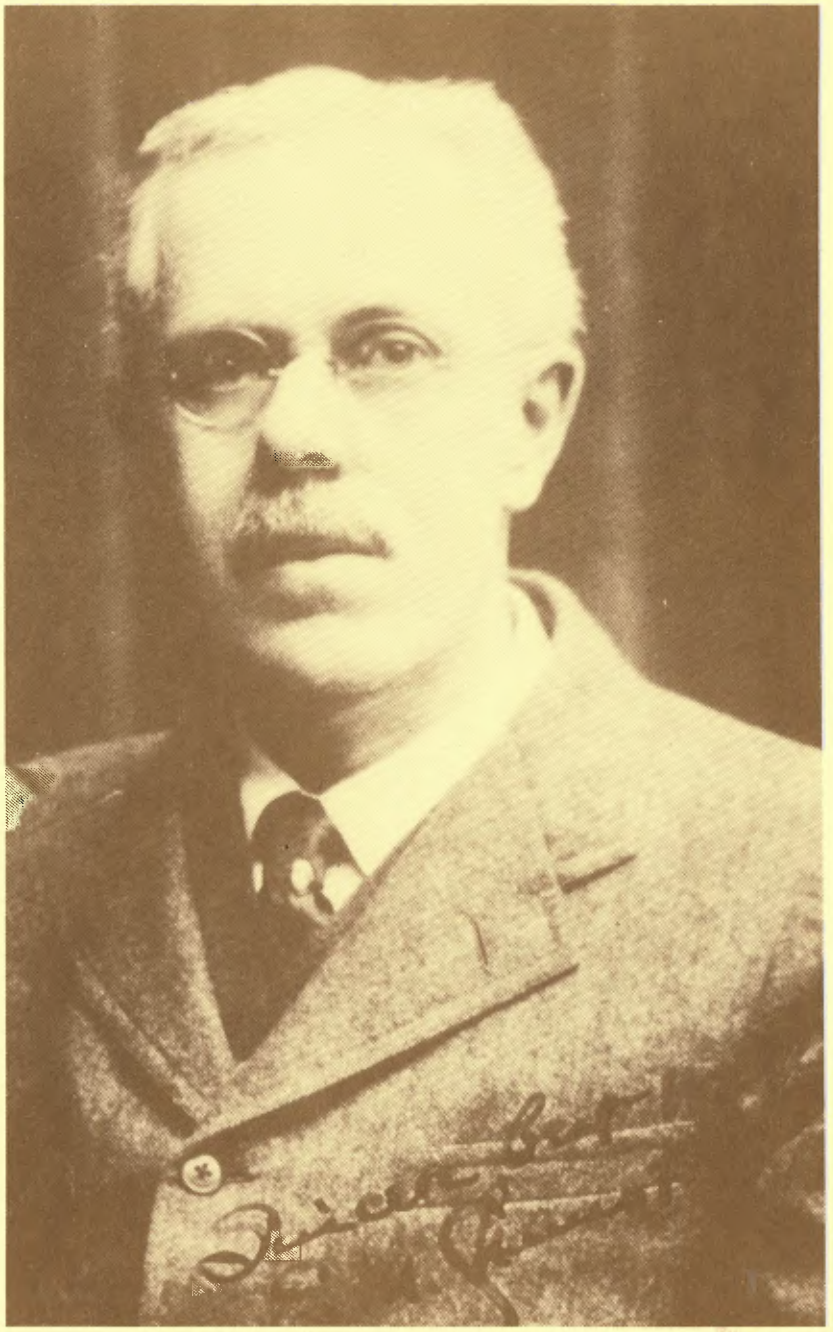
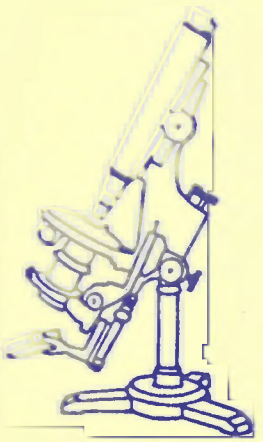
μ • NOTES 2000

Vol. 1 No. 2 July 1997





A Publication of the State Microscopical Society of Illinois

EDITORIAL

The game of science is a non-*bored* game for two players—Nature and man. In the opening gambit, one must realize that there are no stalemates and that there is always one winner, Nature Herself. I personally find that She is exquisite, beautiful, and complex. She challenges man in any guise to find or discover more about Her and Her immutable rules. She, however, sets the rules, not man.

Part of the problem in understanding Nature is that man's time is finite whereas Nature's is infinite. Nature is consistent with respect to time and immune to human frailties; man is not. I hope to show some relevance of the preceding with the articles in this issue of μ-*Notes 2000* and share two telephone conversations.

Microscopy is, as any scientific endeavor, a human activity. Ted Clarke's article reveals the efforts expended by man to produce an instrument that can unveil some of the hidden beauty of Nature. John Delly describes the pride that an amateur microscopist expressed in the decoration of a slide box. Faking amber with insect inclusions and detecting them are explored by Jim Benko. Richard Lee tells us about accusations made against Pasteur's research methods, and from Ted Rochow we glimpse personal moments in the life of a microscopist. These and other articles in this issue of μ-*Notes 2000* tell of some of the players and their moves in the game of science.

Watching pros play games can be fun. I spoke to Dr. Rochow a few weeks ago by phone. He told me how Professor Mason came into a microscopy lab at Cornell one day and inquired of the class "what do you see?" A student replied that "the book says that you are supposed to see..." to which Mason replied "never mind what the book says, what do *you* see?" Microscopy is an interpretive act said Dr. Rochow with a twinkle in his voice.

Playing games also involves risk. In another telephone conversation, I spoke to a person involved in some way with the space program. He "generously" offered me samples from which I might obtain small fragments for use in an independent study project with one of my students. He then stipulated that he must be co-author on any publications resulting from this research! The samples were purchased elsewhere with cash, not compromised ethics.

In the game of science Richard Feynman reminds us that Nature is going to come out the way She is, that we should not have preconceived ideas of how things are, and, most importantly, that "Nature cannot be fooled."

Bill C. Mikuska

μ • NOTES 2000

Volume 1, No. 2, July 1997

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μ • NOTES 2000 is a State Microscopical Society of Illinois publication. Its purpose is to provide a form of communication between amateur and professional microscopists, to share ideas and techniques, to ask questions, to obtain answers, to express opinions, and to publish results of experiments and research. It will also provide space for members to print wanted and for-sale notices of microscopical equipment.

All opinions expressed by contributing authors of μ·Notes 2000 are the responsibility of the author(s) and do not necessarily reflect the opinion of the State Microscopical Society of Illinois or that of the editor.

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STATE MICROSCOPICAL SOCIETY OF ILLINOIS
INCORPORATED
1869

Founded In 1868

Cover: Photograph of Émile M. Chamot, courtesy of Theodore G. Rochow.

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1997 SMSI Émile M. Chamot Award Recipient
Dr. Theodore G. Rochow inside back cover

Forever Amber and Not So Forever Copal

by James J. Benko
Microspec Analytical*

Like many others I have been fascinated by objects trapped in amber. These natural wholemounts of a variety of specimens trapped in fossilized tree sap are surprisingly clear and viewable, even though they may be 10-30 million years old or more. Very small specimens usually cost less than large specimens, and give the microscopist an opportunity to study these ancient specimens at a more modest overall cost.

Lately, a large amount of amber has become available on the market. The movie Jurassic Park seems to have sparked an amber explosion in the gem trade. The collapse of the Russian Ruble and Polish Zloty may also have contributed to this proliferation. Amber jewelry seems to be everywhere, even in tourist areas such as Hawaii and Alaska. I purchased my first piece of buggy amber out of curiosity in a jewelry store in Hawaii and have since purchased several more pieces from different vendors throughout the continental United States. They make interesting objects for study under the microscope. More than once I have found extra objects embedded in the amber that was not obvious through the first cursory examination. Figure 1 shows a large, partially decomposed insect in Dominican amber. This amber piece, when viewed on edge, shows several successive layers of resin. In one thin layer there are two small gnats (see Figure 2).

Unfortunately, the popularity of amber has sparked a number of jewelry fakes. Many necklaces that are sold as amber are actually plastic and will say so on a small label somewhere on the piece. Sometimes this label can fall off "by

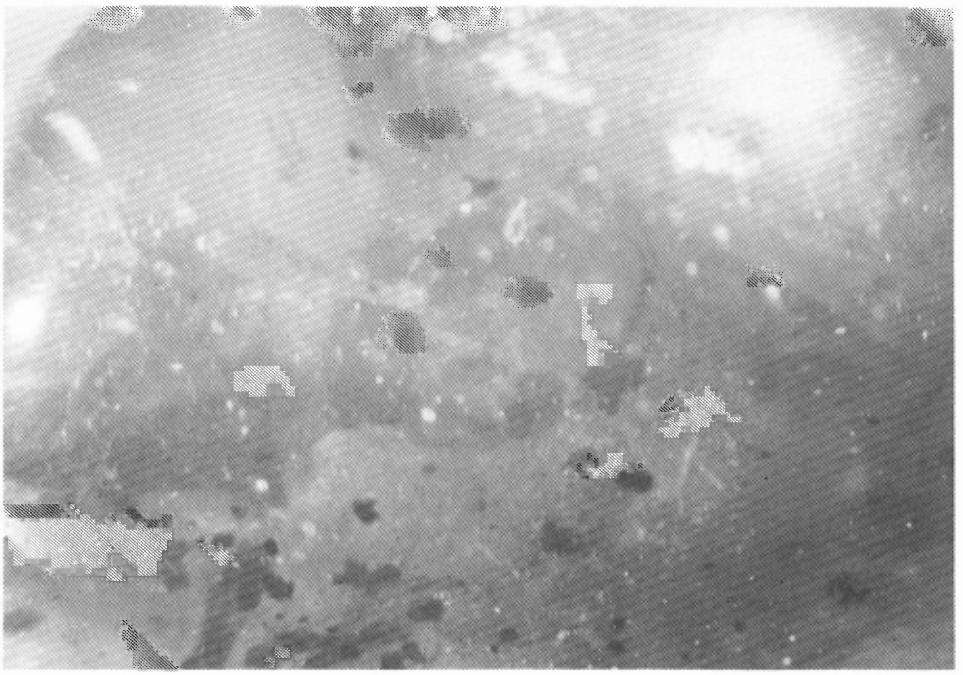

Figure 1. Large, partially decomposed insect along with other organic debris in Dominican amber, 10X.

* 3352 128th Avenue, Holland, MI 49424-9263

Figure 2. Surprise find of two gnats in a thin layer of Dominican amber—same pieces as Figure 1, 10X.

mistake." The House of Onyx, a large wholesale gem dealer, recently stated in their sales circular that they are closing-out their amber pieces because of the large amount of fake amber on the market, thus creating public distrust. (1) The possibility of purchasing amber jewelry fakes in the market today is very real. There is even more incentive for making fake "buggy" amber.

The misfortune of an insect getting trapped in amber seemed to me to be a rare event, but studies have shown that about 0.1% of Baltic amber and about 1% of Dominican amber contains insects, or other creatures. (2) From the number of insects flying around a tropical rain forest, one could presume that this figure is believable. From the shear number of buggy amber pieces being offered for sale, one would have to assume that the true frequency is even higher than this, or there are indeed a large number of fakes being sold. Obviously, an amber piece with an insect can be sold at a much higher price than one without an insect. My curiosity was aroused. How could one test a piece and be reasonably certain it is real amber? Also, just how easy is it to fake a piece of buggy amber? The text which follows is an attempt to answer these questions.

Amber is distributed widely over the world. Literally tons of this material have been mined since antiquity. Assuming that at least 1% does indeed contain some trapped biological forms, the total number of artifacts in amber has to be a rather large number, so there are indeed many genuine articles being offered for sale. More and more of these items are being offered as demand for them increases. From the numerous suppliers offering buggy amber today, there seems to be three principal sources: 1. Baltic amber, collected in and around the coast from the Baltic countries; 2. Dominican amber, from the Dominican Republic; and 3. Columbian amber, from Columbia, South America. Baltic amber is the most expensive with Dominican and Columbian varieties being less costly in that order.

