

Satellite Labs Extend Science

A new type of lab links Western scientists who want to expand with emerging nations seeking access to world-class researchers

Four years ago, Le Quang Minh and Hoang Zung decided to create a cutting-edge chemistry research center at Vietnam National University (VNU), Ho Chi Minh City. The center would also help train the next generation of basic scientists.

But neither Minh, VNU's vice president of international relations, nor Zung, the director of its science and technology department, could think of a domestic researcher with the scientific heft to lead the center. That's not too surprising, given that one of their goals was to strengthen the research capacity of their home institution. So the two men launched a global search, and on a visit to the University of California, Los Angeles (UCLA), they found someone who seemed to fit the bill.

His name was Omar Yaghi, and his scientific achievements clearly qualified him for the job. The Jordanian-born faculty member is one of the most highly cited chemists in the world and an expert on designing novel porous materials. Yaghi had also shown an ability to work with those from another culture, having formed a mentoring relationship with the International Center for Materials Nanoarchitectonics in Tsukuba, Japan. The icing on the cake was a Vietnamese graduate student working in his lab.

Convinced that Yaghi was their man, Minh and Zung invited him to run the center as a satellite of his own lab. Yaghi readily agreed. "Scientists do science to stimulate their mind," Yaghi says. "I want to go into new territories to explore them."

With Yaghi on board, the three men went to work making the center a reality. The university hosted an international conference to flesh out a research agenda for what they called the Center for Molecular and Nanoarchitecture (MANAR). Then they pitched the idea to the Vietnamese government. After countless meetings, Minh and Zung wrung a promise for \$20 million over 5 years for the center, no small feat in a country with a total budget for science and technology of roughly \$700 million a year.

Work began in 2009 on the lab, to be housed on one floor of a newly built high school. Yaghi's graduate student, Anh Phan, began traveling back and forth to Vietnam in 2-month chunks to oversee construction. MANAR officially opened for business in December.

Yaghi is one of several high-profile researchers who in recent years have opened such satellite labs in other countries. It's a hybrid form of international partnership—smaller, more focused, and less bureaucratic than a formal alliance between two institutions, but broader and more structured than a simple agreement between two like-minded researchers to team up on a project.

Western scientists who have set up satellite labs in other parts of the world say the approach provides a relatively easy way to expand their research group and obtain funding without having to run the peer-review gauntlet in the United States and Europe. In return, the host country buys access to a world-class scientist willing to train its students and strengthen its research capacity. That arrangement typically requires less than 20% of a professor's time, comparable

to the amount available to faculty for outside consulting projects. Compensation is also worked out on a case-by-case basis.

Yaghi isn't paid by VNU to direct the center. But VNU has named him a distinguished professor, and the position covers a portion of his travel and administrative costs. Yaghi has also promised to visit as often as needed to keep the research on track and to mentor VNU students. So far he has spent only a few weeks in Vietnam. But e-mail and Skype allow him to stay in close contact with his group of some two dozen students and several senior researchers and professors.

MANAR likely won't be the final satellite lab on his plate. Yaghi is looking into creating labs in several countries in the Middle East, including Qatar, Saudi Arabia, and his native Jordan.

Yaghi, who in January left UCLA to head the Molecular Foundry at Lawrence

Berkeley National Laboratory and join the faculty of the University of California, Berkeley, says he isn't trying to create a global scientific empire. But he would like to help jump-start scientific development in areas that desperately need it.

"These countries are very eager to join the world economy and the world science scene," says Yaghi, who took his satellite arrangements with him when he came to Berkeley. In fact, the three institutions have agreed to back a new center for global mentorship to help other topflight researchers around the world set up their own satellites (see sidebar, p. 1602).

Satellite labs can be a challenge to set up and run, Yaghi and oth-



Global reach. Omar Yaghi (*top*) with the molecular cages he pioneered, and (*above*) with Anh Phan (*far right*) and students at MANAR in Vietnam.

