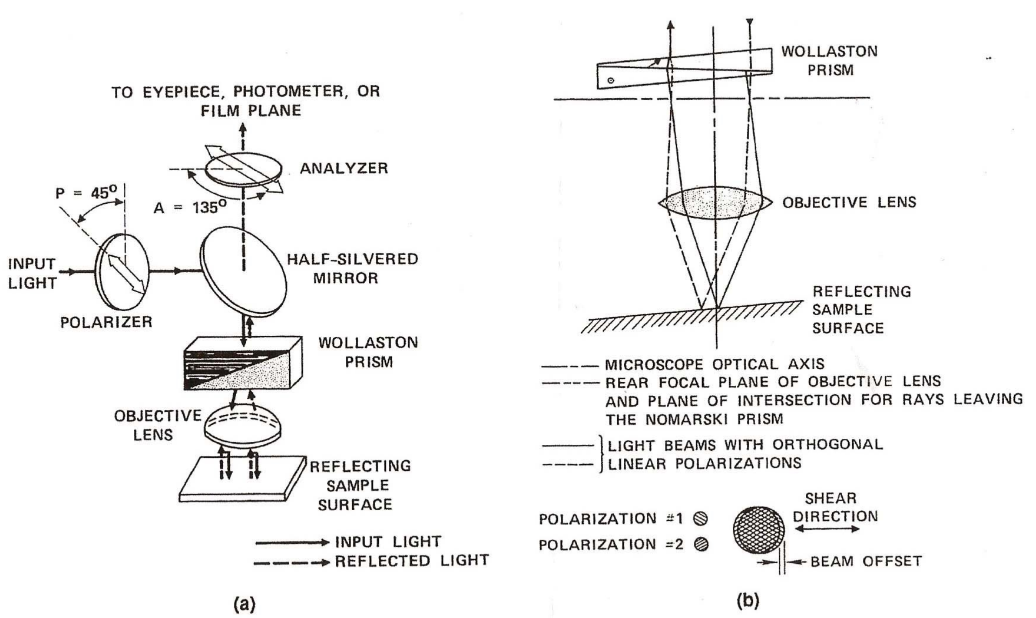


Fig. 1 Schematic diagram of a Nomarski microscope showing (a) overall view and (b) detail of the two sheared images on the sample surface.

# Next Meeting March 10, 2009

Stamp

## Healthy Pond Scum - Small Organisms in our Environment

SFMS

Our next meeting will be again be at Randall Museum on the second Tuesday of the month, 7:30-9:30 PM, March 10. As it is springtime, we will bring samples of *pond water* that we collect in our favorite places. We will identify the various organisms, invertebrate larvae, etc that we find and some specimens that *you* find at this time of the year. Bring your own instrument or use society's microscopes available at Randall. Bring with you any identification guides you may want to help us decipher what we find. This will be a *hands-on* 'wet' workshop.

FROM:

Micro News

San Francisco Microscopical Society

20 Drake Lane

Oakland, CA 94611-2613

**TO:**

MEMBERSHIP INFORMATION

To join the Society,:
fill in the form available at
www. sfmicrosoc.org and mail it to the above address with your annual 2009 dues of $12.– made out to SFMS.

Life membership is $144.00

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would one day be able to expand the visual field far beyond the range of human sight "as decidedly as the presence of animalculae in blood or water is by a microscope". 19th century science began the revelation of the unseen forces and creatures that surround us. Its examination of natural phenomena that cannot be seen became both possible and visible through photography, whether it was a distant star system or a fast moving object, and continues even today.

*By Linda Wraxall, SFMS Sec.*

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The plastic was flat and mostly clean, but there were a few small areas that seemed slightly darker than average. Most of those proved to be just plain dirt. But, on a few, it was possible to see and photograph some colored regions. Careful adjustment of the polarizers revealed the typical conchoidal shape of shattered glass. A slight color pattern proved that the light came from a transparent material with slightly reflective surfaces – clear glass. (See Figure 2.) Yes, there was glass embedded in the white plastic. Not much, but enough to show the direction of the projectile that struck the glass.

This is an extreme case. The missing information is just barely visible. If you look at a semiconductor chip, the contour pattern shows up in clear color contrast. The Nomarski microscope is a standard inspection tool in chip manufacturing. But we can also trick it into showing us hidden secrets obscured by too much scattered light.

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Footnote 1

Optical diagram Figure 1 and quoted explanation from "Introduction to Surface Roughness and Scattering" by Bennett and Mattson, ISBN 1-55752-609-5

Figure 2 Photomicrograph at 200X from System Sciences Group archives

*Helen Gourley is a member of SFMS and the Director of System Sciences Group.*