All amber will float in a saturated sodium chloride solution. Some pieces having numerous air inclusions will even float in fresh water. This can be used to distinguish it from some synthetic plastic substitutes. If your sample sinks, you have something other than amber. If it floats you most likely have amber, but this test is not conclusive. Polystyrene also floats, having a specific gravity of 1.04-1.065. Infra-red spectroscopy, particularly the IR microscope, can be useful in identifying plastic substitutes and synthetic resins. In general, however, many resins from modern day balsam and rosin, to older copal, and even more ancient amber, all have similar IR spectra. Infra-

red spectroscopy, therefore, can expose amber substitutes, but cannot differentiate amber types.

Not too many people are willing to pay more for an IR or GC/MS analysis on a micro piece of amber removed from their jewelry, than they paid for the amber jewelry or amber specimen to begin with, so some less costly tests are in order to at least eliminate or expose possible fakes. Fortunately a few simple tests can be done under the stereomicroscope to at least make a reasonable judgement as to what you have. These tests are described below.

Baltic amber generally is 20-30 millions years old and is considered THE only true amber by some people. Baltic amber always contains succinic acid in percent amounts. This can be analyzed if you have a spare pyrolysis unit with a GC/MS unit lying around. Traces may be collected in upper portions of a capillary tube during pyrolysis of a small piece of amber. One can also perform micro solubility tests by dropping solvents such as acetone, chloroform, or toluene on the piece. The amber should not dissolve or become soft. A hot tungsten needle poked into a piece should cause some crumbling, but little or no melting. A resinous odor is produced, sometimes described as lemony.

Dominican amber generally does not contain succinic acid. Solubility in acetone, chloroform, and toluene is also nil. The hot needle test produces some crumbling but no melting. Much of the buggy amber being sold today is Dominican amber. It typically is lower in cost than the Baltic variety because of the greater number of insects found in this amber.

Columbian "amber", at least the specimens that I have been able to obtain, is most likely copal, rather than true amber. It is sold by most dealers as "amber" and seems to be very common today, almost more so than Dominican amber. Copal may only be a few hundred years old to a few million years old, but it is not old enough to be amber. The slow reaction that forms true amber takes more time. Copal is generally much more soluble in the solvents mentioned above. The hot needle test produces some melting, instead of sintering or crumbling. Pieces can become quite soft on heating and can form a clear melt between a slide and a coverslip.

Figure 3 shows a termite trapped in a piece of Columbian amber. This sample has some limited solubility in chloroform and toluene, much more so than Dominican and Baltic amber I have tested, and is probably copal rather than amber.

The float test, micro solubility tests, and hot needle probes can give some indication as to whether the specimen is amber or some other substitute. The real problem however is when

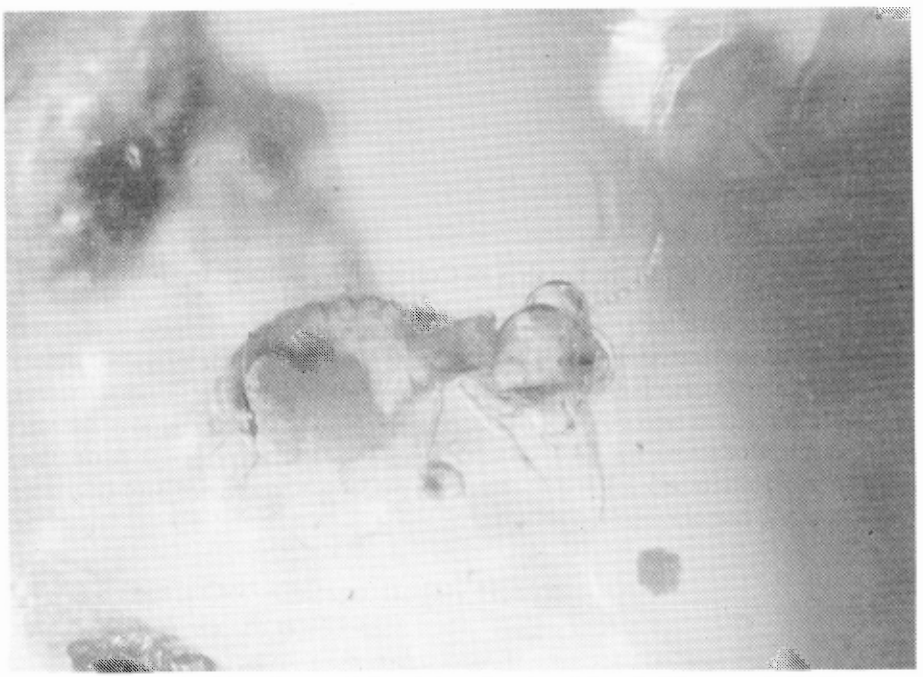

Figure 3. Termite in Columbian "amber" (probably copal) 10X.

copal is used with Baltic and Dominican amber to make insect fakes. Copal is a widely available in many parts of the world (Australia, New Zealand, Africa, and South America) and is used as a raw material in varnish manufacturing. Compared to the cost of amber, it is much cheaper. Since copal has greater solubility and can be more easily melted than amber, it can be used to make fakes from genuine amber pieces by filling holes or depressions containing an added insect in genuine amber. Other than identifying the insect species as modern as opposed to some extinct species, I am not sure how one could tell the difference without destroying the evidence in the analysis. Working with Columbian "amber" or copal, I have put a couple of insects into the amber on the first half-hearted attempt. It was easier than I thought. Figure 4 shows the result. Now I wonder just how many of the "buggy" amber pieces that I have are actually fakes. I would be most suspicious of any Columbian amber piece with insects, since it is not that difficult to put insects into matrix.

CAVEAT EMPTOR!!

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2. Rice, Patty C., *Amber, The Golden Gem of the Ages*; The Kosciuszko Foundation: New York, 1993; 3rd Printing, p. 162.

Figure 4. Insects put into matrix of Columbian "amber" by author, 10X.

Louis Pasteur Rembered*

by Richard H. Lee
Argonne National Laboratory†

1995 is the centennial anniversary of the death of the famous scientist, Louis Pasteur. It is fitting, therefore, that we recall his accomplishments, especially since he has recently been accused of falsifying his discoveries.. Initially trained to be a chemist, he became a biologist and a preeminent microscopist.

You probably have heard of pasteurization, which was one of his first discoveries. You might have learned in school that he discovered a cure for rabies. However, that is only part of his life's story with pasteurization at the beginning and rabies near the end.

After seeing an exhibit at the Chicago Academy of Sciences, sponsored by the Pasteur Foundation that covered many of his major scientific accompliments, I was inspired to do some more research (1).

When I saw an article in the *New York Times* (May 16, 1995) attacking his career, I was moved to set the record straight. Pasteur was an underdog; he had to struggle for success. I have a personal fascination with scientists who made important discoveries and have humble personalities and character. Accusations were made in the *Times* article about the research methods of Pasteur based upon interpretations of his recently released notebooks. He was accused of not giving credit to others, but is that so unusual in science? Pasteur worked primarily alone fo rmost of his career. Working in teams is a relatively recent development. He was also accused of cutting corners to beat rivals, and again that is pretty common even today in scientific research. Finally, criticism was made about his dependence on government grants; where would science be today without that? Would there be Pasteur Institutes without the French government?

He was born in the small town, Arbois, in France, the son of a tanner. At the age of nine he witnessed victims of a mad wolf and asked "Why do people die when mad dogs bite them?" What an ironic coincidence that his curiosity would lead him to discover the exact cure much later in his life. He started out wanting to be an artist, but he became interested in chemistry. His work with Biot resulted in the discovery of asymmetry in tartaric acid crystals with polarized light. Then he was asked by the wine makers to find a way of preventing wine from going sour. That work, and his later work with beer and milk, led to the process we call pasteurization, a process that destroys the microorganisms that causes fermentation or spoilage. Pasteur observed with the microscope that yeast cells of good beer or wine were round, but those of sour products were elongated.

A brilliant theoretician, as well as master technician, Pasteur became preoccupied with the causes of organic substances decomposing and spoiling. Leeuwenhoek actually discovered bacteria with his simple microscopes, but he called them "animacules." By disproving "spontaneous generation," "a lone man with a microscope could venture for the first time where no one else had gone" (2). Pasteur said: "the role of the infinitely small in nature is infinitely great." Pasteur's anthrax dilution experiment demonstrated the virulence principle and microbial multiplication--a classic experiment. In this experiment he diluted an anthrax culture by a factor of 1000 one hundred times, yet it retained the microbial organism§. Pasteur also taught that any microscope is but an aid to a keen eye and, above all, an active mind (3).

Despite opposition from the medical community, he developed ways of preventing disease

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* Presented at INTER/MICRO-95, Chicago, IL, July 11, 1995

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§ It is left as an exercise for the reader to find the overall dilution factor in Pastuer's experiment. Assume that the microbrial reproduction rate is negligible.

and its spread. This led to changes in hospital practices and inspired Lister to develop antiseptics. Pasteur even had the boldness to suggest that the resistance to disease could be enhanced by improving the general physiology of the patient. Probably his most important discovery, which came too late to save his own child, was that of treating people to become immune to a disease or cure infected people. Some people call him the father of immunology. In 1871 he began to crusade for greater support of scientific research in France, contrasting the magnificient support that laboratories were receiving in Germany. He loved the institutions of learning, the libraries, and the laboratories in which he had spent most of his life. After the rabies vaccine was successful, money for research began to pour in from all over the world. The first Pasteur Institute was built in 1888 (4). At the dedication of his new institute, he encouraged everyone to seek peace and harmony, and to search for truth and health as ways of delivering man from his problems--a high calling of service to mankind. Pasteur lived for only seven years after the dedication (5).

The more I read about Louis Pasteur, the more I admire him and his accomplishments. I think that when we look at the mistakes Pasteur may have made, and compare them to his total life's contributions, we can still respect and perhaps revere him. He was one of the world's greatest scientists.

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3. Rochow, Theodore G., "Microscopy: Technique or Technology?"; *American Laboratory*, July/August 1989.

4. Dubos, Rene, *Pasteur and Modern Science*, Doubleday & Co.: New York, 1960.

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More Examples of the Personal Touch in Do-It-Yourself Projects

by John Gustav Delly*

In the last issue of μ•Notes 2000, I described a microscope filter holder and a specimen manipulation apparatus designed and homemade by Charles Kruchten. I'd like to continue on the do-it-yourself theme by describing two examples of personalized slide boxes, and a micro-burner.

SLIDE BOXES

Over the last 50 years, the boxes in which microscopical slide preparations are shipped and stored have changed from wood, through cardboard and Bakelite, to a variety of plastics. In the not-too-distant past, wood was used to make slide boxes. There were two principal designs, those in which the lid was rabbeted, i.e., a recess cut out of all four edges, so that the remaining wood would fit down inside the lower box; and those in which the lid had four descending sides that would fit over inner rails in the lower portion of the box. Both were cheaply made, often of inferior, non-matching wood. Often a label was pasted to the lid, and rubberbands or some kind of tape was used for keeping the lid on: The State Microscopical Society of Illinois' slide collection has a number of these boxes.

Invariably, some owners of these slide boxes felt obliged to personalize them. Some simply put a piece of wide adhesive tape or book-repair tape along one of the long edges so as to form a hinge and then they printed or wrote their name on the lid. This was common in histology and embryology classes where you made your own microslide preparations.

Personally, I took this a step or two further because I wanted my own slide boxes to look pretty as well. Figure 1 illustrates my most common modification to a 3-3/4" x 6-9/16" x 1-7/16" 25-slide wooden box which consisted of the following: 1. Sanding the box and all edges until they were smooth. 2. Staining the wood—I used to mix red mahogany and cherry stains. 3. Lacquering—a light coat of clear lacquer. 4. Attaching hinges and a clasp. 5. Lining the inside bottom of the box and lid, and the underside with felt—I have used blue, red, purple, and green, depending on what I had on hand, or what was on sale. I have done this for boxes that hold 25 slides, 50 slides, and 100 slides. I liked the way my ringed slides looked in these now aesthetically pleasing boxes. The colored felt linings can also be color coded to the type of slides in the box, botanical, zoological, histological, thin-sections, etc. I have also given the finished boxes to friends as Christmas presents, or to mark anniversaries or other special occasions.