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ers admit. The mentoring scientist must find local talent to oversee the lab, bridge cultural differences, and learn how to navigate another, unfamiliar layer of bureaucracy. The new lab can crowd out responsibilities at the scientist's home institution. There's the issue of researchers who receive taxpayer-provided funds taking some of their best ideas overseas. And some wonder whether the arrangement is also a good deal for the host country.

A source of ideas

Science has always been an international endeavor, and individual researchers have long formed collaborations that transcend national boundaries.

Among institutions, the most prominent form of cooperation is a direct relationship between two or more universities. Such collaborations, which typically involve an exchange of faculty members and students, not only help to build new research capacity but also aim to improve curriculum and nurture entrepreneurial talent.

But such university-to-university alliances also have drawbacks. They can take years to create and are open only to faculty and students at participating universities. Such large alliances may also generate mismatched partners. Claude Canizares, vice president for research at the Massachusetts Institute of Technology (MIT) in Cambridge, which has an alliance with the National University of Singapore, says MIT has tried to avoid that problem by tapping only those faculty members who are eager to participate and who are already familiar with the work of their counterparts.

The satellite arrangements, which operate on a smaller scale, avoid this hurdle by allowing the new lab leader to set the research agenda and select the team. At the same time, the host country puts up all the research funds. At UCLA, Yaghi pioneered the creation of new porous solids called metal-organic frameworks that are prized as catalysts, among other uses. But his satellite labs are pushing other research topics that his U.S. group doesn't have time to pursue.

The Vietnam center, for example, specializes in making novel porous materials. Its long-term goal is to find applications in the energy sector, such as storing hydrogen and other energy-rich gases, as well as environmental applications, such as designing novel water-filtration systems. In Japan, members of Yaghi's lab are searching for novel met-



New directions. Chad Mirkin, shown here giving a lecture in Singapore, says his satellite lab allows him to expand the types of research he's able to pursue.

als containing polymers. "I want new ideas to challenge me and keep me interested," Yaghi says.

Chad Mirkin, a nanotechnology expert at Northwestern University in Evanston, Illinois, has pursued a similar research strategy at a satellite lab at Nanyang Technological University (NTU) in Singapore that's not part of a larger university alliance. Mirkin's research blends chemistry, materials science, and medicine, and his group at Northwestern is one of the largest in the world, with more than 60 students and post-docs. Even so, his home lab is not large enough to satisfy his ambitious agenda.

He says that NTU has been particularly helpful in translating his group's basic chemistry and materials discoveries into medicine and then carrying out expensive clinical trials. Clinical trials are easier to initiate in Singapore than in the United States, he notes. NTU also pays Mirkin to train between seven and 10 students at a time in Singapore. The group focuses on translational research, such as honing nanoparticle synthesis techniques to control particles' shapes and sizes so that they function better in the body. The group also investigates energy applications of nanotechnology, a priority for the government of Singapore but less important to Mirkin's U.S. operation.

"I've found it to be very productive," Mirkin says. "It's definitely a model that works."

Satellite labs can also serve as a conduit for students to move back and forth between countries. Edward Yeung, an analytical chemist at Iowa State University in Ames, runs a satellite lab of 20 graduate students at Hunan University in Changsha, China. Lehui Xiao, a graduate student at Hunan, was the first to join Yeung's group in China. Last year he transferred to Yeung's group in Ames to finish his Ph.D.

Xiao says he entered graduate school with the goal of getting a job in industry. But working under Yeung hooked him on basic research, he says. Now a post-doc at the University of Washington, Seattle, Xiao says Yeung also "encouraged me to go abroad and broaden my experience."

For his part, Yeung says he's also been energized by running a new lab in another country. "It's like being an assistant professor again," Yeung says.

