

M&M 2000 Expert's Session On Facility Management

Session organizer: Debby Sherman, Purdue University
sherman@btny.purdue.edu

This article is the first of a series transcribed from the discussion taped during this session. It is printed with permission of the Microscopy Society of America. Bulleted paragraphs indicate comments by individuals attending the session. Additional discussion topics will be highlighted in future publications.

Multi-user Facilities.....Managing Users

D. Sherman: The first topic that we are going to take up today is "Multi-user Facilities Managing Users" and deals with the problems that come up in managing multi-user facilities in either academic or industrial environments. With that in mind I was led to Dr. Keith Darlington as someone who has a great deal of experience in this area and was willing to come to make a few remarks and throw out some ideas for us to talk about. Keith has a Ph.D. in Chemistry from UC-Riverside and, after completing his graduate work, went to work for NL Industries and then Celanese Research as an Analytical Chemist in Technical Service and Product Development. He later joined Atofina Chemicals, Inc. and is presently manager of the Analytical Research Department at their Pennsylvania research facility. He has also been very active in the Analytical Laboratory Manager Association (ALMA) serving as President in 1998. Keith is going to summarize the open user policy that is in place in the Atofina laboratories and how that policy was de-

veloped to allow access to research personnel while still protecting the valuable equipment.

K. Darlington: I want to talk about multi-user facilities this morning and try to get you to share with me some of your experiences. I am not sure what your real interests are but one thought was what people consider to be multi-user facilities. There are different views of that so I would like people to give me an idea of what they think about when they hear "multi-user facilities".

- Two classes of users: a group of users who need technical assistance, someone to do the work and run the scope for them with the researcher observing, and a group of users who can sit down and use the scopes with little or no supervision. We have projects where we never see the investigators. The sample is sent to us and we send back the results. They have no idea what an electron microscope looks like or what it takes to get the results. The investigators can be either on campus or around the world.

- Our facility is pretty much the same as everyone else has described. Also we take people from all over the University, from every department, every discipline you can think of. We never know what is going to walk through the door...whether it is materials or biology or whatever.

K. Darlington: To me a multi-user facility is when someone from outside the department where the instrument resides is allowed to use the instrumentation within the department. Some of this is open instrumentation where we have trained a number of people to use it. One of the NMRs is an example of this, where during the day it is open to those people who are checked out and know how to use it. They walk through the door based on a schedule to run

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their own samples. We also do a lot with research groups on a one-on-one basis, again, using a schedule.

I don't want to spend a lot of time with this, but certainly it pays for all of us to go back periodically and look at the initial questions of why do you have an open user facility...why is the lab open and what instruments you will allow to be open. We have some instruments which we do not open to users because of either the potential of damage, or that we use them on a constant basis so there is never any free time on that instrumentation. What I would like to do is to run through some highlights and thoughts and then pick up from people as to where is it that you would like to have the discussion go.

Operational issues to be considered are: 1) what is the criteria for deciding what instruments are you going to open up to users, 2) how do you identify the users, 3) how do you schedule, 4) what is the training, expenses, maintenance, 5) how are you going to replace equipment, 6) how to handle supplies (do you supply or do users?), 7) do users prepare samples, and 8) do you provide the facilities for sample preparation. Also how do you get rid of the waste: ask users to take it away with them or is there a mechanism where they leave it with you and you dispose of it. The more users you have the more difficult it is to maintain an area from a housekeeping standpoint. The last thing I want to bring up is managing relationships. We all have users that come in to work in our labs, we have someone we report to and, in general, we have an overall higher level of management that we have to work with. We have department heads that are outside of our own group and we also have suppliers that we have to deal with one way or another. These are just some of the things that I thought we could go through and identify some of the subjects to get the discussion started. In general I would like to know what are some of the problems you have and what areas would you like to concentrate the discussion on. Does anyone have a problem (laughter)...a problem you would like to discuss?

