

Israeli and Palestinian scientists are working together in a research program that seems all the more daring now that Hamas has come to power

Bridging the Divide In the Holy Land

JERUSALEM—“This will be the first Palestinian nanotech lab,” says Mukhles Sowwan, peering into a dark, empty room at Al-Quds University in East Jerusalem. Making this a reality will be no mean feat. Sowwan, a physicist, needs about \$1 million to equip a state-of-the-art laboratory for the kind of science he wants to do, and he

can’t look to the university for help: Finances at Al-Quds are so precarious that faculty paychecks failed to arrive on time last month—for the third month in a row. “I’m cutting expenses in every way possible,” Sowwan says, including designing some of his own devices and software.

But Sowwan, 31, has something that few other Palestinians have: an Israeli research partner. Ever since doing a postdoc in the lab of Danny Porath, a physicist at Hebrew University in West Jerusalem, Sowwan and Porath have teamed up to coax biological molecules to assemble into circuitry and memory devices far

MEDITERRANEAN SEA

Tel Aviv

TEL AVIV
UNIVERSITYBIRZEIT
UNIVERSITY

● Ramallah

Jerusalem

HEBREW
UNIVERSITY

● Jericho

AL-QUDS
UNIVERSITY

● Bethlehem

● Gaza City

Dead
Sea

ISRAEL

JORDAN

Palestinian Archaeology Braces for a Storm

RAMALLAH—Six years ago, Hamdan Taha, director of the Palestinian Authority’s Department of Antiquities and Cultural Heritage, was struggling to make ends meet with a skeleton crew and a \$500,000 budget (*Science*, 7 January 2000, p. 33). Then last December, his department got a windfall: The Palestinian Authority offered a \$6 million budget boost. Much of the new money was to be for preservation, but some was tagged for the excavation of a freshly uncovered Bronze Age site called Tell Etell, a few kilometers outside Ramallah—the first archaeological project that would be fully Palestinian from start to finish.

But fortunes change fast here. After Hamas was elected to the Palestinian government in January, Israel ceased transferring customs payments. Last week, the European Union announced that it is suspending direct aid to the Palestinian territories. And the United States is asking international agencies to withhold contributions until Hamas recognizes Israel and renounces violence, although few agencies so far have joined the squeeze.

“This will bring terrible impacts on Palestinian archaeology,” says Moain Sadeq, antiquities chief in Gaza. The Palestinian Authority may be forced to lay off guards at sites, which could exacerbate a serious looting problem. Some also fear that a Hamas-led government may refocus archaeological efforts on the region’s Islamic roots, at the

expense of earlier periods. Such controversies are ongoing, such as the alleged destruction of pre-Islamic archaeological material to improve access to a mosque on the Temple Mount in Jerusalem by the previous Palestinian government. Judeh Morkus, the Hamas-appointed minister of tourism and antiquities for the Palestinian Authority, says his government will not require archaeologists to probe only Islamic sites. “The focus will be as it was,” he says, adding that the ministry hopes to complete a review of existing agreements by the end of this month.

Taha is at home with turmoil. After Israeli and Palestinian leaders signed the Oslo Accords in 1994, archaeologists from Europe and North America swept in to probe the archaeological riches of the West Bank and Gaza Strip, where layers of continuous occupation go back to the origins of civilization. Taha and his Palestinian colleagues were eager to work with partners from outside. International digs began to uncover archaeological gems, from Canaanite waterworks in the West Bank to Neolithic occupations in the Gaza Strip. But after the second Intifada flared up in 2000, one project after another “came to a standstill,” says Taha, who earned his archaeology Ph.D. in Germany. The conflict has restricted access to sites, he says, and in some areas it posed real danger to life and limb.



Making history. For the first time, Palestinian archaeologists are uncovering their heritage—including these Bronze Age pots from Tel Etell—on their own.

CREDITS (TOP TO BOTTOM): K. BUCKHEIT/SCIENCE (MAP); GERRIT VAN DER KOOIJ/LEIDEN UNIVERSITY

- Green Line (1949 Armistice Line)
- Completed barrier route
- Barrier under construction
- Approved barrier route
- Route requiring further approval

smaller than present technology allows. Beyond the promise of breakthroughs, however, what makes the collaboration tick, says Porath, is that “we are first of all good friends.” This rare fraternity amid one of the world’s ugliest conflicts is helping Sowwan realize his dream of bringing nanoscience to the West Bank.

