The MMS Scope

Minnesota Microscopy Society

Local affiliate of the **Microscopy Society of America** and the **Microanalysis Society**

april 2018

In this Issue:

Spring Symposium: Join us for an exciting Spring Symposium celebrating 50 years of the Society at the Minnesota Science Museum. The theme of the symposium is *History and Advancement of Electron Microscopy – Celebrating 50 Years of MMS!* Register by Thursday, Apr. 26 to reserve your spot.

Remember to vote! Election of next year's officers will take place during the business meeting at the Spring Symposium.

MMS Dues: Please remember to pay your 2018 membership dues.

SEM Short Course: Check out the May 10th SEM fundamentals short course led by Society member Peter McSwiggen.

Photo Album: See photo memories from February's tour of the Ziegler CAT Rebuild Center.

MINNESOTA MICROSCOPY SOCIETY
SPRING SYMPOSIUM

FRIDAY, MAY 4, 2018

SCHEDULE on MAY 4

7:30 – 8:15 a.m.	Registration, continental breakfast, vendor displays
8:15 – 8:30 a.m.	Welcome
8:30 – 9:30 a.m.	**C. Barry Carter, University of Connecticut** *The Future of TEM and Why We Must Remember the Past*
9:30 – 10:30 a.m.	**Vern Robertson, JEOL USA** *SXES Soft X-ray Emission Spectroscopy … Coming Close to Doing the Impossible*
10:30 – 11:00 a.m.	Break and vendor displays
11:00 – 12:00 p.m.	**Jeffrey Salisbury, Mayo Clinic** *3-Dimensional Electron Microscopy of Tissue Architecture for Understanding Human Disease Processes*
12:00 – 1:30 p.m.	Lunch and vendor displays
1:30 – 1:45 p.m.	Business meeting
1:45 – 2:45 p.m.	**Michael Hjelmstad, Oxford Instruments** *CMOS Sensors as the New Standard in Electron Backscatter Diffraction*
2:45 – 3: 45 p.m.	**Doug Stauffer, Bruker** *From Experimentation to Understanding in Engineering Devices:* In Operando *Testing*

LOCATION

Minnesota Science Museum
Discovery Hall (*one floor down*)
St. Paul, MN **map it**
Parking: Science Museum or River Centre parking ramps

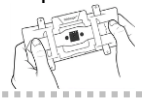
120 W. Kellogg Blvd. | 55102

RESERVATIONS

Member: $75 **Student/K-12 teacher:** $20 **Deadline:** Thursday, Apr. 26

Reserve a spot via PayPal by going to the **MMS events page**. Fee includes the meeting, buffet lunch, breakfast, coffee breaks and a free pass to Science Museum exhibits.

First 50 registrants receive a free Foldscope Microscope Kit!



Spring Symposium | 2018

History and Advancement of Electron Microscopy – Celebrating 50 Years of MMS

continued

SPEAKER BIOS and ABSTRACTS

Barry Carter

C. Barry Carter is Professor of Materials Science and Engineering at the University of Connecticut in Storrs, Conn. Dr. Carter is one of six CINT Distinguished Affiliate Scientists at Sandia National Lab. He has held visiting positions at LANL (as the Bernd T. Matthias Scholar), Chalmers University of Technology (as the 2004 Jubilee Professor), NIMS in Tsukuba, Bristol University, Max Planck Institute in Stuttgart, the Institute for Physical Chemistry in Hannover and the Ernst Ruska Center in Julich. He spent 16 years as Professor and the 3M Endowed Multidisciplinary Chair in the Department of Chemical Engineering and Materials Science at the University of Minnesota. Prior to this, Dr. Carter was a professor at Cornell University. He has coauthored two textbooks and is Editor-in-Chief of the *Journal of Materials Science*. He is past president of the Microscopy Society of America (MSA) and International Federation of Societies for Microscopy (IFSM) and current IFSM Vice President. He holds his bachelor's, master's and doctorate degrees in natural sciences from Cambridge University, a master's in materials science from Imperial College London, and a doctorate in metallurgy from Oxford University.