- Actually I have two. The first is that we train people by putting them through a training course, check them out and they come and run samples for a month. Then they go back to their department for 6 months and then decide to run more samples. They come back invariably when one is on vacation and soon there's a phone call saying "well I was coating samples and there is smoke pouring out of the sputter coater." Users are off the instruments for a long while and they forget procedures. Then they come back with their meager notes and just plod along until something goes wrong. The second problem we have to worry about is when users come, take images, go away, and we don't know how they are interpreting them. The next thing you know, you are at some meeting where they are describing their data and conclusions and that is not what the images mean. These incorrect interpretations are going into reports and there is no control of what they do with the data once they get it.

- To the first problem, do not trust users to take notes. Write everything out step by step and laminate it and leave it by the instrument.

- At a previous lab I worked in, we had a strict training program for all our instruments and users had to pass a practical exam. The rule was that if they did not touch the microscope for 6 months they had to redo the practical so we could identify any problems they had. This worked pretty well and most people understood about it.

- One thing that I have done when training users is, once they are comfortable to go on by themselves and I feel just as comfortable

as they do, I will send them out of the room and sabotage the instrument a little bit. Then I bring them back in and watch them climb out of the problem. Not so much to see if they can solve it, but to observe their thought processes and how they approach the solution. I will do that once or twice and it is very informative and practical.

- This is one concern I have in my facility. I have been asking for a good way to log users on and off an instrument, but there is apparently no easy way to do this, in that every instrument is unique in its wiring. It requires assistance from the service engineer to tie into high tension or main switches or whatever. When I was sitting around talking about this with a service engineer, we decided that the easiest thing would be a swipe card on the room door, if the rooms were isolated from one another. That would not only let someone enter the room but also would record who entered so that a record exists of who used the instrument. I have not looked into the costs yet but this may be an easier way to deal with the problem rather than dealing with each individual instrument.

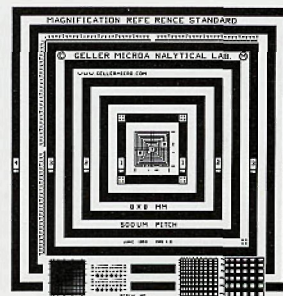
- I have a solution to that problem. What we have done is put combination lock boxes on the door like realtors use. A user has to log in with their password to get that days combination. We know who logs in to get the combinations to the lockbox which gives access to the key to the lab. This has to be thought about when buying instruments too. Think about if this instrument is idiot proof, not just its super performance and price. If there are going to be a lot of users, that is a major consideration. Also fear works. I scare the hell out of people and basically we don't have a lot of

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trouble. We don't have formal training programs or tests, but maybe it is just the fear that keeps us going pretty well.

- My service engineer was able to install the little timers on our instruments. I have a logbook and users log in when they start and finish so I can charge them for beam hours and film they have used. We stopped the problem of people publishing the wrong item with the wrong arrow by requesting that we do a pre-consultation and post-consultation before they publish. We had to stop a professor on campus from publishing "virus particles" which were actually nuclear pores. We talked to him walking across campus as he was going to turn in his publication. Now, even though it takes time, we request that before someone publishes, we have a consultation and go over the data. Our lab name is on it and, as a multi-user facility, we are trying to solicit outside work as well as university work. We don't want to lose users because of incorrect data interpretation.
- I am not sure that I agree about the comment that fear works. It can work in some ways but it also can be very counter productive because what it can do is stop a user from being innovative. They will look at the instructions, they will follow the instructions and then say "well I did what the instructions said and I did not get the results I wanted." The results they wanted may require that they do something a bit different than the instructions indicate. If they are afraid that if they do anything a little bit wrong they will never be let in the lab again, they are

less likely to modify the standard parameters a bit in ways that will not harm the instrument but may give better results for that sample. I think fear can be counter productive, and it must be used very carefully. I think this will vary from facility to facility depending upon the amount of involvement of the facility staff and the variety of work that goes on. We come from a materials lab where there is a tremendous variety of work. Perhaps a pathology lab does limited pathology work. So the conditions will vary, but some sort of interest is needed on the part of the advisors of the students as well. There needs to be something more than the facility staff, who can't know all there is to know about every project that every student is going to bring into the lab.