Help has arrived from UNESCO, which 2 years ago laid a challenge before the two communities: Come up with competitive projects involving scientists from both sides of the ethnic divide, and we’ll fund you. Last year, UNESCO’s Israeli-Palestinian Scientific Organization (IPSO) awarded the first 10 grants. Sowwan and Porath are among the winners.

It’s an open question whether such science-for-peace efforts can change communities. Critics say that truly equal scientific exchange will only be possible when Palestinian researchers

enjoy university infrastructure on a par with that of their Israeli colleagues. But this is part of the plan, says Dan Bitan, an Israeli historian who co-directs IPSO. The intention, he says, is to build up Palestinian science “one project at a time.” The first crop of IPSO projects is receiving raves from observers. “These projects are world-class,” says Edouard Brézin, a physicist and president of the French Academy of Sciences.

The fragile endeavor now has a fresh concern: How will the budding collaborations fare under the new Palestinian Authority government led by Hamas, whose leaders have previously called for Israel’s destruction? “These Palestinian researchers are so rare to be willing to collaborate,” says Brézin. “Will Hamas stop them? That is something we fear.” IPSO’s saving grace may be

that it has been developed “bottom-up” by Israeli and Palestinian scientists rather than as “a top-down imposed cooperation,” says Yaakov Garb, an environmental researcher with Ben-Gurion University of the Negev in Beer-Sheva, Israel, and Brown University in Providence, Rhode Island, who co-directs the Brown-based Middle East Environmental Futures Project. IPSO belongs to both communities. And although science and conflict mix poorly, says theoretical economist Menahem Yaari, president of the Israeli Academy of Sciences, “we realized that if we wait for the fighting to end, then we’ll wait forever.”

Yaari wasn’t the only high-profile academic frustrated by the barriers to Arab-Israeli scientific cooperation. Sari Nusseibeh, a philosopher and president of Al-Quds University, and Torsten



Future hope. Palestinian archaeology students at Al-Quds University prepare for fieldwork.

But as partnerships unravel, some archaeologists hold Taha at fault. He is “autocratic,” says one archaeologist who has worked on collaborative Palestinian projects and requested anonymity. “When people talk about doing something in Palestine and they learn that it will have to go through Taha, the advice is basically to forget it” because, he says, Taha is “very political” and takes control of projects to consolidate his power.

Taha dismisses such criticisms as “colonial cultural attitudes.” He’s supported by Gerrit van der Kooij, an archaeologist at Leiden University in the Netherlands and one of the few Westerners who has continued to work with Taha during the recent crisis. “It doesn’t surprise me that outsiders become frustrated,” he says: Taha “sticks by his policy of equal partnership. That means Palestinians must be involved at every step,” from planning and digging to publishing. Van der Kooij says this policy is “fully justified and adds more social value to the project.” Morkus adds that his ministry will support collaborations “between us and any concerned parties. We believe in partnership,” he says.

Palestinian archaeologists say they just want to get on with their work. “But we have an even more basic problem than collaboration and funding,” says Issa Sarie, a physical anthropologist at Al-Quds University in Jerusalem. To travel between his home in East Jerusalem, his office at Al-Quds University, and meetings with Taha in Ramallah, Sarie says he risks arrest on a daily basis. His application to renew a permit that allows his movement between Israeli- and Palestinian-controlled areas was declined recently “without explanation” by the Israeli government, he says. To get home to his wife and

two children each night, Sarie must cross into Jerusalem illegally, picking his way between fences and mud puddles. “These are the kind of obstacles that keep Palestinian academics from succeeding,” he says.

But Sarie and others are quick to point to signs of progress. For one, having sites under Palestinian control is a crucial step toward making Palestinian archaeology “a scientific enterprise,” says Taha. For the first time, “we are training our own students in the field,” says Hani Nur El-Din, an archaeologist at Al-Quds University. “This makes all the difference for creating the next generation of archaeologists,” he says, although “it will probably be 20 years before we can support our own Ph.D. program.”

International donors at the first conference on Conservation of Cultural Heritage in Palestine, held in Jericho on 20 February, indicated they will keep funds flowing for archaeological projects in Palestine. Outside help will come even if the Palestinian Authority’s budget is frozen, says Sa’id Omar, an officer for the United Nations Development Program in Jerusalem. “Unfortunately, the overall situation remains vague until the dust settles,” he says.

—J.B.



