

ducing supercooled gases and the finding that supercooling simplifies their spectra. Detailed study of the chemical physics of heavy atoms and complicated molecules (uranium hexafluoride is, after all, a seven-atom molecule) has languished be-

cause their complicated spectra seemed insuperably difficult to unravel. This method of simplification offers new hope of understanding their behavior, and from such data numerous practical advantages may someday flow. □

Insect resistance climbs, Academy says

Insects are gaining ground in the battle over food crops. Despite the arsenal of agricultural chemicals developed to destroy them, insects, with their remarkable ability to adapt, are growing increasingly resistant to chemical pest control. More effective methods are thus needed—and quickly—if the United States is to meet the growing demand on its food production.

This was the conclusion of a major study on pest control, just released by the National Academy of Sciences. Seventy scientists, headed by biologist Donald Kennedy of Stanford University, prepared more than 1,000 pages of detailed reports on present pest control techniques, and made recommendations on how they can be improved during the next decade.

Despite the value of agricultural chemicals, "their efficacy is decreasing alarmingly," Kennedy told reporters in Washington last week. A typical U.S. farmer probably gets a return of \$4 on every dollar he invests in chemical pest control, he cited from the report, but more than 200 arthropod species have developed resistance to the chemicals during the last 50 years, and this dollar amount is decreasing. Besides genetic resistance in these "target species," nontarget species, often the natural predators of the targets, are killed inadvertently by broad spectrum pesticides. Cotton farmers in the San Joaquin Valley have found, for example, that when they spray heavily against *Lygus* (a plant-feeding bug) in early- and mid-season, outbreaks of the bollworm *Heliothis* are much worse in late season. The *Lygus* spray, Kennedy explained, kills off the natural enemies of the bollworm and its populations build up rapidly.

The NAS committee also examined other impacts of agricultural chemicals: environmental effects of long-lived compounds, human health hazards (including residues in the human body and the threat of cancer that led to bans on several, such as chlordane, Dieldrin and DDT) and occupational hazards. "The statistics on occupational health of farm workers are so bad," Kennedy said, "that it is impossible to measure the occupational impact." But a recent California study indicates that agriculture is the most dangerous occupation in that state.

Statistics on production and use of agricultural chemicals are equally bad, he said. "The pest control enterprise places a billion pounds of toxic materials into the environment each year," the report states,



Boll weevil: Insects defeat pesticides.

"but it is 'normal' for us to have only the vaguest idea of how much of each compound was used and where, and even then only after half a decade's lag." The committee called for an overhaul of industry-reporting procedures.

The committee also recommended that government agencies (primarily the U.S. Department of Agriculture and the Environmental Protection Agency) give "high priority" to the development of alternative, integrated pest control technologies. These would use several techniques: 1) Chemicals that interfere with insect reproduction and development. These affect biochemical processes unique to insects and thus pose fewer hazards to workers and the environment than broadly toxic chemicals. 2) Control by insect viruses and bacteria that cannot affect other organisms. This week EPA cleared the first such virus, the nucleopolyhedrosis virus of the cotton bollworm and the tobacco budworm, for field use. 3) Genetic manipulation to give crop plants more resistance to pests and to sterilize insects for natural control. 4) The integration of all these methods into a scheme that makes the most use of natural control and the least use of harmful chemicals.

"We realize that there is no magic bullet for this problem," says Kennedy. "The most promising methods will involve a mixture of techniques and knowledge of the local situation and will need to be research- and people-intensive." He estimates that the Government needs to spend \$10 million to \$15 million during the next decade "if the United States is to hold to its planned increases in agricultural productivity of two percent per year." □

A weirdly jittery X-ray source

X-ray astronomy piles astrophysical mystery upon astrophysical mystery. The latest is reported by scientists from the Massachusetts Institute of Technology working with data from the Astronomical Netherlands Satellite. It involves a strange pattern of X-ray bursts or pulses coming apparently from a globular cluster of stars in the constellation Sagittarius.

This is another to add to the menagerie of pulsed signals, but it is an extremely weird one. The bursts rise to maximum in about half a second and take ten seconds to die down. They occur on the average of every 15,718 seconds, but the repetition is not exactly precise. There is a "phase jitter" of about 500 seconds one way or the other, the longest recorded discrepancy being about 1,000 seconds. The data were reported at the meeting of the High Energy Astrophysics Division of the American Astronomical Society held recently at MIT by graduate student Jesse G. Jernigan Jr. His collaborators were George W. Clark, Claude R. Canizares, Satio Hayakawa, a visiting professor from the University of Nagoya, and Fuk Kwok Li.

Such a difference between pulse length and repetition time is unique in pulsed X-ray phenomena. Normally, pulsed signals are attributed to pulsing or rotating bodies, but the difference in the numbers and the jitter make it hard to imagine what kind of body could produce these. If the source is indeed in the globular cluster in Sagittarius from the direction of which the bursts come, the intensity of a burst is a million times the intensity of all radiation from the sun. □

Science adviser act

Bills to create the post of science adviser to the President have now passed both the Senate and House and await action by a House-Senate conference committee. The Senate bill was passed Feb. 4. It is similar in purpose, but not in every detail, to one passed by the House in November. The Senate bill establishes in the White House an Office of Science, Engineering and Technology Policy to provide a continuing source of policy guidance to the President on those subjects. Its director would be the President's science adviser. The Senate bill makes him a member of the Domestic Council, an adviser to the National Security Council and an active participant in development of the Federal R&D budget.

Sen. Frank E. Moss (D-Utah), chairman of the Senate Committee on Aeronautical and Space Sciences, said he expects quick action by the conference panel. "If so, we could have a new law on national science policy by spring." □