prime minister, Alexander Boshkov, is a thermal engineer; the health minister, Petar Boyadjiev, is a pediatrician; and the environment minister, Evdokia Maneva, is a chemist and economist.

If researchers were hoping that all this scientific firepower in government would help bolster research funding, they have so far been disappointed: Basic research is suffering in many countries in central and eastern Europe, as cash-strapped economies wean research institutes from formerly generous state subsidies, and restructured industries are not yet able to fill the gaps with their own R&D funding. The region's scientist-politicians are aware of the plight of their former colleagues, but few can help muster enough resources at a time when their nation's economies are going through rapid changes. "There aren't enough resources now," says Aurel Sandulescu, a theoretical physicist who serves in Romania's Parliament, "but I do what I can in Parliament to help." Sandulescu has pushed successfully for increased academy funding and a competitive granting process.

Poland's prime minister, Buzek—whose wife, Ludgarda, still works 3 days a week as a researcher at the Polish Academy's chemical engineering institute in Gliwice—tries to stay above the fray on scientific funding debates. "Of course, I get a lot of information about the status of Polish research," Buzek says. "But if I show particular interest in these issues, it would look as if I'm not really objective." This year, Poland's government agreed on a controversial austerity budget that freezes the KBN research budget at about 0.47% of gross domestic product. Although Buzek thinks that level of funding is insufficient, he says the government has too many other pressing needs for him to give special treatment to research.

Opinion is divided—even among the scientist-politicians themselves—on whether scientists' skills lend themselves well to government service. Estonia's Lippmaa thinks so. "Some of the talents needed in science and politics overlap," he says. Those skills include "a thorough knowledge of the field of research or political action ... a thorough understanding of all the force fields and interactions at play—be it spins, particles, or states and power blocks, and the human factors involved at all levels ... and the ability to think faster than opponents." Wiszniewski agrees. "We are amateurs and, because of that, we make some political errors," he concedes, but because scientists are trained in objective scientific analysis and are good at recognizing and correcting their missteps, "we learn quickly from our mistakes." But Bratinka says scientists aren't especially well qualified or effective at the business of government—other than in supervising research efforts. "Many scientists are unwilling to challenge the prevailing orthodoxies," he contends.

Even some of those who have joined the influx of scientists into politics say the phenomenon may be short-lived. Estonia's education minister, Mait Klaassen—a professor of veterinary medicine and former university rector—predicts that a new generation of students trained in social sciences eventually "will replace the natural scientists" in many governments. Bratinka, who describes the recent political ascendancy of natural scientists as "an accident of history," says "a new political class is starting to emerge now." And in Warsaw, Buzek believes that more Polish researchers will stay in their laboratories once a new generation of political leaders emerges. "In the future, the proportions of scientists in government are going to be more closely equal to those in other countries," he says. But in the meantime, Buzek and his colleagues are clearly relishing their transition from the lab bench to the pinnacles of government. **–ROBERT KOENIG**

Robert Koenig is a writer in Bern, Switzerland.

INDONESIA

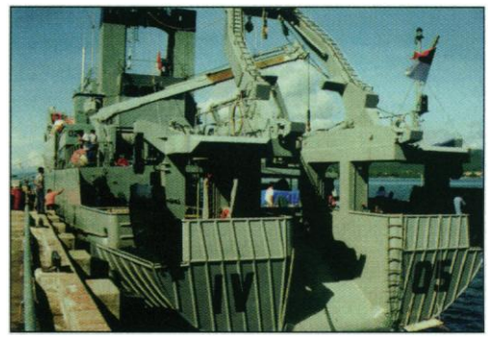
Turbulent Times Mean Trouble for Science

The economic crisis has triggered sharp cuts in research funding, leaving scientists scrambling to find other ways to keep their projects alive

Indonesian agronomist Endah Retno Palupi is continuing with her study of the reproductive biology of snake fruit. But since the government's recent decision to freeze funding for her 3-year grant, she has had to pool money left over from the first year of her grant with personal funds. Sangkot Marzuki, director of the 5-year-old Eijkman Institute for Molecular Biology in Jakarta, doesn't have those options. Instead, he's struggling to pay salaries out of a budget that has effectively shrunk by more than 90%, making it almost impossible to buy reagents and other necessities from abroad.

