YANG LIU/CORBIS

# Making it big in Taiwan

This small but inventive island is putting transgenics and nanotechnology to novel uses. A pay rise might be all it needs to lure its expatriate scientists home, says **Paul Smaglik**.

Made in Taiwan: in the 1980s, that label often meant cheap plastic trinkets. In the 1990s, it referred to microchips. Now, Taiwanese scientists are working to redefine that phrase once more to mean homegrown high-tech products, researched, designed and manufactured on the tiny southeast Asian island — from transgenic papayas to telemedical devices powered by nanotechnology and material sciences.

The island, with its three main cities bordered by mountain ridges, nestled in subtropical rainforests complete with orchids and banyan trees, is abuzz with energy. There's one motor scooter for every two people and they career through narrow, curving alleys under the shadow of Taipei 101, the world's tallest building — a testament to Taiwan's aspirations.

Such aspirations are grounded in reality, because many of the country's senior faculty members and administrators trained and worked in top institutions in the United States and Europe. Some come back, mid-career, to care for ageing parents, and take a pay cut in doing so (see 'Low-tech, high-tech'). But schemes to address repatriates' salary issues are gathering steam as part of a bid to internationalize its workforce and to build better facilities in targeted areas.

One of the largest drivers toward Taiwan's goals, the Industrial Technology Research Institute (ITRI), is steering that change. ITRI boasts about 6,000 researchers, of whom roughly 950 hold PhDs. "We've created about 130 companies in the past 30 years," says ITRI's president, Johnsee Lee. But he acknowledges that many of those companies have focused on contract manufacturing, licensing out technology and outsourcing. The biggest example of this phenomenon is also one of ITRI's most prominent success stories. The Taiwan Semiconductor Company, spun off from ITRI 20 years ago, makes chips for most of the world's laptop computers, and sells them under many labels, including IBM. "We have to change from being a follower to being a differentiator, by combining technology and industrial design," says Lee.

ITRI

**Chasing a killer application: ITRI president Johnsee Lee.**

### WiMAX for wellness

A next-generation telecommunications application called WiMAX is among ITRI's most promising platforms. The wireless communication system has bigger bandwidth and wider range than existing technologies. And combining it with other systems under development — biosensors, for instance — could create a wave of telemedicine applications. For example, using biosensors along with a WiMAX device would allow a diabetes patient to constantly monitor vital information. Already 3,800 people on the ITRI campus have signed up to test-run these devices for 'wellness enhancement', Lee says.

Like many senior Taiwanese officials, Lee trained in the West — in his case at the University of Chicago and working as a physicist at Argonne National Laboratory nearby, before returning to Taiwan in 1990. And like his colleagues, he has difficulty repatriating Taiwanese scientists who have established themselves in the United States or the European Union — although ITRI has some recruitment edges over academia, he says.

"We recruit from industry, our people leave for industry, so our compensation has to be competitive," Lee says. "We have no problem recruiting new graduates. But we have problems recruiting people with industrial experience." This year, ITRI will offer twice the going rate to key leaders and researchers. "Through that, we hope more and more experienced people will join ITRI," Lee says. ITRI also has an international intern programme to attract scientists from outside Taiwan. As another incentive, it lets its inventors receive 25% of a patent's royalties, for up to 10 years

ITRI

**Grass is greener: Taiwan's Industrial Technology Research Institute hopes to tempt expat scientists back home.**

after they leave. "That way it's almost like their own business," Lee says.

Academia Sinica, Taiwan's largest and most prestigious academic research institution, is facing the same problems, but with even more challenges. Its president, Chi-Huey Wong, laments the lack of infrastructure and the low pay for Taiwanese scientists. He launched his chemistry career in the United States before returning home in 2003.

"If we could just get 1–2% more back," Wong says, noting that only about 28% of Taiwanese scientists return after training abroad, compared with 98% of Japanese PhDs. "My biggest concern is salary," he adds. He is seeking sustained annual funding increases for the US$400-million institute, which he hopes will help raise pay. Although Taiwanese research institutions don't have formal schemes to offer higher salaries to Western-trained researchers or teaching faculty, flexibility is "certainly there", says Wong. For example, the president of the National Taiwan University (NTU), Si-Chen Lee, recently tendered an offer to a Nobel laureate chemist that carries an annual salary of US$210,000 — "about 2.5 times the regular salary earned by our rank-and-file professors", says Wong.

## LOW-TECH, HIGH-TECH

S. C. Lee, a professor in the Institute of Applied Mechanics at the National Taiwan University (NTU), represents the current wave of Taiwanese academicians. Like most, he spent time in the United States — along with his two siblings. He came back to his homeland "because my parents are here", he says. Taiwanese scientists who return generally do so to care for ageing family members. His exposure to Silicon Valley and his roots in Taipei — where motor scooters whizz through alleys in front of street-level shops where entrepreneurs make anything from toy microscope parts to electronic components — gives him what he calls a "low-tech, high-tech" approach to physical problems.

For example, during the SARS epidemic, NTU scientists researched the best kinds of breathing masks. They examined different kinds of cloth with varying pore sizes, looked at filtration sizes necessary to keep the virus out and examined the effects of applying electrostatic charges. The 'small alley shop' ethos helped one local company create elliptical fishing gears that yield variable tension to the line, using the same technology that makes elliptical trainers such good work-out machines. The entrepreneurs are now trying to apply the physics and engineering approaches they used on the fishing reels to develop vacuum pumps. **P.S.**

Ji-Wang Chern, commissioner of research and development at the NTU, says that low pay and the relatively few academic posts help explain why few Taiwanese scientists return from abroad and most graduates go directly into industry. He aims to recruit 20 professors at US-equivalent salaries over the next five years.

Chern realizes that Taiwan can't compete with the West in broad areas such as genomics and drug discovery. But by carefully picking specialities, the country can make an impact, he says. For instance, the NTU's medical school has five scientists studying dengue virus. He aims to establish 10–15 world-class groups in similar specialities, with funding of about US$1.6 million a year per group.

### Tropical transgenics

Jei-Fu Shaw, president of National Chung Hsing University (NCHU) in Taichung, shares Chern's strategic approach. "We can be number one in tropical agriculture," Shaw says. Taiwan leads the world in rice genomic research and shiitake mushroom production, and is a major exporter of tropical flowers and fruits. Transgenic varieties can offer longer shelf-life and less disease, he adds.

Shyi-Dong Yeh, vice-president of the NCHU and professor of plant pathology, is a pioneer in transgenic papayas and wants to apply that technology to aquaculture and stick to niche areas. "We don't want to compete with Monsanto," Yeh says. The NCHU, like Academia Sinica and ITRI, aims to combine technologies in focused areas, such as creating micro-sensing devices to monitor viruses in tropical crops.

To this end, the university created its Center for Nanoscience and Nanotechnology three years ago. It has already grown to 26 principal investigators, many of whom are seeking biotech applications for nano-electronic devices. Director Kuan-Jiuh Lin notes that if Taiwan can produce good microchips and flat-panel displays, the country is also capable of creating and manufacturing microelectric devices — whether for telemedicine, communications or agricultural biotech. When that happens, the country's scientists will be proud of the 'Made in Taiwan' label. ■

**Paul Smaglik is editor of *Naturejobs*.**