The war in Afghanistan and rising tensions in the Middle East have temporarily put on hold efforts by scientists from Islamic nations to strengthen ties among themselves and with the West

Collateral Damage

Farouk El-Baz led the team that chose where the Apollo landers set down on the moon. So mapping groundwater on the Arabian Peninsula figured to be a cinch for the Egyptian-born director of Boston University's Center for Remote Sensing. But that was before the 11 September terrorist attacks on the United States. The planned trip to Sharjah in the United Arab Emirates (UAE) for fieldwork has been put off indefinitely, he says, because "people just didn't feel right" about traveling there now.

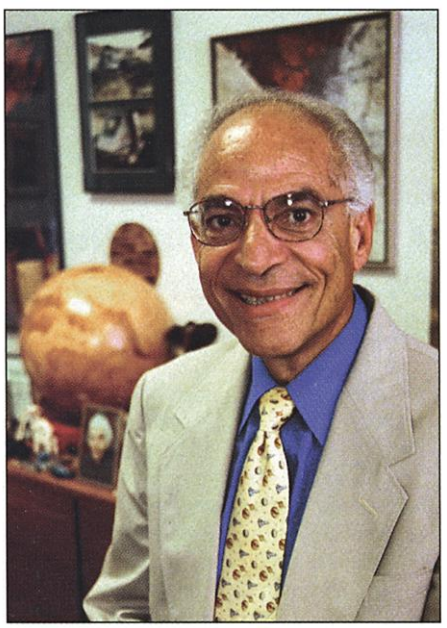
The suspension of such collaborative projects, of course, cannot be compared on any scale to the tragedy of the attacks and the current war in Afghanistan. But they pose a significant interruption to what in the last few years has been a loosening of the ideological shackles on Islamic science. Increasing ties with Western colleagues over the past decade have allowed researchers in many Islamic countries to convince their leaders of the value of science. In the Islamic world, "the tragedy has been a lack of comprehension of how important scientific research is to development," says Abdulkarim Al-Eryani, a Yale University–trained microbiologist who now serves as political adviser to Yemen President Ali Abdullah Saleh.

One vehicle currently being pursued for stimulating science in the region is a nascent agency, based in the UAE, that would be modeled on the U.S. National Science Foundation (NSF). Some opinion-makers are also arguing for a Marshall Plan to restore the Islamic world in the same way the huge U.S.-led investment helped rebuild Europe after World War II. "The gap is far too wide between the haves and the have-nots, and science would be a wonderful vehicle to help bridge that gap," says Egyptian-born chemist Ahmed Zewail, director of the Laboratory for Molecular Sciences at the California Institute of Technology in Pasadena and the first Arab (and second Muslim after Abdus Salam of Pakistan) to win a Nobel Prize in science.

But progress on such ideas has been halted by the tensions stemming from the war in Afghanistan and the continuing Palestinian intifada. And there is risk of a permanent setback. "Damage to long-term relations and scientific collaboration can be limited only if the Afghan war is short and targeted against the criminals," says chemist Atta-Ur-Rahman, Pakistan's minister for science and technology.

Voices in the wilderness

A thousand years ago, Muslim scientists were pioneers in astronomy, theoretical physics, and mathematics, and they invented algebra. "The Islamic world was a cradle of scientific innovation, creativity, and advancement at the beginning of the last millennium," noted Iran's president, Mohammad Khatami, at a meeting of the Third World Academy of Sciences in Tehran last autumn. Islam, he said, values thinkers and scientists because acquiring knowledge "prepares the believer to practice his duties with perfection."



Laying a foundation. Farouk El-Baz helped the Sultan of Sharjah launch one scientific tool essential to the Arab world: a foundation that will hand out peer-reviewed grants.

Over the centuries, however, that message was diluted as Islam's spiritual leaders began to reject European ideas and innovations. "We inherited a Dark Age of refusing new thinking and theories," says Al-Eryani, who adds that in some Islamic countries, "science has become a slave of religion." Perhaps the most obvious clash is over the theory of evolution, which isn't even mentioned in textbooks in some Islamic countries. Darwinism "has essentially been banned" in Yemen and many other nations, says Al-Eryani, although in his view "there is no contradiction between Darwinism and religious faith."

