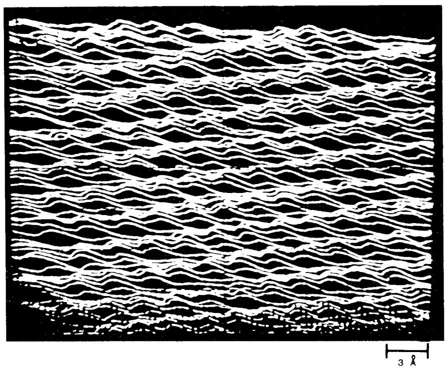

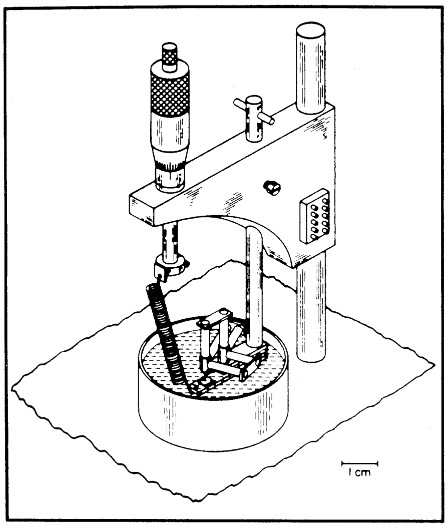

Illustrations: UC-Santa Barbara

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.

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