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THE OCTOBER REVOLUTION AND SCIENTIFIC PROGRESS

by

M. Keldysh

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ABSTRACT

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Keldysh stated that during the fifty years since the October Revolution the USSR has attained an extraordinarily high level in the development of the national economy, culture, and science. New scientific and engineering disciplines were developed, and scientific research centers were founded. Scientific instrumentation has become the researchers' tools. Nuclear physics has enriched world science with discoveries of Cherenkov radiation, the supervolatility of helium, and the spontaneous division of the nucleus. A greater emphasis is being placed on energy systems, chemistry, data processing, and communications facilities. The high-mountain scientific stations and artificial earth satellites have added much to the theory of cosmic radiation.

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Keldysh stated that during the fifty years since the October Revolution the USSR has attained an extraordinarily high level in the development of the national economy, culture, and science. New scientific and engineering disciplines were developed, and scientific research centers were founded. Scientific instrumentation has become the researchers' tools. Nuclear physics has enriched world science with discoveries of Cherenkov radiation, the supervolatility of helium, and the spontaneous division of the nucleus. A greater emphasis is being placed on energy systems, chemistry, data processing, and communications facilities. The high-mountain scientific stations and artificial earth satellites have added much to the theory of cosmic radiation.

During the fifty years which have elapsed since the October Revolution our country has attained an extraordinarily high level in the development of the national economy, culture, and science. With every passing year this forward movement affirms and underscores with ever greater force the ideas of socialism throughout the entire world. Inscribed on the banner of October were principles of profoundly humanistic significance. There is no higher goal than the creation of a Communist society, in which all men will be free of social inequality, of all forms of suppression and exploitation, and of the horrors of war - the creation of a society which will establish throughout the world the ideals of labor, peace, liberty, and the equality and brotherhood of all peoples.

At the dawn of the Soviet administration, even amidst the flames of the Civil War, the Communist Party undertood decisive measures aimed at universal education and at the conversion of a backward, agrarian Russia into a modern industrial state. As early as the spring of 1918, in an article entitled "The Next Tasks of the Soviet Regime", V. I. Lenin pointed out that the principal task of the triumphant revolution was the creative building of a new, socialist society. Noting that our country possesses all the natural resources necessary to this end, Lenin wrote that "the development of these natural riches, using the latest technological methods, will provide the basis for an unprecedented growth of productive forces." L in called for the transformation of the entire sum of knowledge, accumulated by capitalism, from a weapon of capitalism into a weapon of socialism. The public statements and written works of V. I. Lenin are permeated with the thought of the paramountcy of science in the building of Communism.

From the first days of the existence of the Soviet State progressive-minded scientists have played an active role in solving the most important problems of socialist building. In reply to an appeal by the Academy of Sciences in the spring of 1918, Lenin in his famous "Outline of a Plan for Scientific-Technical ork" advanced a number of basic national-economic goals, whose solution required the involvement of large-scale scientific forces. These were prob ms relating to the rational deployment of production facilities, the expansion of the raw material infrastructure in support of the national economy, and the electrification of industry, transport, and agriculture. Lenin's "Outline" became, in fact, the first long-term planning document in the area of scientific and technological activities.

October marked the turning point for our Academy, which was to become an institution of great-state-wide importance. Relying on its far-flung system of institutes, affiliated scientific facilities at the Academies of the Union Republics, and higher educational institutions, the Academy of Sciences of the USSR has been transformed into a center for the coordination of the nation's commonly planned fundamental scientific research.

Vigorous work has been carried out by the Commission for the Study of Natural Productive Forces, set up under the Academy. Even during the period of the Civil War a thorough study was begun of the Kursk magnetic anomaly, leading ultimately to the discovery of enormous deposits of iron ore. Field survey investigations conducted on the Kola Peninsula resulted in the unearthing of colossal beds of apatites and rare elements. The Pechora Coal Basin was discovered. Complete studies of Kara-Bogaz-Gol Bay, and later the Kara-Kum Desert, the regions of Central Asia, the Apsheron Peninsula, the Urals, and other areas brought to light immensely rich resources of chemical and metallurgical raw material and fuel. As a result of broad-based geological prospecting, new oil fields have been mapped between the Volga and the Urals, and in other regions as well.