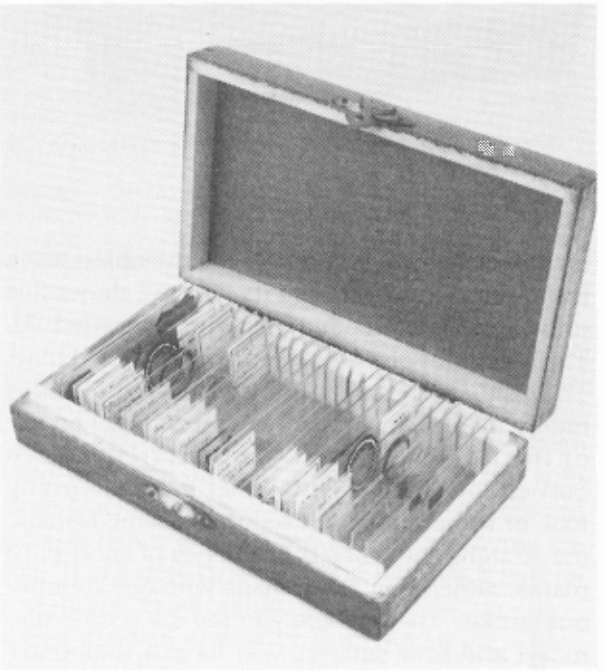

Figure 1

A month or so ago, I was in an antique mall, and found a 3-1/4" x 6-3/4" x 1-3/8" wooden slide box which someone had modified in their

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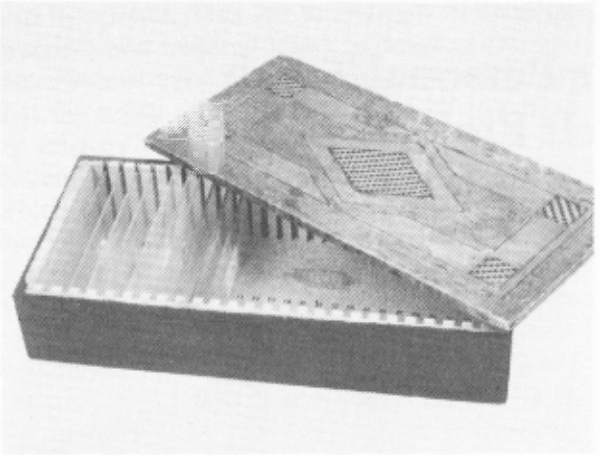

Figure 2

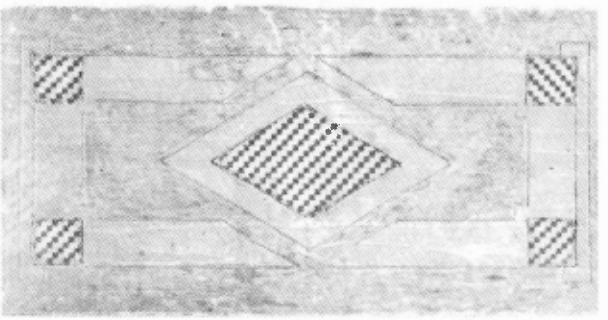

Figure 3

own personal way; it was very reasonable—just a few dollars—and I bought it. Figure 2 shows this to be a 25-slide wooden box with a rabetted lid. The four sides of the box have been painted blue. The inside of the box is unmodified, but the lid is highly modified. Figure 3 is a view down on top of the lid. The geometric pattern has been burned into the lid with either a woodburning tool, or something else used in the same fashion; the straight lines consist of a series of short burn marks, rather than being made with one continuous stroke. Then, where you see the central diamond and four squares that have a diamond/checkerboard appearance, the owner has carved out the wood from beneath those areas, and then cemented within the cutout areas bits of patterned celluloid. These inlaid celluloid pieces have a slightly specular appearance because of embedded pearlescent particles in the celluloid. The lid is otherwise unfinished, i.e., there is no coating of any kind.

Then, when the lid is turned over (Figure 4), we are in for a delightful surprise. The former owner had burned in his name, "ART K," and the date "JAN. 24, 1939" "10:00PM" "BURNED," and, in large letters, "U.S.M.A." The charm of this personalized slide box lies in envisioning this student at the United States Military Academy in his quarters, late on a cold winter's day in 1939. Was the personalizing of this box a distraction from study? I think not. There is too much work in it, with the carving and painting in military academy blue, and the burning. It is an artistic statement that demanded expression. Art K. most likely also became an officer who served in World War II, if he was a student at the U.S. Military Academy in 1939.

For the last item, I would like to tell you about a gift given to me recently by Nicholas LeMieux. Many of you will know Nick through his chapters in *Teaching Microscopy* (Microscope Publications, 1994) as a very enthusiastic teacher of microscopy at Northglenn High School in Northglenn, Colorado. He is now retired; and, as no one is following him in the teaching of microscopy, the books he used as texts, Dover's reprint of Schaeffer's *Microscopy for Chemists*, supplemented by his own contributions, together with some apparatus have become surplus. The gift he gave me is a micro burner, illustrated in Figure 5, and the story behind it is this: the micro burners were used in about 1970 at the University of Colorado Medical School in their Medical Technology Program. The micro burners are quite small, being only 2-1/2" in overall height. They were bought from the Arthur H.

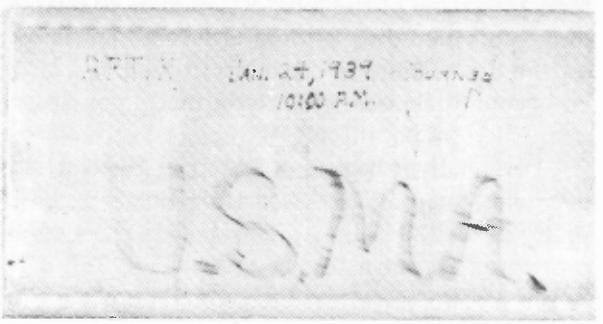

Figure 4

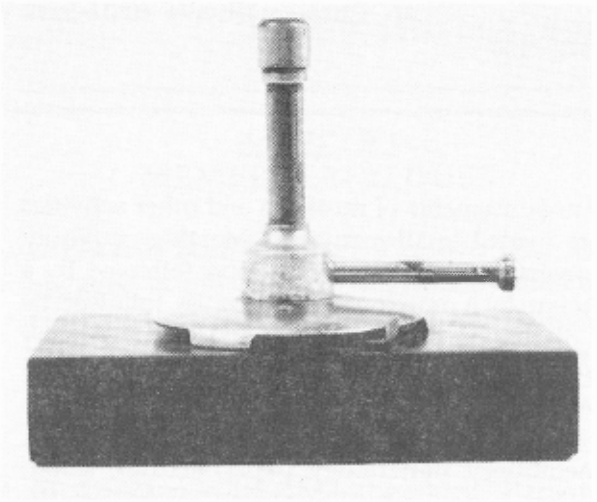

Figure 5

Micro Burners

2589-K 2589-M

2589-K. BURNER, Micro, Natural Gas, 1000-1200 B.T.U. Nickel-plated brass, with mixture control on base, and stabilizer top. Overall height 2½ inches; outside diameter of inlet tube 3/16 inch..... 1.70
10% discount in lots of 12

2589-M. Ditto, but with inlet tube 5½ inches long, complete with serrated connector for ¼-inch tubing 4.75
10% discount in lots of 12

Figure 6

Thomas Company, Philadelphia. Figure 6 is the description of the burner from the 1968 Thomas catalog. It is a wonderful micro burner and is, of course, no longer available.

At any rate, during a program restructuring, the micro burners were made surplus, and Nick, ever the scrounger, obtained them. He mounted each one of the micro burners on a 2-1/2" x 4" x 3/4" thick piece of wood using wire coming up through the block of wood. The bottom of the block is covered with dark green felt. You have to know Nick to know that he wouldn't use a piece of pine, or plywood as the base for the micro burners. No. He used wengé wood. Wengé (*Millettia laurentii*) is a beautiful tropical wood that grows mainly in Democratic Republic of Congo (formerly Zaire), Cameroon, and Gabon. The heartwood, which is what has been used here, is a dark chocolate brown color, with close black veining, and alternate closely-spaced whitish bands of light and dark parenchyma tissue. It is a very durable wood that has a natural resistance to abrasion, so is sometimes used in specialty flooring in public buildings where there is heavy pedestrian traffic. This is another example of a personal touch that converts an otherwise common object into something very special.

State Microscopical Society of Illinois

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THE STATE MICROSCOPICAL SOCIETY OF ILLINOIS was founded in 1868. It is an independent, non-profit scientific organization supported by the dues of its members, and by gifts and bequests. It was incorporated in 1869 and chartered by the State of Illinois as an organization to promote scientific research with the microscope. Preceded only three years by the Royal Microscopical Society of London, England, it is the second oldest microscopical societies in the world.

The society's fundamental aim is to promote the proper use of the microscope and the advancement of applied and theoretical microscopy. In pursuit of this goal it provides a forum for the dissemination of information on all phases of microscopy. The society has worked toward this end by holding lectures, courses, exhibits, and meetings; by publishing The Lens, The Bulletin, and now μ·Notes 2000, and by building collections of books, microscope slides and microscopes, both historical and modern.

The society keeps informed about, and encourages development of, new instruments and techniques; and preserves historical instruments, literature, and work which has been accumulated in the archives. These collections may be used by members in the society's rooms at the McCrone Research Institute. Arrangements for such use are made with the curator.

The society recognizes that hundreds of thousands of technical people working daily with microscopes, teaching or performing analysis, do not consider themselves professional microscopists but would like to increase their knowledge of microscopy and their proficiency in its use. The society's activities are planned to meet the needs of these individuals, as well as the needs of professional microscopists.

Announcements of meetings and other activities are mailed to all members. Meetings typically consist of social hour with food followed by a lecture by a prominent microscopist, followed by a discussion period. The programs cover many fields of application, representing the varied interests of the members: biology, chemistry, ceramics, crystallography, medicine, electronics, metallurgy, mineralogy, paper, textiles, wood, rubber, optics, and instrumentation. The emphasis is on all phases of microscopy, including electron microscopy and advanced special instrumentation.

Activities include field trips, workshops, and other special events which are announced from time to time. Some of the world's leading microscopists participate in these events, which are open to the public and are attended by representatives of other microscopical societies throughout the world.

Among the year's activities are the annual awards banquet, exhibit, and auction, and sale held in July. Proceeds from past auctions were used to support the society-sponsored "Young People's Course" for youths from ages 12-16. These courses have met on 10 consecutive Saturday mornings from 10:00 a.m. - 12 noon at the McCrone Research Institute, 2820 S. Michigan Ave., Chicago, IL 60616-3292.

If you are interested in any phase of microscopy, whether it be research, routine analysis, the formation and interpretation of images, or simply the examination of things for curiosity's sake, you will find that the society is worthwhile.

We invite your membership and the membership of your friends and look forward to greeting you at our meetings.

BY-LAWS

of the

State Microscopical Society of Illinois

ARTICLE I
MEMBERS AND DUES

(A) Active Membership: Persons who are engaged or interested in microscopy shall be eligible for Active Membership. Annual dues for Active Members shall be $20.00 per year if paid individually; $40.00 per year if paid by employer.

(B) Corresponding Membership: Persons who are interested in microscopy and live beyond a radius of 50 miles of Chicago, shall be eligible for Corresponding Membership. Annual dues for Corresponding Members shall be $10.00 per year (minimum).

(C) Student Membership: Students who are interested in microscopy shall be eligible for Student Membership. Membership dues shall be $6.00 per year through high school, $10.00 for college students.

(D) Contributing Membership: Persons who are eligible for Active, Corresponding, or Student Membership shall be eligible for Contributing Membership upon the payment of an Annual fee of $40, or more.

(E) Associate Membership: Individuals, corporations, associations, partnerships, firms or organizations who are interested in support of microscopy shall be eligible for Associate Membership. Dues shall be $150 per year.

(F) Life Membership: Any person who is eligible for Active, Corresponding, or Contributing Membership may become a Life Member upon payment of $150.00. Life Membership shall be considered as being fully paid and not subject to dues or assessments.

(G) Honorary Membership: Any person eminent in science or art or who has specifically promoted the welfare of this Society through service or association with the Society may be elected to Honorary Membership after having been nominated by at least three members of the Society in writing and approved unanimously by the Board of Trustees. (Past Officers may be elected to this level, in appreciation of their service to the Society.)

