PAGE 1626
Carnivorous plant evolution

1629
Embryonic development on the Web

U.S. RESEARCH FUNDING

Physical Sciences Need Boost, Advisory Panel Tells Bush

Researchers in the physical sciences sorely need a significant budget boost to close a ballooning gap with biomedical research, a high-profile White House advisory panel said last week. But in a bow to budgetary realpolitik, the President's Council of Advisors on Science and Technology (PCAST) is vague about specific spending targets and timetables.

The recommendation will be contained in a letter to be delivered shortly to President George W. Bush, just as the White House begins crafting its 2004 spending proposal to Congress. The move reflects growing pressure on the Administration and Congress to reverse a decade-long slowdown in federal funding for basic and applied research in physics, chemistry, math, and other non-biomedical disciplines, which totaled about $9 billion last year. That stagnation, advocates say, has imperiled the nation's ability to develop new talent and technologies and to fully cash in on the taxpayers' $25 billion investment in biomedical science.

"It's great: PCAST is [endorsing] what a lot of people have said needs to happen," says David Peyton, a technology specialist with the National Association of Manufacturers in Washington, D.C., and vice chair of the Alliance for Science and Technology Research in America. The nonprofit alliance is one of many that have called for doubling the budgets of the National Science Foundation and other agencies that fund the physical sciences.

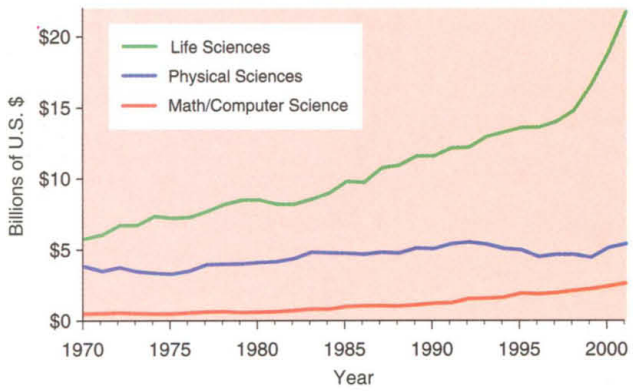
But while some industry and congressional leaders have embraced the idea, the White House has remained quietly skeptical. Last week, presidential science adviser John Marburger again challenged physical science advocates to back their case with solid numbers. The president "bristles at arbitrary formulas," he told PCAST members during a hastily called teleconference to fine-tune the letter, drafted by a PCAST subcommittee led by G. Wayne Clough, president of the Georgia Institute of Technology in Atlanta. Marburger suggested deleting the word "doubling" from the draft letter, saying it had become "politically charged" and "unpalatable." He also urged panel members to take the long view, noting that it recently took 5 years to double the budget of the National Institutes of Health. Swayed by such arguments, the panel is expected to recommend that physical sciences' funding reach "parity" with the life sciences by 2009.

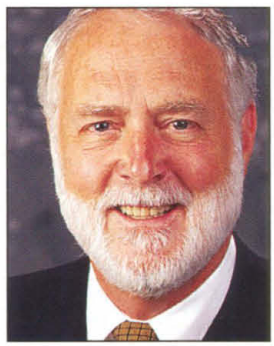
The definition of "parity" will be up to the reader, says Clough. "It doesn't make sense to say that the physical sciences should get whatever the life sciences are getting," he told *Science*. "But the idea is that significant makeup [for the physical sciences] is due here."

The letter's two other recommendations are more direct but no more specific on the fiscal implications. One calls for a major new program to fund graduate school fellowships for U.S. citizens, on the theory that greater support might attract more students into the sciences. The other urges the government to do a better job of analyzing what it gets for its money, how the United States compares with other countries, and the future demand for scientists and engineers.

The effect of the letter won't be visible until February, when the president releases his 2004 budget request. But Clough is optimistic. Budget chief Mitch Daniels, he says, "has proven to be a person that understands good advice." And even if the Bush budget proposal doesn't include a healthy boost for the physical sciences, science lobbyists will surely point to PCAST's high-level endorsement when they take their case to Congress.

–DAVID MALAKOFF





Unbridgeable gap? Funds for physical sciences (mostly chemistry, physics, and astronomy) have remained flat while life sciences have soared. A panel chaired by G. Wayne Clough (*right*) is calling for "parity."

OCEANOGRAPHY

Survey Confirms Coral Reefs Are in Peril

A new census of key coral reef inhabitants shows that they are in terrible shape. Spiny lobsters and bumphead parrotfish have disappeared from most of the surveyed reefs they were known to inhabit, as have Nassau groupers, a favorite food fish in the Caribbean. Even moray eels seem to be suffering.

The tallies come from Reef Check, a 5-year survey of the world's coral reefs by scientists and some 5000 volunteer scuba divers and local fishers. The resulting report, "The Global Coral Reef Crisis: Trends and Solutions," released last week, describes the decline of both fish and invertebrates essential to the well-being of reef communities. The final word: Reefs "are in dire straits," says Steve Gittings, a marine biologist at the National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Maryland.

The conclusion comes as no surprise. For more than a decade, marine biologists have been complaining about the state of the world's reefs, citing ever more frequent observations of dead or dying coral. Some of the first warning bells sounded in 1990, when it appeared that global warming was killing the microscopic algae that feed corals. Over the ensuing years, researchers also traced the blame to coastal development, overfishing, and pollution.