Breaking Up Bomb Plots—and Habitats?

WADI FUQEEN, WEST BANK—From his village cradled in this ancient valley, Muhammad Manasra (Abu Mazen) can see trouble looming in every direction. Atop the northern hillcrest, the Israeli village of Zur Hadasah spills over the Green Line that has divided Israel from the Palestinian territories since 1967. To the south, the concrete high rises of an Israeli settlement, Beitar Elite, stare down over the rim. A rumbling echo fills the air as bulldozers raze the eastern hilltop to make way for thousands more settlers. But what most worries Abu Mazen, a village council member, is approaching from the north: a 50-meter-wide obstacle course of fences, ditches, and razor wire

known as the security barrier. He fears that it will disrupt the flow of rainwater that has recharged the valley's springs for millennia. "Without water, we cannot farm," he says. "Without farming, we cannot live here."

The partially constructed, 670-kilometer barrier has a big value, many Israelis say: It deters suicide bombers. But critics on both sides of the Green Line say it is also wreaking havoc on the environment. "Wadi Fuqeen will not be its only casualty," says Yaakov Garb, an environmental researcher at Ben-Gurion University in Beer-Sheva, Israel, and Brown University. Besides disrupting the flow of surface water, Garb says the barrier could damage the region's unique ecosystems by blocking animal migration. Others are not so sure. "Fragmentation of habitats is our biggest problem, but I don't think [the barrier] is any worse for wildlife than our other roads and fences," says Tamar Dayan, an ecologist at Tel Aviv University in Israel.

To assess the impact of the barrier and other developments, Israeli scientists are assembling a network of long-term environmental monitoring stations. The plan started 7 years ago as a promising U.S.-brokered Israeli-Palestinian collaboration, but after the second intifada, the Palestinians dropped out. Israel has forged ahead with plans to link up 11 existing research stations next year. Data will be pooled on computers at Sandia National Laboratories in Albuquerque, New Mexico, and made freely available on the Internet.

The network's aim is to spot even the subtlest changes in the environment over several decades. "Long-term research is the only way to get the real answers," says Avi Perevolotzky, an ecologist at Israel's Agricultural Research

Wiesel, a Nobel Prize-winning neuroscientist at Rockefeller University in New York City, also felt that it was time for action. At a UNESCO meeting in Paris in 2003, the trio decided that "rather than just talking about peace, we would do it," says Yaari. So with about \$3 million cobbled together from UNESCO, the French government, and several nongovernmental organizations, they launched IPSO in 2004. Grants are modest, amounting to about \$300,000 for each project over 3 years.

Because tensions were high, says Yaari, "we decided to start cautiously" by embarking on a quiet advertising campaign on the electronic message boards of Israeli and Palestinian universities. Selection criteria were strict: Projects had to be "internationally competitive" and involve "an equal contribution from each side." The organizers expected a couple of dozen applications at most.

But the idea struck a chord. Nearly 100 proposals flooded in, in fields from physics to epidemiology. And far from charity cases, the quality "spoiled us for choice," says Bitan, who has administered the program from the start.

Several IPSO awardees let *Science* shadow them for a week. Their schedules consisted mostly of routines familiar to scientists the world over—from group meetings and grinding departmental paperwork to the coveted hours of isolation at the bench. But they also faced an obstacle course of practi-

"We realized that if we wait for the fighting to end, then we'll wait forever."

—Menahem Yaari,
Israeli Academy of Sciences

cal problems that would seem alien to most scientists, any one of which is capable of destroying harmony.

Getting from A to B

Shahal Abbo curls his toes on the silky carpet in Mustafa Khamis's East Jerusalem home as he describes how another IPSO team came

about. "Our collaboration had an ironic start," he says, cracking a smile beneath his bushy moustache. An agronomist in Rehovot, Abbo recalls talking with his Israeli peers: "You can imagine my colleagues' reactions when I told them I had to write a letter for Jihad." He was not referring to an Islamic holy war, but a young scientist. Jihad is Khamis's Palestinian former graduate student, who needed the power of Abbo's pen to get through army checkpoints.

Their project was a natural for collaboration because it focuses on a problem shared by both Israelis and Palestinians: how to use the precious water in sewage to irrigate crops. "Although [Jihad and I] understood the problem well, we only had a slight idea for a solution," says Khamis, a physical chemist at Al-Quds University, as he fills miniature cups with potent Arab coffee.