The Society shall operate on a calendar year January 1st to December 31st inclusive. Notice of dues will be sent to the membership by December 15th and shall be payable by March 31st of the New Year. Dues paid after July 1st will be half of the annual amount (applicable to new members only).

(H) Guest Membership: Membership will be offered to guest speakers for a period of one year to non members.

ARTICLE II
DUTIES OF OFFICERS

SECTION I. President: The President shall perform all of the usual duties of the presiding officer at the meetings of the Society. He shall, when requested, attend the meetings and counsel with the Board of Trustees. He shall countersign all orders on the Treasurer when accompanied by proper vouchers. He may take part in debate but may not vote except in case of a tie. He shall call a special meeting of the Society at the request of the Board of Trustees or of five voting Active Members. He shall present a written report at the Annual Meeting setting forth the general condition and progress of the Society during his year of office with such suggestions for the future as he may deem desirable.

SECTION II. Vice President: The Vice-President shall assist the President and in the absence of the President or in case of the President's inability or refusal to perform the duties of the President's office, the Vice-President shall perform as presiding officer and attend to the usual duties of the President's office.

SECTION III. Recording Secretary: The Recording Secretary shall keep the minutes of the proceedings of the Society. He shall notify new members of their election; shall have custody of the Seal of the Society and shall affix the same as directed by the Society or the Board of Trustees and shall perform such other duties as may from time to time be assigned by the President or Board of Trustees.

SECTION IV. Corresponding Secretary: The Corresponding Secretary shall conduct the official correspondence of the Society. He or she shall maintain a close liaison with the Recording Secretary; shall report to the Society at its regular meetings, the summary of all correspondence received since the previous meeting; may be appointed by the President and may not necessarily be a member of the Society.

SECTION V. Membership Secretary: The Membership Secretary shall keep and maintain the membership list which contains the membership status and names of all persons or organizations of this Society; a record of dues paid; and may not necessarily be a member of the Society.

SECTION VI. Treasurer: The Treasurer shall receive and care for all monies of the Society and shall keep careful accounts of the same; pay all bills and preserve vouchers of all such payments. He shall at the Annual Meeting submit his books with a detailed report of the financial transactions of the Society of the preceding fiscal year and shall perform such other duties as may be assigned to him from time to time by the President or Board of Trustees.

SECTION VII. Curator: The Curator shall, subject to the Board of Trustees, have charge of all apparatus, books, furniture, etc., of the Society. He shall prepare and compile lists of all such properties of every kind and a copy of such list shall be supplied to the Recording Secretary and one to the Board of Trustees and all such properties shall be made available, as far as possible, for the use of the members of the Society. Assistants may be selected to assist the Curator.

SECTION VIII. Historian: The Historian shall compile and maintain a written chronicle of the Society's significant activities and past events.

SECTION IX. The Board of Trustees shall supervise all of the affairs of the Society. They shall elect a Chairman, Vice-Chairman, and Secretary and shall hold such regular meetings as they may deem necessary. Special meetings, however, may be called by the Chairman of the Board or by the President of the Society and one member of the Board or by any two Trustees. Three Trustees shall constitute a quorum for the transaction of business. The Board shall consist of but not be limited to the five immediate past presidents of the Society. A vacancy could be filled by a vote of the remaining members.

ARTICLE III
MEETINGS

SECTION I. There shall be an Annual Meeting of the Society. The date of which shall be determined by the officers. This meeting shall be held in conjunction with the INTER/MICRO conference.

SECTION II. Special Meetings: Special Meetings may be called by the Chairman of the Board of Trustees for the consideration of special items of business. Such meetings

shall proceed at once to the consideration of the Special business for which it was called and no other business shall be brought up before the Society at such Special Meetings.

SECTION III. Scientific Meetings of the Society shall be held at convenient times. At least seven meetings per year shall be held.

SECTION IV. Workshops may be held for educational purposes, typically on weekends for one-half to two days. Fees will be charged to cover expenses and an honorarium.

SECTION V. Compensation for speakers shall be at the discretion of the current officers (President, Vice President, and Treasurer).

ARTICLE IV
NOMINATIONS AND ELECTIONS

SECTION I. The officers of the Society shall be elected by voice vote and announced at the Annual Meeting. If the voice vote cannot determine a majority decision, then voting will be done by ballot.

SECTION II. A Nominating Committee composed of three members shall be appointed by the President at the April meeting and the Nominating Committee shall report to the members at the annual meeting. Nominations may be made from the floor at the Annual Meeting or be submitted to the Recording Secretary in writing previous to the Annual Meeting. Nominations from the floor or submitted to the Recording Secretary shall be sponsored by three voting members on or before the date of the Annual Meeting.

ARTICLE V
COMMITTEES

STANDING COMMITTEES: All committees shall consist of three or more members at the discretion of the President—and same shall be appointed as soon as possible after the Annual Meeting. A list of appointments shall be furnished to the Chairman of the Board of Trustees. The President shall be an ex-officio member of all Committees. There shall be Standing Committees as follows:

SECTION I. Awards: It shall be the duty of the Awards Committee to select a recipients for the Annual Award(s).

SECTION II. Membership: It shall be the duty of the Committee on Membership to devise and carry out means for obtaining new members for the Society.

SECTION III. Education: It shall be the duty of this Committee to cooperate in the dissemination of educational programs in the interest of microscopy and the sciences. This Committee shall establish and schedule the classes on microscopy and related subjects sponsored by the Society and supervise their progress. It shall make arrangements with such organizations as may be selected by the Society for the conduct of such classes and shall make arrangements for facilities and such supplies as may be needed in the proper conduct of said classes or lectures.

SECTION IV. Publicity Committee: It shall be the duty of this Committee to solicit newspaper, radio, and television recognition of the work of the Society and to publish notices of the Society's activities and meetings.

SECTION V. Program: It shall be the duty of this Committee to solicit newspaper, radio, and television recognition of the work of the Society and to publish notices of the Society's activities and meetings.

SECTION V. Program: It shall be the duty of this Committee to arrange the programs for the meetings of the Society—including extra activities such as field trips, etc. It shall make and/or supervise all arrangements for the presentation of the programs.

It shall keep the Publicity Committee informed of its work at all times so that the Publicity Committee can provide and follow through on publicity. The Vice President shall preside over this Committee.

SECTION VI. Publication: It shall be the duty of this Committee to supervise the publications of the Society.

SECTION VII. Not-for-Profit Status: The Society shall be a NOT-FOR-PROFIT CORPORATION under the general Not-for-Profit Corporation Act of the State of Illinois and corresponding federal statutes under the provisions of Section 501(c)3 of the Internal Revenue Code. The Society shall comply with all requisite regulations such as found in the IRS publication 557.

SECTION VIII. Archival of Society Documents, Property, and Records: No individual may remove original documents, property, or records for whatever reason without the written permission of the Board of Trustees. Even after approval, only photocopies may be removed for research or publication purposes. All important documents shall be microfilmed or microfiched for archival storage in a bank safe deposit box. All property such as microscopes and slides shall be photographed, copied, and one copy stored along with archival documents. Liability insurance shall be obtained and maintained to cover the loss of Society property, and documents.

SECTION IX. Special Committees: Special Committees may be appointed by the President with the approval of the Board of Trustees or the voting members at any general meeting of the Society to consider special problems, make studies or investigations when, as and if such actions become advisable in the President's or the Board of Trustees' judgement.

ARTICLE VI
SMSI AWARD DESIGNATIONS

1. Émile Chamot: an annual SMSI award for outstanding contributions to the field of chemical microscopy.

2. August Köhler: an SMSI award for outstanding contributions to the field of light microscopy.

3. SMSI Distinguished Service Award: an SMSI award presented to an SMSI member who has contributed outstanding service to the society.

Note: one or more of these awards may be presented at the Annual Meeting.

The Polarized Light Macroscope

Walter C. McCrone
McCrone Research Institute*

Normally I use the polarized light microscope with 10X oculars and 10X objective supplemented by 40X, 60X, or 100X objectives; occasionally I replace the 10X oculars with 20X or 25X oculars. The corresponding magnifications are given in Table I.

Table I
Magnifications Possible With Readily Available Oculars and Objectives

	Objectives					
Oculars	5	10	20	40	60	100
5	25	50	100	200	300	500
10	50	100	200	400	600	1000
15	75	150	300	600	900	1500
20	100	200	400	800	1200	2000
25	125	250	500	1000	1500	2500

The 25X ocular and 40X objective for a 1000X total is often chosen to give a greater depth of field than when we use the 10X ocular and 100X objective even though we sacrifice some resolution.

How about lower magnifications? We can readily replace the 10X ocular and objective with 5X ocular and 5X objective yielding a 25X total magnification, and there are even 0.5, 1, and 2X objectives and oculars but they are not standard equipment. But how about still lower magnifications with still standard equipment? There is a way to do this photomicrographically if you have a variable bellows camera simply by reducing the projection distance. If the microscope is set for 25X total magnification, then the choice of projection distance leads to:

$$\text{final magnification} = 25\left(\frac{\text{projection distance in mm}}{\text{mm}}\right)$$

Magnifications of 5-10X are possible in this way. In the same way using 35 mm cameras usually gives a reduction to 40%, i.e., 100X reduced to 40X or 25X down to 10X.

But how about lower magnifications? There are two ways to proceed if you can move your slide preparation from the stage to the near vicinity of the field diaphram. If your F.D. is on a separate lamp like the LSD lamp used with the Olympus POS microscope the slide can go into the filter holder just in front of the F.D. If you have an Olympus BH, Nikon Optiphot or any similar binocular POL 'scope the slide preparation can be laid over the base illuminator light source. The F.D. for these 'scopes is usually close to the top lens in the base.

If you have Köhler illumination (not "if", but "since", of course) the F.D. is in focus in the plane of the preparation and a small movement of the substage condenser or of the microscope focus brings the relocated slide preparation into good focus without a serious change in focus of the F.D.

There are two procedures that can now be used:

Method 1. With the microscope set for good Köhler illumination, place the slide preparation on the microscope stand base over the light source. Focus its image orthoscopically with any objective by using the coarse and fine microscope focus knobs, leaving the substage condenser in its usual Köhler position. Focusing is done for any objective by simply refocusing the microscope slightly.

This method I call Method 1 Modification A—simply move the prep to the F.D. vicinity and refocus the substage condenser to view the prep in the usual way. If you wish to use crossed polars you must, of course, place a polarizer under the prep.

A set of data using Method 1 Modification A is given in Table II.

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Table II
Magnifications Achieved by Application of Method 1, Modification A

Ocular	Objective	Condenser	Magnification
5X	4X	up	2.8X
5X	10X	"	5.3X
5X	20X	"	10.3X
7X	4X	"	3.4X
7X	10X	"	6.8X
7X	20X	"	12.8X
10X	4X	"	4.5X
10X	10X	"	10.8X
10X	20X	"	21.3X

Table III
Magnifications Achieved by Application of Method 1, Modification B

Ocular	Objective	Condenser	Magnification
5X	4X	variably down	2.8X
5X	10X	" "	5.3X
5X	20X	" "	10.3X
7X	4X	" "	3.3X
7X	10X	" "	6.8X
7X	20X	" "	13X
10X	4X	" "	5.5X
10X	10X	" "	10.8X
10X	20X	" "	22X

To determine the magnification at each of the settings in Table I, I imaged the ink circle surrounding the scale on my micrometer stage scale; it is 4 mm in diameter. Viewing this image with one eye, I fixed a millimeter rule 10" from my eye superimposed on the field of view. A superimposed 12 millimeters equal to the diameter of the microscope image of the circle corresponds to a magnification of 3X. In the above Table the circle diameter ranged from 11 to 87 millimeters.

Modification B of Method 1 requires that the objectives be left fixed in their usual in-focus position. Focusing the relocated preparation (down to the light source) is now done by racking the substage condenser up or down. Although this Modification of Method 1 leads to essentially identical magnifications, it may be preferable to Modification A (or vice versa). The Olympus POS microscope does not have a rack and pinion for the substage condenser*. Table III covers the magnifications achieved by Method 1 Modification B.

So with either modification of Method 1, we're down to 2.8X; what about lower magnifications? Since Modification B did not lower further our lowest magnification over what we already had with modification A, we will introduce another approach using the Bertrand lens. With Method 2 we insert the Bertrand and remove the condenser top lens. The preparation will be near good focus. I do the final focusing by sliding the ocular up or down since we no longer have drawtubes. Tables IV-V show the results using Bertrand lens (Method 2).

