Antarctic sea ice may herald ice age

Climate has long been an AAAS favorite, and this year was no exception. While most debate still centers around CO_2 and whether its relatively short-term effects will accelerate or stall the coming ice age, James D. Hays and colleagues at Columbia University's Lamont-Doherty Geological Observatory have found what Hays thinks may be "an early warning system" for the oncoming glaciation.

An accepted part of ice age theories is that northern hemisphere glaciation occurs first and drives climate changes in the southern hemisphere. However, Hays's recent, and as yet unpublished, data show that the southern hemisphere, and Antarctica in particular, is much more sensitive to climatic changes and shows ice age-like conditions several thousand years before the northern hemisphere.

In earlier work, Hays and co-workers found that subtle, predictable changes in the geometry of the earth's orbit — the distance to the sun, the tilt of the earth's axis and the shape of the orbit — produce the regular swings from ice ages to warmer climates (SN: 12/4/76, p. 356). But those changes are quite small. What amplifies them and produces the dramatic swings in climate? According to Hays, the amplifier is the change in the amount of sea ice surrounding Antarctica.

Hays and his team examined piston cores of sediments taken near Antarctica in the southern Indian Ocean. Where researchers found sediments enriched with the remains of diatoms, they knew open ocean once existed; where sediments were mostly clay, ice must have covered the seas, preventing the growth of diatoms. The seasonal growth and retreat of the sea ice, therefore, could be found by marking and dating the line between clay sediments and diatomaceous sediments. For example, based on the dividing line found in 20,000-year-old sections of cores, the researchers estimate that during the Antarctic summer at that time, ice covered 20 million square kilometers, 10 times the area covered during a current Antarctic summer. During the winter 20,000 years ago, ice covered about 40 million km^2, twice the area of present-day winter sea ice. More significant, the researchers found, the change between the extensive ice cover and today's conditions was quite abrupt — occurring within 300 years. Similarly, the build-up of sea ice just before the last glacial period took only a few centuries, even though glaciation did not occur in the northern hemisphere for several thousand more years. It is this evidence that leads Hays to call Antarctica an ice age early warning system.

The complete story as read from the cores goes as follows. Small changes in the earth's orbit alter the global distribution of the sun's radiation and change the seasons. Between 3,000 and 8,000 years later, the sea ice surrounding Antarctica builds abruptly. Sub-Antarctic sea surface temperatures drop. Several thousand years later, ice begins to build in the northern hemisphere. It is likely, Hays says, that the increase of sea ice changes the albedo, or reflectivity, of the globe, reducing the absorption of the sun's energy and cooling the climate. It is also possible, he told SCIENCE NEWS, that the lower sea surface temperatures may cause changes in ocean circulation. When the colder oceans hit the warm Atlantic waters, evaporation increases, leading to increased condensation and snowfall which in turn build northern hemispheric ice.

Another glacial period is expected to begin in the next few thousand years; Hays suggests that satellite monitoring of sea ice could provide clues to future climatic changes. At present, he said, there is no sign of a build-up of sea ice, though sub-Antarctic sea surface temperatures have slowly declined during the last 9,000 years. □

Panel poses planetary plan

It's called COMPLEX, and the name fits the job — laying out strategy for the study of the entire solar system. The National Aeronautics and Space Administration gets input both from its own scientists and from outside researchers to whom it has assigned similar responsibilities. But the COMmittee on PLanetary and Lunar EXploration of the National Research Council's Space Science Board has been described as the only independent, external body formally charged with advising NASA on the key scientific questions to be addressed in the agency's probings of other worlds.

In 1975, COMPLEX proposed a strategy for the outer solar system — Jupiter and beyond — covering the years through 1985: an intensive look at Jupiter, reconnaissance of Saturn and a first close look at Uranus. The two-spacecraft Voyager mission and the planned early-1980s Galileo mission with its direct probe of the Jovian atmosphere embody NASA's response. Now the panel has turned its attention to the inner planets — Mercury, Venus, the moon and Mars — a group that also significantly includes the earth.

