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SERGEĬ TIKHONOVICH KONOBEEVSKIĬ (on his Eightieth Birthday)

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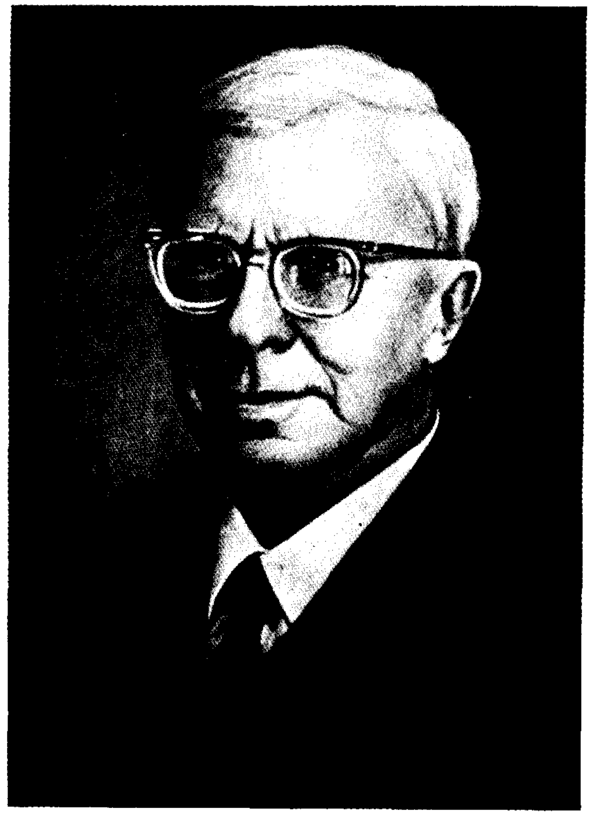
SERGEĬ Tikhonovich Konobeevskiĭ, outstanding physicist and Corresponding Member of the USSR Academy of Sciences, celebrated his 80th birthday on 27 April 1970.

Konobeevskiĭ first received worldwide recognition while a young scientist, in the early 20's, for his investigations on the theoretical interpretation of the x ray patterns of textured metallic samples, particularly the interpretation of the texture of rolled samples. Performance of that outstanding investigation during difficult years of the country was possible because of the great attention which the Soviet government paid to science during its first years. Even at that time, Konobeevskiĭ's scientific creativity could be clearly seen; he did not confine himself to a qualitative treatment of the observed phenomena, but developed for them a theoretical and quantitative foundation. In subsequent years, he was in charge of the large x ray laboratory of the State Institute of Experimental Electrical Engineering. He then revealed a second characteristic feature of his talent as a scientist, namely the tendency to present the experimental results in the most lucid manner. A great accomplishment in this respect was the construction in his laboratory of apparatus for the visual observation of Laue patterns on a fluorescent screen, making it possible to trace the motion of the Laue spots with variation of the crystal orientation.



In 1928, the Soviet government sent a number of scientists, including Konobeevskiĭ, for study abroad. During that time, Konobeevskiĭ carried out an interesting investigation, in a field new to him, of the structure of the amorphous modification of the carbon mineral shungite, in which he observed the existence of doubled groups of iron atoms.

In 1930, Konobeevskiĭ founded an extra laboratory in the newly organized State Central Institute for Nonferrous Metals, and also headed, in the Physics Department of the Moscow State University, the Division of X-ray Structure Analysis. Among the investigations performed by him during that time together with his students, notice should be taken of work on the structure of plastically deformed single crystals of rock salt and aluminum, and also their changes occurring during the annealing process. These investigations have revealed a phenomenon called polygonization. It turned out subsequently that polygonization plays an important role in a number of processes occurring in deformed metals and alloys. The aforementioned investigations were in essence the start of a large complex of developments in many laboratories of all countries, and these investigations are still continuing.

The next topic investigated by Konobeevskiĭ was the mechanism of phase transformations and aging of alloys. This question, which is of great practical importance, attracted the attention of many researchers. Heat treatment of certain alloys, such as duraluminum, leads to a considerable improvement of their mechanical properties.

X ray diffraction investigations by Konobeevskiĭ and his co-workers have contributed much to the explanation of the nature of the changes occurring in the decay of supersaturated solid solutions. An analysis of the experimental data has enabled Konobeevskiĭ to develop a thermodynamic theory of aging, based on the concept of colloidal equilibrium of the submicroscopic segregations of the new phase in the parent solid solution, such a segregation is possible only if the particles of the segregated phase have definite dimensions. In the case when the particle dimensions increase, the equilibrium is violated and the particles coagulate, and this leads to a change in the mechanical properties. In subsequent investigations, the aging processes in the stage prior to the segregation were investigated.

An examination of the phase diagrams of concrete alloys reveals in many cases a striking singularity, namely that the phase boundaries become nearly vertical as the temperature is decreased. This form of the phase boundaries indicates, as it were, that the solubility is independent of the temperature, whereas it follows from thermodynamics and from statistics that as a rule the solubility should increase with increasing temperature. The reason for the indicated disparity is that when the temperature is decreased the rate of diffusion decreases and consequently the time necessary for the alloy to approach equilibrium increases. Therefore, at low temperatures, the annealing times realized in practice are insufficient to attain the equilibrium state of the system and the phase boundaries established by the ordinary methods correspond to nonequilibrium alloys. Konobeevskiĭ has shown that considerable acceleration of the diffusion processes in low-temperature annealing takes place when working with cold-deformed alloys. As a result of the procedure developed by him, it was possible to construct for a number of systems equilibrium phase diagrams, in which the position of the phase boundaries deviated greatly from vertical. The strong temperature dependence of the solubility points to the possibility, in principle, of aging the corresponding alloys. The phase diagrams modified by Konobeevskiĭ and co-workers, as well as the method developed by him for investigating the equilibrium states of alloys, can now be found in all handbooks and textbooks. A natural continuation of this cycle of research was Konobeevskiĭ's work in the field of the band theory of metals. On the basis of Jones quantum-mechanical theory, he interpreted the formation of subtractional solid solutions at certain compositions.