For Method 2, Modification A, the Bertrand is inserted, the condenser top lens is removed, all objectives are in normal focus positions, and the condenser is "all" the way down (about 1", there may be no "all the way down"; it falls out on my 'scope) (see Table IV). For Method 2 Modification B, the condenser is up, tops is in, and focusing is done using the coarse and fine adjustment (see Table V).

Incidentally, replacing the 20X objective with a 40X or 60X objective will further reduce the 0.4X of Table V to less than 0.2 for the 40X objective or to about 0.1X for the 60X; too bad oil immersion is impossible with any of these methods. By the way why do you suppose that going to higher power objectives decreases the magnification? Maybe it has something to do with the fact that interference figures of crystals are also larger (higher magnification) with the 10X than the 40X objective.

So now we're down to 0.1X; what about lower magnifications? Some people are never satisfied. Well, we noted earlier the use of a bellows camera to reduce the magnification on a

* Actually this may not be such a bad arrangement in general because there is only one proper position for the condenser (to focus the F.D. in the preparation plane). Having it less easy to move it up or down helps to keep some biologists from using the substage condenser rack and pinion to control the light intensity.

Table IV
Magnifications Achieved by Application of Method 2 Modification A (Condenser Down)

Ocular	Objective	Condenser	Magnification
5X	4X	down	2.8X
5X	10X	"	1.8X
5X	20X	"	0.8X
7X	4X	"	2.8X
7X	10X	"	1.3X
7X	20X	"	0.6X
10X	4X	"	3.0X
10X	10X	"	1.3X
10X	20X	"	0.5X

Table V
Magnifications Achieved by Application of Method 2 Modification B (Condenser Up)

Ocular	Objective	Condenser	Magnification
5X	4X	up	1.5X
5X	10X	can't focus image	---
5X	20X	" "	
7X	4X	up	1.8X
7X	10X	"	0.8X
7X	20X	"	0.4X
10X	4X	"	2.5X
10X	10X	"	1.0X
10X	20X	"	0.5X

photograph. We could get down to about 0.1X with the Table IV and a 60 mm projection distance. Failing to have a variable bellows, you could resort to an adapter to take a 35 mm camera that would reduce the looking-through-the microscope-magnification to 40% thereof. But really, I think we've gone far enough.

My aim is to show that it is quick and easy to get reasonable lowering of the magnification of the 'scope as we use it without extraordinary accessories or procedures. So, in summary, just move the prep to a position near the field diaphram and refocus the microscope slightly Method 1 Modification A.

Why would anyone want to do such a thing as reducing the magnification below, say, 25X (5X ocular and 5X objective)? Well, just one example, I'm working on a project that utilizes a small glass convex lens to prepare "lens crystals" of fusible compounds grown between this lens and a slide on which it rests. This gives me a concave lens crystal of the compound and a system of Newton's polarization color rings from first-order black to high-order white. Very pretty but, number one, it allows me to visualize anomalous Newton series colors, and number two, it enables me to calibrate the polarization color rings of the lens crystals to give numerical values of birefringence from the diameters of those rings. Some low birefringence crystals require lower magnification to permit measurement of the diameters I need, and, besides, it is difficult to get photomicrographs in the normal way that show the full series of beautiful "Newton's rings."

Okay, one more reason; manipulation of samples on a slide or preparing a slide for POL examination a low magnification look, that is both quickly and easily accomplished, can save time, and improve results. It is but 5-10 seconds to place the slide on the substage illuminator and refocus the 'scope (Method 1 Modification A) just a bit to have a clear view of the whole coverslip area, then another 5-10 seconds to reverse the process. I often spend 10 times 5-10 seconds scanning an entire coverslip area at even 100X to find one or two particles in an otherwise empty prep. Once you get used to doing it you may find lots of occasions where quick low magnifications helps. A stereo 'scope could be used but Method 1A above is quicker, easier, and yield lower magnifications.

State Microscopical Society of Illinois
1996 Treasurer's Report

CATEGORY	AMOUNT	BALANCE
A - Balance, January 1, 1996		$14,916.40
Archives Total	($450.00)	
Auction Receipts Total	$3,281.00	
Awards Total	($54.57)	
Dues Total	$1,498.00	
Gifts Total	($1.61)	
Inter/Micro expenses Total	($25.00)	
Interest Total	$419.09	
"Microscope" subscriptions, Receipts with dues Total	$817.00	
"Microscope" subscriptions, Dispersements to McRI Total	($817.00)	
Picnic Total	($130.03)	
Postage Total	($721.52)	
Receipts for meetings Total	$662.00	
Refreshments for meetings Total	($886.08)	
Speaker Expenses Total	($65.00)	
Speaker Honoraria Total	($900.00)	
Stationery, printing Total	($105.00)	
Videotapes Total	($11.71)	
Workshop expenses Total	($343.71)	
Workshop receipts Total	$150.00	
Net Transactions for 1996	$2,315.89	
Ending Balance, December 31, 1976		$17,232.29

Summary

Balance Year Beginning, Jan 1, 1996	$14,916 40
Total Receipts	$6,827.09
Total Dispersements (including Feb '97 "Microscope" transfer	$4,511.20
Ending Balance - Dec 31, 1996	$17,232.29

Essential Oils as Refractive Index Liquids*

BILL C. MIKUSKA
Triton College†

During a presentation to the members of the State Microscopical Society of Illinois, I made a passing comment that essential oils extracted from gum myrrh, gum olibanum (frankincense), along with other essential oils might make a set of refractive index liquids (hereafter RI liquids) that would be non-toxic, stable, and relatively inexpensive especially when compared with commercially available material. The purpose of this article is to elaborate on that comment.

Light microscopists have depended on commercially available refractive index liquids to meet their needs for decades. Environmental and laboratory safety issues are increasingly important to users of these materials. Alternative materials that may serve the microscopist as crystal rolling media and reference refractive index liquids are suggested.

The idea of using essential oils as RI liquids is not new; Johannsen's book, *Manual of Petrographic Methods* (1), has a table listing ten different oils, five mixtures of these oils, their corresponding refractive indices or ranges of indices along with the temperature at which these indices were measured. To understand better why these materials are not extensively used if at all in commercial preparations is to understand better the problems associated with any RI liquid and the nature of essential oils.

ESSENTIAL OILS

The essential oils are present in various parts of plants but their function in or benefit to the plant is still a matter of controversy. However, some plants contain essential oils that repel animals, or exhibit bactericidal or fungicidal action (Guenther, Volume I) (2). This topic will be addressed later in this paper.

Essential oils are plant isolates which may include various carboxylic acids, esters, ketones, aldehydes, alcohols, terpenes, substituted benzenes and other compounds. Depending on the plant, the plant part, and the oil that is sought, these oils are isolated in various ways. Typical methods employed are simple distillation or steam distillation, volatile solvent extraction, cold fat extraction (enfleurage), and hot fat extraction (maceration) of plant materials. Ethanolic extraction of gum resins produce tinctures. When stripped of their solvent by vacuum distillation, tinctures yield resins, resinoids, and coeurs. Since essential oils are of plant origin, growing conditions will have an effect on the chemical composition of the isolated oil. Oil composition is also affected by storage conditions of the harvested plant material prior to processing and also by the processing temperature and pressure. Manufacturers and suppliers of these oils supply data sheets for their isolates; therefore, even though the refractive index may vary in a given range from batch to batch, the index is known.

STABILITY

For neat liquids stability implies that the material will not be adversely affected by light, the atmosphere, and the temperatures at which these materials are to be used. Mixtures, in addition to the aforementioned problems, have the added complexions of reactivity of the components with each other. In addition, the volatility of the various components differ significantly such that in time the mixture's composition, and hence its refractive index, are no longer representative of the original mixture. The essential oils of the genus citrus exemplify these problems. They are stable when kept in dark colored, well-filled bottles that are stored in a cool place. Air, especially in the presence of moisture, promotes oxidation of these materials. This is accompanied by a change in physical properties (Guenther, Volume III) (2).

Commercial RI liquids are fraught with these problems as well. However, the manufacturer of these RI liquids has judiciously chosen materials such that these problems are, at least, minimized. That these problems are yet extant is reflected in the manufacturer's caveat about the expected useful lifetimes of opened and unopened containers of RI liquids. Regardless of what substances are used as RI liquids, how old they are, or whether they be commercially prepared or merely something common to the home or lab, there must be match between the RI liquid

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and the solid for which the refractive index is sought. The numerical value of this RI liquid must be determined.

Ways to measure these unknown RI values may range from using a refractometer to finding a match with solids of known refractive index. Strain-free glass standards represent a very good choice because they are stable and present a single index since glasses are isotropic. Comminuted minerals and small mineral crystals are also useful but present additional problems; viz., most minerals or mineral crystals are anisotropic and, therefore, present more than one index . Furthermore, minerals may have variable composition with corresponding variable indices. For example, in the olivine group, olivine, $(Mg,Fe)_2SiO_4$, can range in composition from the pale yellow-green/olive green in forsterite, Mg_2SiO_4, to a darker brown-green in fayalite, Fe_2SiO_4. According to the *Encyclopedia of Minerals* (3), both of these minerals are orthorhombic but fayalite is biaxial (-) with $\alpha = 1.827^*$, $\beta = 1.869^*$, and $\gamma = 1.879^*$, and forsterite is biaxial (+) with $\alpha = 1.635$, $\beta = 1.651$, and $\gamma = 1.670$.

What then are the advantages of essential oils as RI liquids over those that are commercially prepared?

TOXICITY

Some commercial materials may have one or more of the following health concerns associated with them: They may be carcinogenic, poisonous, corrosive, a CNS-depressant, etc. When used in small quantities, in well-ventilated areas, and with no skin contact—good laboratory practice—the commercial materials are safe. Yet, they do present a disposal problem. The essential oils, too, have toxic effects; "excessive use in higher animals and man causes depression of higher centers followed by convulsions" (Guenther, Volume I) (2). The list of essential oils listed in Table 1 do not present such risks since they are used as flavoring and perfuming agents; however, there may be associated allergic reactions as with any substance.

Except for frankincence (olibanum) oil, all tabulated data was supplied by LorAnn Oils, 4518 Aurelius Rd., P.O. Box 22009, Lansing, MI 48909 - 2009. Their free 1997 catalog lists 91 oils that range in price from $1.10 to over $23.00 per once. The more expensive oils are available in smaller quantities.

Correction of RI values of the essential oils for temperature is addressed in Guenther, I).[2] The resins, resinoids, and coeurs previously mentioned are extremely viscous liquids that are suitable for crystal rolling.

TABLE 1.

ESSENTIAL OIL	REFRACTIVE INDEX 20 °C; 589 nm
Anise, natural	1.56
Anise, artificial	1.553 - 1.560
Bergamot, natural	1.4643
Bergamot. artificial	1.472
Citronella, artificial	1.4539
Cumin Oil	1.501 - 1.506
Marjoram Oil	1.4631
Pennyroyal Oil	1.483
Peppermint Oil	1.4631
Rosemary Oil	1.468
Rosewood Oil	1.463
Sandal Oil	1.5047
Sassafrass Oil	1.5367
Spearmint Oil	1.486
Thyme Oil	1.5025
Oil of Bitter Orange	1.4734
Frankincense Oil, natural (Guenther, IV)	1.4710 - 1.4784
Myrrh Oil, artificial	1.535

CONCLUSION

Essential oils may serve as inexpensive, nontoxic, environmentally safe RI liquids. These materials are, however, limited in their range of refractive index values by nature of their composition. The researcher interested in pursuing this subject further is directed to Guenther (2).

REFERENCES

1. Johannsen, A. *Manual of Petrographic Methods*; McGraw-Hill: New York, 1918.

2. Guenther, E. *The Essential Oils*, I - VI; reprinted by Robert E. Krieger: New York, 1972.

3. Roberts, W.L. *et.al. Encyclopedia of Minerals*; Van Nostrand Reinhold: New York, 1990; Second Edition.

4. Winchell, A.N.; Winchell, H. *The Microscopical Characters of Artificial Inorganic Solid Substances*; Academic Press: NewYork, 1964.