Khamis envisioned a two-part answer: a water desalination device that would be small and cheap enough to service a single village and a crop that could thrive on the water it produced. With help from the Euro-

Organization in Bet Dagan. It is unclear how long it will take to assess the barrier's impact. And without equivalent data from the Palestinian territories, researchers will have only half the picture.

"We want to collaborate," says Perevolotzky. A one-sided affair could pose huge problems for decision-makers. "When you work with the environment here, it is impossible to separate politics from science," says Yehoshua Shkedy, an ecologist with the Israel Nature and National Parks Protection Authority.

Shkedy pulls out a rumpled topographic map. "You can see what makes this place so special," he says. Like the spokes of a giant wheel, four slabs of color for different biogeographic zones converge. Each represents a distinct recipe of environmental ingredients, such as rainfall and soil type, that supports a characteristic assemblage of species. This is the only place in the world where the scrublands of Iran and Iraq collide with the oasis palms of eastern Africa, where dense Mediterranean oak groves meet Saharan sand dunes. And altitudes range from the peak of Mount Meron at 1200 meters down to the salt-caked shore of the Dead Sea at 400 meters below sea level, the lowest land on earth. "What's amazing," says Shkedy, "is that, in spite of 10,000 years of agriculture and urbanization, we're still ecologically healthy," with more than 100 species of plant per square kilometer on average and a menagerie of big animals such as leopards, jackals, gazelles, and wolves.

This spot is also the explosive meeting point of two fast-growing populations. "Both Israelis and Palestinians are rushing to claim and develop the land," says Shkedy, "and our job as scientists is to give advice." But sometimes it isn't welcome. For example, he asks, "Which direction should Jerusalem be allowed to expand, east or west?" Many important habitats lie to the west, "so from a conservation standpoint, we should say east." This would delight hawkish politicians who want Israel to expand in that direction, but Shkedy says that outcome "would surely lose the Palestinian cooperation we need to manage the environment over the long term."

The only way to preserve Israel's biological assets, says Shkedy, is to try to get beyond politics and take a long view. "What is most important for conservation is to keep the four biogeographic zones connected," he says. So 6 years ago, he and other ecologists proposed to link them with a network

of corridors where development would be off-limits. But then came the second intifada and the security barrier, construction of which started in 2002 (see map on p. 352). "Look, it just could not be worse," says Shkedy, tracing the barrier's jagged course on the map as it slices back and forth through the



A farmer's fears. Abu Mazen (right) says his village in Wadi Fuqeen will wither if the security barrier impedes water flow.

corridors. Shkedy and others have proposed a "virtual" barrier, an electronic system that detects people but allows wildlife to pass freely. However, the Israeli Ministry of Defense last year shot down that idea on the grounds that it would not provide a sufficient deterrent to interlopers.

The security barrier is part of a larger problem, says Shkedy. With casualties on both sides almost every day, "people say the environment is the least of our concerns," he says. "But if the land becomes ruined, then what are we all fighting for?"

—J.B.

pean Union and an Israeli company, he designed a \$50,000 prototype purifier in the 1990s that could process the daily wastewater of 500 people. The output, laden with salts and metals, was not clean enough to drink but did pass muster for agriculture. The next challenge was to find a crop.

This is where Abbo's expertise dovetailed. "Chickpeas were the obvious choice," he says, "not only because everyone eats falafel and hummus here, but because the plant is very well adapted to this soil." Since the project began in 1999, Abbo has been breeding chickpea plants that thrive in Khamis's treated water.

On a dusty hill on the edge of the Al-Quds campus, a truck-sized tank quietly hums, churning wastewater with bacteria and straining it through filters. A pipe leads to a lower terrace where neat rows of chickpea plants are sprouting. Khamis dashes indoors to show the extra dimension to this project that helped clinch funding from IPSO. Piece by piece, he is assembling a world-class environ-

A rare friendship. Although difficulties abound, Mukhles Sowwan (left) says he is encouraging his students to study nanotechnology at Hebrew University with Danny Porath (right).



CREDITS (TOP TO BOTTOM): J. BOHANNON/SCIENCE

mental testing laboratory for the West Bank. Meticulously clean instruments measure nearly everything there is to know about a drop of water. "We don't even have such a facility on the Israeli side," says Abbo. To expand the collaboration, Khamis hopes to add a plant genomics wing within a few years.

