VISIONS

Gabor B. Levy
Wilton, CT

People who have faced imminent death and survived report visions of their entire lives passing before their eyes. My experience at the recent 50th anniversary meeting of the Electron Microscopy Society of America was similar. In a matter of hours I saw a vision of the entire half-century history of electron microscopy. It was exhilarating.

I was an invited guest among the handful of surviving charter members. Attention was lavished on us and we were treated with TLC (the nursing profession's abbreviation for tender loving care). We recounted our experiences and had an opportunity to meet old friends and colleagues whom we had not seen in years. Most significant, however, were the formal presentations that showed the enormous growth of the field, both in depth and breadth.

Looking back, the early days were exciting enough. Anything placed into a microscope provided a view that had never been seen before. The main problem was to figure out *what* you saw. When resolution is improved by more than an order of magnitude, the investigator is in uncharted waters. I empathized with van Leuwenhook and the Royal Society to whom he reported the wondrous "beasties" he saw in drops of pond water, which nobody had seen before. We, too, saw wondrous new things but could never quite be sure because of so many unknown artifacts. There was great uncertainty regarding these murky early photographs, particularly in biological materials, which were like mummies in the required high vacuum. But with new staining techniques, freeze-drying, shadowing, and sectioning - methods that were quickly developed in the pioneering days - structures became clearly and clearer. Of course, artifacts are always a plague, even today. But artifacts are not limited to microscopy. Uncertainties and optical illusions exist in visual observations even without any instrumentation. As the old saying goes: "What you see is your best guess as to what is out front."

As the years went by, the techniques got better and the instruments got better and the race for even higher resolutions was on. We have now reached at least two orders of magnitude better resolution with the newest high-resolution electron micrograms going down to fractional nanometers. At the same time, the surprising new principle of the scanning tunneling microscope allow visualization of individual molecules and even atoms on the surface of a sample. This technique was recently expanded to nonconductive samples using atomic force microscopes. Probes using almost any principle can now be produced to scan samples on an atomic scale.

Scanning is the key here. It has had an enormous impact on microscopy during the past decades. Even the earliest scanning electron micrographs were already so superior that they represented a new dimension. The seemingly mature field of visible microscopy has been revolutionized by scanning techniques. Scanning brought with it computer technology, data manipulation, picture enhancement, and time-lapse movies. Scanning confocal microscopy counteracted the vexing narrow depth of focus in visible microscopy and added three-dimensionality. Through these techniques, much can be learned about the function of the visualized structures.

This is the second major trend in microscopy; learning the fine structure is important, but only by relating structure to function does it become truly significant. One tool is elemental analysis by, for example, electron probe X-ray microanalysis. Significantly, this meeting of the Electron Microscopy Society of America (EMSA) was jointly held, not only with the Canadian sister society (MSC/SMC) but also with the Microbeam Analysis Society (MAS). The most exciting presentations were those of four-dimensional imaging of living tissue. In this mode, the function can be explored by scanning specimens stereoscopically using time-lapse data acquisition. I saw a time-lapse motion picture that showed glowing calcium waves propagating in living tissue. Besides its scientific importance, this film had an esthetic and emotional impact. Perfectly stunning!

There is yet a third facet in the developing technology: that of manipulation of microstructures. It has only been a couple of years since we saw the first astounding demonstration of spelling out "IBM" on a nickel surface by lining up *individual* xenon atoms by means of tunneling microscopy. This laboratory exercise points to micromachining and microfabrication. In fact, the construction of a Cu-Ag galvanic cell of some 20 nm in dimension has been reported recently. On the scale of living cells we also have a new tool, the "optical tweezer." Here, a sharply focused laser beam creates a trap for cells, organelles, and chromosomes. They can then be moved around and handled without damage. It opens molecular biology and genetic engineering up to manipulation of single, discrete microscopic elements.

This EMSA meeting had many novel reports in all these areas. The concurrent instrument show paralleled the wide range of talks. Instruments were displayed that represented new approaches to existing techniques. The new "environmental" scanning electron microscope (Electroscan Corp., Danvers, MA) is an example. The electron optics are separated from the sample chamber, so that the specimens are not exposed to high vacuum and are treated more gently than in the classical instruments. Another direction in instrumentation is the melding of older and newer techniques. Hitachi offers a scanning, tunneling microscope attachment to a scanning electron microscope. In this instrument the areas that are scanned on an atomic scale can be observed simultaneously. Micromanipulation was represented by the Laser Tweezer™ of Cell Robotics Inc. (Albuquerque, NM). These are but a few examples of an extensive instrument show.