* Winchell and Winchell list the RI values for fayalite as $\alpha = 1.824$, $\beta = 1.864$, and $\gamma = 1.875$[4]

Head Lice and the Home Microscopist

JAMES R. MILLETTE

MVA, Inc.*

INTRODUCTION

If you have a child in preschool or elementary school, it is inevitable that you will be faced with the health concern about head lice. Even if you escape the personal infestation, you will probably receive a letter warning that head lice have been found on some child at the school and suggesting that your child's hair be checked carefully. In our case it was the actual infestation of a 5 year old head, probably the result of hugging a stuffed Ninja Turtle obtained from a garage sale. A search of home health books (1) and looking up "lice" in the encyclopedias (2, 3) provided some information about the little critters but not many pictures showing what we were looking for. Even Internet sources such as 'Head Lice' by Judith Tucker NP (4) which provided the most useful summary of information on lice I found, has only a single picture, that of a nit attached to a hair shaft. With a stereomicroscope on a basement work table, our family learned "up-close" about what head lice look like. The following are our findings. In a sense we turned a dreaded lice infestation into a science project.

LICE

Head Lice (*Pediculosis humanus capitus*) are parasites that infect millions of children each year, mostly in elementary school. They are transferred from child to child by hats, combs, blankets, stuffed animals and close head contact. They bite the scalp to obtain blood to live. The constant scratching of the scalp just above the ears is a common symptom. Adult lice are about 1/16 of an inch long and are white to grayish to brown in color. When combing hair in search of lice, the eggs, called "nits," are the most common evidence found. The eggs are attached to the hair shaft at about a 45° angle. Head lice are distinct from body lice which are considered more of a health concern because of bacterial diseases they may carry. The most common treatment is to physically remove nits or nit shells by fine-tooth combing or with tweezers on a daily basis until the lice are gone. Several topical treatments are available in shampoo form to help rid a head from lice. Clothing, bedding, and other articles must all be washed and dried to prevent reinfestation.

EQUIPMENT & METHODS

The primary tool for close examination was a stereomicroscope manufactured by SPI with 15X eyepieces and an objective lens choice of 2X and 4X power. Magnifying glasses were also used for the initial observations. Photomicrographs were taken with a monocular microscope (W. Watson & Sons #44063, 1929) with a 2.5X objective and a 10X eyepiece fitted with a camera adapter for a Minolta XG-SE camera body. A fiber optic light source (Fiber-Lite, Dolan-Jenner Industries, Inc.) was used to illuminate the subjects for examination as well as for photography.

Each day the children's (5 years, 11 years, 14 years, and 17 years) hair was combed out with a lice comb. Combed particles were collected on a clean white pillow case. Suspect particles were viewed through a magnifying glass and the more interesting or unidentified pieces were collected on Post-it Notes (3M Corporation). The particles were then "sent to the lab" in the basement to be viewed with the stereomicroscope.

RESULTS

The nits (Figure 1) were clearly evident in the first day combing of the 5 year old and in the subsequent combings several days afterward. Several of the other children also exhibited nits.

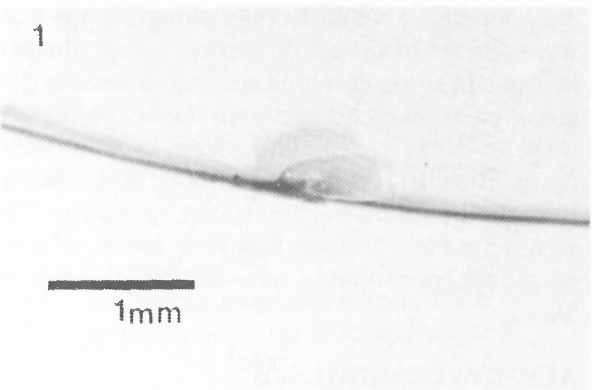

Figure 1. Head Lice Egg capsule, called a "Nit" attached to a hair shaft. Bar equals 1 mm.

* 5500 Oakbrook Parkway, Suite 200, Norcross, Georgia 30093

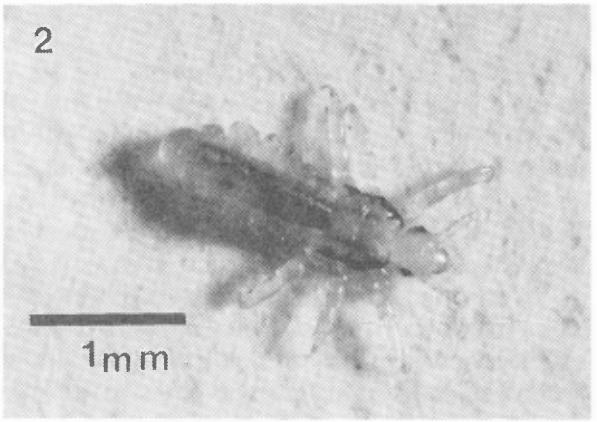

Figure 2. Adult head louse with a transparent body, a pair of antennae, and six legs, each with a hook. Background is a Post-it Note. Bar equals 1 mm.

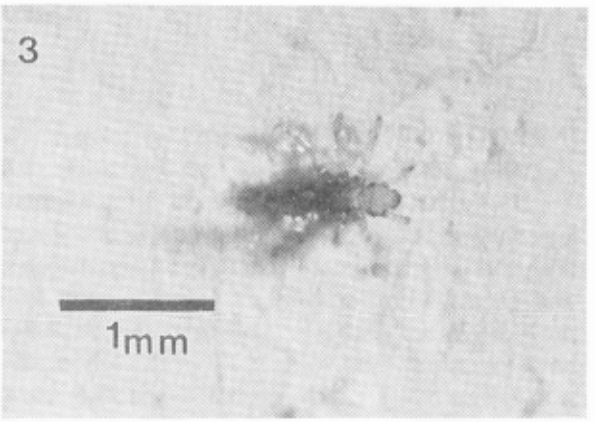

Figure 3. Juvenile head louse. Appears as a smaller version of the adult shown in Figure 2. Bar equals 1 mm.

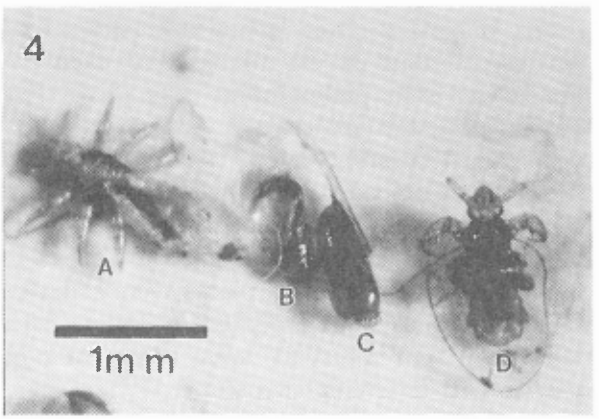

Figure 4. Several particles found during the combing after treatments. A. Juvenile Louse, B. An Egg (Nit), C. Nit with hair shaft attachment, D. Early Juvenile Louse. Cloth threads are also apparent in the field. Bar equals 1 mm.

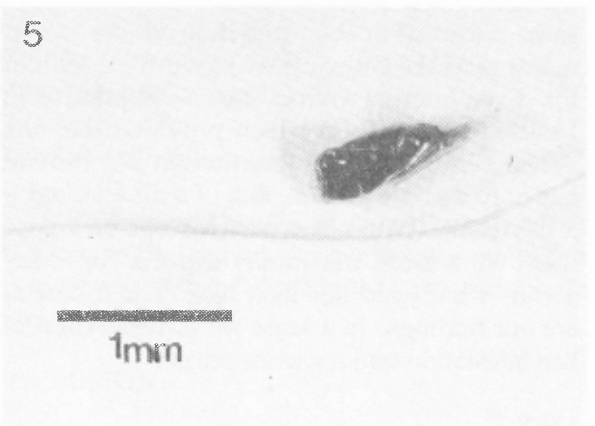

Figure 5. Head Louse Egg after treatment. Inside is dark, assumed to be non-viable. Bar equals 1 mm.

The adult lice (Figure 2) were seen only in the combings of the youngest. As described in the encyclopedia, juvenile lice, as shown in Figure 3, were similar to the adult version except smaller in size. In some combing collections several different particles associated with the lice were seen (Figure 4). Skin cells and pieces of skin scabs from the infected areas were also seen. Eventually, following treatment, no adult lice were found and the nits that were found exhibited a dark, presumably non-viable form (Figure 5).

ACKNOWLEDGEMENTS

The author would like to acknowledge the assistance of Emily, Cassie, and Patrick Millette in examining the samples with the microscope. M. Deborah Millette, MPH, performed most of the combings and provided a critical review of this manuscript from a public health perspective. Lastly, Mikey Millette is acknowledged (but not thanked) for bringing this interesting case home to our attention.

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3. "Lice"; *Encarta*, Microsoft Corp., 1994.
4. Judith Tucker NP, "Head Lice"; Parents Place.com; (http:/ /www.parentsplace.com/readroom/health/lice.html).

Comments and Corrigenda

"What is BISCO?" queried an astute SMSI member about our cover of the last issue of μ-Notes 2000. We were remiss in not telling the readers what this material is.

MATERIAL: BSCCO ("Bisco") Superconducting ceramic crystals, melt-textured with a high-intensity tungsten-halogen lamp.*

WHAT IS IT: A melted and rapidly cooled compound of bismuth, strontium, calcium, and copper oxides made by co-op student George Risch, and photographed with a scanning electron microscope on B&W 4 X 5 film: Image Name, RISCH 3.

WHY IS IT SPECIAL: The melt-texturing results in differences in free energy on the growing crystal faces and the resulting formation resembles flower petals.

IMPORTANCE: Interesting background for scientific publications related to superconductivity. Used as the cover photo for Argonne National Laboratory's annual report, "Research Highlights" 1992-93.

MAGNIFICATION (slide): 500X negative = 2000X (4 x 5 in.).

Image courtesy of Argonne Nat'l Lab neg. no. 9721 (1990)

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* 1st generation material: $Bi_2Sr_2Ca_1Cu_2O_x$ later replaced by
2nd " " : $Bi_2(Pb,Tl)_2Ca_2Cu_3O_x$

# # # # # # # # # # # # # # #

Another reader noted the incorrect statement on page 27 of μ-Notes 2000, Vol. 1:1—"The Hartmann net exhibits a plot of refractive index against a logarithmic wavelength scale."

Two very common ways to express the normal dispersion of the refractive index as a function of λ are as follows:

Cauchy equation: $n(\lambda) = A + B\lambda^{-2} + C\lambda^{-4} + \ldots$.
where A, B, C, and etc., are constants of the refractive index medium and need to be determined experimentally. Higher order terms, including the C term, are generally insignificant.

Hartmann's equations: $n = n_o + C(\lambda - \lambda_o)^{-x}$; where x = 1 or 1.2.
These equations may be used if the wavelength range is small. Therefore, the correct statement is—"The Hartmann net exhibits a linear graph when refractive index is plotted against $1/\lambda$ on a logarithmic wavelength scale."

Interested readers are directed to the following references:

(1) Robertson, J.K. *Introduction to Physical Optics*, D. Van Nostrand, New York, 1929.
(2) Wahlstrom, E.E. *Optical Crystallography*, 3rd Edition, John Wiley & Sons, Inc., 1960.

# # # # # # # # # # # # # # #

Judgement Day for the Turin Shroud

by
Walter C. McCrone

Now you can read this account of
Dr. McCrone's microanalytical research
on this "Holy Relic of the Catholic Church."

In nearly 350 pages with 11 color plates and 68 figures, he covers the details of Shroud research since 1969. He emphasizes the work he did, contrasts it with the STURP approach, and details the reaction of the Catholic Church through his long correspondence with Father Peter Rinaldi in Turin.

Dr. McCrone's conclusion, in a nutshell, is that the "Shroud" is a beautiful painting. The image consists only of red ochre, vermilion, and collagen tempera applied by a talented artist in 1355. There is no blood on the "Shroud."

This just-completed book by Walter McCrone is available from Microscope Publications, the publishing arm of the McCrone Research Institute.

To order your copy of ***Judgement Day for the Turin Shroud*** copy the order form below and enclose it with payment of $36 (plus $4.50 shipping and handling) or credit card information. You may also order using Fax (312-842-1078), phone (312-842-7100), or e-mail: (wmccrone@mcri.org).