Running a satellite lab has been a "dream scenario" for Julius Vancso, a polymer scientist at the University of Twente in Enschede, the Netherlands. The lab, at the Institute of Chemical and Engineering Sciences in Singapore, is trying to find materials that will prevent biofouling of ships by barnacles and other unwanted marine organisms. "We have a project manager that runs the administration, reports, and keeps in contact with the funding agency," Vancso says. "I am responsible for the scientific content." Vancso is also excused



GLOBAL RESEARCH UNIVERSITIES

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This is the second article in a series on global research universities. The first (7 September, p. 1162) examined how Asian universities, particularly in Hong Kong and Singapore, are attracting researchers from around the world. This week, we look at a relatively new phenomenon: Western scientists who have created what we're calling satellite labs in other countries. The arrangement allows prominent scientists to expand their research portfolios while the host nation puts up funding aimed at enhancing its research capacity and fostering economic development.

from serving on faculty committees at the institute, an arrangement common to most satellite lab directors.

Vancso visits his Singapore lab quarterly, spending 2 to 3 days listening to research presentations and the rest of the week helping the team write up its results. Then it's off to Holland, or perhaps Germany or the United Kingdom, where he takes part in other collaborations. "This is a very surgical operation," Vancso says.

Striking a balance

Most scientists interviewed for this story spoke glowingly of the benefits of satellite labs. One of the few to raise a red flag when the topic was broached was Timothy Swager, a chemist at MIT.

"Going global is a tricky thing. We live in airports already," Swager says about the lives of most academic researchers. "There clearly have been benefits. But a number of us are worried about the downside. Are we weakening how we operate?" he asks. "There is a concern, when you are pulling faculty away from an institution, that you are diluting the faculty."

In China, some scientists have questioned an institution's decision to pay top dollar to attract high-profile researchers who spend little time in the country. They say such scientists are only there to raise the prestige of the host university (*Science*, 22 September 2006, p. 1721).

Swager does not operate a satellite lab, although he emphasizes that he's not critical of the concept. He also believes that U.S. universities should help other countries looking to improve their science and technology base. "But there has to be a balance," he insists, to ensure that faculty members remain engaged in their



Surgical efficiency. Julius Vancso (left) says short, regular visits to his lab in Singapore help students and lab directors alike to remain focused.

home institutions. Swager also questions how much a host institution benefits from the arrangement. "I don't know how you run a lab when you're only there 2 weeks a year."

Yaghi and others say that success doesn't hinge on face-to-face contact. "We do a lot of stuff by e-mail," Yaghi says, as well as conducting video conferences. Members of his lab in Japan spent five conference calls hashing out the text for one upcoming paper, he notes. "I don't have to be on the ground there [all the time]. But it's nice to go every once in a while."

At the same time, Yaghi agrees that personal contact with students is important and that he's trying to do more than

teach research skills. "What you cannot do on video is to show the care you are giving that person," he says. "A good deal of mentoring is a one-to-one activity."

Xiao says that Yeung's extended absences from the Hunan lab weren't a problem. Gaining access to professors at Chinese universities can often be extremely difficult, he says, as most of their time is taken up with teaching and writing proposals. In addition, Xiao says Chinese professors put a priority on helping students find work in industry and play down acquiring research skills. And while Yeung spent far less time in China than his domestic professors, Xiao says, "we got more mentoring from Dr. Yeung than from anyone else."

Still, Yaghi and others readily admit that running a satellite lab comes with a host of challenges. Local politicians may try to influence research agendas, they say, and host-country scientists may resent playing second fiddle to a visiting researcher with more clout.

At the same time, the rules regarding travel and time commitments are usually negotiated directly by the host institution and the

How to Go Global

Omar Yaghi was a teenager in Jordan in 1981 when his father asked him to choose between two starkly different futures: Go to the Soviet Union to become a doctor, on a full scholarship that his father had arranged, or move to the United States and make his own way, with only a few months' support from his family.

