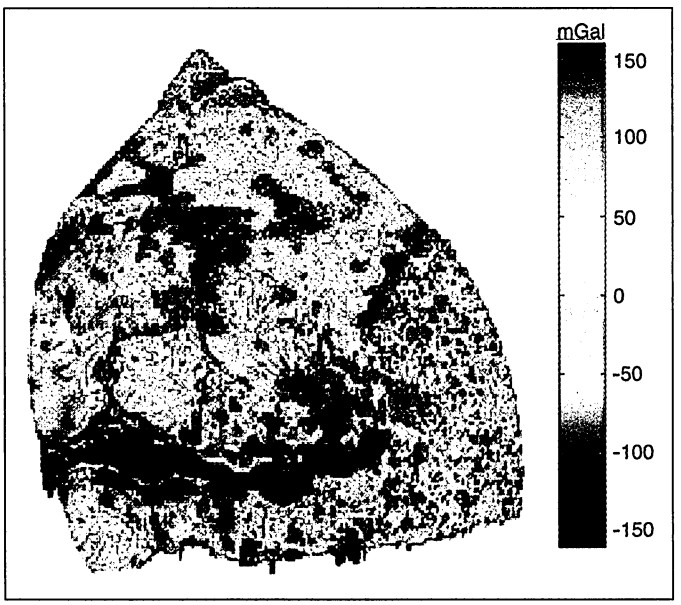
University and his colleagues marshaled a variety of MGS images and topographic data to suggest that the lowlands resemble an ocean basin that has been at least partially filled with water (*Science*, 4 December 1998, p. 1807, and 10 December 1999, p. 2134). But where would the water have come from? Catastrophic floods gushing toward the northern lowlands clearly cut deep channels into the edge of the southern highlands, but they would have been too infrequent and too small to have created and maintained an ocean in the freezing cold of Mars. And there's no sign of a Mississippi or Nile river that carried enough water to fill the lowlands.



Deep blues. Gravity lows (blues) leading northward from the long gouge of the Valles Marineris (bottom) may reveal buried channels.

The new gravity data from MGS may provide the answer. The varying pull of gravity from place to place on Mars causes MGS to bob up and down, motions that show up as Doppler frequency shifts in the spacecraft's radio transmissions. After accounting for gravity variations due to the undulating surface—the extra mass of volcanoes and the dearth of mass over deep basins—the remaining variations can be attributed to variations in subsurface density. The deeper the crust extends into the denser mantle or the deeper sediment fills a channel in the denser crust, the lower the gravity.

On a broad scale, MGS gravity has revealed a thinned crust beneath the northern lowlands, a sign of early plate tectonic–like processes on Mars (*Science*, 14 January, p. 218), but on a finer scale it shows a pattern that geophysicist Maria Zuber of the Massachusetts Institute of Technology and her MGS team members suggest marks a system of now-buried channels. Narrow zones of lower gravity extend from two clearly visible major flood channels—those leading from the Valles Marineris and Kasei Vallis into Chryse Planitia, the plain where the Viking 1 lander still sits. Doubting that the martian crust just happened to thicken along narrow zones that run out from two major flood channels, Zuber, Phillips, and their colleagues attribute the lower gravity to channels cut early in martian history filled with sediment less dense than crustal rock. And these channels are big: 200 kilometers wide, thousands of kilometers long, and at least 1 to 3 kilometers deep.

Such size "indicates that these outflows brought an awful lot of water to the lowlands," says Zuber, as well as a lot of sediment. The putative buried channels extend northward past the end of the flood channels at about 30°N, past the last signs of surface flow now put at about 45°N in MGS topography, to as far north as 75°N, which is well into the North Polar Basin. "You need a huge amount of sediment deposited in the northern part of Mars" to bury the channels, says Phillips. Presumably the sediment would have been carried by an equally huge amount of water.

Oceans of water in the first eon of martian history "may very well be correct," says Sleep. "The explanation they offer is a perfectly reasonable one," agrees planetary physicist David Stevenson of the California Institute of Technology in Pasadena, but "the problem with gravity is there are always other explanations." MGS geologist Michael Carr of the U.S. Geological Survey in Menlo Park, California, would prefer one of those. The gravity lows are real enough, he says, but they could reflect some thickening of the crust rather than sediment-filled channels. "I'm very skeptical," he says, because the flow paths indicated by the buried channels do not follow "what you can see in the topography."