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Building a Polarized Light Microscope

by Theodore M. Clarke
Case Corporation†

My wife, Trudy, has been my nearly constant companion at SMSI meetings and banquets. Although neither of us have used a transmitted polarized light microscope, she had expressed interest in having one of her own in order to photograph colored crystal patterns like those that Anna Teetsov took for a McCrone Associates Christmas card and also described in an SMSI lecture. Therefore, I modified an Edmund Scientific Monolux "student microscope" so that Trudy can begin her artistic use of a POL microscope. She also plans to learn some of the basic microchemical techniques to build upon her academic training as a chemist. Her new microscope is shown in Figure 1.

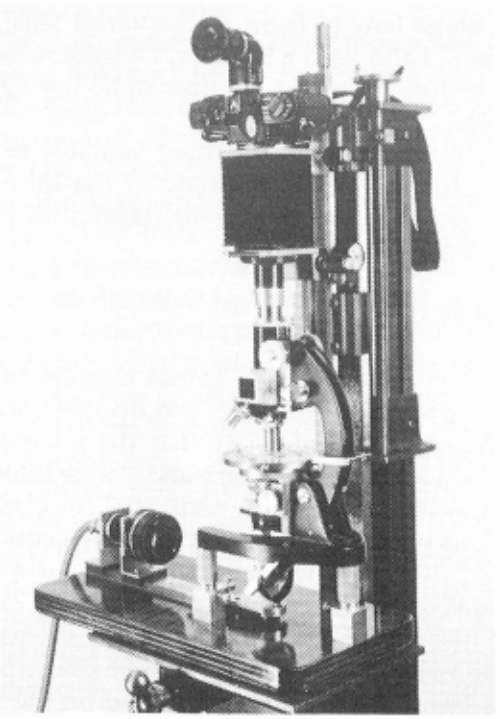

Figure 1. POL microscope on the photomacrography stand with fiber optic light guide source, collector lens, and mirror mounted on the dovetail slide under the microscope base.

* 7 S. 600 County Line Road, Hinsdale, IL 60521

In addition, I want a student microscope for the family, a microscope with Köhler illumination that can be used for microbiology, chemical microscopy, and later for metallography. If adopted by manufacturers, some of the design features of Trudy's microscope could add POL capabilities to commercially available student microscopes without major cost increases.

John Delly's widely known classic, *Photography Through the Microscope*, was my inspiration and guide for building Trudy's microscope. I also have had many helpful phone conversations with both John Delly and Lucy McCrone who contributed some of the design features. The development of the POL scope proceeded in three phases over a period of more than ten years.

The first phase involved the repair of the focusing mechanism and the making of a projection eyepiece. This was done so that photomicrographs could be obtained with the microscope mounted on a photomacrography stand. Illumination was to be provided by a fiber optic light guide source.

The second phase consisted of the discovery that the substage mirror was not properly located to allow high N.A. illumination, and that an additional lens was necessary to form a compound condenser lens.

The third phase was the simultaneous development of novel designs for the rotating stage and Köhler illumination from a fiber optic secondary light source. At an earlier time I bought an Edmund Scientific 0.85 N.A. 60X objective which no one in my household wanted to use. Therefore, the desire not to waste this investment was an additional incentive for completing this last phase of development.

PHASE I

The project began with my brother's long

abandoned 1960's Edmund Scientific Monolux microscope, inoperable due to a ruined rack and pinon coarse focus mechanism. I replaced the rack and pinon with one from another microscope that my brother owned.

The Monolux came with a plano convex lens mounted in a 13 mm thick phenolic plastic stage. An iris diaphragm threaded into the underside of this stage. A maximum opening of 20 mm for the iris meant a maximum numerical aperture of 0.4 for the illumination. The illumination was normally provided by placing either a mirror or the Edmund Scientific Plug-in Substage Illuminator into the hole in the microscope stage bracket directly below the iris. However, only the mirror of the Monolux remained. I still needed a source of illumination. An earlier (1986) interest I had in photomacrography resulted in my invention of a fiber optic double condenser illuminator for vertical incident and oblique illumination (1, 2). Components from this illuminator were used as my light source. A fiber optic light guide end with a 50 mm f/1.8 35 mm camera lens as a collector lens produced intense illumination for the microscope mirror.

It was from John Delly's *Photography Through the Microscope* that I learned about projection eyepieces. I followed his suggestion of moving the eye lens away from the field lens so that the eye lens can form a real image on the film plane in a camera. A 5X Huygenian eyepiece was modified by mounting the eye lens in a separate tube which has a sliding fit over the microscope tube. A nylon thumb screw locks the setting after a suitable projection magnification is obtained with the image in proper focus in the camera viewfinder. The proper microscope tube length is assured by focusing the microscope while viewing a virtual image through a 10X Huygenian eyepiece. The image quality produced with this microscope when I used a 10X objective appeared satisfactory; however, other objectives were not tested.

At about this same time I also built a rigid and precise stand for photomacrography. This stand, built on a reconditioned tool maker's lathe, is suitable for use with the Monolux scope.

PHASE II

The microscope was not used until 1995. Then I was inspired by John Delly's INTER/MICRO lecture on "Lakeside Microscopy," to look at the microscopic life in the water of Fish Lake, where my summer home is located. This was the first attempt to use the 0.85 N.A. objective. Unfortunately, the images of the lake organisms were not sharp. After I removed the eyepiece, viewing the image of the fiber optic light guide end showed that the mirror socket was not properly located in the microscope stage bracket to permit the mirror to reflect the entire beam from the collector lens into the single element lens in the microscope stage. Therefore, the substage iris holder was removed to permit a wider cone of illumination to enter this lens, and the mirror was removed from its socket and lowered so that the entire beam of illumination could be reflected into the stage lens, which acts as a condenser. A complete image of the 6.4 mm diameter light guide end and aperture at the light guide end could then be seen at the back focal plane of the 0.85 N.A. objective. However, dramatic improvement in image quality and full filling of the objective aperture with illumination was achieved only after a salvaged 36 mm f/1 microscope lamp collector lens was held below the stage lens to form a compound lens condenser. I also used a 50 mm f/1.8 camera lens as the collector lens for the fiber optic light guide source.

This experiment provided valuable experience for the recent upgrade of the Monolux microscope to a student grade transmitted polarized light microscope.

PHASE III

Recuperation from spinal surgery in late 1996 provided me with the opportunity to redesign the Monolux so that the microscope would have a rotating stage and Köhler illumination, without purchasing additional components. Serious planning began after measurements indicated that there was enough room for a slide mounted condenser below the stage. By raising the microscope's horseshoe base on extensions, there was room for the mirror to be placed below this base. The mirror is mounted on the same dovetail slide as the fiber optic light source and the collector lens, see Figure 1. The dovetail slide and mating bases were salvaged from my first fiber optic illuminator (2).

My initial plan was to make a two element condenser lens using the 36 mm f/1 lens and the plano convex lens from the Monolux's stage.

The stage had to be cut with a saw so that the lens could be removed. This lens and the salvaged 36 mm lens were placed in temporary mounts so that the illumination system could be tested on a bench top. A reference cone of 130°, corresponding to a 0.90 N.A. to approximate the maximum achievable N.A. of about 0.95 without oil immersion, was drawn on a piece of white paper. By holding this paper against the condenser, with the cone's apex normal to the lens surface, I measured the N.A. of the illumination for the light guide and various lens configurations. I finally reached my goal of 130° when I placed a 16 mm diameter lens of f/1 almost in contact with the 10 mm stage lens. Both convex lens surfaces faced the light source. The crossover position was determined by placing the paper normal to the emergent beam. Now the fiber pattern at the end of the light guide was imaged on a far wall while the aperture of the collector lens was simultaneously imaged at crossover. The image of this aperture, which would become the microscope's field diaphragm, indicated that the full field of the 10X objective might not be illuminated.

The rotating stage, condenser mount, and the bracket to hold both had to be designed simultaneously using scale drawings. This assured compatibility and fit within the limited space allowed by the Monolux. Because of space limitations, the stage support bracket was made from a 3" X 3" X 1/4" thick aluminum angle machined to have a ring section on one leg and a male dovetail on the other leg. The dovetail for the condenser slide attaches to the Monolux frame in place of the original bracket. A dowel pin, added between the two mounting holes, aids in quick alignment of the bracket so that the ring support of the rotating stage can be centered and normal to the optical axis of the objective. Since an alignment gauge was needed to mount the new bracket, I made one which had one end that threaded into the objective lens nosepiece and the other end that had a 45 mm diameter gauging flat made parallel to the narrow flange on the threaded end. To mark the exact location of the optical axis when making the stage support ring and condenser housing, I used a 1/4" diameter drill rod with a hardened point. This slipped into the hole bored down the long axis of the gauge. Precision parallels were used to span the gap between the gauge end and the face of the stage ring, see Figure 2. Before machining the

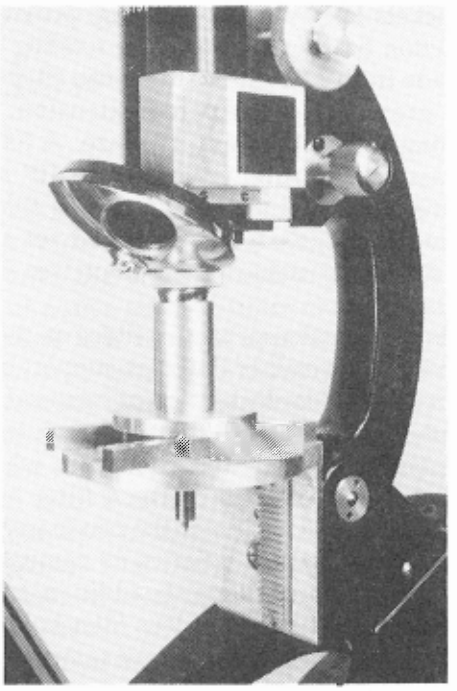

Figure 2. Stage bracket alignment gauge threaded into nosepiece. Note drill rod with hardened point, the condenser focus rack, and square accessory plate housing.

support ring, the vertical mounting surface of the Monolux was hand scraped to insure that it was parallel to the optical axis. For this I used the gauge and a precision machinist square to check alignment.

Typical low cost rotating stages use greased rings sliding upon each other, with a tubular extension near the center of the upper ring mating with a cylindrical socket in the lower ring. This design results in significant runout from wear and initial runout from manufacturing tolerances. Costly ball bearing stages are used for high quality microscopes. My design used a feature borrowed from 19th century American watchmaker's lathes to eliminate the runout and compensate for wear.

The cylindrical extension and socket concept of low cost grease stages was replaced by that of a tapered extension mating with a tapered socket in the lower ring. These mating surfaces were precisely machined and then hand fitted by scraping until the mating surfaces indicated a smooth, uniform and simultaneous contact when rotated together. The sides of the conical socket made a 100° included angle with the annular flat. A film of light machine oil, trapped in the shal-

low pockets left by hand scraping, provided a low friction bearing surface. The rotating stage was made from 1/4" thick aluminum alloy plate with a gray cast iron tapered extension. The lower ring and socket were of bronze. A 100 mm OD brass sliding ring, graduated in 10° major divisions and 1° minor divisions, was fitted to the rotating stage. A nylon-tipped set screw allows for an adjustable zero position (see Figure 3).

A bronze condenser mount slides on the aluminum male dovetail of the stage support bracket. A defective door lock actuator removed from my mother's car provided the nylon rack and die cast pinon for the focusable condenser, which is also centerable (see Figure 4). A filter holder attached to the underside of the condenser support was threaded for a Series 60 camera lens polarizer and colored filters. In addition, a slot is provided above the camera lens filter holder for insertion of a $\lambda/4$ plate to allow samples to be viewed between two crossed $\lambda/4$ plates.

The fiber optic illumination system for this microscope is unconventional. The aperture diaphragm is placed at the end of the fiber optic light guide rather than in the substage condenser. This permits Köhler illumination with the 5X objective when the top elements of the condenser were removed. Another unique feature is the light intensity control. An iris diaphragm and a tubular extension were added where the light guide connects to a 150 watt quartz halogen illuminator. This results in a pin-hole camera. By adjusting the distance between this iris diaphragm and the end of the light guide, an evenly illuminated image of the far end of the light guide is viewed at the rear of the objective: Köhler illumination is established.

