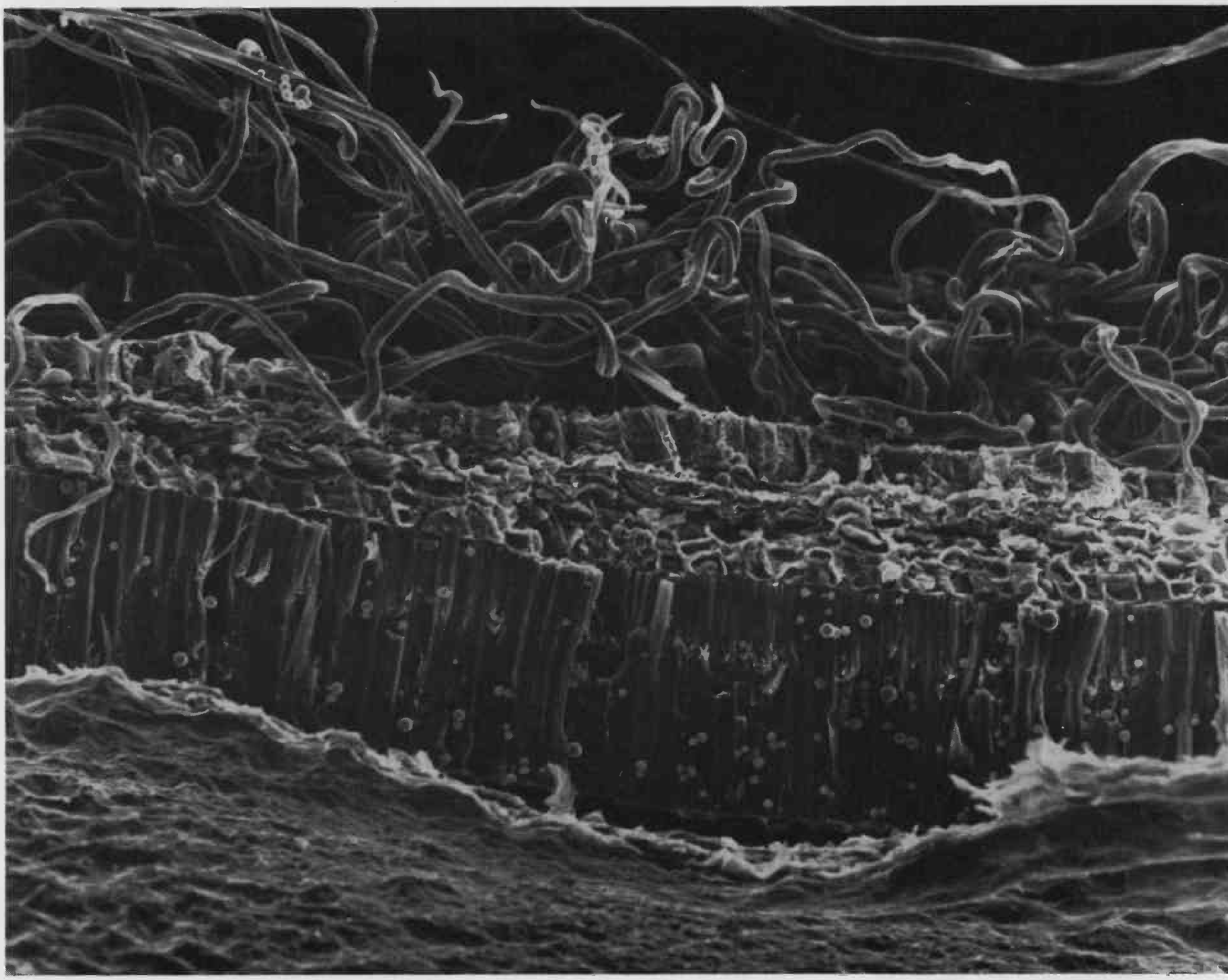


A Big Eye Sees a Small World

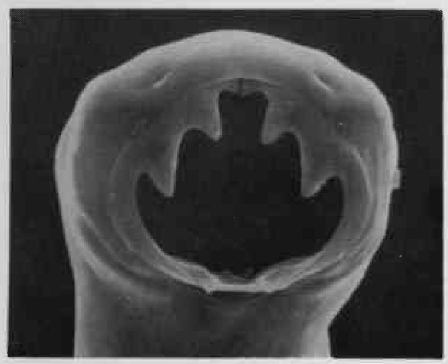
A new tool at the College of Agriculture lets scientists examine the layers of a cotton seed's coat, the intricacies of an insect egg the size of this dot · , and other details microscopic in size, but large in importance to agricultural production.

