COMMENTARY

In 1988 the unmanned spacecraft Buran (left) orbited Earth and landed successfully before the project was cancelled. It met its demise in a hangar collapse in 2002.

R. RESSMEYER/CORBIS

Breaking up is hard to do

Economist and former science minister **Boris G. Saltykov** sees opportunity for change and innovation in Russia.

Since the break-up of the Soviet Union, the Russian government has often declared a desire to create a 'knowledge-based economy'. In 2007, there are signs that a type of national innovation system can be created in Russia, assuming that a series of important institutional reforms are adopted. How will these moves affect the balance of power in Russian research and development (R&D)? To answer this question we need to understand the condition of Russian science at the beginning of the twenty-first century.

The fiftieth anniversary of the launch of the first Sputnik satellite reminds us of a time when two great powers — the United States and the Soviet Union — began an exhausting technological race. This was the symbolic beginning of a 'golden age' of Soviet science (see page 542) during the 1960s and 1970s, with a long line of Russian achievements in space, aviation and nuclear physics, the creation of unique research instruments, including the world's first tokamak — a fusion reactor — and world-class facilities, such as the Joint Institute for Nuclear Research in Dubna.

But Soviet science and technology (S&T) was based on a paternalistic model. All resources were centrally distributed and the highest priority was given to military-related research. There was weak communication between sectors, with each industrial research centre reporting to its branch ministry, and with most basic research under the control of the independent Russian Academy of Sciences (RAS) in Moscow. Little research was conducted by universities.

The Soviet system also created dozens of 'science cities', built in remote areas or in secure compounds alongside civilian cities. In all cases, there was little interaction between scientific–technical organizations and the wider Soviet economy. And of course all assets, including intellectual property, belonged to the state.

Such a model allowed the state to concentrate huge resources on a restricted number of prioritized S&T projects, such as Sputnik, and allowed basic research to flourish. In 1990 Soviet science was still a heavyweight enterprise supported by high levels of public funding, almost 2 million highly trained scientists, engineers and technicians and more than 4,600 highly specialized research institutes. But the system was wasteful, conservative and unable to respond quickly to new challenges. And in the long term, there was no effective way of renewing the ranks of élite researchers. The isolated and specialized institutes had little chance of adapting successfully to life after the end of Soviet rule.

The last major success of Soviet science was the launch in 1988 of the reusable unmanned spacecraft Buran, which orbited Earth twice before landing at Baikonaur Cosmodrome, Kazakhstan. The project — begun in the 1970s to rival the US space shuttle programme — was the most expensive in the history of Soviet space exploration. It was cancelled in 1993, with one flight to its name, because the Soviet economy could not continue to supply the necessary resources.

Economic crisis

After the dissolution of the Soviet Union in 1991, the new government of Russia needed to solve two problems: to prevent the complete collapse of the economy and to move towards a market-based system. Moves to attain this had dramatic effects on Russian science: by 1992 the R&D budget was three to four times smaller than it had been in 1990, industrial demand for R&D had vanished, and by 1995 the number of civilian R&D personnel — half of whom were researchers — dropped to around a million. Much of this contraction has been attributed to poor wages causing younger researchers to migrate to jobs abroad or switch to more lucrative professions within Russia.

Three steps were needed for R&D reform: demilitarization, integration into the world research community and democratization of R&D management. The huge shortage of resources dictated two main strategies: to support only the best teams and to give money to priority fields of research. This approach required new financing mechanisms and structural changes across the R&D system.

During the first stage of reform (1992–96), when I was science minister, four new 'targeted

foundations' were established, including the Foundation for Basic Research. These agencies first introduced the concept of competitive funding to Russian research. At the same time, civilian industrial-research institutes and design bureaus were privatized. New legislation for science, including modern patent law, was adopted. But these sweeping reforms did not touch the other two sectors of public research — the RAS and the military S&T sector.

Since the Soviet collapse the RAS has focused on preserving the status quo (see page 524). Because of this strategy, and the contraction in military and industrial spending, the share of basic sciences within the federal R&D budget rose from 10% in 1992 to 30–35% in 1996, although it declined by three to four times in real terms. The number of researchers also dropped while the number of RAS institutes grew, from 330 to 450 by 2004.

In general, the number of R&D organizations declined across Russia, falling to 3,500 by 2005. Others switched to commercial activities unrelated to science — leasing land or property to business — to survive the economic crises of the 1990s. The population of Russian scientists is also ageing quickly: by 2004 researchers in the most productive age group, 30–45 years, had almost disappeared and the average age of professors exceeded 60.

