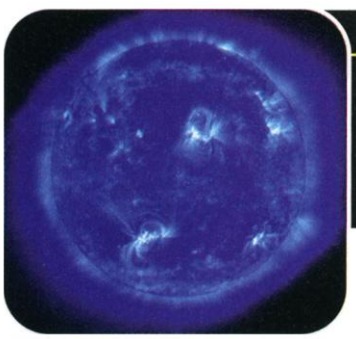
Solar scientists are scrambling to put their stamp on NASA's new Living With a Star initiative, a billion-dollar program to study the sun that faces obstacles in Congress

Controversy Flares Up Over NASA Solar Project

Ancient astronomers thought the sun was the most important object in the heavens. But in recent times, solar astronomy has been left in the shade by dramatic images of celestial wonders ranging from colorful nebulae to channels cut by springlike seeps on Mars. NASA, the primary federal source of funding for studies of the sun and its impact on the solar system, devotes only about 10% of its annual $2 billion space science budget to such research.

This year, however, was supposed to be solar physicists' moment in the sun. In February, the president requested a $20 million downpayment on a 12-year, $1-billion-plus effort, called Living With a Star, to launch a flotilla of satellites to study the sun and the streams of particles it hurls into space. The data are expected to give researchers critical insight into the sun's inner workings as well as a window on space weather, which has a profound effect on Earth's climate as well as terrestrial communications. The program seemed to have everything going for it, including the backing of space scientists, NASA chief Dan Goldin and the White House, and influential senators.

But instead of ushering in a new dawn for solar science, the initiative has become mired in controversy that includes a bureaucratic tug-of-war, a debate over research goals, and questions about the propriety of a lucrative contract to manage it. The saga shows how, in the trenches of Washington politics, what seem like assets can quickly turn into liabilities, and how researchers must compete with other interests for organizing and running a big science program. NASA officials are convinced that the project will survive, but the rough-and-tumble politics have upset and perplexed the effort's scientific supporters, a community generally naïve in the ways of Washington. "I thought I was buying a ticket to the ballet, but I ended up at a wrestling match," says Arthur Poland, the lead scientist for sun-Earth programs at NASA's Goddard Space Flight Center in Greenbelt, Maryland.



Solar Sentinels

Focus:	Solar surface, wind, and seismology
Cost:	$600 million
Spacecraft:	Five
Launch Date:	2008–09

Hot spot. The pulsating disc of the sun as seen by Europe's SOHO (Solar and Heliospheric Observatory) satellite.

What Poland and other researchers have proposed is a network of satellites ringing the sun and Earth that would monitor solar variability, solar wind, and the interactions of the sun with Earth's magnetosphere and ionosphere (see gallery of images). The first mission, a spacecraft with four main instruments to study solar dynamics, would be launched late in 2006. Two years later, NASA would begin launching several satellites to examine how the sun affects Earth's magnetic field and atmosphere, followed by a series of spacecraft that would closely circle the sun and study the solar cycle. "This will provide terrific data and great opportunities for scientists to understand space weather," says Richard Behnke, a program manager at the National Science Foundation (NSF). The price tag is estimated at $500 million over the next 5 years and between $1 billion and $1.5 billion over its lifetime, according to Gilberto Colon, the Goddard program manager.

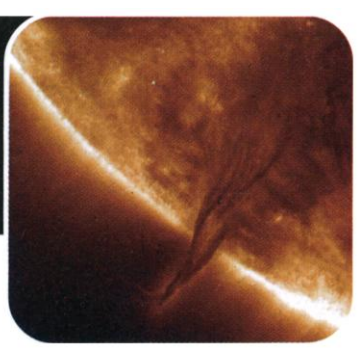
The idea for such a network goes back to the mid-1980s. But other missions with wider popular appeal, like the Hubble Space Telescope or Mars Pathfinder, repeatedly pushed it down the priority list. "We are a field accused of studying wiggles on a graph," says Dan Baker, a space physicist at the University of Colorado, Boulder. "To convey our work in a visual way was difficult." Graduate students were drawn to more vibrant fields, leaving in place gaps created by a spate of retirements. In addition, the field's interdisciplinary nature hindered an effective grassroots lobbying campaign. As a result, as other areas of space exploration blossomed, Baker laments, "we were going out of business."

