Mental Skills in the Elderly: Lost and Found

It is a common assumption that aging often impairs the ability to think and reason. But declines in two important types of intellectual function among the elderly are largely avoidable and, in many cases, quickly counteracted by supervised training, according to psychologists at Pennsylvania State University in University Park. Furthermore, report K. Warner Schaie and Sherry L. Willis in the March DEVELOPMENTAL PSYCHOLOGY, the same training boosts the performance of a substantial number of older adults whose intellectual abilities have remained stable.

"There are different types of decline in thinking ability with age, some of which are associated with neurologic loss," says Willis, "but for many older adults we think our data indicate that decline occurs because they don't use acquired skills as much as they used to."

Not all investigators are confident that training can pump up fundamental thinking skills, but Willis points out that this is the first study to chart intellectual decline over time and then examine training effects. A number of studies have shown that training techniques improve the performance of elderly subjects on tests of memory, reasoning and problem solving, she notes, but researchers do not know whether these approaches remedy a loss of function or bolster the skills of people suffering no decline.

Schaie and Willis addressed this problem by comparing measures of the same thinking skills – inductive reasoning and spatial orientation – obtained from 229 healthy adult volunteers in 1970 and in 1984. Subjects, recruited from a health maintenance organization near Seattle, were screened for neurologic and mental disorders and ranged in age from 64 to 95 years by the end of the study. A significant decline on one or both of the measures occurred among 122 subjects; the rest remained stable.

Inductive reasoning was assessed by showing subjects several series of letters, numbers and words. They were asked to find the pattern in a series and select the next element from among five choices. Spatial orientation involved the ability to mentally rotate two- and three-dimensional objects.

Subjects then were assigned to five-hour training sessions in reasoning or spatial orientation. Those declining in one area took training in that ability; subjects who declined in both areas or who remained stable were randomly assigned to a training program. Training concentrated on practice problems and strategies to improve performance, such as underlining repeated letters in a series or focusing on two or more features of a figure during rotation.

More than 60 percent of subjects whose performance had declined in one or both areas since 1970 achieved markedly higher scores after training; 40 percent scored as high as their 1970 performance levels. More than half of the subjects whose scores remained stable over the 14 years also showed significant improvement after training on either ability. Training effects, say the researchers, were unrelated to differences in age, education and income.

In other words, says Willis, relatively simple training techniques reversed declines in two primary intellectual abilities and improved performance among the considerable proportion of subjects – almost 47 percent – whose scores remained stable. The training has practical consequences, she adds. Reasoning skills relate to everyday tasks such as understanding instructions on medicine bottles and food labels, and spatial ability aids in navigating neighborhoods and buildings and in reading road maps.

Other investigators of adult development are impressed with the study but caution that its meaning is not yet clear. "I'd put [Schaie and Willis's] interpretations on hold until there's more data on health and history of heart disease among their subjects," says psychologist James E. Birren of the University of Southern California in Los Angeles. Physical ailments, particularly coronary disease, have been linked to intellectual decline.

"The study was meticulous," adds Birren, "but the researchers may be measuring something other than basic intellectual capacities. I wouldn't expect fundamental abilities to change so much after only five hours of training."

Psychologist John L. Horn of the University of Denver agrees that "this is a very important study if it's replicable, but it's really not known if reasoning or spatial orientation tests apply to general types of thinking."

Further long-term studies are needed, says Horn, to examine whether training specifically helps the elderly or has comparable effects on subjects followed from youth to middle age. "I don't want to set up false hopes for people," he notes.

In their report, however, Schaie and Willis stress that the improvement and reversal of decline they demonstrated "may be a rather conservative estimate of what could be achieved by more extensive programs of this kind." The "$64,000 question," adds Willis, is: What distinguishes the older adults who responded to training from those who were not helped?

– B. Bower

Microsketching an underwater surface

Surface details on the scale of typical atoms are notoriously difficult to detect, especially when the sample is immersed in water. Now a team of researchers reports the design and construction of a special "scanning tunneling" microscope that can pick out the atomic-scale bumps and hollows on a water-covered graphite surface.