Despite the skepticism of clerics and the growth of Islamic fundamentalism, the past decade has seen shoots of scientific growth in many Islamic countries. The most recent available statistics for the Arab world, from the United Nations Educational, Scientific and Cultural Organization's (UNESCO's) *World Science Report 1998*, put R&D spending at $780 million in 1996—a mere 0.14% of the region's gross domestic product, but a 43% rise over 1992 levels. Four countries—Egypt, Kuwait, Morocco, and Saudi Arabia—accounted for 72% of this R&D spending, but the growth has been widespread. In addition, Iran, not classified as an Arab nation in the report, last year spent about $350 million on research and higher education (*Science*, 24 November 2000, p. 1484).

Helping fuel enthusiasm for science was Zewail's Nobel in 1999, a solo award for his pioneering use of ultrafast spectroscopy to study chemical reactions. "There was great rejoicing throughout the Arab world," recalls Zewail, who used his influence to persuade Egypt's leaders to start building a new science and technology university near Cairo. However, the country's economic woes and the Middle East turmoil have slowed the project since a groundbreaking ceremony early last year.

One place where the scientific awakening is especially evident is Yemen (see sidebar). Emerging in the 1960s from self-imposed isolation, the oil-poor nation has pushed hard to foster scientific cooperation in the region. Yemen's government has organized a major meeting in each of the past 4 years, including one earlier this month, aimed at brokering regional ties in all fields of science. Nurturing this scientific enlightenment are key individuals such as Al-Eryani and Moustafa Bahran, a neutrino physicist trained at the University of Oklahoma who is science adviser to Yemen's president. "We want science to be integral to the fabric of the country," says Bahran. "Nobody in his right mind would

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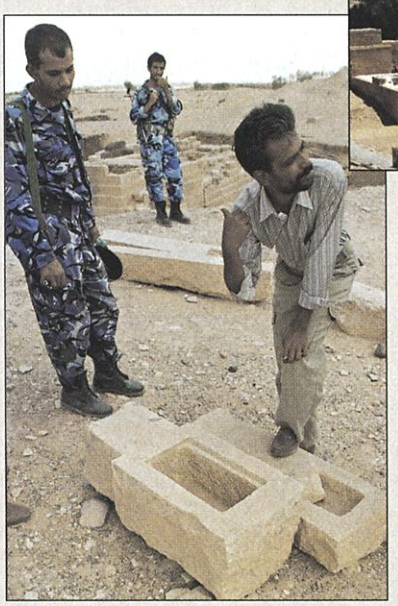
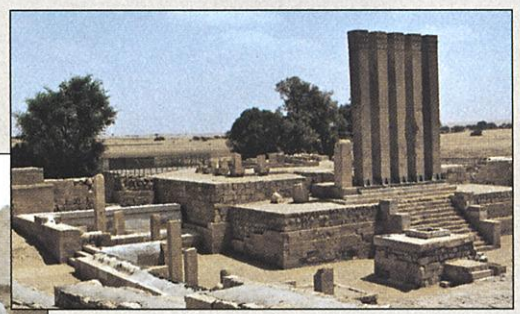
War Is Latest Assault on Progress in Yemeni Science

MARIB, YEMEN—The chance to prove the existence of the Old Testament's most famous temptress, the Queen of Sheba, would normally be enough to attract many an archaeologist or adventurer to this southern fringe of the Arabian desert. But now, at what should be the height of the autumn excavation season, there is not an archaeologist to be seen in the sprawling Mahram Bilqis temple in what was the powerful Kingdom of Saba, from which traders once carried frankincense and myrrh across the Middle East and North Africa. On a sun-drenched October day, the only sign of life is a lone Bedouin guard in a billowing white frock and gray wool vest, with a traditional Yemeni curved dagger in a sash around his waist and a Kalashnikov assault rifle slung over his shoulder. Life-sized alabaster faces peer solemnly from a silent mausoleum half buried in drifting sand.

In the aftermath of the 11 September terrorist attacks, many field projects involving Western researchers have been put on hold. The interruptions extend even to a moderate Arab nation like Yemen that has aligned itself with the U.S.-led coalition and has so far seen only muted public protest against the bombing campaign in Afghanistan. That is why researchers from the United States and other countries who were supposed to have come to Marib this month remain thousands of kilometers away. "It was difficult in my heart but not in my mind" to postpone this season's dig, says Merilyn Phillips Hodgson, president of the American Foundation for the Study of Man in Falls Church, Virginia, the U.S.-led team's major backer.