Transcending the high quality of the exhibition, the lectures and the seminars was the remarkable inclusiveness of EMSA. I have lamented about the "Balkanization" of science in a recent editorial (*American Laboratory News*, August 1992). It seems that each scientific discipline and subdiscipline attempts to build an exclusive little kingdom with its own language, its own journal, and its own society. Here we see the opposite - the unification of all matters microscopic, the study of structure and of function, and the means of manipulation, including diverse instrumentation. Nor did this just happen by chance. It was a considered intention of EMSA, the New England branch of which organized a workshop recently. Researchers from different fields were invited. They informed each other of their varied work, and they exchanged ideas. It was a great success. Significantly, this was the *last* meeting of the old EMSA. To conform to the unifying concept, it will be known as the Microscopy Society of America (MSA) starting this year. This is surely moving in the right direction, and we should salute the old EMSA and the new MSA. I do so, and I left this anniversary meeting with the conviction that the $2 initial membership fee 50 years ago was the best investment of my life. ■

Reprinted thanks to the courtesy of International Scientific Communications, Inc.

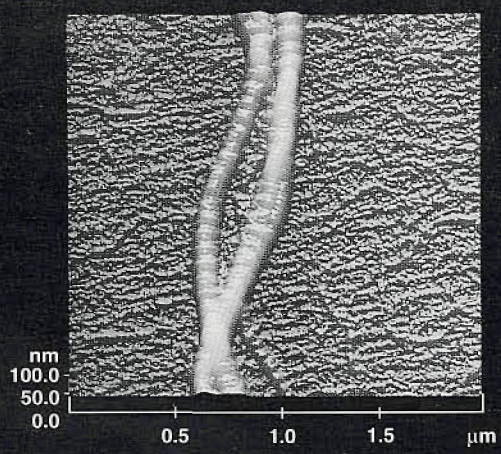
WANTED

For a public high school vocational microscopy training program. The following equipment is desperately needed for program to begin in fall of 1993 and auxiliary programs planned for 1994. Donations are tax deductible. Equipment donated will be placed in Dayton, OH area public schools.

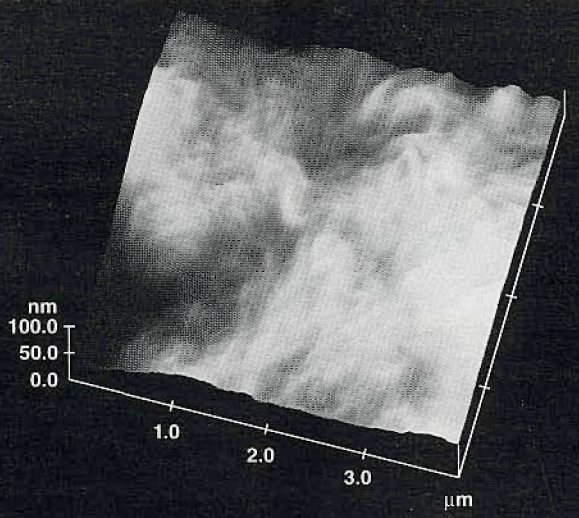
Scanning Electron Microscopes (especially ISI Mini SEMs)
Light Microscopes (Stereozooms/Biological/Reflected/Metallurgical)
Microphotography Systems for Light Microscopes
Sample Prep Equip. (Sputter & Carbon Coaters, Diamond Saws, etc.)
Metallurgical Polishing Equipment.
Microscopy Journals (EMSA Proc/RMS/Science/Scanning/etc.)
EDS Systems or components.
Company/short course manuals for above (with/without equipment).
SEM components/spare parts (working or not) for demos.

Contact Joseph Williams for more information: 4401 Dayton-Xenia Rd., Dayton OH 45432, Tel.: (513)255-9338

A Breakthrough in AFM Imaging of Soft Samples.



Type I Collagen Scanned in the TappingMode™ (patent pending) using the NanoScope Multimode AFM. Both the 70nm bands and the 30nm sub-bands are resolved in this uncoated sample. Data: E. Chernoff of Indiana University-Purdue University at Indianapolis, D. Chernoff of Advanced Surface Microscopy, Inc., and K. Kjoller of Digital Instruments.



Polyethylene Film Scanned in Air using the TappingMode™ of the NanoScope MultiMode AFM. Now soft, delicate samples like these can be scanned quickly and easily without the use of a fluid cell. This is another example of our commitment to meet our users' needs. Data: C. Boles of Digital Instruments.

The TappingMode™ of the NanoScope® *Multimode* Atomic Force Microscope gives you the capability to image soft samples with ultra-high resolution.

Our exclusive TappingMode™ AFM makes it easy to image soft, sticky samples without the use of a fluid cell. This newly-discovered scanning probe method allows samples to be measured using very low compressive force–and no lateral force–between the AFM probe tip and the sample. Using the TappingMode, samples such as polymers and biological materials can be imaged in air with ultra-high resolution, and without the tearing and sticking that can occur with standard contact AFMs.

The NanoScope *Multimode* AFM can also be used as a standard contact AFM, a noncontact AFM, a Magnetic Force Microscope (MFM), a Lateral Force Microscope (LFM), and an Electrochemical AFM–another example of how the NanoScope gives you constantly expanding capabilities.

Call today to discuss your application.

di Digital Instruments

Santa Barbara, CA •TEL: 805-899-3380 or 800-873-9750•FAX: 805-899-3392
Japan: Toyo Corp.•TEL: 81-3 (5688) 6800•FAX: 81-3 (5688) 6900