The members of COMPLEX maintain, however, that the group is not in business to recommend specific missions. That's NASA's department. Instead, the panel stresses scientific goals, independent of the spacecraft that may address them. One reason is that such goals remain despite the annual ups and downs of NASA's budget. Perhaps more important, however, is the feeling that it is better to ask questions first, with missions assigned to seek the answers, than to let predetermined mission designs limit the questions that can even be asked.

The COMPLEX report on inner-planet strategy, which covers the period through 1987, recommends that the major focus should go to "the triad of terrestrial planets" — earth, Mars and Venus. Comparative planetology is the name of the game here, and "a key," says the report, "to the understanding of the formation of the earth, its atmosphere and oceans, and the physical and chemical conditions that lead to the origin and evolution of life."

- Mars: NASA is now studying the possibility of bringing back a sample of the planet, and from some accounts one gets the impression that this is viewed as the climactic Mars mission, with the only question being whether to first send a separate mission with "rovers" to explore the surface. COMPLEX asserts that such studies are complementary — "each of the components is separately necessary" — but that although a specific sequence is desirable, it is not necessary. A piece of Mars in an earthly laboratory can be subjected to painstaking isotopic, trace-element and other analyses impossible within the constraints of a spacecraft. Other questions, however, may be better answered on Mars itself: Some depend on atmospheric interactions, some on changes with time, some on the ability to conduct similar investigations at differing sites. Sample-return, the panel says, is "a major technique" but not a "terminal" goal, and the scientific questions raised by the group — chronology of surface-forming processes, distribution of water and other volatiles, etc. — could evoke a suite of devices from multi-sensor orbiters to dropped "penetrators" to long-range roving vehicles.

A planet to ponder: Myriad mesas and isolated hills dot the Martian surface south of the crater Lyot.

- Venus: The COMPLEX report was drawn up before the Pioneer Venus mission had been to the planet, and some of the group's major recommendations (such as atmospheric composition measurements) were in part addressed by the Pioneer probes. Only two photos and

some limited-resolution earth-based radar studies have ever been seen of the surface, however, and COMPLEX's first priority is to get a global map of the haze-ridden planet's ups, downs and types of terrain. Among other recommended goals are data on surface-atmosphere interactions and seismic activity (in part, perhaps, because some researchers have interpreted the limited radar data to suggest a recently or possibly even currently active planet) — both of which would be natural candidates for landing craft such as only the Soviet Union has ever sent to Venus. The panel thus calls for increased efforts at U.S.-Soviet cooperation up to and including "coordination ... with full disclosure of mission planning and objectives so as to optimize the scientific contributions of both nations." This could mean, for example, that the proposed U.S. Venus Orbiter Imaging Radar would map the planet, with both countries then working to pick the best sites for subsequent Soviet landers.

Besides the "terrestrial triad," says the report, earth's moon and the planet Mercury also form a related set, both nearly atmosphere-free and thus preserving a record of meteorite bombardment and solar-wind interactions that relates to the early history of the solar system.

- The moon: Measurements of the surface chemistry and heat flow on a global and regional scale are the committee's top priorities, along with efforts to seek the nature of any central metallic core. Remote-sensing capabilities developed since the Apollo program (and made possible in part by calibration from the Apollo moonrock samples) could be used from lunar orbit — an idea supported by many U.S. planetologists. Soviet robot spacecraft have returned samples to earth, and COMPLEX again advocates the possibility of the two nations cooperating. A U.S. "geochemical orbiter," for example, could identify promising sites, with Soviet craft later retrieving samples from those areas.
- Mercury: Only one spacecraft — Mariner 10 — has ever been there, and it merely flew by three times. The next step would presumably be an orbiter, and although there are numerous unanswered questions (the planet's density and proximity to the sun make it "a boundary to many cosmological theories"), there is also a limit to the ability of present technology to put a suitable payload into a circular orbit around the barren world. The panel thus recommends that Mercury be considered for study later in the decade, though not at the expense of the terrestrial triad.

The COMPLEX report also recommends planning with regard to comets, asteroids and interplanetary particles and fields. It furthur covers such nuts-and-bolts issues as the ability of the space shuttle and its planned auxiliary boosters to launch payloads of the necessary weights. NASA is reading the document with care. □

Cancer statistics and views of causes

The public has been bombarded a lot lately, both by scientists and the press, with the notions that the United States is embroiled in a cancer epidemic, and that the epidemic is 80 to 90 percent due to industrial chemicals. Both concepts are now being challenged by an American Council on Science and Health report released last week, entitled "Cancer in the United States: Is There an Epidemic?"