But the road ahead is bumpy. Pausing next to a plasma spectroscope, a \$120,000 device that identifies heavy-metal contamination, Khamis's cheerful guise clouds over. "This broke down last year, and we have not been able to get a replacement part," he says. Nearby is another expensive instrument that has never been installed. "The companies refuse to send technicians because of security reasons," says Khamis. That's one impediment an IPSO grant has not overcome.

Show me the money

Sowwan checks his watch and gasps. The European sales director of a nanotechnology device company has flown in from the United Kingdom just to meet the Al-Quds physicist for lunch today. "We must rush," says

Sowwan as he passes through a rainbow of hijab veils worn by his female students. Although the meeting is in an hour at Hebrew University, just 5 kilometers away, the road is blocked by the security barrier—which in Jerusalem takes the form of an 8-meter-high concrete wall that chokes traffic and possibly creates ecological problems as well (see sidebar on p. 354). It was built, the Israeli government says, to protect its citizens from terrorist attacks. The best route these days is to drive 45 minutes through outlying Arab villages on narrow, crumbling roads and, inevitably, through a checkpoint. Because Sowwan lives on the Israeli side of Jerusalem, his license plate makes it easier to pass, although he is sometimes stuck for hours in a queue.

The contrast between Al-Quds and Hebrew University is staggering, as if we've teleported from the Middle East to southern California. Bare-shouldered students bask on manicured lawns between stone buildings and a statue of Albert Einstein, a university patron. The campus has also been a haven for Palestinian scientists such as Sowwan, who would otherwise have no equipment to use, let alone experts to learn from. Nanoscience at



Good chemistry. Mustafa Khamis (left) has teamed up with Shahal Abbo (right) to tackle the shared problem of water scarcity.

Hebrew University has been particularly open-armed, producing a string of successful researchers of Palestinian origin publishing in major journals, including *Science*. Although Sowwan has now officially moved to Al-Quds, he retains full membership at



War-zone science. Psychiatrist Viveca Hazboun's Bethlehem offices were destroyed by artillery fire.

the university's Center for Nanoscience and Nanotechnology.

The salesman is waiting in a bustling campus cafe. The meeting proves frustrating. Yet it's typical for Sowwan and other talented but underfunded Palestinian scientists. He spends an hour trying to bargain a \$250,000 atomic force microscope down to \$50,000, to no avail. (Tip to lab managers: Sowwan did get it to \$120,000.) The IPSO grant alone will not be enough to put his new lab at Al-Quds on par with Porath's. Nevertheless, Sowwan says, "it's a start."

Where collaboration is a dirty word

To some critics, IPSO's problems run deeper than a shortage of funds. One Israeli professor, in a series of open letters e-mailed to the Israeli academic community last year, railed against it as "dangerous" and "playing into the hands of terrorists." Yaari responded but was unable to persuade him that the collaborations were worthwhile. "In the end we agreed to disagree," he says.

IPSO scientists have been taking even more flak from the Palestinian side. "Cooperation is viewed as an attempt to normalize the abnormal situation of occupation," says Khamis. "Even the word 'collaboration' is taboo here," adds Viveca Hazboun, a West Bank psychiatrist with a project proposal under review for IPSO funding. Palestinian "collaborators" deemed too helpful to the Israeli government have been murdered by extremist groups, she says.

Hazboun has two strategies for easing tensions on the Palestinian side. Among colleagues, she avoids the term "collaboration." "We call it 'scientific exchange' instead," she says. She also promotes tolerance among her research subjects, the estimated 45% of Palestinians in Bethlehem who suffer from posttraumatic stress disorder. "If you can forgive, you can move on," says Hazboun, whose previous clinic was destroyed 3 years ago by Israeli shells during a siege on Bethlehem.

Ultimately, Israeli and Palestinian scientists will need the consent of their governments to work together. It remains unclear how Hamas will interact with the newly elected Israeli government led by Ehud Olmert, but IPSO is forging ahead. "Creating a culture of peace is our responsibility as Israeli and Palestinian scientists," says Hasan Dweik, a chemist at Al-Quds who co-directs IPSO with Bitan. Another 13 projects have been chosen for the next round of funding later this year, he says.

IPSO researchers, too, are optimistic. Despite the barriers, Sowwan plans to send his Palestinian students to learn in Porath's lab on the Israeli side. "It will be difficult," he admits, but "science is a universal language, like music. It can make people understand each other."

—JOHN BOHANNON