This effort represents the first successful attempt to resolve such fine details on a wet surface. At best, an optical microscope is restricted to features 1,000 or more times larger. An electron microscope operates only when the sample is in a vacuum.

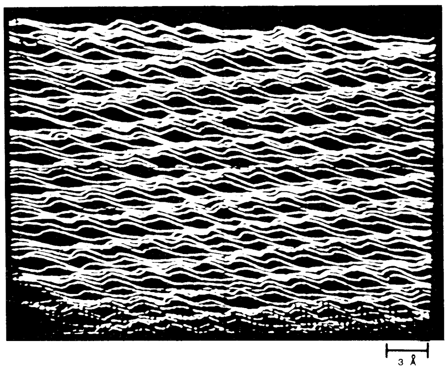
In the April 11 SCIENCE, Richard Sonnenfeld and Paul K. Hansma of the University of California at Santa Barbara also report that the new instrument can be operated in salt solutions. This opens up the possibility of imaging proteins and other biological materials in their active states. The microscope may also be useful in electrochemistry for detecting surface changes that occur at electrodes.

In a tunneling microscope, an extremely sharp metal needle is brought within a few angstroms of the sample's surface. This distance is small enough for electrons to leak or tunnel across the gap and generate a minute current. As the gap between the tip and the sample increases, the current decreases. A scanning mechanism pulls the needle across the sample's surface, constantly adjusting the tip's height to keep the current constant. The result is a microscopic sketch of the surface's contours (SN: 4/6/85, p. 215).

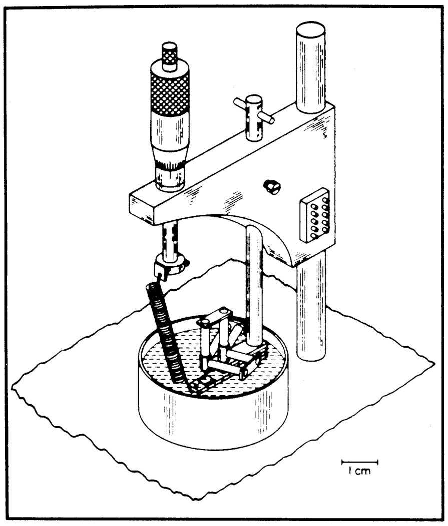
Getting such a microscope to work in water was a challenge because water conducts electricity. The resulting electrical current could swamp the tunneling current. The answer was to minimize the area of the needle that could conduct current through water and into the sample surface. The researchers did this by coating a platinum-iridium needle with glass insulation, leaving only its tip bare.

Says Sonnenfeld, "Because the electrical current through the water remains constant, we could pretty much ignore it. It didn't have any effect on the images."

The microscope took 20 seconds to produce an image of a clean graphite surface immersed in deionized water. The image revealed rounded peaks and val-



Images of an underwater graphite surface showing features smaller than 3 angstroms (above) are possible with a special scanning tunneling microscope (right) designed to work with immersed samples.



Illustrations: UC-Santa Barbara

leys that fell into the hexagonal pattern of graphite's characteristic honeycomb lattice. The researchers also obtained lower-magnification images of a gold film immersed in a sodium chloride solution.

Meanwhile, IBM and Stanford University scientists have modified a scanning tunneling microscope to map forces on the surfaces of both conducting and insulating materials. Conventional tunneling microscopes work best if the sample is an electrical conductor.

This new device, called an atomic force microscope, has a diamond tip mounted on a tiny gold-foil spring, which is sandwiched between a sample and a microscope needle's tip. Fluctuating forces between atoms in the sample and on the end of the diamond tip cause the tip to waver slightly.

