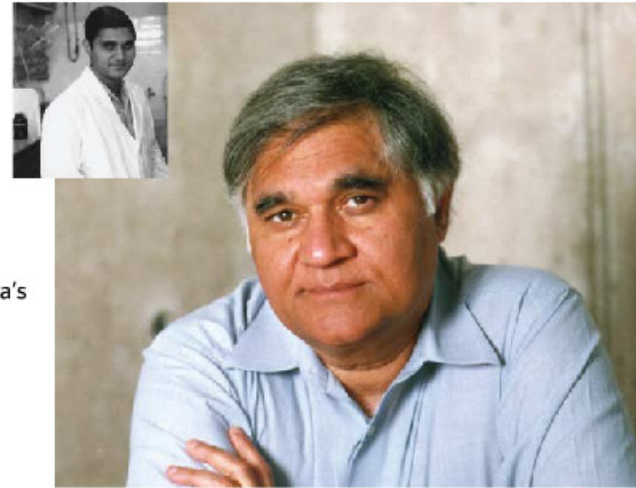


Then and now

Inder Verma celebrates the recent success of India's biotechnology industry, applauds the increased investment and looks to the future.



"Your job is to collect urine in the men's bathroom and bring it to the laboratory at the end of the day." These were the instructions my thesis adviser gave me when I began my graduate career in 1966. Others would then purify factors from the urine that might function as a male contraceptive in monkeys. He pointed to a 20-litre glass bottle with a broken rim and a small glass funnel. I was expected to obey his orders — and I did. (My only intellectual contribution was to switch to a larger funnel, which made it easier for both the donors and for me.)

A few months later I was told that monkeys were no longer available and the study was being shelved. From now on I would work

with a plant researcher in another lab. At no point was I consulted during these arrangements. I was merely a graduate student expected to do as my supervisor commanded. In the years since, the situation has improved, and the overbearing attitude of many advisers is becoming a thing of the past. Young scientists in India are more independent and increasingly resentful of the autocratic system.

For many decades, Indian universities have churned out biologists, many of whom move to the United States or Europe. Those that remain in India are usually destined to publish in local or low-impact scientific journals. Life-science research in India has been constrained by insufficient funds and equipment coupled with a lack of will to compete with the rest of

Inder Verma believes that young scientists must be able to challenge the status quo. As a graduate student (inset), Verma felt that he had to obey all his thesis adviser's commands.

the world. Funding agencies such as the Council of Scientific and Industrial Research have always emphasized translational research but, because the success of such programmes rests on a strong foundation of basic science, the results were often dismal. Indian medical schools, lacking resources for research, have failed to train scientists in translational research. Not surprisingly, India has not produced a single original drug sold in the world market. All this, I hope, is about to change.

I've been to India every year for the past 35 years, have visited many institutions, met many colleagues, students and young investigators and participated in countless meetings. In that time, I've witnessed the growth of Indian biosciences with concern and pride.

Recently, I've been delighted by a run of excellent papers published in top-tier journals by scientists in India. And I've been impressed by the desire of the biotech and pharmaceutical industry to undertake novel challenges.

The first prime minister of India, Jawaharlal Nehru, believed that science is the way out of poverty. The scientific opportunities in India may well prove him to be a true visionary, but there is much work to be done first.

Novel ideas

Biotechnology companies are among the most profitable in the country. Today, Indian companies provide 22% of the world's generic drugs — copies of brand-name drugs. India also manufactures a significant proportion of vaccines made for the developing world.



Science has always been important to the Indian government. It's first prime minister, Jawaharlal Nehru, greatly admired Albert Einstein. Current leader Manmohan Singh has made science a priority.



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Within India, vaccines against hepatitis B are manufactured by Indian companies and sold for less than 30 cents per dose. True, most of India's biotech and pharmaceutical industry is based on duplicating existing products, but that still requires considerable sophistication and know-how. But with the passage of a new law on 23 March this year forbidding companies from making copycat drugs (see page 480), Indian companies will be forced to be more innovative.

But how do we encourage such innovation? In the mid-1980s, the Indian government established the Department of Biotechnology (DBT) and invited several researchers—including me—to serve on its overseas advisory committee. We encouraged the DBT to furnish state-of-the-art laboratories, provide increased funds for research, reduce the bureaucracy required for importing research materials such as restriction enzymes, initiate projects that promote the sharing of expensive equipment, offer visiting fellowships and build manpower to support the biotech industry.

Since the DBT's inception, its budget has grown from a meagre US\$15 million to more than US\$125 million a year. That may not be much compared with the US\$27 billion budget of the US National Institutes of Health, but it's a good start.