The turnaround came after Europe's Solar and Heliospheric Observatory (SOHO), launched in 1995, began returning stunning pictures taken by a Goddard telescope. Other small spacecraft have since filed other images. Researchers hoped to parlay the popularity of those pictures and interest in the current peak in solar activity into a 2002 budget initiative. But NASA did them one better. A presentation last August by George Withbroe, who manages NASA's sun-Earth programs, was so successful that Goldin decided to jam Living With a Star into this year's request, and the White House agreed.

Solar Dynamics Laboratory

Focus:	Interior, dynamics of solar atmosphere
Cost:	$300 million
Spacecraft:	One
Launch Date:	2006

With flare. A solar prominence caught by NASA's TRACE (Transition Region and Coronal Explorer) spacecraft.



CREDITS: (TOP TO BOTTOM) SOHO/ESA/NASA; TRACE/NASA

Home-field advantage

Maryland politicians, apprised in January of the new initiative, were enthusiastic. With a nod from the White House, Democratic Sen-

ators Barbara Mikulski and Paul Sarbanes announced the effort just before President Bill Clinton released his budget request on 7 February. "This means jobs today and jobs tomorrow," declared Mikulski. Nine days later, Goddard managers published a notice of their intent to award a sole-source contract to manage the project to the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland. The contract, according to the notice, would run for 12 years and be worth $600 million.

The announcement upset much of the solar science community. Goddard scientists, caught by surprise, wondered if the arrangement signaled a diminished role for their center. Industry officials complained that they were being blocked from competing for the contract. Republican House members bridled at a major government program moving forward without competition. The notice even rattled the White House, which sought an explanation.

"It was terrible," says Andrew Christensen, chair of NASA's sun-Earth advisory panel and a space physicist at The Aerospace Corp. in El Segundo, California. The decision, he says, "unfortunately has politicized the program." Judith Karpen, chair of the American Astronomical Society's solar physics division and a Naval Research Laboratory researcher, warned that "the likelihood for success for any mission will be greatly compromised" if APL is given control over the initiative. In a 3 March letter to William Townsend, Goddard deputy director, she also noted Goddard's success in planning and managing previous sun-Earth missions, including SOHO, and criticized "the unprecedented degree of secrecy" surrounding the choice of APL.

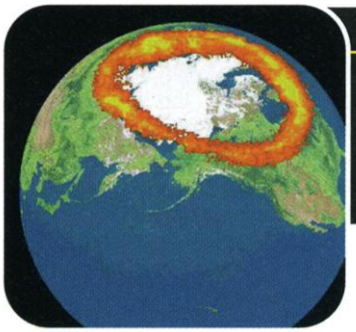
Researchers, industry lobbyists, and congressional staffers see the arrangement as a bid by Goldin to curry favor with an influential legislator—Mikulski is the ranking Democrat on NASA's spending panel—by propping up a key research facility in her state. APL, with 3000 employees, has seen its mainstay military contracts dwindle in recent years. As evidence, an industry source cites a meeting this spring with Mikulski in which the senator told corporate leaders to accept the fact that APL had won. "We were told not to disrupt the program," adds one industry official. But Mikulski aides dismiss such talk. "There was no deal," says a spokesperson. "She has nothing to do with assigning contracts."

The arguments over the contract quickly caught the attention of House Republicans. After getting wind of industry and research community concerns, Representative James Sensenbrenner (R–WI), who chairs the House Science Committee, asked NASA's Inspector General (IG) in April to look into the matter. In June, at Sensenbrenner's urging, the House spending panel with oversight of NASA's budget denied funding in part because of its concerns surrounding the contract. Earlier this month, NASA's IG issued a report finding "insufficient justification for NASA's decision to award this contract on a sole-source basis to APL." Last week, Sensenbrenner wrote a letter to Goldin asking him to "remove the cloud of uncertainty" hovering over the program by holding a competition.

But, true to the smoke-and-mirrors nature of Washington politics, some congressional sources say the House criticism is not what it seems. Instead, they see the attacks as part of an effort to win concessions from Mikulski and her Senate colleagues on other programs when the two bodies meet this fall to hammer out NASA's 2001 budget.

For their part, NASA and APL managers say that the criticism is misguided. "The IG's findings are a huge misunderstanding" riddled with "factual errors," says Tom Krimigis, a magnetosphere physicist and chief of APL's space department. A NASA response to the study labels it "inaccurate." NASA managers say they haven't ceded control over the project to APL, and that headquarters will decide where individual spacecraft will be built. "A lot of people assume this [means the initiative] is going lock, stock, and barrel to APL," says one agency official. "That's not the case."

