

# COMMENT

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## Architects of South American science

Ten research leaders call for policies to build science, and ways to build science into policy.

### ARGENTINA Strengthen networks

Eduardo Arzt is director of the BioMedicine CONICET-Partner Institute of the Max Planck Society, Argentina

Regional and cross-continental networks strengthen science in South America. They encourage young scientists to return home, motivate governments to invest in their own science, and fill gaps in core technologies such as advanced microscopy and proteomics, which require sophisticated instruments. A number of initiatives in recent years illustrate several creative approaches.

One model relies on partnerships with other prestigious institutes. For example, Uruguay's Pasteur Institute in Montevideo was founded in 2004 through an agreement with its counterpart in Paris, and the Biomedicine Research Institute of Buenos Aires, inaugurated in 2011, is a partner institute of the German Max Planck Society. Both institutes have recruited dozens of young researchers and built dedicated laboratories. They have also appointed international boards of scholars to offer advice and evaluate the quality of the science. This positive feedback loop should motivate similar evaluation schemes across other institutions.

Other programmes also foster collaborations between scientists in South America and scientists in North America and Europe. In April, Argentina became an associate member state of the European Molecular Biology Laboratory (EMBL). Symposia have already been organized, and Argentinian scientists now have access to the EMBL's state-of-the-art resources.

The Millennium Science Initiative (active in Chile and Brazil), the US National Institutes of Health's Fogarty International Center, the Howard Hughes Medical Institute, the Pew Charitable Trusts (see ►



► page 213) and the Partner Groups of the Max Planck Society all sponsor individual scientists to help to create a critical mass in fields such as molecular biology, neuroscience and nanotechnology.

Regional entities have recognized the benefits of such programmes. The multinational South American trade group MERCOSUR, through its fund FOCEM, provided US\$7 million to build a biomedical research network spanning six institutions in Argentina, Uruguay, Brazil and Paraguay. The network will foster research, training and technology transfer in molecular medicine. National governments will chip in a further \$3 million.

These networks are building momentum in the region's science. As they begin to bear fruit, the time is right to build on them and not become complacent.

## PERU

### Build research capacity fast

*Gisella Orjeda is president of the National Council for Science, Technology and Technological Innovation, Peru*

It is an exciting time for science in Peru. After years of neglect, the budget of the National Council for Science, Technology and Technological Innovation (CONCYTEC) has grown 20-fold in just 18 months to almost US\$110 million, and it will continue to grow at the same rate. For the first time, Peru has a president who is prioritizing science and innovation. Journalists are trying to grasp and explain new concepts.

Now Peru needs highly qualified scientists and scientific managers. We must learn how best to organize calls for proposals, allocate funds, build programmes and reach companies. Then we must work out how to build prosperity with our new-found knowledge.

CONCYTEC establishes and promotes national policies for science, technology and innovation, and funds research. We work with local governments, the private sector, scientific institutes, universities and colleges. This is a big task for an organization of 148 people that until 2012 had an annual budget of just \$6.3 million and almost no information about the set of institutions that produce, transfer and use knowledge.

We are building these capacities: defining evidence-based policies and priorities, adhering to conflict-of-interest guidelines,

and establishing a merit-based review of proposals and incentives for innovation. We are eliminating rigid rules for immigration, buying scientific equipment and hiring qualified personnel.

I returned to Peru eight years ago, after spending ten years in France, because I wanted to make a difference in my country. After publishing the potato genome in *Nature* in 2011, I never imagined that I would have to leave science to lead science, but I have no regrets. It is thrilling to be at the helm of CONCYTEC as we face the formidable challenge of constructing a knowledge-based economy.

## BRAZIL

### Boost pro-forest economics

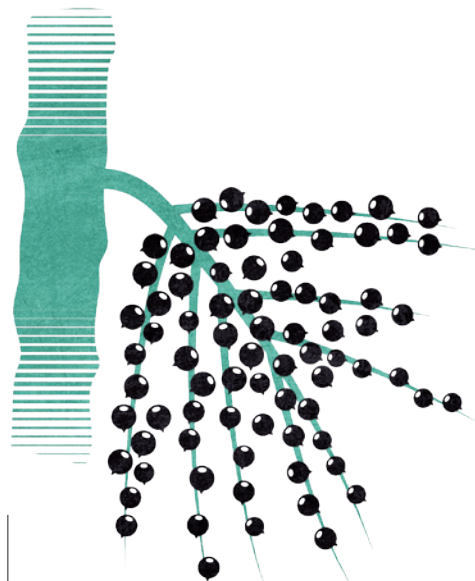
*Carlos Nobre is national secretary for research and development policies at the Ministry of Science, Technology and Innovation of Brazil*