These conclusions were somewhat shaky, however, because so few reefs had been evaluated; even fewer had been monitored long

CREDITS: (LEFT TO RIGHT) SOURCE: AAAS; STANLEY LEARY/GEORGIA TECH

term (*Science*, 25 July 1997, p. 491). Stepping forward, Gregor Hodgson, a marine ecologist at the University of California, Los Angeles (UCLA), and his colleagues established Reef Check (*Science*, 6 June 1997, p. 1494). About 200 people helped with the first survey, in Kauai, Hawaii. By the year's end, the organizers had data on about 300 reefs in 31 countries. That success prompted the establishment of yearly Reef Checks.

Drying up. A count of coral reef organisms such as the Nassau grouper (*top*) and a cowry snail called the flamingo tongue (*right*) revealed human-inflicted losses.

Some researchers have questioned the value of data gathered by volunteers. But according to UCLA's Jennifer Liebeler, a co-author of the report, straightforward protocols and data review by scientists make the results sound. At each site, volunteers and their scientist-supervisors estimate the ratio of live coral to dead coral. Some species they count, such as parrotfish, are indicative of reef quality. Others, such as spiny lobsters, help reveal the extent of overfishing. And a few, such as the giant clam, show how curio and aquarium-trade collectors are affecting reefs. As far as Gittings is concerned, with just a few species to keep an eye on, "the volunteer counts are not going to be that far off."

Clive Wilkinson of the Australian Institute of Marine Science in Townsville, Queensland, says that the surveys have given him new information, even though he is a longtime veteran of coral biology. For example, the extent of overfishing was news to him. Sea cucumbers are missing from half the reefs, and in Guam their numbers dropped from 17 per 100 square meters in 1997 to about three in 2001. The Nassau grouper has virtually disappeared: Among 162 reefs, 142 reefs had none, 12 more had just one. But the good news is that marine sanctuaries, where fishing is limited, appear to be working. The surveys found higher numbers of certain key species there compared to other areas, which "is valuable to note," says Wilkinson.

Those arguing for new measures to protect reefs may soon get more ammunition. A NOAA report coming out next month highlighting reefs in the United States and U.S. Territories will include data from volunteer surveys, long-term research projects, and remote sensing. And by November, Wilkinson expects to finish a catalog of damage done to reefs, including an assessment of reefs' prospects. Both reports are expected to show widespread damage to reef communities. Gittings hopes the efforts will "continue the momentum" and draw attention to the plight of this marine resource. **–ELIZABETH PENNISI**

CREDITS: (TOP TO BOTTOM) JACK RANDALL; CLAUDINE BARTELS; SOURCE: NOAA

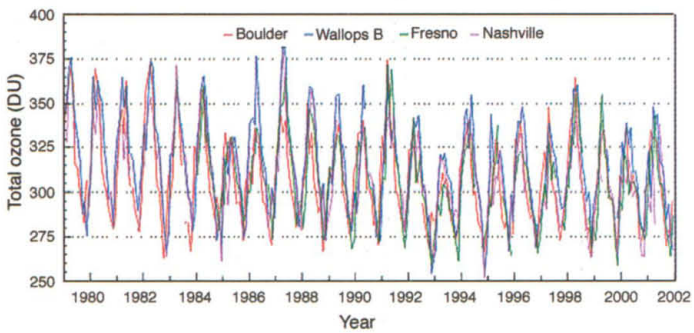
OZONE DEPLETION

A Brighter Outlook For Good Ozone

Things are looking up in the stratosphere. The latest quadrennial assessment of the state of the protective stratospheric ozone layer is just out, and the international report* from about 250 scientists finds that restraints on production of ozone-destroying chemicals such as chlorofluorocarbons are having the intended effect. The concentration of the prime offender, chlorine, is at or near a peak in the stratosphere. And an improved scientific understanding of stratospheric ozone is reassuring scientists that the world has probably seen the worst of ozone loss. Global ozone should soon begin increasing, fast enough that within the decade the infamous Antarctic ozone hole should start to shrink. All this assumes, of course, that signatories to the 1987 Montreal Protocol limiting emissions of ozone-damaging chemicals continue to meet their obligations and that the major remaining scientific uncertainty in ozone's future—climate change—doesn't spring a big surprise.

When the previous scientific assessment came out in 1998, prospects for stratospheric ozone were muddled. The great eruption of Mount Pinatubo in 1991 had spewed megatons of debris into the stratosphere, where it interacted with pollutant chlorine to accelerate ozone loss. As a result, global ozone plunged to a new low, complicating extrapolations of the rapid ozone losses seen in the 1980s. Most predictions called for ozone losses to worsen in the 1990s, particularly in the midlatitudes, where most people live. The Antarctic ozone hole had been deepening and widening at a frightening rate. And the first model to simulate how accumulating greenhouse gases affect ozone showed future Arctic losses ballooning, even as real Arctic ozone suffered a series of unprecedentedly bad years.

After four more years of observations and research, stratospheric ozone's future is looking clearer and brighter. The Antarctic hole is obviously hitting bottom over the South Pole each October. During the austral spring, as sunlight returns to the stratosphere, icy polar stratospheric clouds (PSCs) combine with chlorine to catalyze ozone destruction in the layer between 12 and 20 kilometers where PSCs can form. For the past decade, there's been no ozone left to destroy



Down but not out. Northern midlatitude ozone declined in the 1980s and took a hit from the 1991 Mount Pinatubo eruption but held its own in the 1990s.

*Executive Summary, UNEP/WMO Scientific Assessment of Ozone Depletion: 2002, available at www.unep.ch/ozone/pdf/execsumm-sap2002.pdf