Throughout Indonesia, scientists are reeling from new policies aimed at reviving a crumbling economy. The crisis began last summer when several Asian currencies took a nosedive. It spread to a general economic and political meltdown that led to the ouster in May of the country's longtime ruler, Suharto, and the elevation of his deputy, B. J. Habibie, the former science and technology minister. This year officials are bracing for a double-digit contraction in the economy, an abrupt turnaround after more than a decade of 7% annual growth rates that fueled significant new investments in research. "I think our situation is worse than in the former Soviet Union," says Marzuki, who was lured back to Indonesia from Australia in 1992 by the government's commitment to basic biomedical research (*Science*, 6 March, p. 1471). "I'm afraid that, without outside help, we could lose most of what we have built up over the past decade."

That sudden reversal of fortune has left researchers scrambling to preserve the capacity to do science. For Palupi, a faculty member at the country's leading agricultural university, Institut Pertanian Bogor, the blow came with the government's recent decision to cancel what would have been a new competition for RUT grants, which serve all areas of science, and to freeze current awards. Part of the savings will go toward a new applied research program starting this week aimed at increasing the production of food and medicine using existing technology. The grants are intended to foster small and medium-sized businesses, explains Indroyono Soesilo, a senior official at BPPT, the science and technology ministry.



ARNOLD L. GORDON / LAMONT-DOHERTY EARTH OBSERVATORY

Rough waters. Indonesia hopes foreign funds will keep its research fleet afloat during economic crisis.

Ironically, the freeze in the RUT program will slow Palupi's efforts to learn how to manipulate the qualities—taste, texture, and seed size—of a fruit in ways that could boost its value as an export crop. But that's a long-range goal in a country desperate for immediate solutions. "I understand the economic difficulties facing the

government and the need to set priorities," she says.

Funding for new laboratories, buildings, and other major facilities has also been assigned a low priority, says Triono Soendoro, an administrator with BAPPENAS, the national planning agency. That poses a problem for Marzuki, who is already trying to overcome the double whammy of a 30% across-the-board cut in agency budgets imposed this spring and a rupiah that has lost 80% of its value since last summer. Instead of working in his lab, Marzuki sits in his office, writing up research already completed and trying to interest overseas medical philanthropies in his proposal for a high-rise laboratory and office building—a plan that has been shelved indefinitely by his own government.

Marzuki recognizes that, with rising unemployment and soaring food and fuel prices, science policy must take a back seat to more basic human needs. But he worries that even a short-term suspension of RUT and other programs aimed at improving Indonesia's scientific infrastructure could come back to haunt the country. "It may be hard to restore the funding," he frets.

The government is, however, continuing international scientific collaborations, and it is still providing support for sending students abroad and for other training programs deemed essential to the country's long-term economic health. Oceanographer Arnold Gordon of Columbia University is preparing to welcome one of those students next month. And he's packing up his equipment for a September cruise aboard the *Baruna Jaya IV*, Indonesia's newest research vessel, to track regional ocean circulation patterns that affect global climate and weather. The cruise is one of three scheduled for the fall by U.S. scientists that builds on Indonesia's recent offer to open up its waters to scientists around the world (*Science*, 5 December 1997, p. 1703). The surge of cruises will provide a major source of revenue for BPPT's oceanographic program.

While Gordon is planning additional research projects, he's concerned that his longtime ties to the country could start to fray if the political and economic situation worsens. "Unfortunately, Indonesia is being asked to do more at a time when the government is more hard pressed than ever to support such research," he says.