His father was offering him the choice of studying in one of the two most technologically advanced countries in the world because Yaghi's prospects for obtaining an advanced education in Jordan were slim. Despite the likelihood of economic hardship if he came to America, Yaghi says the decision was an easy one: "I didn't want anything to do with" the political system in the USSR.

So Yaghi crossed the Atlantic Ocean, found part-time work, enrolled in a community college

in upstate New York, and began learning English. Nearly a decade later, armed with a Ph.D. in chemistry from the University of Illinois, Urbana-Champaign, he launched an academic career that has included stops at Arizona State University, Tempe; the University of Michigan, Ann Arbor; and the University of California, Los Angeles (UCLA). In January, he became head of the Molecular Foundry at Lawrence Berkeley National Laboratory (LBNL) and a professor at the University of California, Berkeley.

The 47-year-old Yaghi says his saga proves that America is truly the land of opportunity. Now he's hoping to offer other aspiring scientists that same opportunity with what he calls the Center for Global Mentoring.

Launched this year, the center is a partnership between Berkeley, LBNL, and UCLA, which is providing \$1.5 million in seed money. Its goal is

to help faculty members at the California institutions and elsewhere emulate what Yaghi has done in setting up satellite labs around the world (see main text, p. 1600).

Yaghi and co-chief of the center David Eisenberg, a proteomics expert at UCLA, already have their eye on their first possible project: a collaboration with Vietnam National University (VNU), Ho Chi Minh City, on cancer research. And it would be built around another immigrant whose scientific career has blossomed in the United States.

Vy Lai grew up outside Saigon, then the capital of South Vietnam. When she was 5, her family joined the flotilla of boat people trying to escape the war between the United States and North Vietnam. Her younger brother died before she and the rest of her family made it to a refugee camp in the Philippines. Eventually, Lai's family settled in Canada, and in 2004, Lai earned a Ph.D. in tumor biol-

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group leader. For Yeung, who is officially retired from Iowa State but still advises a handful of students, that means coming to China four to six times a year, for a few days at a time. When National Taiwan University in Taipei asked him to be there 6 months a year for 3 years, he initially balked but eventually agreed to spend between 2 and 4 months there each year. Faculty members with more active research programs typically can't afford to devote this much time to a satellite lab, however, unless the researcher is given a joint appointment.

Under any scenario, however, the head of a satellite lab will need a trusted research partner to run the lab on a daily basis, Yaghi and others says. A homegrown scientist works best. Phan, Yaghi's former graduate student and a Vietnamese native, filled that role at MANAR.

"Every culture has its own way of doing things," Yaghi says. "She coaches me on things unique to Vietnam." After negotiating what he thought were the terms of his research arrangement, for example, Yaghi was surprised when his colleagues in Vietnam came back with a list of additional changes. Phan explained that many Vietnamese think it's rude to disagree openly with people.

But even a native can run into problems managing a satellite lab. Balancing the constantly fluctuating needs for reagents with the country's rigid rules for purchasing and stocking controlled chemicals was a never-ending source of concern for Phan, for example.

Those administrative responsibilities eventually took their toll on Phan, whose husband and young child had remained in the United States. Her grueling travel schedule became untenable after she had a second child last year. So in January, Phan, now a U.S. citizen, took a job with the computer chip giant Intel in Hillsboro, Oregon. Yaghi is still looking in Vietnam for her replacement.

One persistent issue for researchers setting up a satellite lab is how to handle intellectual property (IP). Although each agreement is negotiated separately, Yaghi

says that his arrangement with MANAR is typical: The center retains rights to whatever is developed in Vietnam, while IP developed jointly is split between Yaghi's home institution and the center.

Scientists running satellite labs say they are aware of criticism that their ideas, funded by taxpayers at home, will be used to boost the economies of other countries. But few researchers feel such an argument has merit. "We train [foreign] students all the time who go back to their home countries," says James Heath, a chemist at the California Institute of Technology in Pasadena. Heath recently closed a satellite lab in Singapore after achieving his goal of developing a high-throughput method to generate compounds designed to bind to specific proteins.