The deforestation of the Amazon must stop: when forests are cleared for agriculture, cattle ranching and logging, the damage is felt environmentally, economically and socially. But simply curbing deforestation is not enough: sustainable-development strategies must also improve well-being for local communities.

Unfortunately, the global economy places a higher premium on meat and soya beans than on forests. Creating a new economic model for the Amazon forest will therefore take two transformations; both require science.

One strategy is to add value to locally harvested products. A good example of such a bioindustry is the açai fruit of the palm tree *Euterpe oleracea* that grows in the Amazon. Until around 20 years ago, the dark berries were a food staple consumed only by the local population. Today, açai fruit is used in produce including food, nutritional supplements, cosmetics, dyes and industrial oils around the world. Annual pulp production exceeds 200,000 tonnes and contributes more than US\$2 billion to Brazil's economy, second only to beef and tropical timber.



Local açai producers can make more than \$1,000 per hectare in annual profit, 5–10 times more than from soya and at least 15 times more than from cattle. Embrapa — the Brazilian Agricultural Research Corporation — has used açai to produce a dye for bacterial plaque that is now ready for commercial use in toothpaste and mouthwash.

More research is needed to identify uses for new and known natural products, and to scale up production. In a decade or two, it should be feasible to increase the exploitation of dozens of forest products.

A second strategy is to make better use of the large areas of already cleared forest — estimated at more than 750,000 square kilometres in the Brazilian Amazon alone — to reduce the need to clear even more. A nationwide Low Carbon Agriculture Program aims to more than double cattle occupancy per hectare within a decade. Field research conducted by Embrapa and the Brazilian cosmetics company Natura showed that oil-palm plantations on smallholdings could be integrated with other crops, such as nitrogen fixers, to obtain yields comparable to those of large-scale plantations.

Both these transformations require educating the rural and urban populations

**“In a decade or two, it should be feasible to increase the exploitation of dozens of forest products.”**

to change their ways. Technical programmes to increase agricultural productivity must reach hundreds of thousands of farmers. Isolated traditional populations will need help to reap value from collecting and selling products of biodiversity. Doing so will rely on modern communication — a new government-owned telecommunications satellite is set to start operations in 2016 to bring high-speed Internet to communities in the Amazon.



## CHILE

## Empower coastal research

Juan Carlos Castilla is professor emeritus at the Pontifical Catholic University of Chile

Rich countries can protect vast areas of their seas. Australia bans fishing in 345,000 square kilometres of the Great Barrier Reef; California protects about 16% of its coastal waters, some 2,200 km<sup>2</sup>. This approach will not work in the parts of the developing world where people's livelihoods depend on coastal fishing. A promising alternative is community-centred stewardship, boosted by research and education.

The Chilean government grants coastal communities exclusive territorial use rights in fisheries (TURFs) to extract seafood from a designated area, in exchange for a management plan that limits the annual catch proportion of algae and benthic organisms (bottom-dwelling animals including molluscs, shrimp and crabs). Around 500 of these co-management areas encompass more than 1,100 km<sup>2</sup>. The areas are only 4–10 km apart, so larvae and young animals from one area can disperse into another.

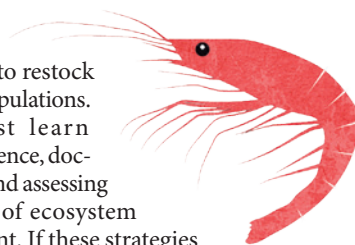
This system of fishery co-management was established in 1991. Communities differ in their performance, but results reported in 2012 revealed a desirable by-product: TURF areas show robust increases in the biodiversity of invertebrates, algae and rockfishes compared to uncontrolled areas.

Co-management empowers people to care for their resources. If a port or power plant begins operations nearby, communities demand that any damage to their area is assessed and compensated.

