field and marine stations and new sites. A second workshop this fall will prepare recommendations for NSF, says Siegel-Causey.

Meanwhile, a smaller NSF initiative is nearing the starting gate. That's a plan to spend $2.5 million in 1999 to set up microbial observatories at half a dozen existing field stations, with the intention to double or triple that number in 2000. The money would fund research that extends existing studies ranging from identifying new species and sequencing DNA to measuring nitrogen fixation and other biogeochemical processes. "For far too long, microorganisms have been a black box," says Colwell. "But it turns out that they play a fundamental role in everything."

The two initiatives would dovetail nicely, says Siegel-Causey: "I could imagine one station having adjacent plots of land labeled microbial and biodiversity observatories." But he says the biodiversity observatories initiative, once unveiled, could well be a far more ambitious project than the microbial stations: "We're thinking an order of magnitude larger." Not quite astronomical proportions, maybe, but a big step for environmental researchers and taxonomists. —JEFFREY MERVIS

CITATION ANALYSIS

Harvard Tops in Scientific Impact

Harvard University wins bragging rights in the latest ranking of U.S. research universities, according to the September/October *ScienceWatch*. It not only churned out more papers than any other university between 1993 and 1997, but the work was rated as having higher scientific impact across the board.

The Philadelphia-based Institute for Scientific Information, which publishes *ScienceWatch*, tracks citations from hundreds of scientific journals. To rank the top 100 federally funded universities in 21 separate fields, *ScienceWatch* worked out the average number of times that papers from researchers at each institution were cited in another paper. These scores were then calculated as a percentage above or below the world average for papers in the same field, to yield an estimate of their "relative impact." In clinical medicine, for example, papers from Johns Hopkins University were cited, on average, 9.19 times—129% above the world average for the field. Chris King, who edits *ScienceWatch*, says the calculation "represents what scientists think is important in their field when they write papers."

Harvard placed in the top 10 in 17 of the 21 categories, *ScienceWatch* reports. It was followed by Stanford University (13 top-10 placings), California Institute of Technology (Caltech) with 11, Yale University (9), the University of Michigan (9), Massachusetts Institute of Technology (MIT) with 8, University of California (UC) Berkeley (7), University of Washington (6), UC Santa Barbara (6), Cornell University (6), and UC San Diego (6).

Although the overall rankings were based on performance in all fields of science, *ScienceWatch* published rankings in only nine biological science fields in the current issue; it plans to publish the rankings in the physical sciences and some social science fields in its next issue. The biology rankings indicate that quality does not always go hand in hand with quantity. In neuroscience, for example, Caltech came out on top for relative impact, publishing 395 papers compared to Harvard's 2419. Washington University in St. Louis ranked first in immunology with only a third as many papers as number two Harvard, and MIT had the highest relative impact in molecular biology and genetics with a fraction of Harvard's publication rate. The same held true for the rankings of biology and biochemistry, which Duke University topped. —AMY ADAMS

Amy Adams is a science writer in Santa Cruz, California.

TOP UNIVERSITIES IN BIOLOGICAL SCIENCES

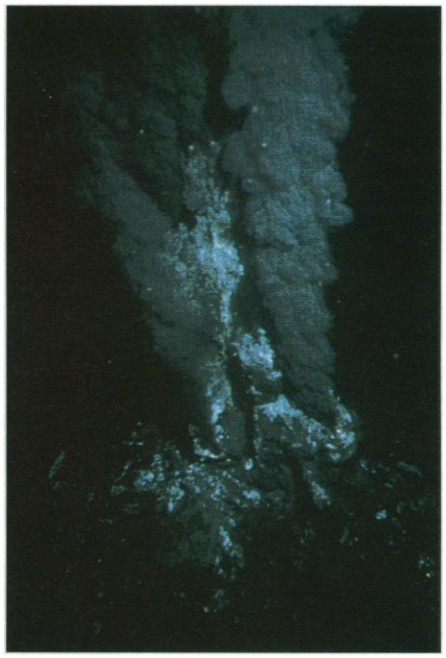
Institution	# of papers	Relative impact*
Neuroscience		
Caltech	395	135
Stanford University	911	106
Johns Hopkins University	1558	105
Immunology		
Washington University	551	140
Harvard University	1668	107
Stanford University	631	87
Molecular Biology and Genetics		
MIT	823	239
Rockefeller University	547	213
Harvard University	3064	149
Biology and Biochemistry		
Duke University	1446	130
Univ. of Texas Southwestern Medical Center, Dallas	1377	124
Harvard University	4525	123

* Citations per paper as percent above world average for that field.