Of inestimable significance was the drawing up in 1920-1922, under the initiative of V. I. Lenin, of the Plan for the Electrification of Russia (GOELRO), the first long-term national economic development plan in the history of the country. The implementation of this blueprint for progress required the solution of the most varied and diverse economic, technical, and scientific problems. Such gigantic power facilitates as the V. I. Lenin Dnepr Hydroelectric Station, the V. I. Lenin Volga Hydroelectric Station, the Bratsk Hydroelectric Station, and the circumferential electrical power systems represent the embodiment not only of the heroic labor of the Soviet people but also the progress of our science and technology.

Lenin gave particular support to research in the area of radio. A newspaper without paper and without distances", in his vivid phrase, Lenin saw in radio a promising medium for the dissemination of culture to all corners of our incredibly vast land. The first broadcast station, named the Comintern, began operation in 1922. Also related to research in the area of radio was the creation of important scientific schools and training centers, which were to make a major contribution to radio wave propagation theory, the theory of nonlinear vibrations, problems of automation, electronics, and many other branches of science, destined, in turn, to generate vital new channels of technological advancement. It is nothing less than remarkable how, in a period of the utmost difficulty for the country and the people, the Party

succeeded in literally creating a host of new scientific and engineering disciplines. It was during those years, for example, that there were founded such scientific research centers as the Central Aerodynamics Institute (TsAGI), which was to play an outstanding role in the development of the science of aerodynamics and of aviation engineering; the State Optical Institute, which was to set the technical foundation for our optical industry; the All-Union Institute for Electrical Engineering, and many others. A deep comprehension of the role of science was reflected also in the establishment of those research institutes which were to provide the basis for fundamental scientific studies and for the rapid expansion of research in the area of the natural sciences.

In 1918, the Socialist Academy of Social Sciences was founded, marking the beginning in our country of the establishment of scholarly institutes for studies in the humanities, which subsequently played a major role in the development of a Marxist-Leninist world outlook and culture.

Lenin's national policy received vivid expression in the creation of a whole network of national science centers. With the aid and assistance of the Academy of Sciences of the USSR, primarily within its system of affiliated ordanizations and bases, the Union Republic undertook the creation of their own Academies of Sciences with numerous subordinate scientific institutes. Within the framework of these Academies sprang up the scientific schools which are now making important contributions to Soviet and world science. Among many others, we might recall in this connection the schools of astrophysicists in Armenia, and of mechanics and mathematicians in Georgia; significant research in alkaloid chemistry is being conducted in Uzbekistan, and in fine organic synthesis in Latvia. Much has been accomplished, particularly in recent years, to develop science in Siberia and in the Far East. With its scientific community near the city of Novosibirsk, the Siberian Branch of the Soviet Academy of Sciences has become one of the largest scientific centers of the country.

The rapid expansion of industrial potential has made possible the exploitation of the Northern Sea Route, expeditions to the North

Pole, flights into the stratosphere, inroads against the desert, and other feats of incalculable significance to science and to the harnassing of the forces of nature. Conversely, in our age science itself can successfully evolve only in reliance on the achievements and accomplishments of the industrial sector. Scientific instrumentation and such large facilities as telescopes, accelerators, wind tunnels, geological survey equipment, and oceanographic apparatus have now become the indispensable tools of the researcher.

The continuing threat to our people, engaged in the building of a Communist society, on the part of aggressive imperialist forces renders it imperative that great attention be given to the defense of the nation. From its very inception, it was evident that aviation was destined to become one of the primary means of defense. Soviet science, and above all mechanics, has done much in the development of air power and has written remarkable pages in the history of aviation. One need only recall the spectacular long-range flights that were made, including over the North Pole, in the years before the war. The role of the Soviet Air Force in the Second World War is also well documented. The first supersonic aircraft were created in our country.

We are justly proud of the contribution made by Soviet science to the victory over the Fascist invaders. As the result of the intense labor of our scientists, engineers, and workers, first-class weapons were created for our heroic armies. The latest achievements of scientific and technical thought were embodied in our powerful guard mortars, in our destructive explosives, in the armor of our tanks, in our optical instruments, in our communications equipment, and in our anti-mine apparatus. New and effective techniques of restorative surgery, medicine, and epidemiological prophylaxis to eliminate the danger of outbreaks of dangerous epidemics on the front and under the difficult conditions of the rear resulted in the saving of millions of lives.