The Future of TEM and Why We Must Remember the Past

The subject of this talk concerns the future of TEM. TEM is facing many challenges including the fact that the top-of-the-line microscopes are becoming more expensive and more complex even when they seem simpler because of the increasing use of computers and a clear affordable textbook. The techniques used by the different communities (physical sciences and life sciences) are also often converging especially for those specializing in 3D imaging, spectral imaging, low-dose imaging (we all should be) and aberration-corrected imaging. (Who is specializing in non-aberration-corrected imaging?)

I'll illustrate the talk with some examples of work from my group and from friends. My field of research is ceramic materials so I'll use my crystal ball to suggest some potential directions that TEM as a whole might follow in the next few years, and in so doing, explain the title.

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History and Advancement of Electron Microscopy – Celebrating 50 Years of MMS

continued

SPEAKER BIOS and ABSTRACTS

Vern Robertson

Vern Robertson is EPMA/SA Product Manager and SEM Technical Sales Manager for JEOL USA Inc., in Boston, Mass. Vern has been with JEOL USA for more than 32 years and was appointed EPMA/Surface Analysis Product Manager in early 2016 and will continue as SEM Technical Sales Manager, providing in-house and in-the-field technical product support and customer applications support. Vern served as the senior SEM Applications Specialist at JEOL beginning in 1986.

He was appointed National Laboratory Manager in 2004 and FEG SEM Product Manager in 2005. Vern received his B.Sc. in geology from the University of New Hampshire. His prior industrial experience includes eight years of consulting in an independent testing lab specializing in industrial and environmental problem solving, with responsibilities including polarized light optical microscopy, and atomic emission and absorption spectroscopy SEM with EDS/ WDS and X-ray diffraction. Vern was a recent member of the MAS (Microanalysis Society) Council.

SXES Soft X-ray Emission Spectroscopy … Coming Close to Doing the Impossible

Recent advances in X-ray spectroscopy include the commercialization of a Soft X-Ray Emission Spectrometer (SXES). Initially available only on EPMAs, this Wavelength Dispersive Spectrometer technology is now available on both EPMA and FEG SEMs. This new type of spectrometer not only can see very low-energy lines (50ev-300ev) with high spectral resolution (0.3ev) and high sensitivity (<10ppm), it has the capability of detecting Li and at very low levels which has been the unattainable holy grail of many microanalysts. The latest version of the spectrometer has an extended range with the capability of detecting low-energy X-rays up to ~2.5kV. It provides the ability to perform maps and line scans on previously inseparable peaks due to their severe energy overlaps. The SXES's other key advantage, and perhaps its strongest, is that it allows chemical state analysis – once only the realm of scanning Auger or XPS. Application examples and comparisons to existing microanalysis technologies will be discussed.

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History and Advancement of Electron Microscopy – Celebrating 50 Years of MMS

continued

SPEAKER BIOS and ABSTRACTS

Jeff Salisbury

Jeffrey L. Salisbury is Professor of Biochemistry and Molecular Biology at Mayo Clinic in Rochester, Minn. He is Scientific Director of Mayo Clinic's Microscopy and Cell Analysis Core. His faculty research focuses on the role in cell division of the protein centrin in tumor progression. Dr. Salisbury and colleagues were the first to clone two of the human centrin genes and establish the crystal structure for this protein.

Prior to his work at the Mayo Clinic, Dr. Salisbury was Associate Professor in the Developmental Genetics and Anatomy department at Case Western Reserve and Assistant Professor in the Anatomy and Structural Biology department at Albert Einstein College of Medicine.

Dr. Salisbury completed a postdoc fellowship in cell biology at Albert Einstein College of Medicine. He holds a doctorate and master's degree in botany from Ohio State University and Rutgers University, respectively, and a bachelor's degree in life sciences from Indiana State University.

3-Dimensional Electron Microscopy of Tissue Architecture for Understanding Human Disease Processes

I will present the very exciting **recent acquisition** and success using the FEI Serial Block Face SEM VolumeScope for 3D electron microscopy. I will discuss the rich and interesting history of microscopy at Mayo, with a focus on both the early history in optical microscopy and the later developments of electron microscopy techniques in clinical pathology.

