Vladimir Aleksandrovich Kotel'nikov (on his eightieth birthday)

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Academician V. A. Kotel'nikov celebrated his eightieth birthday on 6 September 1988. He occupies a place among a number of prominant Soviet scientists: the development of modern radiophysics, radio engineering and electronics is associated with his name.

Kotel'nikov's principal scientific achievements lie in the field of information theory of which he is one of the founders, and in radar astronomy the establishment and development of which involved his direct participation and direction. One can also point to other fields, for example parametric oscillations, fiber-optics communication etc. However, the first two are sufficient to characterize V. A. Kotel'nikov as a scientist.

Speaking of information theory, we first of all note the famous readout theorem formulated by V. A. Kotel'nikov in 1933 in his paper "The transmitting capacity of "ether" and of a wire in electrical communication". This theorem shows how a continuous function with a bounded spectrum can be represented in the form of a sum of discrete readings. It is essentially one of the basic theorems in the theory of digital systems and its significance goes far beyond the framework of communication theory. Although the theorem was known previously in mathematics—it is sometimes referred to as the WKS (Whittaker-Kotel'nikov-Shannon) theorem—V. A. Kotel'nikov was the first to understand the serious technical conclusions following from this theorem and in fact gave it a new scientific significance.

V. A. Kotel'nikov's article "The theory of potential stability against interference", which determines the ultimate possibility of reception of signals in the presece of noise, is widely known among specialists in the field of communications. This paper reveals the nature of the physical limitations on the sensitivity of receivers, and in this lies its fundamental significance. In essence this and other papers of V. A. Kotel'nikov allow one to regard him as one of the founders of information theory.

Kotel'nikov's ideas in the field of weak-signal reception naturally attracted his attention to radio astronomy. For many years he was chairman of the relevant Scientific Council and has contributed much to the development of this branch of science in the USSR. Kotel'nikov's most significant contribution to this was in the establishment and development of the new scientific field—radio-ranging of planets. In its technical aspect this scientific direction is very complicated. Here, essentially, one has to utilize in all the components devices with ultrahigh parameters (powerful UHF oscillators of hundreds of kilowatts, large antennas of several tens of meters in size, cooled ultrasensitive detectors, etc.). The organization of all this could be carried out only by such an authoritative scientist as Kotel'nikov had become.

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At present the relative accuracy in measuring distances that has been achieved in radar-ranging astronomy, appears to be fantastic—of the order of 10^{-8}. It has made possible to increase the accuracy in measuring the dimensions of the solar system and to determine with high accuracy the principal scale factor—the astronomical unit (the average earth-sun distance). In addition to its scientific significance a good knowledge of the distances between the bodies of the solar system has also made it possible to solve the practical problem of ensuring the safety of spacecraft sent to study planets. At the present time the planetary radiolocator is one of the methods of obtaining the necessary initial data for the programs of controlling the flight of spacecraft.

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From a different point of view the high accuracy of measurements has made it possible to improve significantly the theory of motion of planets of the solar system. In particular, it has turned out to be necessary to take into account the equations of the general theory of relativity. Thus, measurements made with the aid of the planetary radiolocator have once again confirmed the existence of effects predicted by the general theory of relativity.

A natural development of planetary radio-ranging from the earth is the planetary radio-ranging from spacecraft. An achievement of worldwide importance is the radar survey of the northern portion of Venus carried out with the aid of the spacecrafts "Venera-15 and -16". Formally V. A. Kotel'nikov here is not the director of the work which was carried out by his colleagues and students from the Experimental Construction Department of the Moscow Power Institute (OKB MEI) and the Institute of Radio Engineering and Electronics of the Academy of Sciences of the USSR (IRE AN SSSR). But undoubtedly his scientific influence here is prominent and everyone acknowledges that without his participation it would hardly have been possible to achieve success.

By using radar ranging it was possible to obtain a radio image of the northern part of the planet on a large scale—of the order of 115 million square kilometers with quite a good spatial resolution of the order of 1 km. The material that was obtained is unique and at the present time is being intensively studied by planetary scientists both in the USSR and in other countries, primarily in the USA.

The next stage in radar astronomy is the radar ranging in depth of the solar system. This is now being planned in the "Phobos" project for the study of the structure of surface layers of this satellite of Mars (the spacecraft have already started on the interplanetary expedition) and in future projects for the study of the cryolithosphere of Mars itself.

One can also note other papers of V. A. Kotel'nikov in the field of parametric amplifiers, and fiber-optics communication lines, with which he has been particularly actively concerned in recent years. One can also point to a number of serious engineering designs carried out under his direction in the prewar years and during World War II for which he was awarded two State Prizes of the USSR. They all represent a significant contribution to the development of science and technology. But it appears that the favorite "children" of the scientist are, as before, communications theory and planetary radio-ranging.

Not much needs to be said about V. A. Kotel'nikov as a prominent organizer of science. This was first of all manifested in his activity over many years in the position of Vice-President of the Academy of Sciences of the USSR. For many years he was the head of the Institute of Radio Engineering and Electronics which by now has become the largest scientific organization of the Academy of Sciences of the USSR. Many investigations carried out within this institute are in one way or another associated with the name of the now honorary director of the IRE AN SSSR. V. A. Kotel'nikov has expended much effort in the initiation of new research. Thus on his initiative a number of investigations was started in the field of millimeter and submillimeter ranges of radiowaves, in automation of scientific investigations by using electronic computers, in the field of fiber-optical systems and in other directions.

V. A. Kotel'nikov is not only an outstanding scientist and organizer of science, but also a prominent figure in the life of the State: he is a Deputy to the Supreme Council of the USSR, a delegate to a number of congresses of the Communist Party of the Soviet Union and to the XIX All-Union Party Conference.

Kotel'nikov's work has brought him many high awards. He has twice been named a Hero of Socialist Labor, has been awarded six Orders of Lenin and other state awards. V. A. Kotel'nikov is a laureate of both a Lenin and a State Prize of the USSR.

The Presidium of the Academy of Sciences of the USSR has awarded to him the A. S. Popov Gold Medal, the M. V. Lomonosov Gold medal and the M. V. Keldysh Gold Medal.

The scientific achievements of V. A. Kotel'nikov have brought to him election as a foreign member of the Academies of Sciences of the GDR, the People's Republics of Mongolia, Bulgaria and Poland, and the Czechoslovak Socialist Republic. He has been elected Vice-President of the International Astronautics Academy and an honorary member of the American IEEE.

In spite of his great workload V. A. Kotel'nikov constantly carries on creative activity. He is always full of ideas and suggestions. All those who meet him experience a sincere delight in discussing scientific problems with him and are often amazed by the originality and depth of this thoughts.

Translated by G. M. Volkoff