An important role in the development of metal physics was played by the researches of S. T. Konobeevskiĭ on rising diffusion. It was demonstrated experimentally, first using the magnesium alloy "elektron" and then aluminum bronze, that when deformed alloys are annealed there are produced concentration inhomogeneities, i.e., regions that are richer and poorer in the dissolved component.

Konobeevskiĭ developed the theory of rising diffusion by starting from the generalized equation, to which he added a term that takes into account the presence of an inhomogeneous internal-stress field in the alloy. When a deformed metal is annealed, the decrease of the internal stresses, and consequently of the energy of the alloy, is due, among others, also to the migration of the atoms having a smaller volume into compressed sections of the lattice, and the displacement of larger atoms into stretched sections of the lattice, and this leads to an increase of the concentration gradients in the microscopic volumes of the crystal. This theory was subsequently confirmed many times. The possibility of producing so-called Cottrell and Suzuki atmospheres follows directly from Konobeevskiĭ's theory. An investigation of short-range order carried out later by other scientists in a number of alloys revealed the occurrence of concentration inhomogeneities upon annealing of deformed solid solutions, even far from the solubility limit; this shows that Konobeevskiĭ's theory is valid in a wide range.

A very interesting investigation at that time was also the quantitative theory of condensation from a molecular beam, which explained the features, experimentally established by Konobeevskiĭ and co-workers, of the texture of a thin sputtered layer of an alloy, and also investigations of the symmetry and the form of the atom. The latter has by now been extensively developed.

Konobeevskiĭ is in our country one of the pioneers of the study of phase diagrams of alloys of heavy metals (uranium, plutonium) and of the founding of a new trend in solid-state physics, namely the study of the effect of radiation on the structure and properties of materials (radiation metallurgy). With his direct participation, an experimental base was created for the investigation of the structure and properties of irradiated materials, new original procedures were developed. In particular, he proposed, jointly with his co-workers, a method (published simultaneously with that of American authors) for x-ray structure investigations of stronger reactive materials, based on the "reflection" of a diffracted beam by a monochromator. At the present time this method is widely used both in the Soviet Union and abroad, and is the basic method for x ray structure investigations of irradiated materials.

Konobeevskiĭ is the author and co-author of a large number of publications on the influence of radiation on the structure and properties of fissioning, construction, and reactor materials and alloys and of non-metallic materials (diamond, beryllium oxide, and others). The discovery and theoretical interpretation of such practically important phenomena as radiative homogenization of uranium-molybdenum alloys, the relaxation of stresses in uranium and its alloys under the influence of neutron irradiation, have gained him world renown. For may years, Konobeevskiĭ has been one of four editors of an international journal on reactor materials.

In 1967, Konobeevskiĭ published a monograph "Effect of Radiation on Materials," which was highly esteemed here and abroad. In 1968 and 1970 he published together with his co-workers papers devoted to a most important phenomenon, radiative growth (change of shape without an essential change in volume) of uranium, in which a new theory of this phenomenon was developed. This theory, unlike the earlier ones, explains the delay of the growth of single crystals of uranium following low-temperature irradiation, recently discovered in the USA, and also presents experimental proof of the theory.

A long period of Konobeevskiĭ's life and activity is associated with the Moscow State University, where his talent as a pedagogue was revealed. Konobeevskiĭ's work at the Moscow State University was of great importance in the training of Soviet x-ray physicists, in the preparation of cadres of specialists on metal physics. Konobeevskiĭ was able to attract and train a large group of young co-workers, many of which subsequently became outstanding scientists in the field of x ray analysis and metal physics. In 1926, Prof. Yu. V. Vul'f proposed to organize at the Moscow State University a special department of x ray structure analysis, the significance of which in the investigation of the atomic structure of matter was continuously increasing. After Vul'f's death, Konobeevskiĭ was invited to organize and direct this new specialty in 1927, with the then employed duty of privatdozent. Within several years, a special x-ray-practice course was organized in this department, in which all the modern methods of structure analysis were taught, and work began on the construction of new types of x-ray apparatus, which subsequently grew strongly, and scientific-research was organized on the study of timely problems of metal physics. The x-ray structure analysis department headed by Konobeevskiĭ, subsequently renamed the Department of Metal Physics, successfully prepared qualified specialists in the field of x-ray structure analysis. Soon the Physics Department of the Moscow State University became one of the basic centers for the training of Soviet specialists on x-ray diffraction. Graduates of this department are now in charge of major x-ray laboratories and scientific research institutions, departments in higher institutions of learning, and also work in many plant laboratories of leading branches of industry in different regions of the country.

In 1946, the USSR Academy of Sciences selected Konobeevskiĭ a Corresponding Member. The Soviet government rewarded him with two Orders of Lenin, Red Banner, and medals.

We wish the celebrant health, new progress in science, and warmly congratulate him on his 80th birthday.

Translated by J. G. Adashko