Deserted. Flanked by interior ministry guards, Yemeni antiquities official Sadiq Sa'id Othman inspects the dormant archaeological dig at the Mahram Bilqis temple, which Yemen hopes to see restored to the splendor of nearby Arsh Bilqis (*inset*).

Even under the best of circumstances, doing science in this part of Yemen can be difficult. Over the past few years, members of the Marib team had grown accustomed to traveling from their hotel to the site every day accompanied by armed guards to ward off potential kidnappers from a tribe hostile to the Yemeni government. They haven't been alone in needing protection. On his most recent foray to collect a moth unique to Yemen, University of Bonn entomologist Clas Naumann was assigned 10 heavily armed guards. "And they expect you to feed them, too," he says.

But the war in Afghanistan has sent the country's economy reeling, along with Yemeni science. Tourism, a major industry that typically crests in October and November, is down 90% from last year. And Yemeni scientists, like many of their counterparts throughout the Islamic world (see main text), are feeling increasingly isolated as Western colleagues shun travel to the region. A conference intended to forge collaborations in the applied sciences, held in the capital, Sana'a, earlier this month, had been expected to draw more than 200 researchers from Islamic nations outside Yemen and a few dozen from Europe and the United States. The actual attendance from abroad: 80 foreigners, including only Naumann from the West.

The disappointing turnout was another blow to the Yemeni scientific community, which had already endured a self-destructive decision by the government to side with Iraq during the Gulf War. Scientists have also had to be on guard against the sudden appearance of dozens of "scientific institutes" that introduce high-school-age children to religious fanaticism, says Abdul Wahed Mukred, vice chair of the Agricultural Research and Extension Authority in Dhamar, adding that the government has successfully converted most of the institutes into secular schools. In particular, two events have forced the government to crack down hard on fundamentalism. In December 1998, four tourists were killed when government forces stormed their kidnappers' hideout. Then last year, terrorists linked to Osama bin Laden blew a hole in the side of the U.S. warship *Cole* docked in the port of Aden, killing 17.

Despite the risks, the country still attracts Western scientists eager to make their mark. "The last time anyone studied spiders here was [in] 1890," says Tony van Harten, a Dutch spider specialist in Sana'a who advises the Ministry of Agriculture and Irrigation on biological pest control. Collecting on behalf of dozens of specialists around the world, van Harten has helped discover nearly 130 novel species in Yemen. But he and others acknowledge that the long-term prospects for their work are clouded. "I have not yet bowed to the strong pressure to leave and abandon my work midstream," says University of Chicago archaeologist Krista Lewis, who studies ancient food practices in the Yemeni highlands. But it's "nerve-racking," she says, "to watch and wait and hope that things will not get worse than they are at present."

Over the next several months, many other scientists will be watching and waiting before deciding whether it's safe to work in Yemen. "Any decrease in foreign cooperation is really going to hurt science in our region," warns physicist Moustafa Bahran, who organized the Sana'a conference. Fewer outside collaborators, he says, would leave a fledgling scientific community even more adrift.

–R.S.

CREDITS: R. STONE

say that scientific research is not important to development."

But the fighting in Afghanistan and the unsettled political situation have cast a pall over the region that has darkened the immediate outlook for science. Dozens of conferences have been shelved, including the Third World Academy of Sciences annual meeting scheduled for next week in New Delhi. From Casablanca to Karachi, field expeditions and lab-to-lab exchanges are coming under scrutiny, with many being cancelled or postponed indefinitely.

"I do not feel at liberty to travel to any country in the Middle East right now," confesses Harald Kehl of the Technical University of Berlin, who leads a mountain ecosystem project in southeastern Turkey. He worries that local people "may see me and my fieldwork as part of a hostile maneuver of some sort." Population geneticist

Gordon Luikart of Joseph Fourier University in Grenoble, France, who studies the genetics of wild sheep, has postponed an upcoming excursion to eastern Turkey: "I would not want to have to show my American passport [there]."

Reflecting the jitters of research officials, a manager at France's basic research agency, CNRS, issued a strongly worded communiqué on 12 September urging scientists to forgo travel to Arab countries. Although the CNRS—under pressure from the Ministry of Foreign Affairs—retracted the memo 2 days later, the original notice has clearly had a chilling effect on travel to the region. One group exercising prudence is Laurent Marivaux and his colleagues at Université Montpellier II, who have postponed fieldwork in Balochistan, a province in Pakistan where they and local scientists have unearthed stunning lemur fossils dating back 30 million years (*Science*, 19 October, p. 587). Team member Jean-Loup Welcomme says his group intends to return in the spring: "I'm sure we'll always be welcome there."

