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Akademgorodok and the development of Siberia

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The importance of science in industrial and economic development and in military defence has become particularly clear since the Second World War. Science has emerged from small university laboratories to occupy whole 'science towns' with gigantic installations which require many thousands of scientists, engineers and workmen to design and erect; while the leading industrial works are engaged in the manufacture of the individual items of this equipment. This by no means excludes creative work by individuals, however. Many problems in mathematics and theoretical physics, and even new principles for the building of heavy equipment, are often solved by independent research, involving the collaboration of a very small number of scientists of different disciplines. The design and operation of heavy equipment raise many special problems in different areas of science and technology which also require creative individual work.

On top of all this, there is the constantly increasing volume of documentation. The number of magazines and books being published is increasing by hundreds and thousands of times. One physicist has worked out that, if the world's output of books were placed end to end on an infinitely long shelf, and if the output of books continued to increase at the same rate as it has for the last ten years, in approximately 100 years the speed at which the shelf was being filled would exceed the speed of light.

I have mentioned only a few of the features of the new science, but these alone are enough to show the need to find new ways of organizing and planning science, of accommodating it, and of supplying its material needs and finally—particularly important—the need to find new and more efficient ways of training scientists.

Siberia and the Soviet Far East occupy two-thirds of the territory of the U.S.S.R. but have only 10 per cent of the population. The low density of population is attributable primarily to the severe climatic conditions. It is therefore possible to make effective use of the area's natural resources only by means of large-scale automation and by introducing the latest technical advances, in other words by the active participation of science in the colossal task of opening up Siberia and the Far East.

Ten years ago, the Government decided to set up a Siberian Department of the Academy of Sciences of the U.S.S.R., to include the scientific establishments already existing in Siberia and a number of new scientific centres which were to be organized. The one which has developed most rapidly is the Novosibirsk Science Centre, which now includes twenty institutes.

PRINCIPLES FOR THE ORGANIZATION OF AN 'ACADEMIC CITY' (AKADEMGORODOK)

The principles on which we planned and established the science centre—the 'akademgorodok'—were based on our own and foreign experience of scientific development.

The centre should include scientists representing all the main branches of science. Institutes of mathematics, physics, chemistry, mechanics, geology, biology, economics, a computer centre and so on, should be set up.

An institute should be organized by leading scientists, with considerable scientific and organizational experience in the particular field, and willing to work in the institute. More than 60 per cent of institute staff should be young people, carefully selected for their scientific qualifications and businesslike approach.

The centre should be economically justified; it should offer expert advice to works and factories, it should deal with particularly important economic problems and promote the incorporation of scientific discoveries into the national economy. All this should make it possible to speed up the construction and manufacture of apparatus and equipment.

The centre should train science personnel for its own expansion requirements and for the introduction of scientific discoveries into industry. The university should form an organic whole with the centre's scientific institutes, so that young people can be induced as early as possible to undertake scientific work under the guidance of scientists of all ages, anxious to see science brought up to date. After the first or second year, basic instruction should take place in the centre's scientific institutes.

The academic city should be situated in pleasant surroundings and care should be taken in its building to preserve woodland and natural beauty, wherever possible. The subject which provoked the most discussion was the composition of the university and the organization of studies—in particular, whether the university should be large (10,000-20,000 students), with subsequent selection of the most gifted students, or small (3,000-4,000), but with very stiff selection. The second alternative was chosen.

It was decided that a three-stage all-Siberian 'Olympiad' should be held to select the best candidates from all parts of Siberia and the Far East. The first of these was held in 1962. There were about 1,000 candidates, of whom about 700 got through to the final selection. This year, about 1,000 got through out of about 6,000. Some of the chosen candidates go straight to the university, while those who have shown talent, but have not been through secondary school, are accepted into a specially organized boarding school where instruction in the basic subjects (mathematics, physics, and chemistry) is given by the university teaching staff.

We can now say that this approach has proved fully justified. Among the students chosen from the most outlying regions of the northern taiga have been some genuinely brilliant Lomonosovs,[1] who have already produced interesting work in their second year.

The principles on which the Scientific Centre was established have successfully stood the test of time and now, ten years later, we may say that Siberian scientists have discharged the tasks assigned them. Akademgorodok now covers an area of 100 square kilometres. It includes twenty institutes, living accommodation, a general facilities centre, a shopping centre, an experimental factory and a botanical garden. The township has 40,000 habitants.

Fifty members of the Academy of Sciences of the U.S.S.R., about 100 doctors of science and 1,000 candidates of science are working in the Siberian Department. There are some 3,000 students at the university.