From the very birth of nuclear physics Soviet scientists have played an active role in the development of methods for the study of charged particles and in the evolution of theoretical thought regarding

the atomic nucleus. Soviet scientists have enriched world science with their discoveries of Cherenkov ratiation, the supervolatility of helium, and the spontaneous division of the nucleus. A chain of the most epochal discoveries in physics led to the realization that the energy of the atomic nucleus could be liberated - a realization that was to exert an enormously profound influence on societal life and on the material and spiritual life of mankind. The emergence of atomic weaponry in the context of the political situation which developed after the Second World War was a vital imperative for the protection of our country and of the entire socialist commonwealth. This task was solved in a short time. However, we have always, from the very outset, directed great efforts toward the peaceful use of atomic energy. It is well known that in 1954 industrial current was supplied by the world's first Soviet atomic power generator. At the present time, powerful atomic power stations are being built throughout the country and new reactor types are being developed, particularly reactor multipliers, which hold great promise for the future of atomic power. The creation of the atomic-propulsion icebreaker "Lenin" marked the beginning of the use of atomic energy in transport, and in our days we have witnessed a proliferation of work on the development of atomic engines designed to meet various transport needs. Great attention is given to the use of isotopes, various forms of radiation, and other findings of nuclear-physical research in medicine, industry, and agriculture. Soviet scientists are responsible for advancing the basic ideas in the detention of high-temperature plasma and have achieved significant successes in this field, linked as it is with the extraordinarily difficult but extremely promising problem of controlled thermonuclear sunthesis.

Another vital scientific accomplishment of our age is the production of high-speed electronic computers, based on the concepts of mathematical logic and the achievements of electronics. Here the impetus was supplied by the need of highly complex technical calculations, above all in atomic engineering, aviation, rocketry, and space science. Soviet science has made a major contribution to the development of many branches of mathematical science. Recent decades have seen great advances in computer methodology and control process theory,

as well as the creation of the theory of linear programming and economic simulation (models), which is fundamental to the use of computer technology in economic management.

The emergence of electronic machines has stimulated an extraordinarily rapid development of research into the control functions occurring in nature, technology, and social evolution - indeed, in ever newer areas of human activity. It has become possible to design systems capable of performing functions heretofore thought to be the exclusive domain of human intellect and of mastering many vital new control functions. It is no exaggeration to say that electronic machines will leave no less profound an imprint on the evolution of productive forces than the dissemination of machine tools and mechanical devices at the time of the industrial revolution.

The support given by our Party to the idea of interplanetary flight, the research conducted as early as the prewar period in the area of rocket engineering, and finally, the experience gained during the war itself in the creation of rocket weaponry for our armed forces - all these factors have contributed to the gradual realization of what once appeared to by a fantastic dream: the dream of space flight. The way to such flights was prepared by the establishment in our country of the theoretical fundamentals of astronautics and by the latest accomplishments of science and industry.

Ten years ago, the first artificial Earth satellite, launched in the Soviet Union, heralded the beginning of man's penetration into space. Since that time, the volume of space research has swelled from year to year. Numerous scientific satellite studies have given rise to fresh concepts regarding circumterrestrial space and the effects of the cosmos on the Earth, and are playing a role of increasing importance in the exploration of the Universe. Satellites are presently being called upon to provide answers to vital practical problems in the realm of long-range communication, meteorology, and navigation.

Within a single decade, we have been witness to a series of remarkable milestones, established by the Soviet Union, in the area

of space exploration. Among these milestones is the study of the Moon, initiated by the first flight to that body and concluded by the soft landing of instrumented probes and the orbitting of circumlunar satellites, resulting in high quality photography of the lunar landscape and of the Moon's opposite, unseen side. We have recorded spacecraft voyages to the planets Venus and Mars. And finally, there have been manned flights into outer space, an important and decisive step on the road to interplanetary travel.

On 18 October, on the eve of the fiftieth anniversary of the Great October Socialist Revolution, the Soviet automatic station "Venus-4" reached the planet Venus, effected a smooth descent in its atmosphere, and landed on the surface of the planet. For the first time, this station performed measurements on another planet, revealing the structure of the Venutian atmosphere, which for centuries had remained a mystery hidden from mankind. This feat represents a major scientific achievement in the investigation of the planets of the Solar System and a new step forward toward the goal of interplanetary communication.

It has now become clear that the day is no longer far off when man will set foot on other celestial bodies. The Earth will no longer be the sole arena of human activity, but other planets and the vast reaches of outer space as well.