- One of the things I have noticed is to keep things as simple as possible. We were talking about equipment with too many options. I inherited a cryostat that had every option under the sun and people kept screwing it up. So we traded it in for something much simpler and it works better. As far as the electron microscopes are concerned, I try to keep it again as simple as possible, drawing analogies if possible. Most people are familiar with the light microscope and they understand the concepts of condensers, moving the stage around, and things like that. Most of our users are not heavily involved in using the equipment. We don't have a lot of students, as we are a private research institute. The users like to run down, look at the sample, take a few pictures, and disappear. So if I keep it simple, they don't get into much trouble.

- To elaborate a little on the fear, it should be used where it is appropriate. I don't have any qualms about telling someone if they don't wear gloves and work in the hood when using osmium that they may go blind. I like a good healthy fear of osmium tetroxide in my users. On our confocal instrument we have a lock where each user has their own combination. If there is a problem we can audit the lock and see who was the last user.

- I find that fear works sometimes because I tend to be on an even keel and if I start to get that angry look they know they are in trouble. Fear works sometimes, but I also find that fear can be counterproductive in the sense that too much fear causes espionage of sorts...hiding things, not coming clean. This ends in walking into a room and obviously something has gone horribly wrong and there is no one in the room anymore. So it can be problematic. There have been a few selected users that I personally have not wanted to let into the lab on an unsupervised basis. I am curious, not as to why you wanted them out, but have you ever asked anyone to leave and did they stay out.

- I have a different perspective from an entirely different country. I am from South Africa and we have many of the same problems that you are describing here. We had occasion to ban a full professor from our laboratory because he has five thumbs on each hand and he breaks everything that he touches. Eventually we reduced him to the level of a supervised user. Whenever he operated an instrument there had to be someone sitting next to him and that was that...non-negotiable.

- I had some instances where I did not ban them but threatened them. For example, we require users to pump down the scope when they are finished. Sometimes they come in late at night and they forget to do it. I will tell them it is allowed once but that if it happens again I will take their room passes. Usually that works. But again on the fear issue I am kind of against it because we are in education and I really want to encourage them in this field. I love microscopy and most of my students also like it. If they like it they try to find ways to improve.

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- Several years ago I tried fear to get users to respect the lab equipment and environment and I had a student start crying on me. That didn't work out and I think it is better not to intimidate people to the point where they do cry over learning how to use an electron microscope. What I have done in the past is have a furlough for the whole laboratory. Now we presently have about 90 users. When we had the furlough system we had about 50 users. They thought that I was the janitor at the same time that I was helping them. Everything was dirty...kimwipes everywhere. So we shut down the whole lab for about one week, I cleaned everything in the lab, and said "I will let you back in assuming you can leave it the way I have it today"...and that was on a Monday. That lasted about two years before I had to do it again. Now the information is passed down to the other graduate students that John will shut down the lab if you leave it messy or you foul up the microscopes.
- One of the ways we have dealt with people who leave the scope in unacceptable conditions is bill them for our time for putting things back into shape. Don't let them off the hook without paying for it. Let them know that they have been billed them for it. There was one particular person who continued to abuse the privilege. I required that there be a checkout every time they were on the scope and billed them for 1/2 hour of my time because I had to check the alignment and all the other things. That was for a defined period of time and at the end of the time I put them on regular access. However, I ended up having to do it repeatedly. So bill for your time putting the instrument back into shape.
- We have one instrument that is very user friendly so that is the one that users get to use. They have to work with me on the more complicated ones. That may change with some users if they know

what they are doing. I sort of use fear in a judicious manner. When they use a LaB₆ instrument I get it into their head to turn up the filament right or they get to buy a new one when it cracks. The thing I find most useful is that I don't just train people and give them the directions, I explain what they are doing and why they are doing it, why a LaB₆ filament isn't saturated the way a tungsten filament is, and give them some understanding of the basic principles. They like that, especially since I inherited a whole bunch of users from people who never explained things. They are much better about using the equipment and they understand now why a certain thing isn't done or why something is done in a certain way. If they want a particular result, they might do it a slightly different way to get the result without hurting anything. I think most of the problems can be solved during the original training by not just teaching them how to use the scope but teaching the basic principles of what they are doing and why they are doing it.