In unmanaged areas, the coast is overfished. TURFs are not enough. One strategy is to develop communal-management approaches for specific resources in the areas that can be fished by anyone. Regulations in Chile that came into force last year will set a total allowable catch for key species, attempting to account for a marine stock's reproductive, growth and mortality rates. A network of no-take areas between TURFs would also help. Ocean life in the no-take areas

could help to restock depleted populations.

We must learn from experience, documenting and assessing the effects of ecosystem management. If these strategies fall into place, communities can continue to fish, protect biodiversity and safeguard coastal ecosystems.



## ARGENTINA

## Fuel public-private consortia

Lino Barañao is Minister of Science, Technology and Innovative Production, Argentina

After a decade of policies aimed at boosting research, science in Argentina is starting to have positive effects on economic development and society. Now, greater involvement from the private sector is required.

Five years ago, the Argentinian government launched the Sectoral Funding Strategy to promote public-private consortia. From 2008 to 2013, more than 5,000 companies, including 80 start-ups, received a total of US\$800 million as grants or loans with below-market interest rates. The government also created programmes for postdocs and established researchers to gain experience in private companies. The number of scientists in industry increased from 7,200 in 2003 to 12,300 in 2012, and is expected to rise to more than 18,000 by 2020.

Projects funded by the strategy must combine a key enabling technology (such as biotechnology, nanotechnology, or information and communications) with a strategic area (such as health, energy, or environment and social development). They must also provide a business plan to bring an innovative product or service to market within five years. Some projects have already moved beyond proof of concept, including production of human growth hormone in the milk of transgenic cows and nanotechnology systems for drug delivery. Another example is Satellogic, a company that is developing nanosatellites for imaging. It is about to launch its third prototype and has already received private investment.

In 2012, Argentina's national research council, CONICET, and its national petroleum company, YPF, came together to create a joint company called Y-TEC. The firm, which employs more than 70 researchers, is developing technologies to exploit unconventional oil such as shale and renewable energy, and has already submitted six patent applications, three of which are licensed.

In developing countries, the science and technology sector cannot focus only on cutting-edge technologies; it must also promote social inclusion. The latter is illustrated by the Guanaco Project in the Andes, which is developing textiles for the 'responsible luxury' market. Guanacos, close cousins of llamas and vicunas, produce a fibre superior to cashmere.

In the past, science had only a cultural role in Argentina. Now it is contributing to a knowledge-based economy as a means to achieve a more just society.

## BRAZIL

## Reward quality not quantity

Sidarta Ribeiro is director of the Brain Institute at the Federal University of Rio Grande do Norte, Brazil

In the past decade, the Brazilian government has put substantial resources into education and science. It has: established a minimum wage for school teachers; allocated 1.2% of the gross domestic product to fund research; and launched the Science without Borders scholarship programme to attract foreign talent to the country and

to help promising Brazilian researchers to train abroad.

Two of the biggest remaining barriers to improving the nation's research are performance evaluation and rewards. Valuing quantity over quality is so ingrained in Brazil's scientific culture that it is nicknamed *numerologia* (numerology), a pun on the mystical belief in the power of numbers.

The official Qualis system for the evaluation of scientific papers and journals — which carries heavy weight in grant and job applications — encourages Brazilian researchers to publish as many papers as possible, regardless of the international impact of their research. Qualis does recognize different tiers of journals, but the categories are so broad as to be almost meaningless — a paper published in a journal such as *Nature* or *Science* and one in a highly specialized journal might be counted equally. Rather than gathering a full set of experiments into a coherent story, scientists gain more recognition in the system by breaking related work into multiple papers.

Independent international evaluations at universities and research institutes might be the key to rewarding innovation and cutting-edge science more effectively.

*"Independent international evaluations at universities and research institutes might be the key."*



## VENEZUELA

## Respect science and scientists

Claudio Bifano is president of the Venezuelan Academy of Physical, Mathematical and Natural Sciences

Much of Venezuela's technology and scientific capacity, built up over half a century, has been lost in the past decade. We need to restore respect and funding to basic research to halt the brain drain and reverse this catastrophic trend.

In recent years, Venezuela has invested more than 2% of its gross domestic product (GDP) in science and technology, and boasts a workforce of about 13,000 scientific researchers. But the number of publications in international journals declined by 40% in 2008–12, from roughly 1,600 to 1,000. The total number of publications in 2012 matched that of 1997, when the country had fewer than 3,500 researchers, and a science and technology budget of just 0.3% of the GDP.