ORIGIN OF LIFE

A Biomolecule Building Block From Vents

In 1952, University of Chicago chemists Stanley Miller and Harold Urey staged a simple demonstration that transfixed other scientists pondering the origin of life. They showed that a mixture of ammonia, methane, hydrogen, and water yielded amino acids—the building blocks of proteins—when zapped with the lab equivalent of a lightning bolt. The demonstration was hailed as a re-creation of a likely first step toward life. But critics later dubbed the experiment a creation rather than a re-creation, pointing out that whereas inert nitrogen gas (N_2) would have been abundant on the early Earth, the reactive forms needed to make amino acids, such as ammonia (NH_3), would have been scarce. "The formation of ammonia has always been a big problem for origin-of-life scenarios," says Jim Ferris, a chemist at Rensselaer Polytechnic Institute in Troy, New York.



J. EDMOND/WHOI/VISUALS UNLIMITED

Pressure cooker. Minerals formed at deep-sea vents like this one could have catalyzed the formation of ammonia.

Now, a team of researchers at the Carnegie Institution of Washington, D.C., report in this week's issue of *Nature* that they may have found a major source of early ammonia: the hot springs on the deep sea floor. In a series of laboratory tests, the researchers found that minerals deposited there make efficient catalysts for converting nitrogen into ammonia at the high temperatures and pressures of the vents. And because the vents continuously heat up and spew out huge volumes of water, says study leader Robert Hazen of the Carnegie Institution of Washington's Geophysical Laboratory, they could have churned out enough ammonia to set the stage for life's beginnings—either at the surface, perhaps sparked by lightning, or at the vents themselves. "If these guys have come up with an abundant source of ammonia, that's an important step forward," says Ferris.

The new study isn't the first to propose a source of ammonia in the prebiotic Earth. Other teams previously suggested that ferrous iron dissolved in water or titanium dioxide particles in desert sands could have converted N_2 to ammonia. But these reactions probably would have been too slow to keep pace with the destruction of ammonia by the sun's ultraviolet rays as it wafted into the atmosphere.

Hazen wondered whether the high pressures and temperatures found at deep-sea vents could have sped things along. Such vents line the midocean ridges, where magma wells up to form new ocean crust. Cool water seeps through fissures in the crust, hits the superheated rock near the magma, and roars back upward at temperatures of up to 350 degrees Celsius. Iron and sulfur dissolved in the hot water then rain out as it emerges from the vent and cools, depositing minerals such as pyrite (FeS_2), pyrrhotite ($Fe_{1-x}S$), and magnetite (Fe_3O_4).

These minerals, Hazen thought, might act as catalysts for ammonia production. Testing the idea at present-day vents was impractical, because ammonia from microorganisms would swamp any ammonia made by the minerals. So Hazen, postdoc Jay Brandes, and their Carnegie Institution colleagues devised a laboratory test by combining a vent mineral, a nitrogen source such as N_2, nitrite (NO_2^-), or nitrate (NO_3^-), and water, then cooking the mixture at varying temperatures and pressures. The results were unambiguous. In most ventlike conditions, the minerals turned into little ammonia factories. At 500 degrees Celsius and 500 atmospheres of pressure, for example, pyrrhotite converted up to 90% of the nitrate to ammonia in just 15 minutes. At lower temperatures of about 300° to 350°C, Hazen says, the ammonia conversion was still as high as 70%. Even powdered basalt, the stuff of the sea floor itself, seemed to do the catalytic trick.