- On the training issue, we require people to take a several hour workshop on theoretical background of electron optics, vacuum systems; a brief introduction gives them some of the background with another training session on each instrument before they go on it. It is not a 15-minute "push this button, push that button". I think everyone here is in agreement that adequate training cannot be given that way. We used to require a full semester course in electron microscopy before having open access to the instruments and that was overkill...the pendulum went in the other direction. We find that giving the intense workshop solved the problem for us.
- This whole problem leads us to one of the other topics. At a time

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when it is necessary to become an enforcer or ban someone, it is a good idea to have a good relationship with your superior and up the line of command. Then when a department chairman comes in and screws up, support is available through the people in charge who will support banning someone or insisting they get better training or other assistance regardless of rank. Maintaining that good relationship up the chain of command is really helpful in maintaining law and order in the facility.

- In the past our facility Director required that all users had a formal course or demonstrated substantial experience before they were allowed free access to the microscopes. Experienced users were still given a short "one on one" on any new instrument just to make sure that they knew what they were doing. This has not pleased some faculty who feel that their graduate students have to be good at so many other techniques that they don't have time to take another course. They want their students to come down, twiddle a few dials and take lots of pictures. A lot of these faculty members are very, very vocal. I have found that department heads and administrators who are not microscopists do not understand how easy it is to reduce the instrument performance by improper handling. This also really affects future users. The problem may not be something that can be corrected in just a few minutes or even recognized before the next user arrives. I see a real problem in educating administrators as to the needs of the equipment and of the facilities in addition to educating users. I personally have no trouble with regular users. Those that are trained either through the courses that we teach

or are trained individually usually do fine. I try to set up a relationship where we discuss the data. If we do that, if the user feels free to come in and say "look at these pictures" then I am in the position to go the next step saying "yes this is good but maybe we ought to try this". Then I can act as both a resource person and as an advisor as well as a traffic cop. I think that this has worked extremely well because many people who come to use the facility learn about one instrument but don't know the limitations of that instrument. There may be another instrument that is better for what they want or another technique that is better. I think that as a microscopist it is important that we not only master our instruments but that we have an idea about microscopy in general so we can direct people to the instrument that's best for their needs, even if it is not in our laboratory.

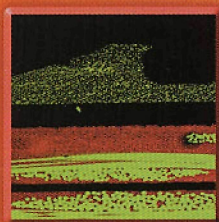
- One thing we have recently done at our university is to initiate a series of free workshops that we offer to the university as a whole with a limited enrollment of up to 10 students at a time. We announce these over an E-mail system that I set up with anyone I could think of, anywhere on campus that I thought might have a remote interest in electron microscopy. These have been very successful. We have them on such things as specimen preparation, TEM and SEM theory, and operation of the scopes. We hope to do one on immunolabeling as soon as one of us in the lab gets really good at it, as well as other topics that people may suggest. The purpose of this is two-fold. One of them is so people will become more confident in preparing their own specimens whether in our facility or in their own labs. The other one is that if they give us their specimens, they have some idea of what happens in that black box between the time they give us the specimens and when they get the results back. They have a better idea of what we do

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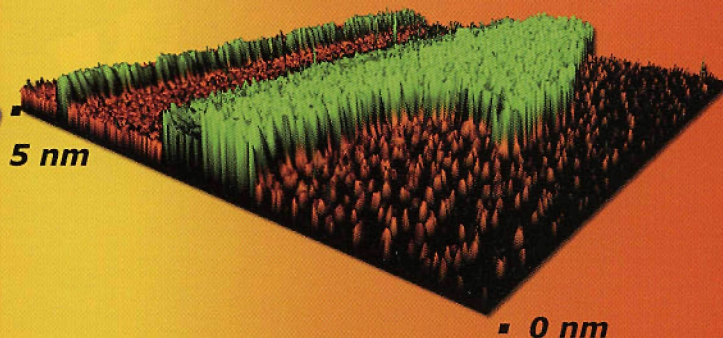


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in the lab and I think it makes them better at interpreting the results. This somewhat addresses the need for users to understand what goes on.