Besides, he adds, the economic benefits from a satellite lab are not limited to the host country. Heath's protein capture technology, for example, was spun out to a start-up company located in southern California to take advantage of the talent and venture capital funding there.

Yaghi believes that the ties created in his satellite labs also give the United States and other Western countries increased access to rising scientific stars. "The pools of talent that made the U.S. great are drying up," he says, referring to reports that many talented students in India and elsewhere are either staying in their home countries for their training or returning home soon after they earn their degree. "This is helping us in a very profound way in keeping our country competitive."

But perhaps the most important benefit of satellite labs is the ability to cultivate friends and allies around the globe. "If we succeed in internationalizing what we do, ... it is a basis for a mutual, respectful relationship based on trust," Yaghi says. "To continue to thrive, we need to engage the world in a mutual, meaningful way. This is a very good way to do it."

—ROBERT F. SERVICE

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—LEHUI XIAO,
UNIVERSITY OF WASHINGTON, SEATTLE

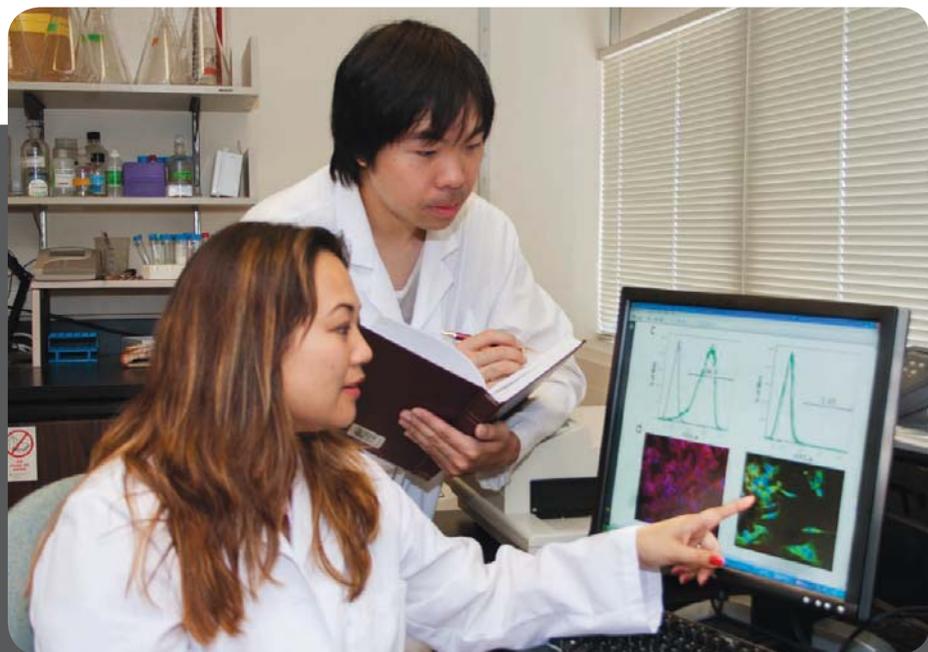
ogy and immunology at the Mayo Clinic's Mayo Medical School in Rochester, Minnesota.

Now a postdoctoral fellow in cancer immunology at the University of Washington, Seattle, Lai is eager to return home. And she is hoping that a cancer center modeled on the materials research satellite lab that Yaghi has created with VNU will give her a chance to fulfill her wish.

"Even though I left Vietnam when I was young, my heart has always been there," Lai says. "My dream would be to go back to Vietnam and help the people there."

For that to happen, VNU must agree to fund the center itself and find outside support for faculty members, students, and research grants. And Yaghi has created a road map for her to follow: "This model has given her a platform to say, 'I can go back to my country.'"

—R.F.S.



Coming home. Vy Lai, with student Matthew Leung, hopes Yaghi's center will help her return to her native Vietnam to launch a cancer immunology lab.