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History and Advancement of Electron Microscopy – Celebrating 50 Years of MMS

continued

SPEAKER BIOS and ABSTRACTS

Michael Hjelmstad is an Applications Specialist at Oxford Instruments in Calif. for the company's NanoAnalysis division. He provides training on all Oxford nanoanalysis products including Energy Dispersive Spectroscopy (EDS), Electron Backscatter Diffraction (EBSD), and Wavelength Dispersive Spectroscopy (WDS).

Prior to his work at Oxford, Mike was a senior nanofabrication engineer at the University of Washington in Seattle and research engineer then lab manager of Washington Technology Center's Microfab Laboratory. Before joining WTC, Mike was a graduate student at the University of Michigan. He holds bachelor's and master's degrees in materials science and engineering from the University of Michigan.

The Evolution of EBSD Cameras: How CMOS Enables High-Resolution, High-Speed Pattern Collection for Bulk EBSD and TKD Techniques

Since EBSD became a commercialized technology, charge-coupled devices (CCDs) were the chosen camera technology for acquiring diffraction patterns. As the demands of EBSD increased, a dichotomy evolved that forced users to choose between sensitivity and high-speed chips. In recent years, it became clear that both CCD chips were reaching the limits of the technology. Last year, the first CMOS-based EBSD detector was released. The CMOS architecture employs a more parallel processing method than CCD and returns high sensitivity and high speed applications into a single detector. Speeds can now reach 3000 patterns/sec without excessive binning. Even sensitive applications, such as beam-damaged material mapping, can now be done at higher speeds and resolution than previously possible. It does appear that for EBSD, CMOS technology has retired the CCD era.

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History and Advancement of Electron Microscopy – Celebrating 50 Years of MMS

continued

SPEAKER BIOS and ABSTRACTS

Doug Stauffer

Doug Stauffer is the Senior Manager for Applications Development for the Hysitron product lines at Bruker. His current research is focused on developing instrumentation coupled with new techniques for understanding structure and processing relationships with regards to nanomechanical performance. These relationships and techniques can then be applied to a wide range of applications that include both applied and fundamental studies for assessing component and microstructure capabilities to resist failure. These techniques include *in* and *ex situ* testing and the development of *in operando* type experiments, to gain insight into the role that plasticity and fracture play in the varying failure regimes under operating conditions.

He joined Bruker in 2011, after receiving his Ph.D. in materials science from the University of Minnesota. Prior to graduate school, Douglas was an engineering supervisor at Ecolab.

From Experimentation to Understanding in Engineering Devices: *In Operando* Testing

Materials behavior is often dominated by highly localized phenomena, and the ability to probe these local properties for engineering devices is critical. Often these devices are operating in environments with large differences in temperature and pressure: From the high vacuum and cold of space to the high temperature and high pressure inside a deep water oil well. Two studies will be presented to show how nanomechanical testing can be applied to fundamental materials understanding, on drastically different length scales.

Standard nanoindentation tests are "high throughput" in comparison to nearly all other mechanical tests, such as tension or compression. However, the typical rates of tens of tests per hour can be significantly improved. These higher testing rates enable otherwise impractical studies requiring several thousands of indents, such as high-resolution property mapping and detailed statistical studies. This is demonstrated on 1018 steel. Steel is an incredibly important structural material, providing a literal framework for modern society. While the ductile to brittle temperature transition is well known, and for the most part well understood, localized measurements of this phenomena in this complex material are less common. Here, a simple low-carbon steel, 1018, is examined to show the contribution of the ductile to brittle temperature transition of each of the two critical phases: ferrite and pearlite to catastrophic failure.

Fatigue crack growth has long been investigated via post mortem analysis, leading to a phenomenological understanding of crack initiation at stress concentrators. However, post-mortem investigations can be very difficult for ultrafine grained materials, such as the Cu thin film in this study, and give little insight as to the dynamic changes in the material under cycling. *In situ* TEM studies can give a wealth of information, such as grain size, grain orientation, continuous monitoring of crack length/direction/radius, and plasticity present at the crack tip. Here, *in situ* fatigue is demonstrated using cyclic mechanical loading experiments at frequencies up to several hundred Hz. More than 10^6 cycles can be reached within one hour. Moreover, the nanometer-scale spatial resolution of the TEM allows the observation of "incipient" crack growth rates of $<10^{-12}$ m·cycle^{-1} very near to the minimum threshold stress intensity factor.