Phillips isn't yet ready to insist on the reality of buried channels. "They could be something else, I suppose," he says. "It's a difficult hypothesis to test." He and his colleagues will be doing their best by checking whether the buried channels could be sloping downward all the way north and whether the highlands could have supplied all the sediment that the buried channels imply.

–RICHARD A. KERR

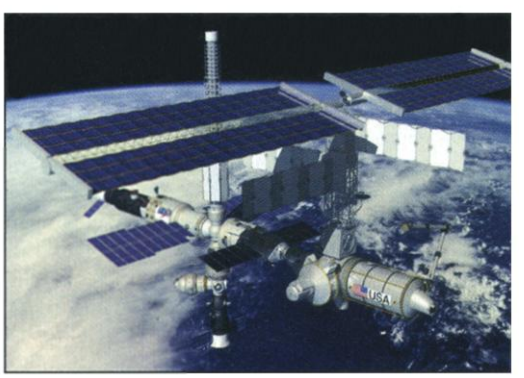
SPACE STATION BIOLOGY

Panel Says NASA Must Show Results—Fast

NASA should pull the plug on efforts to grow crystals in space unless it can show better results from its investment. That stern advice comes from a National Research Council (NRC) panel in a report (www.nap.edu/books/NI000245/html) that takes a critical look at the agency's oft-repeated scientific rationale for building the $100 billion international space station: using a microgravity environment to produce new crystals and to better understand cell growth in microgravity.

NASA spends nearly $20 million annually on cell science and protein crystal growth, which will shift to the space station in the coming years. But the NRC panel said that significant changes are needed to warrant continued support for crystallography. Reviewing years of work on the U.S. space shuttle and the Russian space station Mir, for example, the panel concludes that "one cannot point to a single case where a space-based crystallization effort was the crucial step in achieving a landmark scientific result." The panel also takes NASA to task for not dealing adequately with the perception that the agency is "not really interested in input from outside" in running its research program.

Eugene Trinh, the new NASA microgravity sciences chief, accepts much of the criticism but says the agency already is addressing most of the issues raised. "We're way ahead of this report," says Trinh, a former fluids researcher at NASA's Jet Propulsion Laboratory in Pasadena, California.



Weighty criticism. NRC panel says some microgravity studies need rethinking.

CREDITS: (LEFT TO RIGHT) ZUBER *ET AL.*; NASA

Protein crystals serve as a foundation for much basic science in biology as well as drug development, and the near-complete absence

of gravity in orbit offers the possibility of creating larger and purer crystals. But the more powerful beams coming from such new synchrotron sources as the Advanced Photon Source at the Department of Energy's Argonne National Laboratory outside Chicago are providing sharper pictures of these structures, making size less important. The role of microgravity in creating purer crystals is also ambiguous. Some 36 of 185 proteins and other biological macromolecular assemblies studied in space have shown higher resolution than the best results for those same materials on Earth, the panel notes, but it's not clear whether microgravity was the biggest factor contributing to those results.

Overall, the panel concludes that the impact of microgravity crystal work on structural biology "has been extremely limited." It urges NASA to fund competing work on Earth- and space-based crystals and to compare the results. If the results show no new breakthroughs from space-based projects, the panel warns, "then NASA should be prepared to terminate its protein crystal growth program."

Trinh says NASA will conduct such a competition and that the agency already intends to de-emphasize its former plans to grow crystals on a large scale. But he adds that the agency does not want to shut the door on potential commercial users of the station who might conduct crystal experiments. And Larry DeLucas, a crystallographer at the University of Alabama, Birmingham, says the past may not be a good guide to the future. He points out that the typical weeklong shuttle flight is often too short. "On the shuttle, 50% of our crystals grew too slowly" to be useful, he says. "The length of time is the real handicap," not the environment.

The panel also recommends that NASA reduce its emphasis on bioreactors, rotating vessels for growing cells aboard the station. The small amounts of data generated by the bioreactors, the difficulty in removing dead cells, and other technical issues could limit their usefulness, the panel members argue, and newer technologies, such as miniaturized culture systems and compact analytical devices, should be explored. But Trinh maintains that the bioreactors work well in the early stages of research.

Going beyond biotechnology, the panel also takes a swipe at NASA's practice of "borrowing" money from the pot allocated to new research facilities to pay for station construction. That trend, the panel members warn, will erode trust in the agency's user community, because "continual uncertainty is demoralizing and discouraging" and because researchers want to use the best facilities. If it continues, the report states bluntly, "NASA will send a clear message that science on the [space station] has a low priority and will alienate the research community even more."