Instead, agency officials say the decision to award a management contract to APL, which has a long history of managing space projects, is intended to ensure that the Maryland lab retains its space capabilities over the next decade. Other organizations, such as APL's archrival, the Jet Propulsion Laboratory in Pasadena, California, have received similar contracts, they add.



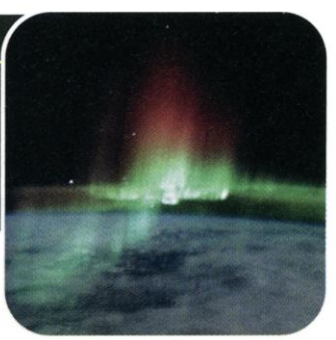
Radiation Belt Mappers

Focus:	Origin and dynamics of radiation belts
Cost:	$150 million
Spacecraft:	Two to six
Launch Date:	2008

Heaven-sent. A layer of charged particles rings Earth's North Pole in this composite image by NASA's Polar satellite.

Ionospheric Mappers

Focus:	Effects on Earth's atmosphere
Cost:	$150 million
Spacecraft:	Two to six
Launch Date:	2009



Light show. NASA's ACE (Advanced Composition Explorer) spacecraft captures this aurora moving through Earth's ionosphere.

Applied backlash

Another controversy over the program also stems from what seems at first glance like an asset. When NASA officials briefed staffers on Sensenbrenner's panel in February, they emphasized the potential applications that could flow from the program, including the ability to issue timely warnings of pending communications outages due to solar storms. That strategy appears to have backfired, however. Republican staffers "came unglued" by all the talk about benefits, according to one participant. If the effort was about applications rather than basic research, the staffers argued, then the Defense Department and the National Oceanic and Atmospheric Administration should help pay for it.

NASA officials, wary of interagency programs after a long and bitter battle over control of the remote-sensing Landsat satellites (*Science*, 30 June, p. 2309), were horrified by the suggestion. Researchers were equally dismayed, flashing back to a protracted debate in the mid-1990s over the relative merits of basic and applied research. Living With a Star, they say, is an effort to understand the complex interactions of the sun and Earth and is firmly rooted in basic research. "There is elegant science to be done," says Karpen. But the applied side should not be ignored, she adds, contrasting it with other fields of astronomy that "have nothing to do with whether your cell phone works." NASA and outside researchers are trying to repair the damage, but the House spending bill takes the program to task for its

CREDITS: (TOP TO BOTTOM) POLAR/NASA; ACE/NASA

emphasis on applications.

Yet another challenge is the short time available to flesh out the program's details and win the research community's full backing. The accelerated timetable has left many researchers feeling left out of the process. "Many people are miffed," says one. The current Goddard plan has not been well received by many outside scientists, who worry that the myriad spacecraft and instruments don't add up to a coherent package. "The community is delighted with the idea of Living With a Star, but there is room for reexamination," says NASA adviser Christensen. "There is a feeling we need to take a more systematic look."

NASA's Withbroe acknowledges that tension. "People are not terribly happy out there," he says. To address that concern and to avoid the kinds of mistakes that have hampered NASA's Mars program, the agency is creating an independent advisory panel to help develop a clearer and more acceptable plan. "We have the building blocks, and now we want to have a set of architects make sure they fit together," says Withbroe.

With the program ensnarled in controversy, outside researchers face the task of mobilizing a field that has never before been asked to go to bat for a program of this magnitude. "I don't think this community is very effective," says Louis Lanzerotti, a space physicist with Lucent Technologies in Cherry Hill, New Jersey. "And it's a damn pity." Colorado's Baker expects the controversy to be a learning experience for most researchers. "Only a few people in the community have been [politically] active," he says. "For the most part, people have been a little too content to let things play out."

Observers predict that Mikulski will triumph this fall in winning funding for the program and for APL. If that happens, the next step will be to maximize the project's scientific value without alienating the politicians who foot the bill. "We really don't like this [APL] deal—we think it stinks—but we don't want it to sink Living With a Star," says one solar physicist. Adds Christensen: "We want to get the program approved, so we don't want to torpedo it by being too negative."