Although many people are under the impression that the United States has one of the highest cancer death rates in the world, this is not so, the report claims, citing statistics from the World Health Statistics Annual, 1972-1973, published by the World Health Organization. In fact, according to this source, the United States ranks only 21st out of a list of 44 countries. What's more, the report declares, while there has been an increase in the absolute number of cancer cases in the United States in recent years, there has been a decrease in the real incidence of such cases when the incidence is adjusted for age. This time the report's source is the JOURNAL OF THE NATIONAL CANCER INSTITUTE (Vol. 60, p. 545, 1978). Why is age adjustment necessary? So that statistics from year to year can be compared without the distorting effects of changes in age distribution, the report explains. A population with more older people will have, all other things being equal, more cancer deaths than a young population. Still further evidence that the United States is not in the throes of a cancer epidemic, the report continues, is that while the overall cancer death rate among Americans has increased during the past few decades, it is by no means large. The report bases this conclusion on the latest published mortality report from the National Center for Health Statistics, which appeared in 1976, plus updated, nonpublished material that it obtained from the center.

As for challenging the prevailing concept that 80 to 90 percent of all cancers among Americans are due to industrial chemicals, the report points out that the much-used claim that "80 to 90 percent of all cancers are environmentally induced" originated with the International Agency for Research in Cancer in Lyon, France. That agency compared the high and low cancer death rates around the world and concluded that, because human cancer death rates vary so drastically from one country to another, some aspects of the environment, as opposed to genes, must cause most human cancers. The agency's conclusion, the report contends, then led to the widespread, unsubstantiated belief in many quarters that 80 to 90 percent of all cancers are caused by chemicals in the air, water, food and workplace.

The report then stresses, on the basis of statistics in the JOURNAL OF THE NATIONAL CANCER INSTITUTE, that whereas the incidence of most cancers in the United States has decreased in recent years, the incidence of one cancer — lung cancer — has increased dramatically. The report then points out that extensive studies have confirmed a link between smoking and lung cancer, and that the International Agency for Research on Cancer estimates that only one to five percent of all human cancers are the result of occupational hazards. The report also contends that "there is no convincing evidence that chemicals added to food increases the risk of any form of cancer," and that "the case for air pollution as a cause of human cancer is distinctly unimpressive." On the basis of all these data and conclusions, the report reasons that human cancers in the United States must be largely due to people's lifestyles, such as smoking, rather than to inadvertant exposure to industrially imposed chemicals.

It's unlikely, however, that all American cancer researchers will agree with this particular conclusion. Back in 1972, for instance, the National Academy of Sciences issued a report linking air pollution to lung cancer more impressively than ever before (SN: 9/16/72, p. 183). Last year, a study by the U.S. Department of Health, Education and Welfare predicted that 20 to 40 percent of all cancers that will strike Americans during the next several decades will be caused by workplace chemicals (SN: 9/30/78, p. 228). And last month, after analyzing the link between cancer and occupational chemical exposure, David Schottenfeld and Joanna Haas of the Department of Epidemiology and Preventive Medicine at Memorial Sloan-Kettering Cancer Center in New York City estimated that for American men at least, workplace chemicals may account for five to 20 percent of all cancers.

The American Council on Science and Health, located in New York City, was recently founded by Elizabeth M. Whelan, who holds a doctorate from the Harvard School of Public Health, Fredrick J. Stare, a physician and nutritionist with the Harvard School of Public Health, Thomas H. Jukes, a scientist with the University of California at Berkeley and some other nonindustry scientists who contended that an organization should be formed to dispassionately, scientifically evaluate the relationships between environmental chemicals and human health. The council is funded by private foundations and individual contributions and not by the food or chemical industries, at least for the present, in order to remain as independent as possible. This, the council's first report, was prepared by Whelan, who heads the council, with the help of two staff members and also with inputs from various university scientists, medical center physicians and staff members of the American Cancer Society. □