Publishing productivity noticeably diminished and Russia dropped from fourth or fifth place in the world hierarchy in 1990 to eleventh place by 2005. Publications by Russian researchers in leading scientific journals declined by 20% over the 10 years to 2005, with the share of Russian articles in world publications falling from 3.64% to 2.26% (ref. 1).

M. LYSTSEVA/ITAR-TASS

Future hope: a scale model of Superjet 100, a new Russian jet built with international partners.

A new lease of life

When Russia's economy finally recovered after the shocks of the 1990s, it was heavily dependent on exporting natural resources — oil, gas and metals. But after the election of Vladimir Putin as the president of Russia in 2000, the government turned to S&T as a means of diversifying the economy.

"Only a new, young élite can help Russia become a modern knowledge economy."

Following the re-election of Putin in 2004, the modernizing activities of the Ministry of Education and Science increased sharply. Today's ministry has two important advantages compared with that of the early 1990s: a larger R&D budget and a strong team close to the president. The new minister, Andrei Fursenko, has prepared a strategy for the development of Russian science until 2015 and initiated a federal targeted programme in priority areas of R&D. Similar to the targeted foundations, this programme allows competitive project funding, and so is helping to shift Russian science away from basic institutional funding.

The old élite of the RAS have resisted the ministry's attempts to reform it, so, in 2007, the ministry made a strong and unusual move — they established the Russian Nanotechnology Corporation with a rapidly passed special law. The nanotech project has been declared as being as important as the space project of the 1960s and has been allocated huge resources, comparable to the 2007 budget of the RAS.

The scale of the project makes it possible to create a new sector of basic and applied science outside the RAS. The nanotech corporation is a non-profit organization with unusually broad rights. It can finance any S&T project, establish new organizations and improve R&D teaching. In particular, it can support the development of research in universities, which have historically been underfunded. In my view, it is important for students to be taught and inspired by active researchers, and university research can increase the productivity of facilities.

A key characteristic of the new science policy is linking R&D to the demands of markets and society. Private-sector firms in the United States, Japan and Europe account for 75%, 71% and 65% of R&D spending, respectively[2]. In Russia the private sector accounts for around 30% of total funding — slightly less than it did in 1995. The public purse still accounts for 62% of research spending, whereas countries that are part of the Organisation for Economic Co-operation and Development average about 30%.

Not surprisingly, Russian production of patents per capita is 10 times lower than in Spain, and 60 times lower than in South Korea[3]. Despite having a similar proportion of researchers to Germany, German researchers produce 100 times as many patents per capita. The low level of Russian innovation is a hangover from weak international competitiveness during Soviet times, and the wide gap between much of R&D and the needs of the market.

Innovation is also being pursued by the Ministry of Economic Development and Trade. It has established a $600-million venture company — a state corporation for creating new private-venture funds — and five special 'tax-free' zones for S&T firms, including the former science cities of Zelenograd, Tomsk and Dubna. In 2006, the state created the Russian aircraft corporation (OAK), bringing dozens of existing plants, design bureaus and institutes under one umbrella organization. Moves to create similar corporations in shipbuilding, atomic energy production and other fields are underway.

Cooperation or monopolization?

My impression is that this new system of state capitalism in Russia is very similar to the South Korean 'chaebol' model — with government-assisted business conglomerates — of the 1990s. Generally speaking, it may help Russia to enter some global high-tech niche markets, especially if we focus on broad international cooperation, and forget the Soviet strategy of making everything ourselves. A successful example here is the new Superjet 100 commercial aircraft built by Sukhoi corporation (formerly the Sukhoi design bureau and now part of OAK) along with many international partners.

But the state domination of business and R&D may lead to monopolization and bureaucratization of S&T. We may even get a reprise of the Soviet administrative system. To avoid these negative consequences it is essential to encourage private investment in R&D and support for small innovative businesses. In basic science, the main tasks are structural reform of the RAS and creation of research universities. We need to identify and trust young leaders who have international experience, to solve these tasks. Only a new, young élite can help Russia become a modern knowledge economy. ■

Boris G. Saltykov is president of the Russian House for International Scientific and Technological Cooperation, Briusov per. 11, 125009 Moscow, Russia.

1. Science Indicators 2007 (State Univ., Higher School of Economics, Moscow, 2007).
2. Kouzminov, Y. *et al. The New Economy — A Chance for Russia.* (State Univ., Higher School of Economics, Moscow, 2003).
3. http://ns.worldbank.org.ru/files/rer/RER_13_eng.pdf

See Editorial, page 507.