"It could be that this is the dominant mechanism" for forming ammonia on the early Earth, says Chris Chyba, an early Earth expert at the Search for Extraterrestrial Intelligence Institute in Mountain View, California, and Stanford University. Still, Chyba says it's hard to say exactly how much would have been produced, as so little is known about conditions in the planet's early days. But Chyba notes that if vents did churn out ammonia, this could help explain another mystery: the faint young sun paradox.

Researchers have long known that early in Earth history, the sun only put out about 70% of the light and heat it does today. The oceans and all other surface water should have frozen, yet life's early appearance on the planet suggests liquid water must have been present. Abundant ammonia resolves this dilemma, says Chyba, because as a powerful greenhouse gas it could have helped trap the sun's warmth. If so, Chyba says, "it suggests that there may have been an important synergy between subsurface and surface environments that helped life get its start."

–ROBERT F. SERVICE

U.S. FOREIGN POLICY

Panel Calls for Science-Savvy Diplomats

Diplomacy is often noted for its slow pace and bland language. But last week an unusually fast-moving National Academy of Sciences (NAS) panel offered the U.S. State Department some plain-spoken suggestions for improving the quality of the scientific advice available to makers of foreign policy. Although government officials say they welcome the input, many observers are skeptical that it will lead to significant changes.

> "It's not difficult to get good scientific advice. ... The real trick is knowing when to ask for it."
>
> —Robert Frosch

The interim report* is the latest in a long line of well-meaning but often ignored reports aimed at helping the department cope with a growing array of technology-based issues, ranging from bioterrorism to biotechnology (*Science*, 15 May, p. 998). It comes less than 4 months after Secretary of State Madeline Albright asked for outside guidance on shoring up the diplomatic corps' sagging expertise in science and technology. In recent years, scientists have criticized the department for undermining its already slim scientific capabilities by abolishing embassy and headquarters positions once filled by science-savvy foreign service officers.

The NAS panel outlines nine "immediate and practical" steps Albright could take to increase the State Department's sensitivity to science and technology issues. The suggestions range from appointing one of her five undersecretaries as a science czar who would integrate science, technology, and health issues into top-level decisions to creating a new external advisory board. A State Department official says senior administrators "are grateful that the committee responded in such a quick and highly focused manner" and are organizing a task force to "digest the report and examine its financial implications" as they assemble their request for the fiscal year 2000 budget.

But panel members say money shouldn't be an obstacle. "There are ways to do some of this on the cheap," says panel leader Robert Frosch of Harvard University's Kennedy School of Government in Cambridge, Massachusetts. For instance, Frosch says adopting a new policy on integrating scientific concerns into day-to-day diplomacy doesn't require new spending, nor would building closer ties to knowledgeable staff at other government agencies.

At the same time, the panel concedes that some solutions will cost money. One is to create about a dozen new positions at headquarters for science and health experts, with half assigned to the 130-person Bureau of Oceans and International Environmental and Scientific Affairs. The committee also proposed strengthening scientific posts at a handful of key embassies, as well as spending up to $500,000 per year on a scientific advisory board to help staff with cutting-edge issues, such as the impact of the Internet on foreign relations. The costs of making such moves, the committee concludes, "seem modest given the stakes involved."

Other recommendations are aimed at changing a State Department culture that has discouraged career staff from taking a professional interest in science. Becoming an embassy science attaché is often viewed as a "kiss of death" among foreign service officers hoping for promotion, says Frosch. To combat that trend, the panel wants the department to encourage young diplomats to learn more about the growing role of science in foreign affairs and to provide a career ladder for scientifically literate employees. Details will be included in the committee's final report, due out sometime next year.

In offering its suggestions, the NAS panel acknowledged that it's not the first committee to offer suggestions for injecting more science into foreign policy. "Over the years, the department has gotten a lot of advice on

* "Improving the Use of Science, Technology, and Health Expertise in U.S. Foreign Policy," an interim report of the National Research Council Committee on Science, Technology, and Health Aspects of the Foreign Policy Agenda of the United States (http://www.nap.edu/readingroom/enter2.cgi?NI000955.html)