# A CLOSER LOOK AT LEAVES

Stephen W. Carmichael,[1] Mayo Clinic

All of us have looked at leaves. They're interesting. Some of us have looked at leaves under a light microscope. Still interesting. Some have looked at leaves under more powerful microscopes, and apparently they found it interesting still. Now some folks have looked more closely than ever before, and guess what? This may be the most interesting! Wendy Mechaber, Durwood Marshall, and Frances Chew of Tufts University, Richard Mechaber of GEI Consultants, Inc., and Renee Jobe of TopoMetrix turned to the atomic force microscope (AFM) to analyze the landscape of the surfaces of leaves, apparently for the first time.[2]

They begin by making the obvious point that the landscape, viewed on a scale of meters, influences the diversity of the flora and fauna we see. Why not take this view to the micron scale to see the way critters on leaves, and they're lots of them, see their landscape. They took young and old leaves from American cranberry plants and fixed them with osmium tetroxide vapors. Squares of about 100 µm on a side on the upper surface of the leaves were examined with TopoMetrix TMX 2000 Explorer AFM in the contact mode at about 1,600X magnification. Pyramidal silicon nitride tips, 3 µm by 3 µm at the base and 3 µm high, with a radius of curvature of 0.05 µm were used. A force constant of 1 nN was used to minimize deformation of the leaf surface. The topography of the young and old leaves was compared using computerized statistical programs.

The published micrographs in their PNAS article look for all the world like contour maps, because that is exactly what they are. The AFM gives this type of view, and the information can be quantitatively analyzed. The surface of the young leaves have conspicuous plateaus that were found to correspond to the "tops" of single cells, with valleys between the cells. Older leaves did not have such definite plateaus, as if the surface had eroded over time. Statistical analysis established that these topographic differences were significant.

These observations are important, particularly if you were a microbe or insect who spent most of your life foraging on the surface of a leaf. The landscape is rugged, and it smoothes out over time. This change could effect the microclimate, specifically features such as temperature, humidity, and windspeed. The likelihood that some human gardener could ruin your day by flooding your landscape with a poison changes with the topography. The volatile material that the plant gives off could vary, as could the chance that any chemical signal you release while on the leaf surface reaches its intended target. These things change as the leaf ages.

When you put yourself on this level, the AFM description of leaves by Mechaber *et al.* is truly fascinating. They have shown the importance and feasibility of looking at leaves very closely. ■

1 The author gratefully acknowledges Wendy L. Mechaber, now at the University of Arizona, for reviewing this article.

2 Mechaber, W.L., D.B. Marshall, R.A. Mechaber, R.T. Jobe, and F.S. Chew, Mapping leaf surface landscapes, Proc. Natl. Acad. Sci. USA 93:4600-4603,

### X-actly So

*I'm full of daze*
*Shock and amaze*
*For now-a-days*
*I hear they'll gaze*
*Thro'cloak and gown—*
*and even stays*
*Those naughty, naughty*
*Roentgen Rays*

*Contributed by Chris Cochrane, Alabama A&M University, Department of Physics, PO Box 962, Normal, AL. Chris noted the poem around the time X-rays came to the attention of the general public - and would very much like to know the name of the author.*

## Front Page Image

### Cryo-Electron Microscopy and Three-Dimensional Structure Analysis of a Neutralizing Antibody Bound to an Enveloped Virus

*Cutaway view of a three-dimensional image reconstruction of an alphavirus (center), that was obtained from images of frozen-hydrated specimens* (background). Eighty trimeric, glycoprotein spikes on the surface (blue) surround a lipid bilayer (green) and a nucleocapsid core (yellow and red) that contains 240 protein subunits complexed with the single-stranded RNA genome. An enlarged view of three monoclonal antibody Fab fragments (orange contour lines) bound to one spike (yellow-brown), with an atomic model of an Fab (yellow and green ribbon diagram) docked into one of the Fab "cages" appears at the lower left. Three Fab molecules bind to three E2 glycoproteins in each spike (a trimmer of E1 + E2 glycoprotein heterodimers) at positions where a cellular receptor for the alphavirus is believed to bind. Please see Cheng *et al.* (1995) Three-dimensional structure of an enveloped alphavirus with T=4 icosahedral simmetry. *Cell* **80:621-630** and Smith *et al.* (1995) Putative receptor binding sites on enveloped viruses as visualized by cryo-electron mcroscopy. *Proc. Natl. Acad. Sci. USA.* **92:10648-10652** for details.

Photo courtesy of T.S. Baker, Purdue University, Department of Biological Sciences and Holland Cheng, currently with the Karolinska Institute, Center for Biotechnology, Sweden.