The new branches of technology, especially atomic and aerospace science, are imposing increasingly severe requirements on materials, control systems, indicator devices, and logic elements. The continuously expanding, almost fantastic prospects offered by the use of computers generate demands of ever greater severity on the electronics sector. A greater emphasis is being placed on energy systems, chemistry, data processing and communications facilities. All this leads to expanded research programs in structural materials and in the electromagnetic properties of solid bodies and gases. Earlier than other countries, long before their wide-spread introduction in electronics, we began the systematic study of semiconductors. Physical, inorganic, and radiation chemistry, and especially solid state physics, have made

enormous contributions to the solution of these problems.

The emergence of quantum electronics, the foundations of which were laid by Soviet scientists, is one of the most spectacular events in the history of physics in recent years. Even during the initial stage, these achievements have made it possible to create new, highly efficient radio devices and to expand the waveband available to this advanced equipment. Of particular promise are optical quantum generators, through which mankind has been afforded unique possibilities for research and progress in numerous areas of science and engineering.

The successes attained in the field of modern control systems are perhaps most clearly exemplified in the guidance and control of space vehicles at distances of millions of kilometers. Control system automation is making its way with increasing speed into many areas of our day-to-day activity.

Our chemistry fell heir to the glorious traditions of Russian science, represented by a whole pleiad of talented chemists. It was Soviet scientists who discovered branched chain reactions and developed the theory for them. The basic postulates of modern teaching on combustion and explosions were worked out on the basis of chemical kinetics. Breakthroughs in the chemistry of high-molecular compounds have signaled the production of many items previously manufactured only from vegetable and animal raw material and in many cases from metals.

In recent years the chemical industry has seen particularly rapid growth. A solid foundation for further development has also been created for chemical science, which is performing an incalculable function in the establishment of a rational system for the processing of natural resources, new substances, and materials. Soviet chemists have played an active part in the creation of a new branch of chemistry - elemental-organic chemistry, which through the interaction of many chemical elements, gives rise to new and varied compounds and materials. Research into the structure and kinetics of polymer formation has provided the key to the creation of valuable new plastics, rubbers, and fibers. There are fast-breaking developments in the chemistry of natural compounds.

To our science belongs the credit of authoring the doctrine of higher nervous activity and elaborating the principles of classical genetics and selection. The findings of biological research have been instrumental in solving many practical problems in agriculture and medicine. It was in our country, in particular, that there was built the world's first artificial blood circulation mechanism, which was in essence the prototype of all modern "artificial heart - lungs" machines. Revolutionary things have been happening in biology in recent years. A new era in the study of living matter has been heralded by the discovery of the structure of albumins and nucleic acids, the decypherment of the genetic code, the explanation of the molecular essentials of biological catalysis, the first chemical synthesis of albumin molecules and the near-synthesis of the material substrata of heredity, the nucleic acids. Progress in molecular biology is exerting a meaningful effect on the development of genetics and virusology, biochemistry and biophysics, with immediate and direct practical applications to medicine and agriculture. A broad-based infrastructure for this kind of research is currently being established, with significant results already achieved, at the scientific institutes of the Academy of Sciences and the Academy of Medical Sciences of the USSR, at the Republic-level academies, and at the universities.

The striving of the human mind to come to a more and more complete understanding of the world surrounding us knows no end. We are moving toward radical new frontiers in our comprehension of nature primarily through an increasingly more detailed study of the structure of matter and of the physico-chemical and cybernetic foundations of living phenomena, and through the unveiling of the laws of the macrocosmos. In all research of this kind, the material infrastructure assumes a position of basic importance. Recent years have seen a considerable expansion of this infrastructure. Major research centers for nuclear and elementary-particle physics have been created, including the International Joint Institute for Nuclear Research. New one-of-a-kind facilities have been built among them the opposing-beam accelerator at Novosibirsk and the electron accelerator at Yerevan. Operations have been begun on the world's largest proton accelerator at Serpukhovo, where for the first time under laboratory conditions

protons have been obtained having energies of 76 billion electron-volts, more than two times greater than the energy levels achieved on the largest foreign accelerators. Soviet science has made an important contribution to the development of the principles of particle acceleration and to the synthesis of transuranium elements. Our high-mountain scientific stations and artificial Earth satellites have also done much to elaborate a theory of cosmic radiation.