• I think it is very important to establish respect for yourself in your position whether it is up or down the line, so people understand that you are the person they need to come to for whatever reason. I would like to change direction a little bit and go to house keeping because we have a real problem with housekeeping not so much with the microscopes but with other parts of the laboratory. It is not like we can lock people out so I would like you to address this a little bit.

• I can address several of these issues. One is that when I am training users I always give them theory at the same time. It slows it down a little bit but they are grateful and I'm happy. This also feeds into the question of interpretation of images because that goes along with what I am talking about. Nobody wants to publish erroneous data so they learn their lesson on interpretation that way. As to people with all thumbs, I have only had one or two but, because of that, when I go on vacation I'll do something like unscrew the main valve to the vacuum evaporator. I also routinely hide the drive belt to the rock saw and that way I always know who is going to want to use these things when I am not aware of it and make sure they come to the source. Then I can supervise the use. That helps in the housekeeping.

• I am from the University of Connecticut. For 21 years we have had a self-service facility. We tried fear and non-fear and they both work and both don't work in certain instances. As far as house-keeping, it seems to come along with just teaching people that as part of the flow of things. They don't get their results and then just go out the door and leave a mess. They must know how to dispose of dangerous chemicals and such. We teach the housekeeping in that when they walk in the door, this isn't than McDonalds, this is an EM lab. As far as service goes, since it is self-service and a personal thing, we basically shut things down when we cannot be there. Industry cannot afford to do that but, until I get back from this meeting, the SEM doesn't run. It is only a few days and a few weeks out of the year. We have a director of the lab who, if she is interested, can take a break from her other work and watch someone while I am away. It is very important that people really know what they are doing. We have been bribed with chocolate to overlook mistakes. I think that if a facility cannot afford to shut down, someone must be available to take over. The lab cannot be left with a million dollars worth of equipment and expect everyone to come in and do the right thing.

• I will second the shutting down the lab. We don't allow after-hours work except on an extraordinarily limited basis. There is always a qualified person in the laboratory to supervise the equipment. So we don't have the problem of knowing who had access to the equipment. I am fortunate that all of our microscope rooms are facing the main lab where I normally sit so I can monitor comings and goings. We also have sign-ins and sign-outs for our instruments. I also encouraged people when I have trained them that I would far rather have someone call me if they see anything that is at all aberrant rather than ignore it or try to fix it themselves. I would rather work with them to solve the problem than have them take it upon themselves to turn every knob on the microscope and then come find me and tell me that "I don't have any light". And this has worked reasonably well. I have only had a couple of knob twisters. For the most part people are intimidated enough by the instrumentation that they will come find me before there is a problem. I try not to chew them out so that I encourage them to con-

tinue to ask for help.

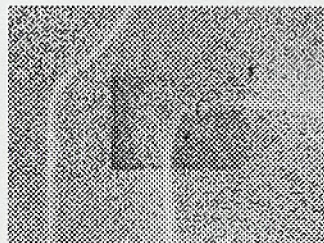
• We have a system which is related to the fear but perhaps a little more considerate towards our users. We have something like 80-90 users and we have a rule that says, "cake for tea if you make a mess of blunders." And the fact that we're not all massively overweight shows that the system is working. They have to bring cookies for tea the next day if they've done something really funny. That doesn't include things like breaking detector windows. We need to do other things about that. On the training side of it, we have a structured system so that anyone wanting to use our instruments has to undergo our theoretical training course. If someone comes in during the year we sort of close the gap on a one-to-one basis. After that we go through a fairly structured process of sitting and demonstrating how to use the instrument, then the user would sit and use it with us sitting next to them. As part of the structured process we have names for each stage. All of our operators are familiar with them. If we talk about a particular user we talk about someone who is not yet ready for stage x or stage y. Eventually they have a solo license and that would be for the particular instrument. If they go to another instrument, they would go through the process again. They are not assumed to be solo user on a more complex instrument. Eventually, the highest accolade they get is that they would be someone who would be allowed a key to the facility and they would be able to operate on weekends or evenings *if* the pressure on the facility makes that necessary.