With Daniel C. Bufford, William M. Mook, S.A. Syed Asif, Brad L Boyce, and Khalid Hattar

DON'T FORGET!

Election of MMS officers for 2018/2019 will be conducted during the business meeting following lunch.

Candidates proposed by the board:

- President Elect – Doug Stauffer
- Secretary – Patti Sanft
- Treasurer – Dave Burleson

* *Nominations will be accepted from the floor.*

MEMBER DUES

Please remember to pay your 2018 MMS membership dues.

CALENDAR of EVENTS

10 MAY 2018

Fundamentals of Scanning Electron Microscopy and Microanalysis
Normandale Community College
Bloomington, Minn.
8:30 a.m. – 4:30 p.m.

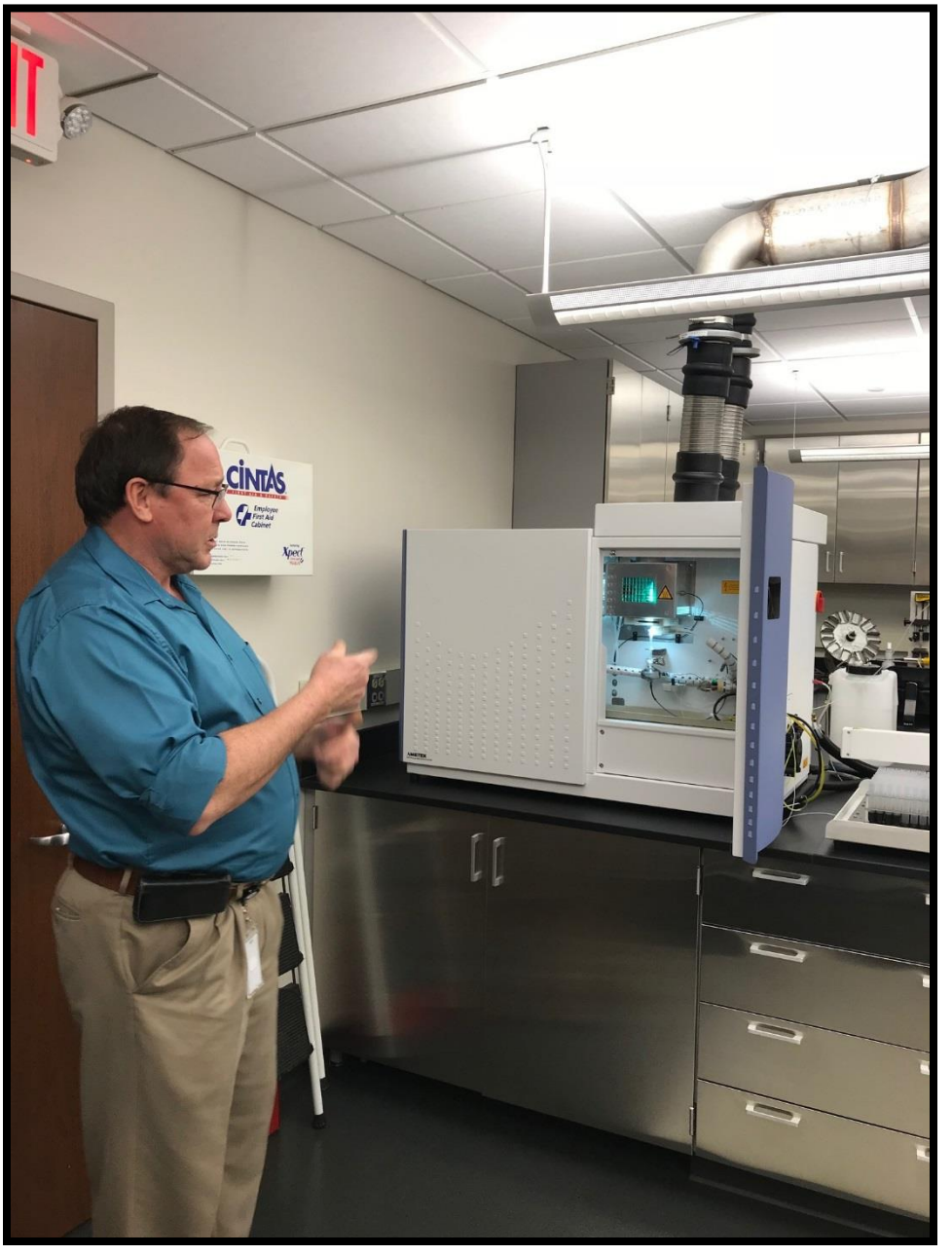
The objective of this AVS short course is to introduce participants to the scanning electron microscope, and to show how one can move away from using the SEM as a "point and shoot" camera. Course taught by MMS member and consultant Peter McSwiggen.