As the diamond tip scans a surface, the changes in the tunneling current reflect the arrangement of atoms on the surface. A prototype instrument has mapped the surfaces of insulators to a resolution of 30 angstroms, which is getting near the atomic-scale resolution possible for conductors like graphite. — *I. Peterson*

Physics to the end of the century

Every decade or so the National Research Council issues a report on the state of the science of physics in the United States. These reports contain surveys of recent progress in the science, assessments of prospects for the immediate future and advice to the government on how to foster that future. Since World War II the federal government has been the largest patron of basic scientific research in the country, and although some astronomers have recently returned to the older custom of seeking large private gifts for capital equipment (SN: 1/12/85, p. 21), the government is likely to remain the builder and owner of the accelerators and similar equipment that physicists need.

"Physics Through the 1990s," the latest in this series of reports, authored by the council's Physics Survey Committee under the chairmanship of William F. Brinkman of Sandia National Laboratories in Albuquerque, N.M., was published last week. It is intended to cover physics to the end of the century. In its prognosticating and advisory aspects, the eight-volume report contains a few things that are not surprising and some that are mildly surprising.

One of the latter is a plea for better support of small research groups. "Research carried out by small groups . . . is responsible for over 70 percent of the physics doctorates that are awarded in this country," says the summary distributed to the press. The image of physics is that of a science where it can take upward of 1,000 people to mount a single experiment (SN: 1/19/85, p. 45). Dozens, even more than a hundred, routinely sign a single research paper. Yet there's another side. As the report points out, "[S]mall group research is the dominant mode for professional education in the universities. . . ." The committee recommends greater support, particularly in matters of equipment, for these groups.

The committee also foresees a possible shortage of physicists in coming years unless more young people can be recruited. In the 1960s there was a shortage of physicists, in the 1970s an oversupply, in fact something of an employment crisis. Now the pendulum seems to be swinging back. Momentarily supply and demand are in approximate balance, but a shortage could develop in the future.

The list of capital equipment desired is shorter than the ones presented in previous decades. For particle physics the committee recommends the Superconducting Super Collider (SN: 9/22/84, p. 181), the most powerful accelerator that ever was or is likely to be. For nuclear physics it recommends the Continuous Electron Beam Accelerator Facility, which is planned for construction in Newport News, Va., and an apparatus to collide atomic nuclei with each other at relativistic speeds. All three of these already have significant support in government agencies and Congress, as does the recommendation for condensed-matter physics, new synchrotron-radiation facilities and neutron scattering facilities.

In plasma physics the committee recommends continued efforts toward controlled thermonuclear fusion, both magnetic confinement and inertial confinement experiments. It endorses what it calls the next logical step, the so-called burning core experiment.

The really unusual departure is the recommendation of the Long-Baseline Gravitational-Wave Facility (SN: 8/4/84, p. 76). Gravitational waves are disturbances supposed to be caused by motions of large astronomical bodies. They are the gravitational analog of radio waves — cyclic disturbances of gravitational forces — as radio waves are cyclic disturbances of electric and magnetic forces. They have not yet been unequivocally discovered, but when they are found, they will tell us new things about the cosmos. Up to now they have been considered a rather exotic specialty. If the report, which is published by National Academy Press, is any indication, maybe they are now becoming mainstream. — *D. E. Thomsen*

Extremely magnetic degenerate dwarf

White dwarfs can be fascinating. They are sometimes degenerate, and they are often shifted well to the red. Yet some of them can be very magnetic.

These white dwarfs do not lurk in dark alleys; they are a class of stars found in the distant reaches of our galaxy. White dwarfs are a unique venue for astrophysics. Matter there behaves in ways unattainable on earth. One instance of such behavior is the almost unbelievable magnetic field of 700 million gauss (MG), recently found in the white dwarf PG 1031+234 by a group of astronomers led by Gary D. Schmidt of the University of Arizona's Steward Observatory in Tucson. Schmidt told SCIENCE NEWS that he has never seen a theoretical calculation of the upper limit on a white dwarf's magnetic field, but he expects that 700 MG approaches the maximum possible strength for such a field.

The earth's field, which is approximately 1 gauss, is more typical of magnetic fields found in nature. The most powerful long-lasting magnetic fields in terrestrial laboratories go to a quarter-million gauss, and perhaps a little higher than that. "The physical structure of matter as we experience it does not permit the existence of fields like those we have