According to a 2011 survey, 51% of Venezuelans over 25 years old living in the United States have finished university (compared to 13% of the US Hispanic population and 29% of all US residents). The online publication *Piel-Latinoamericana* reports that 1,100 of 1,800 physicians who graduated from medical school in Venezuela in 2013 have left the country. In other words, educated Venezuelans are fleeing — or are being forced out. For example, in 2003, roughly 1,000 professionals, mostly physical scientists and engineers, were fired from Venezuela's petroleum research and development institute, INTEVEP. International agencies report that no patents have been granted since that time.

Since 1999, the Venezuelan government has imposed a political model called socialism of the twenty-first century. I and others find it based mainly on authoritarianism, with some ideas from Marxist philosophy and extreme populism. Science, according to the minister for science and technology, is for the solution of societal problems. The National Science, Technology and Innovation Plan (2005–30) says that science must be conceived as a process that involves new participants, such as the holders of traditional and local knowledge.

To achieve this goal, the Ministry of Science, Technology and Innovation supports projects submitted not only by scientists but also by those without scientific training and by organizations such as community councils, environmental groups and associations geared towards the social services. Funded programmes include one that

distributes computers to school children and missions for a remote-sensing satellite and a data-transmission satellite. These may be laudable projects, but they are not science.

Allowing those who lack scientific training to access public funds for scientific research trivializes science.



## BRAZIL

## Banish bureaucracy

Jose Eduardo Krieger is provost of research at the University of São Paulo, Brazil

Brazil needs a better environment for knowledge creation and innovation. Bureaucracy currently holds back research. Fixing this will require changes to institutional policy and national legislation.

At the University of São Paulo, for instance, we began a major initiative in 2011 to enable scientists to focus on what they do best, rather than wasting time filling in forms. The university is the largest research institution in South America, responsible for about 20% of all papers published in Brazil every year. The institution's 6,000 scientists win almost half of the US\$450 million that the state of São Paulo awards to support research.

But most Brazilian grants do not cover overhead or indirect costs, such as facility maintenance. So our universities lack the support offices that North American and European researchers rely on to help with ordering equipment and reagents, paying invoices, financial reporting, contract negotiation and account monitoring. Every researcher must set up these systems individually.

By the end of this year, the University of São Paulo will roll out a digital platform to assist researchers with procurement, accountability and operations. We are also creating a network of trained project managers to assist specialized schools and large research groups. These measures follow a \$100-million, four-year effort by the university to reorganize its research enterprise.

More than 100 research support groups have been created, each with a technician, to encourage scientists to organize themselves into interdisciplinary clusters.

These strategic moves will be complemented by improvements in the regulatory laws currently under discussion in the Brazilian Congress. These should allow equipment and consumables for academic research to be imported more quickly and easily — giving our scientists more time for research, and helping them to compete with their peers in North America and Europe.

## CHILE

## Base policy on evidence

Pablo C. Guerrero is assistant professor at the University of Concepción, Chile; Mary T. K. Arroyo is director of the Millennium Institute of Ecology and Biodiversity, Chile

Chile needs a system for formulating public policy on the basis of sound scientific information. The government's decision in March not to create a ministry of science passed up a valuable opportunity for that.

The current disconnect between science and policy within the government is worrying, as two recent examples show. First is the devastating fire that swept through

**"The current disconnect between science and policy within the government is worrying."**

parts of the city of Valparaíso in April. For decades, authorities ignored ecologists' warnings about expanding highly flammable eucalyptus plantations that are now near many cities in central Chile, and where the Valparaíso fire started.

Second, Chile has experienced seven earthquakes measuring magnitude 7 or more in the past decade. Here, too, scant attention was paid to scientists' predictions about the accumulation of seismic strain.

Some have suggested that Chile's highly regarded science-funding body, the National Commission for Scientific and Technological Research (CONICYT), could regain its past influence and advise on public policy once more. To do so it will need to adjust its current emphasis on impact factors and international recognition of basic science. CONICYT should give explicit credit to basic-science problems that are relevant to the concerns of Chileans, such as the availability of water resources in a changing climate and innovative ways to use minerals. ■