The tool, a scanning electron microscope (SEM), gives a clear image of a three-dimensional surface magnified up to 300,000 times. At that magnification, a penny would look about four miles across and 500 yards thick.

Even at much lower magnification, the SEM shows surface details with vastly greater clarity than other types of microscopes, says plant pathologist Dr. Michael A. McClure. He heads the committee that coordinates use of the instrument and wrote the proposal for the $50,000 grant from the National Science Foundation that helped buy it.

Researchers from more than a dozen university departments have used the SEM since its installation in the basement of the Agricultural Sciences Building last summer.

Photograph: This scanning electromicrograph shows a cross section of the hull of a cottonseed. The white meat of the seed is at the bottom, the surface fibers at the top. The layer of tall cells packed together helps protect the seed from injury. (Photo by Robert McDaniel.)



Top: An aflatoxin-producing mold growing on a cotton fiber. (Photo by Thomas Russell. Bottom: head of a hookworm. (Photo by Michael McClure.)

McClure uses it to study nematodes, parasitic worms less than 1/25 inch long. Several types of nematodes are expensive agricultural pests. For instance, the citrus nematode causes about $1.2 million in lost production in Arizona per year; the root-knot nematode costs the state's cotton farmers about $800,000 per year in losses and control efforts. With the SEM, McClure has found and photographed details of nematodes' anatomy never before recorded.

Nematodes come in thousands of varieties, so just telling them apart and classifying them is an important part of a nematologist's work. This winter, McClure used the SEM to identify pinewood nematodes that had killed several pine trees in Tucson. This worm had never before been reported in the Southwest.

The instrument's value in distinguishing among similar species extends well beyond the study of nematodes. UA entomologists Dr. Theo F. Watson and Michael F. Potter are using the SEM to describe differences between the almost identical eggs of the tobacco budworm and the bollworm. Both insects attack cotton. Plant pathologist Dr. Robert L. Gilbertson is using it to develop a classification system for fungi that decay trees and cacti.

The SEM also allows researchers to study specific events in detail. With it, plant physiologist Dr. Kaoru Matsuda is tracing how water stress affects the development of wheat and barley flowers into grains. Seed scientist Dr. Robert G. McDaniel is finding ways to evaluate the quality of cotton seed with the SEM, especially the seed's ability to resist damage in processing. Cotton researcher Dr. Thomas E. Russell is studying how aflatoxin-producing mold attacks cotton seed.

Other current or planned uses of the SEM by College of Agriculture scientists include studies of soil structure, of calves' use of disease-fighting chemicals in milk, and of the cells in alfalfa leaves that help regulate the rate at which water evaporates from the plant.

The microscope is also available to researchers outside the College of Agriculture. For example, archaelogists have examined edges of bone and stone tools for minute scratching and chipping that suggest how the tools were made and used. Electrical engineers have checked the circuitry on electronic microchips. A medical pathologist has studied diseased kidney cells.

Electron microscopes use a beam of electrons, rather than light rays, to illuminate a specimen. Transmission electron microscopes, in which the beam passes through the specimen, have been available for 40 years. Scanning ones, which bounce a moving beam off the surface of the specimen, were invented about 15 years ago. Improvements have been made steadily since then.

The new SEM at the College of Agriculture is a state-of-the-art model made by Scientific Instruments, Inc. Besides the National Science Foundation grant, another $20,000 from the UA Vice President for Research helped finance the microscope and accessories. The SEM's small room is part of a suite that includes a specimen preparation room, a room housing the college's transmission electron microscope, and a darkroom for processing micrographs.

The tool's value to researchers hinges on its versatility as well as its power. It can take specimens up to four by six inches. They can be moved and tilted by remote knobs. The built-in, instant-film camera allows taking 30 or more different photographs in an hour. After thorough drying, specimens can be prepared for the microscope in a

few minutes. A computerized control board permits many manipulations of the image, seen on a pair of TV screens.

Imagine being able to move a pin-point size sample around freely until you see it from the perspective you want, then to zoom in for a hundred-fold or a thousand-fold close up of the surface. The movement and details on the screens can be as wondrous as Star Wars special effects. But these views are not imaginary. They are a glimpse into a real microscopic world that researchers understand better every day.

Research Assistant Gopinath Rao (seated) and Michael McClure focus the image of a tapeworm head on the scanning electron microscope's double video display. The sample being magnified is in the chamber at the bottom of the cylinder at left. (Photo by Ted Bundy.)