THE SCIENTIFIC WORK: BOTH BASIC AND APPLIED RESEARCH

The help that scientists are giving in the development of Siberia and the Far East can be particularly well illustrated by the work done by our geologists and economists. The geological institutes are carrying out large-scale research work on the integrated study of the structure, composition and history of the earth's crust, the conditions in which minerals are formed, and present-day geological phenomena connected with the forming of the earth's crust. Considerable use is being made in this work not only of the classical geological methods of geochemistry and seismology but also of mathematical models of geological processes.

The results obtained have helped in the discovery of major deposits of gold, diamonds and rare non-ferrous metals in Siberia, and in the development of prospecting operations for potassium salts and phosphorites. Methods evolved by our geologists have made it possible to assess, with the minimum amount of drilling, the geological reserves of oil and gas in the little-developed and inaccessible areas of the West Siberian lowlands, the Vilyuy and Verkhoyansk depressions.

Integrated economic and mathematical investigations are of outstanding importance for Siberia and indeed for the whole country. The country's leading economics and mathematics school has been set up in the Siberian Department. In the last few years, in particular, under the guidance of Academician Leonid Kantorovich and of Abel Aganbegyan, Corresponding Member of the U.S.S.R. Academy of Sciences, a radically new method of constructing a complex of interrelated economico-mathematical models has been worked out.

Recommendations for improving planning methods in many branches of industry have been passed on to the economics departments concerned. Our recommendations, if carried out, make it possible to save 10 to 20 per cent on capital investment and current expenditure, as compared with existing methods.

It was the work of our power engineers which first made it possible to choose the best of the alternative plans for the development of such unique achievements as the unified Siberian power-grid and the power-grid for the European part of the U.S.S.R.

I should like to dwell specially on the work of the oldest of Siberian academic institutions, the Institute of Mining, whose director, Nikolai Chinakal, Corresponding Member of the U.S.S.R. Academy of Sciences, was recently made a Hero of Socialist Labour. One of the main achievements of this institution has been to devise a number of pneumatic machines for blast-hole drilling and drifting and also to devise vibration-proof hammers. Drills designed by the Institute of Mining were used in the building of the Aswan Dam. The institute has also put forward a number of technological schemes for working large deposits of coal and ores. The work of the institute now saves the country 100 million roubles a year.

In the last ten years Novosibirsk has become one of the biggest science centres in the world. Results of outstanding importance have been achieved there in fundamental research and many works of research have been rewarded with Lenin Prizes.

The Siberian Department and the Novosibirsk Science Centre, in particular, hold a leading position in our country in the sphere of mathematics and its practical applications. The Novosibirsk mathematical school is now acknowledged to be the next largest comprehensive mathematical school in the Soviet Union after Moscow; some trends of thought represented in the Siberian Department are not only in the lead in the U.S.S.R. but ahead of the corresponding mathematical schools in foreign countries.

New methods of accelerating elementary particles, the principles of the creation of high temperature plasma, and the lines of approach to the problem of controlled thermonuclear fusion—these are some of the questions on which Siberian nuclear physicists are working. They have completed the construction of apparatus producing electron-electron collision beams with an energy of the order of 100,000 million electron-volts (100 Gev—giga-electron-volts) and electron-positron beams with a relative energy at up to 2,000 milliard[2] electron-volts (2,000 Gev). Theoretical preparatory work has also been completed and the construction started of a proton-antiproton apparatus with a relative energy of 1,200 milliard electron-volts (1,200 Gev), which will also be without an equal in our country or abroad. Lenin Prizes were awarded this year to G.I. Budker, A.A. Naumov, A.N. Skrinsky, V.A. Sidorov and V.S. Panasyuk for having worked out the collision beam method for research into elementary particles.

Our biologists work in close liaison with other scientists. They have achieved a number of practical results. In particular, preparations invented at Novosibirsk have proved highly effective in the treatment of such diseases as multiple sclerosis, encephalitis and infections of the eyes, nervous system and skin caused by the *herpes* virus, which had hitherto been considered incurable.

Close contact with practical problems is a characteristic of all the institutes in the Siberian Department, even those which would appear to be concerned with abstract, academic research. The Nuclear Physics Institute for instance, has devised, besides scientific accelerators based on new

principles, industrial electron accelerators with an energy of about 1.5 million electron-volts and a beam with a power of up to 25 kilowatts. Specialists acknowledge that this apparatus is the cheapest and most convenient available source of radiation, and it is widely used in various sectors of the economy.

The Institute of Hydrodynamics invented welding by means of explosions. It was discovered that any pair of metals could be welded by means of an explosion, creating the composite materials needed for the most advanced fields of technology.