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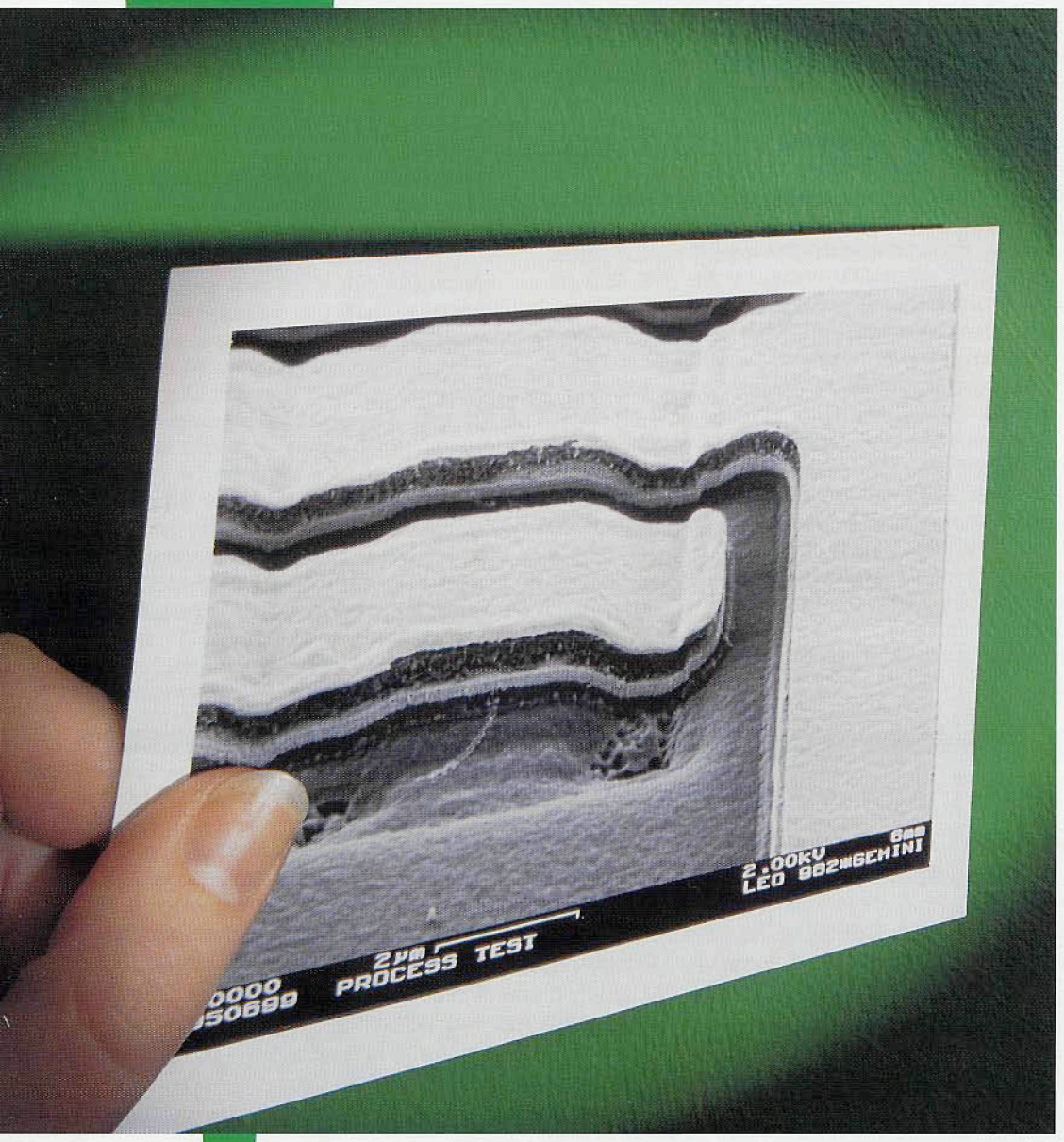
Don Grimes, Editor

# Electron microscopy – the future is clear

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# NEW AND/OR INTERESTING IN MICROSCOPY

## Philips Acquires Electroscan

Philips Electronics North America Corporation has closed on its purchase of the assets of ElectroScan Corporation, Wilmington, Massachusetts, a U.S. maker of electron microscopes.

Electroscan started developing and producing Environmental Scanning Electron Microscopes (ESEM is a registered trademark) in 1985. The ESEM allows specimens to be observed in a water vapor environment up to a pressure of 50 Torr. This prevents dehydration of wet specimens, reducing or eliminating the need for sample preparation.