Even with half of BPPT's budget committed to international collaborations, Gordon and others worry that a lack of funds may force the agency to either neglect necessary repairs and routine maintenance on its research vessels or price itself out of the market. "The day rate [for oceanographic cruises] has gone up by two-thirds in the past 6 months," says program manager Eric Itsweire of the U.S. National Science Foundation, which funds Gordon's Arlindo project. "But they are looking at a key region of the world's oceans and at the connection between El Niño and the Asian monsoon, and so far we think the scientific payoff justifies the cost and the difficulty of working there. We plan to stay flexible and see what happens."

Such a wait-and-see attitude has become de rigueur for Indonesian scientists and foreign scientists working in the country. Gordon plans to ship his equipment via Singapore, for example, as a hedge against any last-minute change in plans. But keeping one's options open has its limitations, too. "The worse thing is that you can't make any plans," says Marzuki. "So we take things one day at a time, preparing for the worst and hoping for the best."

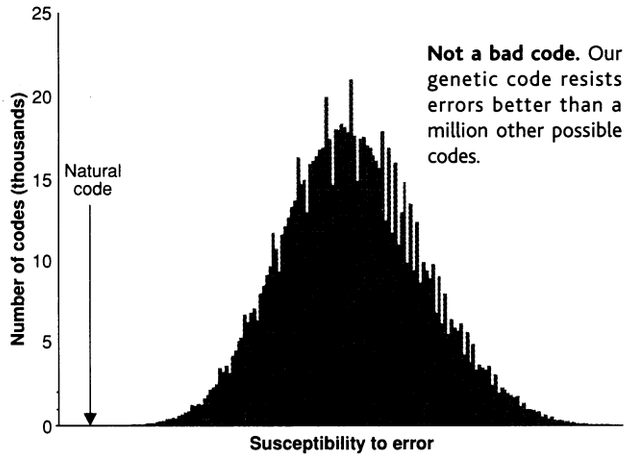
–JEFFREY MERVIS

EVOLUTION

Tracking the History of the Genetic Code

Computer analyses and experiments with RNA molecules offer new insight into the forces that may have shaped the genetic code over time

VANCOUVER—For the 3 decades since biologists cracked the genetic code—the key to translating DNA into proteins—they have debated its origins. Some claimed it must be a random accident forever frozen in time, while others argued that the code, like all other features of organisms, was shaped by natural selection. Most of those debates have been philosophical, with little data to back up either side. But at the annual meeting of the Society for the Study of Evolution held here last month, two speakers presented evidence suggesting that forces other than chance shaped the code's origin and history.



Not a bad code. Our genetic code resists errors better than a million other possible codes.

SOURCE: FREELAND AND HURST

Experiments with RNA have shown that chemical attractions between the genetic material and the components of proteins may have helped shape the original code, reported one speaker. Another researcher, using powerful computer analyses, suggested that the modern code is the product of evolution because it is so error-proof: Only one in a million other possible codes is better at producing a workable protein even when the DNA carries mistakes.

Doubters such as evolutionary biologist Niles Lehman of the State University of New York, Albany, still remain unconvinced that the code is anything but an accident. But he and others say that new studies such as these, as well as other work probing the history of individual genetic "words" (see sidebar, p. 330), are beginning to make a dent in their skepticism. "We're at a turning point" for probing the origins and history of the code, says Lehman.

Living things use DNA to store the instructions for making the proteins that build cells and direct them to develop into a complete organism. The four different subunits, or bases, that make up the DNA chain are grouped into three-letter "words" called codons, and each codon specifies a protein's amino acid building block. Specialized cellular machinery copies the DNA code into RNA—which has a similar code—and then reads the RNA to piece together the amino acids to make proteins. A codon "means" the same thing in a koala as it does in a rose or a bacterium. Yet there's no clear pattern in the pairing of codons and amino acids, which has persuaded many scientists that the code arose by accident.

But test tube experiments now suggest that before cellular machinery had evolved to read the code and build proteins, the code could have been shaped by affinities between specific base sequences and amino acids. Many scientists have speculated about such a scenario, but new data from experiments in which short strands of RNA are