Course description

Registration form on AVS site

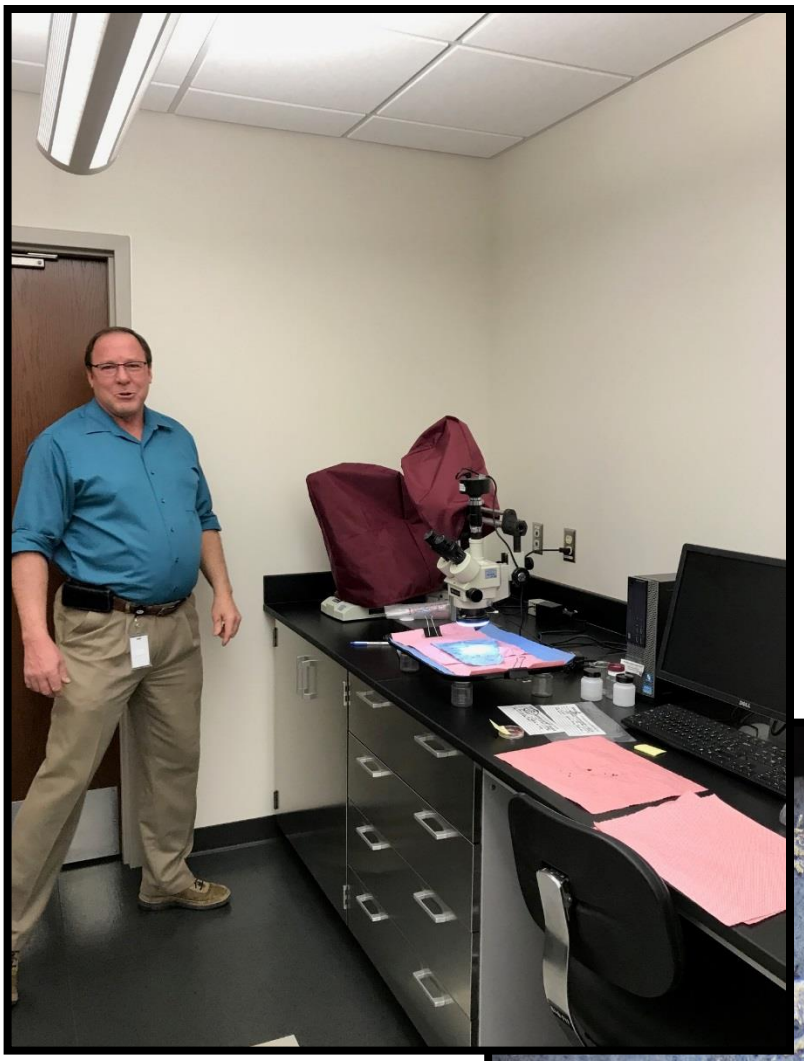
ZIEGLER CATERPILLAR SERVICE LABORATORY TOUR

The Ziegler CAT Rebuild Center repairs/rebuilds components from Caterpillar products from all over the upper Midwest. MMS members toured their newly renovated lab space in Bloomington, Minn., on February 15. Review what you saw or see what you missed in the photo album here.



Ziegler CAT Equipment Manager and tour host **Dale Benson** shows attendees the lab's inductively coupled plasma (ICP) instrument.

ZIEGLER CAT TOUR - 2



Dale Benson next to the inspection microscope looking at metal flakes in oil filters to visually identify the type of metal and determine the component that is wearing.