• Listening to you all makes me very jealous because you have

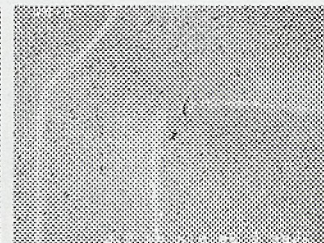
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the staff to do a lot of these things. I am a one person EM facility for a medical college and half my time is spend teaching people how to use the confocal. We access the confocal facility via a combination lock and that works very well after training, if I am comfortable with the user. I am fortunate with the EM lab in that my Dean of Research is a very reasonable person and did not object when I declared myself empress of my facility and put up a note that said, "if you can't work here neatly you can't work here." I had occasion recently to call a full professor who held an endowed position. He had worked in the lab for three days and left it looking like a tornado had gone through it. I said, "This is not the way you found the lab when you came here on Tuesday. Please come down and restore it to its former condition." What is needed, as someone already said, is a good relationship with the upper management in order to do that. But having the lab clean when people walk in is important. I have people say "Wow, this place is really clean and neat!" and I say "Yes, and we try to keep it that way because otherwise it affects the quality of your samples." To get back to the issue of having your users understand not just the theory but the practicality of what they are doing, hopefully it clicks in that something seemingly as trivial as cleanliness and neatness affects the quality of their research and their results. ■



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Sections of formalin-fixed and paraffin-embedded tissues are commonly used to detect antigens of diagnostic, therapeutic, or prognostic importance in patients with many types of cancers. Sections (~ 5 μm thick) cut from paraffin-embedded tissues are mounted on glass slides usually one or two days before immunostaining. In some cases, paraffin blocks are no longer available, and so immunohistochemistry must be performed on unstained slides that have been prepared sometime ago. It is not uncommon in both clinical and research laboratories to store unstained paraffin-embedded sections on glass slides at room temperature. Also, research laboratories that serve as reference centers for multi-institutional studies store slides for future use in order to rapidly return the tissue blocks to the originating institution. Such institutions want tissue blocks returned to them as soon as possible, as this may have medicolegal implications.

Storage of sections also becomes necessary when one marker study is proceeding and future marker studies need to be followed. Moreover, in such studies comparison of similar histologic feature among neighboring sections requires the availability of a large number of slides prepared from the same tissue block. Very small tissue samples, such as premalignant lesions of oral leukoplakia and dysplasia, require cutting a number of sections at the same time, so that the tissue block is cut conservatively, with only initial trimming of the meager sample.

Storage of slides at room temperature tends to result in temporary or permanent loss of antigenicity or antigen alteration, leading to false-negative immunostaining of tumor markers. Immunostaining of most antigens located in the nucleus, in the cytoplasm, or on the cytoplasmic membranes could be impaired by storing the paraffin slides. Only a few weeks of storage may induce diminished antigenicity, although the shortest duration of storage that has an adverse effect on antigenicity of most types of antigens is not known. The effect of storage of slides on some antigens is listed later.

A number of factors influence the temporary or permanent loss of antigenicity on paraffin sections stored on glass slides. The loss of antigenicity is gradual and consistent in most tissues. The most important factor that affects the antigenicity is the type and duration of fixation. The longer the fixation, the greater the masking or loss of the antigenicity. The tissue should be well-fixed, but not over-fixed. Generally, formaldehyde is preferred over glutaraldehyde because the latter excessively masks the antigens (Hayat, 2000a,b).

Not only the type of fixative and duration of fixation but also the duration of storage and the temperature of storage of sections influence the immunoreactivity. Prolonged storage of sections at room temperature causes diminished immunoreactivity. Grabau *et al.* (1998) have studied the immunoreactivity of estrogen receptor, Ki-67, p53, RBI, bel-2, E-cadherin, EGFR, and C-erbB2 on paraffin sections of lung carcinoma and breast cancer; the sections were stored for 3 years at -80°C , 4°C , or 20°C . In this study the immunoreactivity of all antigens except C-erb B2 was reduced at increasing temperatures of storage. Storage of sections at 4°C resulted in some diminished immunoreactivity that could be restored for all antigens, except for EGFR, using microwave heating. Quantitation of immunohistochemistry also