In better times. Laurent Marivaux, examining a piece of sediment with tooth remains, hopes to return to Balochistan with his French colleagues in the spring.

Some regional efforts have hit snags as well. For example, the U.S. National Cancer Institute has put off a visit this month by U.S. scientists to Egypt, Jordan, Israel, the Palestinian Authority, and Cyprus to inspect cancer registries under the Middle East Cancer Consortium. And a U.S. National Institutes of Health project on hypertension in the region, officials say, is now dormant.

A promising future?

Once the crisis is over, Western scientists hope to strengthen their nascent links to the Islamic world. "There is a feeling that a resolution of the current situation may actually make work easier in places like Tajikistan, Uzbekistan, Turkmenistan, and perhaps even Iran," says Steve Roecker, a geophysicist at Rensselaer Polytechnic Institute in Troy, New York. Roecker, who does seismic fieldwork in Central Asia, even foresees the possibility of returning someday to the Hindu Kush in Afghanistan, where he did his thesis research in the mid-1970s.

One major regional collaboration still on track is SESAME, an international research center being built at Al-Balqa' Applied University near Amman, Jordan. The SESAME project began in 1999 when Germany offered to give the Middle East BESSY-I, a 0.8-giga–electron volt synchrotron in Berlin that had been replaced by a newer model. "The problems with terrorists have so far had no influence on SESAME," says Herwig Schopper, a former director-general of CERN, the European particle physics lab near Geneva. Schopper has worked tirelessly to spearhead the project in collaboration with UNESCO. The 11-nation consortium that's building the center is now on track to receive shipment of BESSY's components in early 2002.

The region is hoping to import grantmaking as well as Western hardware. A promising initiative is the Arab Science and Technology Foundation in Sharjah, UAE.

Thinking ahead. The first science Nobelist born in an Arab country, Caltech chemist Ahmed Zewail is one of many prominent figures calling for a "Marshall Plan" to build research capacity in Islamic countries once the crisis abates.

The foundation began a few years ago when Sultan bin Mohammed Al-Qasimi of Sharjah—who holds a Ph.D. in agricultural science—invited experts, including El-Baz of Boston University, to brainstorm ideas for improving science in the Islamic world. El-Baz and his colleagues concurred that what the region needed most was a grantmaking body for science: a "mini-NSF," El-Baz says. The sultan started the endowment with $1 million of his own fortune. El-Baz and others have just embarked on a fund-raising drive to increase the pot to $100 million.

Even that amount could seem like peanuts, however, if a scientific Marshall Plan for the Islamic world were to take shape. Scientists and politicians have begun preliminary talks about holding an Arab summit on scientific development next year. They're making a wish list for some of the richer nations in the region. Pakistan's Minister Atta told *Science* that he would like to see the 57 countries of the Organization of the Islamic Conference contribute $10 billion over 3 years to such a fund. What is needed, he says, is "a head of an Islamic state, like the King of Saudi Arabia, who could champion the cause." And there's an expectation that once the war ends, Europe and the United States may help rebuild the shattered economies of Islamic nations. "After the tragedy of September 11," says Zewail, "I hope that the U.S. will take a new look and take a more active role in helping the region."

The first fruits of the conflict, ironically, may be a reverse brain drain. Many Muslim scientists living in Western countries say they have begun feeling uncomfortable since the terrorist attacks. Pakistan is seizing the opportunity and trying to lure talent back home. Just in the past few weeks, Atta says, Pakistan's science ministry has offered positions to 23 expatriate researchers at three times the current salary of a full professor in Pakistan. So far, he says, 17 have accepted. Pakistani researchers will also benefit from the recent lifting of some U.S. sanctions.

But hope is tempered with a realism based on experience. "Anytime scientists in the Arab world want to collaborate, politics gets in the way," says El-Baz. And no one knows when the region's politics will cool down enough to allow Islamic scientific initiatives to regain some of their lost momentum.

–RICHARD STONE AND ROBERT KOENIG

With reporting by Pallava Bagla in New Delhi, Vivien Marx in Boston, and Aude Sonneville in Cambridge, U.K.

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