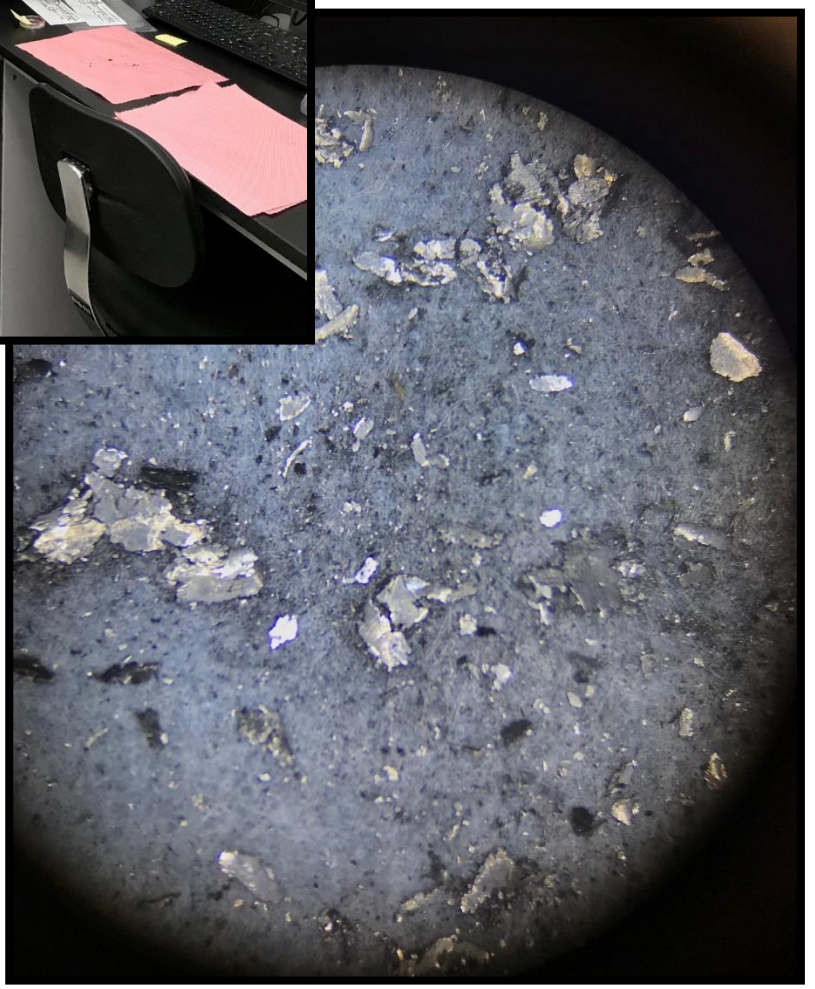


Image of the metal flakes taken by an iPhone through the eyepiece of the stereo microscope .

ZIEGLER CAT TOUR - 3

Tony Anderson, Medtronic, looks at a large Caterpillar component.

Engine housing with massive cylinders.

ZIEGLER CAT TOUR - 4

A refurbished part after painting.

Filter inspection for metal flecks.

ZIEGLER CAT TOUR - 5

Handheld magnifier with light to confirm if a metal fleck is present.

Jeff Payne, 3M, in the Caterpillar conference room with lit color shifting neon engine table support.

ZIEGLER CAT TOUR - 6

Farida Kasumzade, Max Consulting Firm (*left*), and Sue Okerstrom, Lichen Labs, in front of an engine.

Artistic arrangement of replaced ball bearings in the scrap bin.

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The Minnesota Microscopy Society would like to express sincere thanks to our Sustaining and Patron Members. These members provide financial support to the organization above the standard membership fee. This additional support makes it possible for MMS to maintain its financial well being. To become a Patron or Sustaining Member, complete and return the MMS membership form at the end of the newsletter.

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MINNESOTA MICROSCOPY SOCIETY | MEMBER INFORMATION FORM

All microscopists are urged to support their Society at one of the membership levels offered below. Often, supervisors will support MMS memberships out of their project budget because they recognize that it is a very inexpensive way to maintain and increase the skills of their microscopists. If you have been a member over the years and recognize the value of MMS to the community of microscopists it serves, consider upgrading your membership this year to the Patron or Sustaining level. Thank you.

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