Experience with computer equipment has shown that it would be useful to have big computer centres with modern equipment and means of establishing direct contact with clients wherever they may be. The Computer Centre of the Siberian Department is at present working on just such a system. Its main feature is a method of coding information and transmitting it through the normal telephone network; this is known as the 'Ob' system, and with it errors can be completely eliminated in the transmission of signals. Tests were carried out in 1966 over more than 7,000 kilometres of the telephone network.

Thanks to the Ob system and the equipment of the Computer Centre of the Siberian Department, the administrative and managerial activities of Barnaul radio works have been partly automated, and the works is now planning to automate these activities completely. We are beginning to introduce similar systems at enterprises in Moscow, Krasnoyarsk, Izhevsk and Novosibirsk.

Our chemists are working on methods of separating substances with closely allied chemical properties, on preparing chemicals of high purity and ultra-purity, and on research into certain organic compounds. This work has a close bearing on the needs of the national economy. The theory of chemical catalysis is particularly important in modern chemical engineering and in the control of biochemical processes. About 70 per cent of all industrial chemical reactions involve the use of catalysts. Making catalysts more active or prolonging their service life by an average of 10 per cent would represent a saving of the order of ten million roubles. The U.S.S.R.'s first Institute of Catalysis was, therefore, set up in the Siberian Department. For the successful work of this institute, the Director, Academician Georgy Boreskov, was recently awarded the title of Hero of Socialist Labour.

We have come to the conclusion that the traditional 'conveyor belt'— academic institute/design office/industry—by which scientific discoveries are brought into practical use in industry, often works too slowly. We have, therefore, begun to look into new methods. A design office for hydraulic machinery, headed by Bogdan Voytsekhovsky, Corresponding Member of the Academy of Sciences of the U.S.S.R. and Lenin Prize winner, has been set up under the direct control of the Institute of Hydrodynamics. In its short existence, it has already brought a number of interesting ideas from the institute's rich 'stockpile' into practical use in industry. In particular, on the basis of the theory of so-called hydraulic pulse jets, it has devised groups of extremely high-powered presses, with an impact force of 200 metre-tons (1,550,000 foot-pounds), for the die-forging of the most intricate parts from various materials. It has worked out and introduced into industry a new process for the manufacture of domes for various high-pressure chemical reactors. Works experts have calculated that the hydraulic impact forging of such domes for oxygen equipment alone could save over 100 million roubles a year.

The Siberian Design Office experiment, whereby valuable scientific ideas are brought to the point of practical industrial utilization under the direct control of the inventors themselves, has proved highly successful. At the end of last year, the Government decided to establish design offices, engineering consultants' offices and experimental sections for the rapid application of the achievements of Siberian scientists in a number of ministries and departments; these are now being set up.

As the Soviet State celebrates its fiftieth anniversary, science in Siberia is entering on a new stage in its development. A group of design offices is to be situated not far from Novosibirsk, in the settlements of Pravye Chomy and Levye Chomy, on the picturesque banks of the Ob Sea. An engineering faculty is to be established at Novosibirsk University. A technical college is to be opened. The Novosibirsk Centre will become an integrated scientific establishment which will carry

out fundamental research, provide industry with new machinery and technical processes, and train personnel for science and industry.

OTHER SCIENTIFIC CENTRES IN SIBERIA AND THE FAR BAST

Before the Siberian Department of the U.S.S.R. Academy of Sciences was set up, various branches of the Academy had been established at different times in Siberia and the Far East—in Novosibirsk, Irkutsk, Yakutsk and Vladivostok—as well as a number of regional institutes in Krasnoyarsk, on the island of Sakhalin and the Kamchatka peninsula. All these scientific establishments have been absorbed into the Siberian Department. Building sites have been chosen all over the area, some in towns, some near to towns. The biggest of these is the Irkutsk branch, with its ten institutes and its Akademgorodok, near to the dam of the Angarsk power station.

Over the last ten years, several supplementary complex research institutes, have been, opened (Magadan, Ulan-Ude, Tiksi and Khabarovsk). Consideration is being given to intensifying scientific research in Siberia's main cultural and scientific centre, Tomsk, a town where there are several higher educational institutions.

Mikhail Lomonosov forecast many years ago that 'Siberia will add to the might of Russia'. His prophecy is today coming true. The scientists of Siberia are making their contribution to the gigantic process of transforming this immense territory.

1. Mikhail Vasilievich Lomonosov (1711-63), outstanding scientist and poet, and founder of the University of Moscow.
2. 1 Milliard = U.S. billion = 10^9 = (prefix) Giga.

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