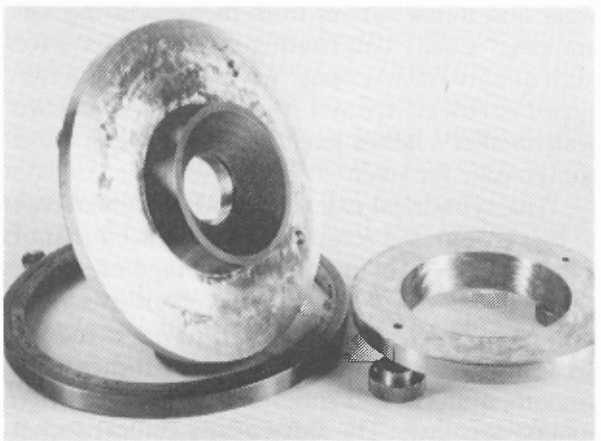

Figure 3. Rotating stage components oriented to reveal the mating annular flats and conical sections.

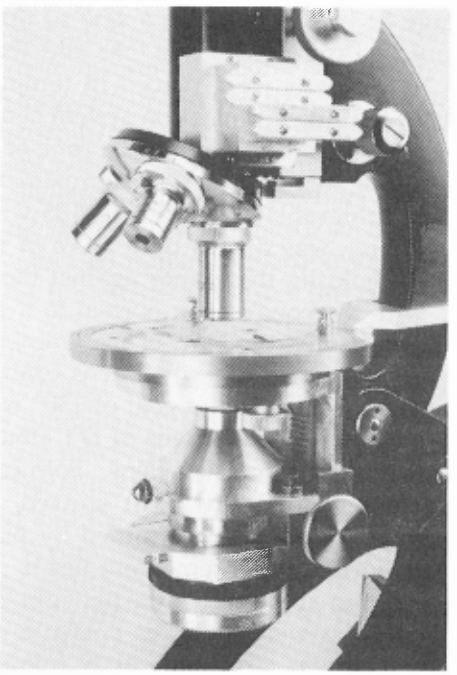

Figure 4. Substage condenser in the lowered position with a quarter wave plate above the polarizer. Analyzer and accessory plates are also shown.

CONCLUSION

This microscope is not yet complete. A 22 mm square slot in the microscope tube above the nosepiece was cut to accommodate a housing that holds up to four sliders. These sliders hold Edmund Scientific's polymer films of $\lambda/4$, $\lambda/2$, and λ that were punched as 12 mm disks from the bulk material. The disks themselves were secured in the sliders by caps locked with 0-80 screws. Alignment of the disks (retardation plates) is yet to be made. A centerable draw tube and vertical illuminator are planned for use with metallurgical objectives of 215 mm tube length.

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Theodore Rochow

Theodore George Rochow was born in Newark, N. J on July 7, 1907. He attended the public schools of suburban Maplewood, N.J. His chemistry teacher in high school advised him to study chemistry at Cornell University (1925-1929).

At that time, the curriculum in chemistry led to the B. Chem. degree. It included a laboratory course in chemical microscopy, scheduled in the junior year. For me, that was 1928, when the lectures were alternated between Professors E. M. Chamot and C. W. Mason. Professor Chamot looked just like the photograph that he sent to me a few years later- after he had retired from teaching, as he kept coming to his office for a number of years.

Meanwhile, I assisted in the microscopical laboratory at Cornell for Professor Mason. I was a graduate student with chemical microscopy as my major subject and physical chemistry as one of my two minor subjects. My other minor was in experiential psychology. Why? As Professor Mason put it: "No microscope is any better than the eye and brain above it!"" Still, Professor Mason wasn't impressed with my minor in psychology. But I west To this day, I believe that microscopy is the experiential use of a microscope. My experience can be the same as, or different from, yours.

One day, as I was engaged in winding up the requirements for the Ph. D. in microscopy, Professor Chamot came to me with a proposal from the American Cyanamid Company to develop a microscopical laboratory in Linden, N. J. I got the job!

A few years later, my boss brought me two samples labeled ~artificial wool," via the N. Y. office. While he sipped the coffee that I had ready for him, I looked at both samples with my microscope. I recognized that one sample, indeed. was man-made, but the other sample looked just like the natural wool supplied by Prof. Chamot to the microscopical lab. "Oh," said my boss, "Take your time; look again in the morning." I did, but the result was the same. The big boss in the N. Y. office objected strongly, so I sent him comparative photomicrographs of the sample and a snipping from the seat of my slacks. "How do you know that your trousers are woolen?", Big Boss wanted to know. The presence of scales and the other characteristics did not satisfy him. Finally, I appealed to my father, a tanner, who gave me a sample of lamb's wool that was still attached to the skin. Even that was not enough. My boss asked me, "Are you sure? Because if you're wrong, you're fired!" Well, I wasn't fired. It turned out that I was being tested with a sample of surgical wool from a drugstore. I concluded that the other sample of "artificial wool" was regenerated casein.

Eventually, my immediate boss had a nice microscopical lab built for me and my assistants. I proudly sent a publication describing it to Professor Chamot. For the first time, he "preached" (a favorite word of his): "What matters is what comes out of your lab."

In 1937, the whole plant-laboratory group was moved to the big Cyanamid lab building in Stamford, CT. There, I was assigned to a different boss, who bought the first electron microscope sold by R.C.A. We learned (the hard way, sometimes) to interpret electron micrographs of Cyanamid's polymers, such as Creslan® acrylic fibers. When I felt the need to know more about polymers, I attended some of Professor Herman Marks' lectures at the Brooklyn Polytechnic Institute. I often took electron micrographs to show him during his 5 o'clock coffee hour, and he sometimes showed them during his lectures.

In 1956, I was promoted to Research Fellow and relieved of the administration of the Microscopical Group. I studied the isotactic and syndiotactic varieties of polymethyl methacrylate (PMMA).

In 1958-59, I received a Senior Research Award which allowed me to spend six months at Penn State University working with Professor Mary L. Willard (a former student of Professor Chamot). She was a very popular teacher of chemical microscopy.

In October, 1968, I was retired by Cyanamid and hired by the Department of Textiles at N. C. State University in Raleigh to teach microscopy to juniors and to advise graduate students.

I was retired "with appreciation" from N. C. State University, June 14, 1974.

In 1978, I published "An Introduction to Microscopy by Means of Light, Electrons, X-Rays, or Ultrasound" with my brother, Professor Eugene G. Rochow, as co-author, The book went through three printings.

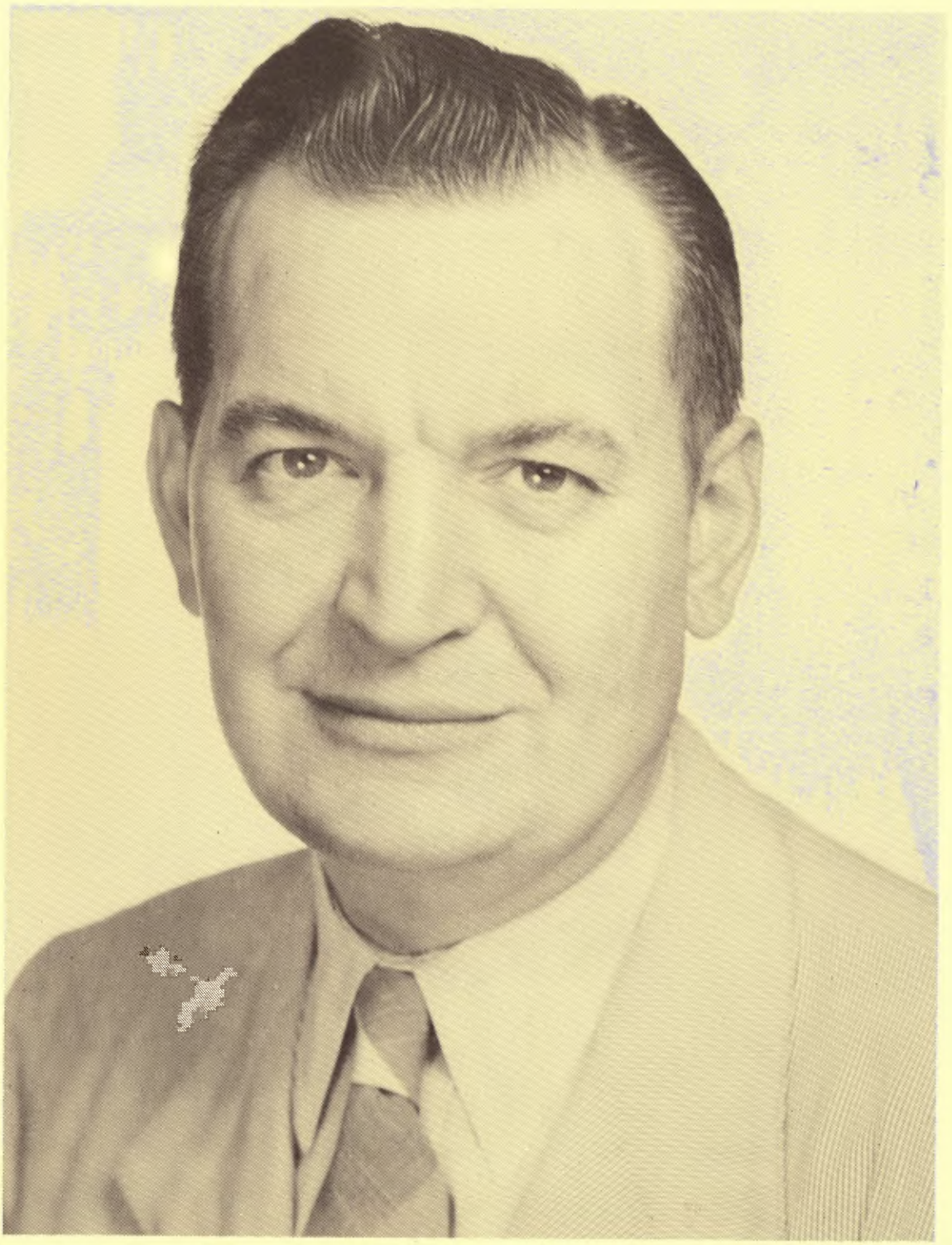
In 1994, a second edition was published with Professor Paul A. Tucker as coauthor. Paul was one of my first graduate students at what is now the College of Textiles, located on the new centennial campus of N.C. State University in Raleigh.

Ted is married to Elizabeth Cook Rochow. his chief editor. They live at 740 Smallwood Drive, Raleigh, N.C. 27605-1346.

Microscopy*

In 1890, Caldwell offered a course in microscopy at Cornell University. His teaching of chemistry was affected by a deep interest in plant constituents, toxicology, and Wormley's methods of *Microchemistry of Poisons* (1869). Chamot (1868-1950), a student of Caldwell, wrote his thesis in 1891 for the B. Chem. on the various crystalline phases obtained in the hydrolysis and reduction of lead nitrate and nitrite (41). Chamot was also influenced at Cornell by Gage and his biological applications of microscopy (42). After receiving his Ph.D. in 1897, Chamot trained with Mace in toxicology in Paris and visited Behrens in Delft, where he had the good fortune of sharing Behrens' instructions to Kley, his new assistant. Chamot returned to Cornell, and following Behrens' advice started teaching (1899) microchemical analysis of inorganic and organic substances and foods. Henrichs was active int his field about the same time at St. Louis (published in 1904). Chamot coined the term *chemical microscopy* (about 1914) and applied it in his book (1915) and in successive handbooks (6, 7), starting in 1930 with his pupil, colleague, and successor, Mason. In these books Chamot and Mason introduced to thousands of students in classrooms and to professional in industrial and commercial laboratories the philosophy of microscopy not only for chemists, but also (6) for biologists, metallurgists, ceramists, resinographers, and technologists in foods, leather, paper, textile, cordage, and all industry. In introductory courses, Chamot and Mason could only touch upon philosophy (31) and fundamentals (43), but they penetrated deeply into industrial microscopies with graduate students who intended to teach or enter the professions. One of them, Mary Willard, a former student of Chamot, spent an entire career teaching a wide variety of industrial microscopies at The Pennsylvania State University. A former student of Chamot and Mason, C.F. Poe, started courses in microscopy at the University of Colorado.

1997 State Microscopical Society of Illinois
Émile M. Chamot Award Recipient



DR. THEODORE G. ROCHOW