Microscope yields sharp 3-D images

By adapting optical methods used in astronomy and medicine, scientists have developed a computer-assisted microscope that makes high-resolution three-dimensional images of living cells in dim light.

"This method lets us observe live specimens with a resolution far higher than that of ordinary light microscopes," says Walter A. Carrington, an imaging researcher at the University of Massachusetts Medical School in Worcester. "The technique doesn't damage the cells. They remain alive and intact."

Carrington and his coworkers describe the technique in the June 9 SCIENCE.

With ordinary light microscopes, attempts to increase magnification beyond a certain point cause blurring, says coauthor Fredric S. Fay. Moreover, an optical microscope creates a sharp image only of objects that lie in the flat focal plane, making it difficult to see a three-dimensional structure—especially if the object is alive.

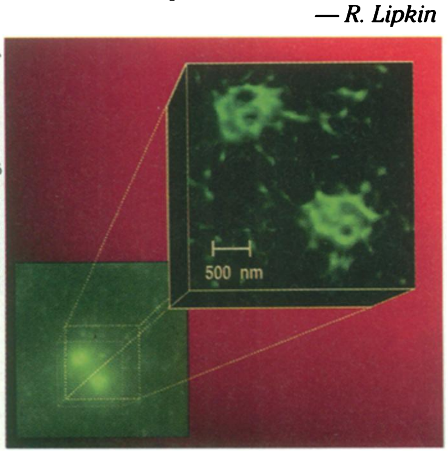
To solve these problems, the researchers joined a charge-coupled device to an optical microscope, then devised computer algorithms to correct the blurriness caused by the microscope optics at high magnification. The method is similar to the procedure astronomers used to correct images from the flawed optics of the Hubble Space Telescope before its repair. Using a second computer procedure, the microscope scans many focal planes and builds a three-dimensional image of the object, much as CAT scans do.

The researchers have imaged organelles without killing cells or cutting them into slivers, says Fay. The final resolution is four times greater than that provided by an unaided light microscope.

"An electron microscope would provide higher resolution," says Carrington. "But then the specimen would be dead."

— *R. Lipkin*

Jason Dictenberg, Steven Doxsey



Aided by a computer, a light microscope achieves "super-resolution" of a centrosome in a cell undergoing mitosis.

Drawing a violin bow to new lows in music

Scraping a bow across a string, a beginning violin student can readily create a remarkably diverse array of ear-jangling screeches, whines, and grunts.

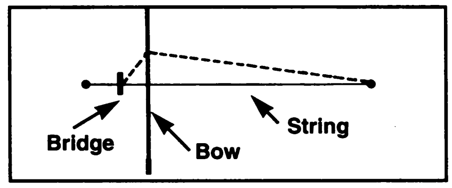
Now, a leading violinist has developed a new bowing technique that transforms some of the sounds unintentionally created by beginners into steady, clear, and loud musical tones. This method also enables a performer to play notes of much lower pitch than those customarily played on a violin.

"A violin can reach the range of a cello," says Mari Kimura of New York University. She described and demonstrated her technique at last week's Acoustical Society of America meeting, held in Washington, D.C.

When the hairs of a violin bow travel across a string, they alternately stick and slip. Each time the hairs stick, they in effect pluck the string, sending a pulse in the form of a kink up and down the string (see diagram). Such pulses cause vibrations in the wooden bridge over which violin strings stretch.

Several years ago, physicist Roger J. Hanson of the University of Northern Iowa in Cedar Falls and his coworkers noticed that by pushing down very hard when drawing a bow across a string, it was possible to create low-pitched sounds having frequencies below a string's fundamental frequency.

Studying this effect experimentally, the researchers discovered that these "anomalous low frequencies" occur when the bow force is great enough to prevent a propagating kink from triggering the normal release of the string from the bow hair. As a result, a violin's bridge vibrates less often than usual, transmitting an abnormally low pitch to the violin's body.



The stick-slip motion of a violin bow drawn across a string excites pulses that travel along the string, making the violin's bridge vibrate.

Recent computer simulations by Knut Guettler of the Norwegian State Academy of Music in Oslo support the experimental findings.

"But we did not initially consider these sounds as having much musical significance," Hanson says.

Meanwhile, unaware of the scientific work, Kimura had become intrigued by low-pitched tones that she could hear while doing a certain bowing exercise. She decided to explore the possibility of creating such sounds with sufficient control and precision to use them in performance.

Eventually, she learned how to handle her bow, drawing it with a large, steady force across the string, to consistently produce musical notes an octave or more below the string's normal frequency. Sound quality also depended on string type.

Though it requires considerable effort to perfect, her technique can be taught to other violinists, Kimura says. She has also written a number of solo violin compositions to take advantage of this new capability.

Musicians using stringed instruments with bows now have a new type of sound to play with. — *I. Peterson*

If you smoked Kents in the 1950s . . .

The fine, hairy fibers (arrow) sticking out of the filter of this 40-year-old Kent cigarette are crocidolite, a very carcinogenic type of asbestos. Each puff of smoke from these cigarettes—some 11.7 billion of which were sold through at least May 1956—could carry more than 131 million asbestos structures (each containing up to hundreds of fibers), a new study shows.

William E. Longo of Materials Analytical Services in Norcross, Ga., and his colleagues used mechanical smoking devices to study the asbestos released by Kents from previously unopened packs. They say their data, reported in the June 1 CANCER RESEARCH, suggest that early Kent smokers—even those who gave up cigarettes long ago—may face some risk of mesothelioma, a virulent, asbestos-related cancer. — J. Raloff

Longo/CANCER RESEARCH