ElectroScan holds a number of essential patents for this technology which have been transferred to Philips. The company employs about 30 people, who will be offered employment by Phillips.

In the past few years, Philips and ElectroScan jointly developed and marketed a Field Emission Environmental Scanning Microscope. Buying ElectroScan's assets will allow Philips Electron Optics, Eindhoven, The Netherlands, and its affiliates to further integrate this unique and proprietary technology into Philips current and future product line of scanning electron microscopes.

Philips Electron Optics supplies transmission and scanning electron microscopes to research institutes, universities and industrial customers throughout the world.

For further information, contact:
Annebelle Wijnen: +31 40 275 8329, Philips Press Office, Eindhoven
Jon Kasle: +1 212 850 5342, Philips Electronics, New York

➡ The Symposium on Materials Issues in Art and Archaeology will be held on December 2/6, 1996 in Boston, MA as part of the Fall Meeting of the Materials Research Society.

The symposium will provide a multidisciplinary forum for scientific and technological issues in art, archaeology, conservation and preservation. Of particular interest will be contributions which explore the interface and overlap among traditional materials science, the history of technology, and the archaeological and conservation sciences that investigate new methods and applications of materials science in art and archaeology.

Address inquiries to:

| | |
|---|---|
| Ms. Pamela Vandiver | |
| Conservation Analytical Lab | Tel.: (301)238-3700 X162 |
| Smithsonian Institution, | Fax: (301)238-3709 |
| Washington, DC 20560 | eMail: PBV@cal.si.edu |

## Highlights at Microscopy & Microanalysis '96

### Social Events

- Sunday, 10 August
  **Ninth Annual Golf Tournament:**
- Sunday, 10 August
  **Tour University of Minnesota Gabbert Raptor Center:** 12:30/2:30
- Sunday, 10 August
  **Sunday Evening Reception:** 6:00/10:00 at Knott's Camp Snoopy in the Mall of America.
- Wednesday, 14 August
  **Wednesday Evening Dinner Cruise:**
- Friday, 16 August
  **Tour Mayo Clinic:** 7:30a.m./4:15p.m.

### Special Scientific Events

- Saturday, 10 August
  **High Resolution Field Emission SEM in Biology**
- Saturday, 10 August
  **Resources on the World Wide Web for Microscopy and Micro analysis**
- Sunday, 11 August
  **Short Courses:**
  Colloidal Gold Labeling for LM, TEM, SEM and SPM.
  Scanning Electron Microscoy in the Physical and Biological Science
  Introduction to Digiital Imaging.
  Advanced Image Analysis and Image Processing in Microscopy.
  Atomic Force Microscopy.

### Commercial Exhibition

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|---|---|
| Monday: | Noon - 5:00 p.m. |
| Tuesday: | 9:30 a.m. - 5:00 p.m. |
| Wednesday: | 9:30 a.m. - 5:00 p.m. |
| Thursday: | 9:30 a.m. - 3:00 p.m. |

## COMING EVENTS

✓ **1996 Microwave Workshop Series.** (Ted Pella, Inc.) Kathy Stangerberg (800)637-3526 (CA), (800)237-3526 (except CA)
Aug 7/9 '96: Madison, WI

✓ **CCD Imaging Workshops** (Photometrics) Tucson, AZ. Lisa Soroka: (520)889-9933, Fax: (520)295-0299.
Oct 3/4 '96

✓ First Wed. of Each Month in '96: **New Strategies & Tactics in Image Analysis.** Iowa City, IA. Dr. J.K. Beddow, (319)337-2427, Fax: (319)337-2474.

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✓ August 2/3 '96: **47 Annual Meeting of the Histochemical Society.** Bethesda, MD. (508)563-1155, Fax: (508)563-1211.

✓ August 3/8 '96: **45th Annual Denver X-ray Conference and Powder Diffraction Satellite Meeting.** Denver, CO

✓ August 8/17 '96: **17th Congress and General Assembly of the International Union for Crystallography.** Seattle, WA. Prof. R.F. Bryan, http://www.hwi.bufallo.edu/aca/

✓ August 11/15 '96: **MSA/MAS/MSC Joint Annual Meeting.** Minneapolis, MN MSA Business Office: (508)540-5594/(800)538-3672, Fax: (508)548-9053.

✓ August 26/30 '96: **EUREM '96.** University College, Dublin, Ireland. Prof. Martin Steer: 353-1-7062254 Fax: 353-1-7061153

✓ Sept 4/7 '96: **Surfaces in Biomaterials '96.** Phoenix, AZ. (612)927-6707, Fax: (612)927-8127.