Our scientists have been in the vanguard of theoretical work in the area of cosmology based on non-stationary solution to Einsteinian equations. Soviet accomplishments in stellar cosmogony have also been outstanding. Of major importance has been the discovery that the star-formation process is continuing even in our age. We have also recorded successes in various specific areas of astrophysics, where it was Soviet scientists who proposed and developed in detail the now universally-accepted theory of radio emission from the residual effects of flares in supernova stars and radio galaxies on the basis of the synchrotron radiation mechanism. Our astronomers have carried out important work in the study of active processes on the Sun and the role of magnetic fields in these phenomena. Their discovery of the solar supercorona is an outstanding example of creative research. In recent years, the study of galactic nuclei has led to remarkable findings, and here again it was in the papers of Soviet investigators that this problem was initially formulated and substantially advanced. A high degree of attention is currently being given to the consolidation of the material infrastructure for radio and optical astronomy. There is being mounted, for example, the world's largest six-meter telescope, while the foundations of exo-atmospheric astronomy are being laid through the use of sondes and satellites.

Meanwhile, on the surface of the Earth and near it there still remain many "gaps". More and more, we are directing our attention to the deep-lying layers of our planet and to the ocean. A theoretical basis for penetration within the depths of the Earth is emerging from studies on the structure of the planet's core and investigations of the world ocean. Many representatives of the animal and vegetable kingdoms have yet to be properly examined and classified, and there

is thus ample opportunity for the many schools of biologists, geologists, and geographers, engaged in this field, to bring to light invaluable material for a better understanding of our world.

The vitality of a socialist society is determined not only by its level of material prosperity but also by its spiritual development. As a result, the complex of social sciences assumes an increasing importance. The paramount accomplishment of the social sciences - Marxism-Leninism - constitutes the scientific basis of the proletariat revolution and for the building of socialism and Communism. This revolutionary theory must undergo continual development through the analysis of new happenings and trends in social evolution and science. Today, against this background of the bitter struggle throughout the world between the forces of reaction on the one hand and those of progress on the other, there is need, as never before, for a profoundly scientific approach to the determination of the proper course in the revolutionary movement and in the building of Communism.

In the strengthening of the multi-national Soviet state an important place belongs to the study of the history and culture of all nations and to the development of the languages of lately backward peoples. Many remarkable discoveries have been made by our archeological teams, particularly during the diggings at Khorezm and Novgorod. The study of the material and spiritual culture of the world's peoples leaves us enriched and promotes the expansion of friendly ties with an ever larger number of countries. Economists have lent great assistance to the realization of the monumental transformations which have taken place in our country, and they are now confronted with the responsible task of further developing the principles to guide the management of our economy during the period of the building of Communism, and of working out techniques and methods for the computerized solution of economic administrative problems.

Science today is playing an increasingly important role in the development of society and is more and more becoming an immediate and direct productive force. It is in large measure socially-related phenomena which have been responsible for the mushrooming advances in

the scientific sector and for the rapid implementation of so many of its advances. Technical and social progress are intimately interrelated. The October Revolution unquestionably had a profoundly stimulating effect on the social advances that ultimately resulted in the scientific-technological revolution.

The Soviet Union is the first nation in which science has been organized on a state-wide basis. This approach is currently being adopted by many other countries, capitalist as well as socialist. This form of research activity organization alone permits the realization of such grandiose accomplishments as the mastery of atomic energy and the penetration of outer space. In turn, this gives rise to one of the most characteristic hallmarks of the present period - the sharp reduction in the time lag between the conception of a scientific idea and its technical embodiment.

October opened the way to the building of socialism, with its irradication of the peril that the achievements of scientific thought might be employed for purposes of destruction and suppression. Under socialism and Communism, the greatest scientific accomplishments are totally directed at the wellbeing of humanity. There is thus realized a genuinely humanistic orientation of the scientific sector, with the social sciences more and more becoming a powerful source of accelerated social progress.

Science is an international matter. For this reason, in all our scientific activity we are strengthening our ties with the entire scientific community. The scientists of the Soviet Union feel a sense of great responsibility for their contributions to the building of Communism and for that other contribution which our country, the world's first socialist state, is making to world science.

The October revolution and the monumental successes of socialism on our planet in the last half-century also signify a great triumph for science. Revolutionary Marxist-Leninist teaching is lighting the way to the victory of Communism in the future.