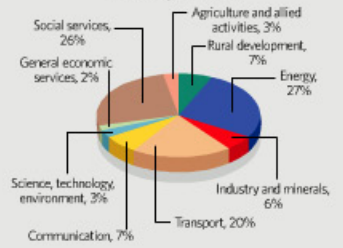
Increased investment

In addition to the DBT, there are at least three major funding sources for life scientists within India, so finding funds for a good project is no longer a hurdle. Indian scientists have been able to win significant funding from international sources such as the US National Institutes of Health, the Bill & Melinda Gates Foundation, the European Union and the Wellcome Trust (see page 489).

Despite this, India will not succeed unless it encourages innovation and rewards excellence. Most Indian universities still operate under a feudal system, which stifles creativity. Science is best carried out in an irreverent environment, where the status quo is challenged, often at the risk of offending superiors. But the Indian scientific enterprise frowns on questioning authority and rewards obedience. Senior scientists are too often selected by seniority and rank, rather than their ability and achievements.

In common with many scientists at institutes in neighbouring China, Indian researchers once hired are there to stay. I do not know of any case in which someone was denied tenure or did not have their contract renewed because of low productivity. This

INDIAN GOVERNMENT BUDGET, 2005-06
Total: US\$118 billion



problem is compounded by the lack of lateral mobility in India. Most scientists who train abroad return to India for family reasons and are loath to live away from their home town. They would sooner go back abroad than swap cities or states within India.

But science thrives when there is a nucleus of scientists striving for excellence. The Indian Institute of Science in Bangalore and the National Institute of Immunology in New Delhi have achieved this. Scientists at these institutes, which are independent of universities, are publishing in international journals and are being invited to prestigious national and international meetings. To be competitive on a global scale, India needs to nurture such centres rather than worry about equitable distribution of the country's resources.

These centres can also encourage collaborations across cities and disciplines. Modern biology requires the expertise of scientists from many different fields. Unfortunately, scientific departments at Indian institutions and universities have traditionally operated as islands. Experts in microbiology, biophysics and biochemistry might all work within a few feet of each other and yet hardly interact, much less collaborate. The government should provide incentives for interdisciplinary research. It should also encourage academics to forge alliances with industry, market their inventions and set up technology-transfer offices.

Government officials are always coming up with catchy slogans, such as 'IT today, BT tomorrow', but often they do not follow through on those ambitious plans. India is still far behind the United States, Europe and Japan. Although India has the advantage that its citizens know English, it still lags behind other Asian countries such as China and South Korea.

India sometimes gives the impression that it will never compete properly in the global arena. But life scientists will be able to

if they can learn from the success of the IT sector.

India's position in the global IT industry is a source of pride and confidence. Graduates of the Indian Institutes of Technology (IIT) have started numerous companies worldwide, and their innovative spirit should inspire biologists to be more adventurous.

Last year, *60 Minutes*, a popular investigative television programme in the United States, featured the IITs. When the interviewer asked N. R. Naryana Murthy, founder and chairman of the multibillion-dollar company Infosys, what his son would do if he did not pass the arduous entrance examination for the IITs, Murthy replied, without skipping a beat: "Well, we have back-ups like Cornell, MIT and Stanford."

I don't usually support starting new institutions, but an Indian Institute of Integrative Biology, much like the successful IITs, is worth considering. Alternatively, the IITs could broaden their curriculum to include degrees in biology and biotechnology.

Promoting science

The time is ripe for life sciences to blossom in India. Every day, newspapers carry headlines reporting Indian successes in information technology, tales of rich Indian biotech tycoons and highlighting the enormous purchasing power of the growing middle class. In my experience, the Indian government, regardless of which party was in power, has always been highly supportive of science. But the current left-leaning administration is particularly so (see graphic, above). For example, the government recently gave the Indian Institute of Science a one-off grant of about US\$25.3 million. Prime minister Manmohan Singh has also endorsed the creation of a US\$250-million independent agency to support basic research.

India is not a poor country—indeed, it is rich in natural and intellectual resources—but it has many poor people. More than 700 million people, nearly 70% of the population, live in rural areas but contribute only 20% of the GDP. Until this disparity changes, vast sectors of the Indian population will never see the benefits of biotechnology or modern medicine. It's very clear what India needs to do to become a world player in the life sciences, but unless the government, researchers and the industry work together to put the solutions into practice, all their best laid plans will not succeed.

Inder Verma is American Cancer Society Professor of Molecular Biology at the Salk Institute, La Jolla, San Diego

SOURCE: MINISTRY OF FINANCE