✓ Sept 18/21 '96: **Gold Cluster Labeling Workshop.** Brookhaven Nat'l Lab, Upton, NY. Jim Hainfeld, (516)344-3372, Fax: (516)344-3407

✓ Sept 20/22 '96: **Symposium on Integrated Microscopy** (Univ. of Wisconsin & Carnegie-Mellon Univ.) Madsion, WI: eMail: http:\\www.bocklabs.wisc.edu/imr/imr.html

✓ Sept 26/Oct 2 '96: **14th International EM Congress.** Cancun, Mexico. Miguel Jose Yacaman: Tel./Fax: 525-570-85-03

✓ Sept 26/27 '96: **Iowa Microscopy Society Fall Meeting.** Iowa City, IA. Kenneth C. Moore: (319)335-8142, Fax: (319)335-9049

✓ Sept 30/Oct 4 '96: **OIM Academy: Course in Orientation Imaging Microscopy.** (TSL), Provo, UT. Klaus Behnert: (801)344-8990, Fax: (801)344-8997

✓ Oct 1/4 '96: **Ultramicrotomy for Materials Science Applications Workshop.** (RMC & AZ Materials Lab). Tucson, AZ. Dr. Bob Chiovetti: (520)889-7900, Fax: (520)741-2200.

✓ Oct 7/11 '96: **Scanning Electron Microscopy and X-Ray Microanalysis for the Materials Scientists.** (SUNY). New Paltz, NY. Dr. A.V. Patsis: (914)255-0757, Fax: (914)255-0978.

✓ Oct 13/16 '96: **5th Brazilian Conference on Microscopy of Materials - MICROMAT 96:** Rio de Janeiro. Prof. W.A. Mannheimer, +5521 280-7443, Fax: +5521 290-6626, wamann@metalmat.ufrj.br

✓ Oct 14/18 '96: **43rd American Vacuum Society National Symposium.** Philadelphia, PA. (212)248-0200, Fax: (212)248-0245

✓ Dec. 2/6 '96: **Symposium on Materials Issues in Art and Archaeology V.** (Smithsonian Inst.) Boston, MA. Pamela Vandiver: (301)238-3700, Fax: (301)238-3709.

✓ Dec. 4/6 '96: **26th Annual Conference of the Microscopy Society of Southern Africa.** Durban, South Africa Dr. Fiona Graham, +27-31-260-2174, Fax: +27-31-261-6550.

✓ February 8/14 '97: **Photonics West '97.** (SPIE). San Jose, CA. Marilyn Gorsuch: (360)676-3290, Fax: (360)647-1445.

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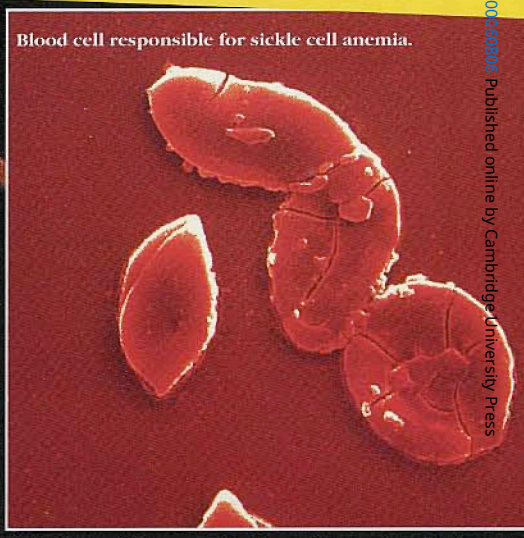


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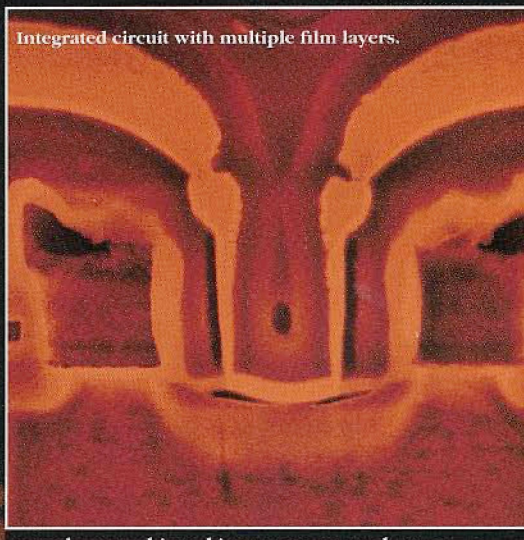


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