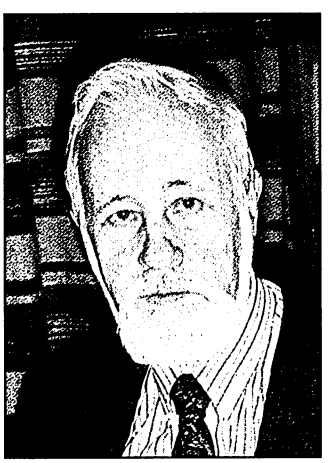
Another tough issue is how to undo the perception that NASA's biology program is a closed shop. Many of those involved in working groups or advisory committees "are ... the same people who make up the pool of grantees," the report notes. The panel urges the agency to expand its outreach efforts with the scientific community, and Trinh says NASA is doing just that. "We were really remiss," he says. "But once we open up our program to researchers in academia and industry, it will be easy to show that we are not parochial."

–ANDREW LAWLER

SCIENTIFIC COMMUNITY

Duo Dodges Bullets in Russian Roulette

One is in the twilight of his career, a physicist virtually unknown beyond Russia's borders. The other is an oceanographer in his prime, a rising star outside his native Ukraine. What these two have in common is a tribulation that once spelled death for a scientific career, if not for the accused himself: Each was charged with a serious crime by his country's security apparatus. Now the two share happier circumstances. Last month, both won victories suggesting that the judicial systems in the young democracies of Russia and Ukraine are not inclined to rubber-stamp trumped-up accusations against scientists.



KGB target. Physicist Vladimir Soyfer is hoping for exoneration.

In one case, 70-year-old Vladimir Soyfer of the Pacific Oceanological Institute in Vladivostok had been accused by the Federal Security Bureau (FSB), the successor to the KGB, of mishandling classified data. He won an initial court battle on 11 February, when a judge in Russia's Far East ruled that the FSB obtained the evidence on which the charges were based through an illegal search. The FSB has appealed the ruling, but if allowed to stand, it would cripple the FSB's case, observers say.

The second researcher, Sergey Piontkovski, 46, of the Institute of Biology of the Southern Seas in Sevastopol, Ukraine, got even better news. He was preparing to stand trial on charges of financial improprieties relating to his Western grant when, on 25 February, the local prosecutor dropped the charges soon after meeting with a delegation from the European agency whose grant was at the center of the controversy.

These victories, along with the recent acquittal of a Russian environmental activist, are huge morale boosters for former Soviet scientists, who have forcefully and publicly defended their colleagues. "It is a very important sign for me. I used to believe that the court is always on the KGB's side," says Valentina Markusova of the All-Russian Institute of Scientific and Technical Information in Moscow.

Before it dissolved in 1991, the Soviet Union was notorious for making its citizens pay for opposing its policies or getting too cozy with Western colleagues, and scientists were no exception. The constant was a presumption of guilt, until glasnost in the late 1980s laid the groundwork for the almost libertarian freedoms briefly enjoyed by Russians after the Soviet Union's dissolution. The pendulum soon swung back, however. In 1994, for example, Russia's security service charged a former chemical weapons researcher, Vil Mirzayanov, with revealing state secrets about a new class of nerve gas (*Science*, 25 February 1994, p. 1083). The arrest sparked an international outcry, and charges against Mirzayanov were subsequently dropped. Nevertheless, arrests of scientists and environmentalists have continued.

Among those seized was activist Aleksandr Nikitin. He was charged with espionage and divulging state secrets after co-authoring a report for Bellona, a Norwegian environmental group, on nuclear contamination from Russia's Northern Fleet. Last December, a judge in St. Petersburg acquitted Nikitin, a former nuclear safety inspector and retired Navy captain, and last month, the American Association for the Advancement of Science (which publishes *Science*) gave him, in absentia, its 1999 award for scientific freedom and responsibility. But Nikitin is not yet out of the woods. His case is on appeal, and he has not received his passport for foreign travel.

Only weeks ago, prospects were looking much bleaker for others who had been accused. Take Soyfer, whose nightmare began on 26 June 1999, when FSB agents raided his office, then descended on his home a week later. During the second raid they seized papers related to Soyfer's research on Chazhma Bay off Vladivostok, which was contaminated with radioactive materials after an accident involving a Soviet nuclear submarine in 1985. The work—sponsored by the Ministry of Atomic Energy and done

CREDIT: R. STONE