Proponents are rooting for the solar community to demonstrate that it can play in the scientific big leagues. "It's a great program, and it's a real shame it started off on the wrong foot," says NSF's Behnke. "Let's hope it recovers." **–ANDREW LAWLER**

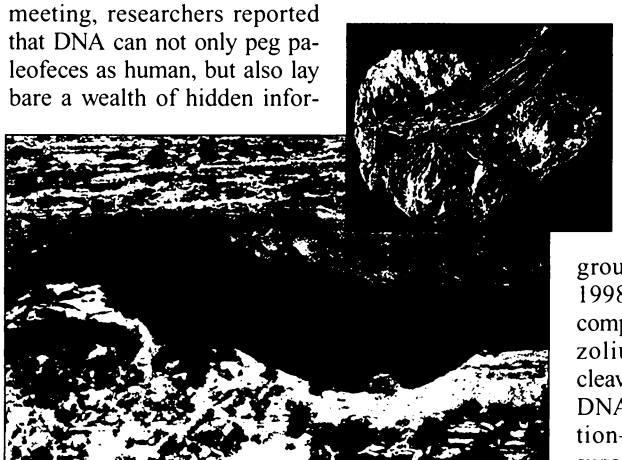
MEETING 5TH INTERNATIONAL ANCIENT DNA CONFERENCE

Divining Diet and Disease From DNA

MANCHESTER, U.K.—Some 110 scientists from a range of disciplines gathered in the overcast British midlands for the 5th International Ancient DNA Conference, held here from 12 to 14 July. Among the attractions were successful DNA extractions from human dung and from mammoth bones.

Tales of Paleofeces

What you eat can reveal a lot about your lifestyle and health. That's why archaeologists try to piece together ancient diets by picking through campsites for bones, seeds, and other leftovers. What you excrete can reveal even more. It's no piece of cake, however, to identify paleofeces or coprolites—the polite words for ancient poop—as human. Even then, the contents may have been chewed and digested beyond recognition. At the meeting, researchers reported that DNA can not only peg paleofeces as human, but also lay bare a wealth of hidden information on diet. "This is really neat," says longtime paleofeces examiner Karl Reinhard, an archaeologist at the University of Nebraska, Lincoln. "It will expand our ability to identify the total diet and use of natural resources."



Pit stop. The Hinds Cave rock shelter, where prehistoric hunter-gatherers left the digested remains of their meals, including this 6-cm specimen *(inset)*.

CREDITS: V. BRYANT/TEXAS A&M; (INSET) K. SOBOLIK/UNIVERSITY OF MAINE

Dry, cool caves were not only a good place to live in prehistoric days, they would seem to offer decent enough environmental conditions to preserve DNA. Still, the hunt for DNA from cave samples of paleofeces proved frustrating until 2 years ago, when Hendrik Poinar and Svante Pääbo, then of the Max Planck Institute for Evolutionary Anthropology and Zoological Institute in Munich, Germany, pioneered an approach to release DNA trapped inside the 20,000-year-old dung of extinct ground sloths (*Science*, 17 July 1998, p. 402). The secret was a compound called *N*-phenacylthiazolium bromide (PTB), which cleaves sugar bonds that entangle DNA and prevent its amplification—a particular problem for sugar-rich paleofeces. Since then, Poinar—now at the Max Planck Institute for Evolutionary Anthropology in Leipzig—and his colleagues have shown that the technique works for paleofeces of an extinct mountain goat and a different ground sloth from Patagonia, Chile. But their failed attempts to extract DNA from Egyptian mummies had discouraged them from tackling human paleofeces.

Then Kristin Sobolik, an archaeologist at the University of Maine, Orono, suggested they try paleofeces from Hinds Cave, a well-studied prehistoric rock shelter in the Lower Pecos River area of Texas. Thousands of specimens, ranging in age from 8500 to 500 years old, have been collected, but only a few analyzed. Poinar was game, so Sobolik sent the lab five of the fist-sized nuggets ranging in age from about 2100 to 2400 years old.

The PTB method worked like a charm. Poinar pulled out human mitochondrial DNA and found sequences, called haplogroups, that are known to be Native American. (An independent lab has replicated the findings.) The group next extracted chloroplast DNA, from which they matched sequences to buckthorn, acorns, sunflower, a shrub called ocotillo, and a kind of nightshade, probably wild tobacco. Sobolik examined the samples under a microscope but could see no remnants of these plants. (On the other hand, cacti and rodents found by Sobolik did not show up in the molecular analysis.) Both the DNA and visual methods identified traces of legumes, yuccas, and elm, which may have been used to brew tea.

The paleofeces also contain visible bones of pack rats and mice, as well as fish scales. Poinar didn't find DNA from these, perhaps because the samples that he tested lacked the tiny bone fragments. However, he did find sequences for sheep and pronghorn antelope, bones of which have not been found in Hinds Cave. That suggests that the large game was killed and eaten elsewhere,