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Personalia

IN MEMORY OF V. I. VEKSLER

M. S. RABINOVICH

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ACADEMICIAN Vladimir Yosifovich Veksler died on September 22, 1966 at the peak of his strength and creative energy.

Soviet and world science have suffered a grievous loss. Veksler's name is connected with an entire era in high-energy physics, an era marked by a rapid growth of the particle energies attained under laboratory conditions in accelerators due to Veksler's ideas, as well as by important discoveries in the field of elementary particles.

V. I. Veksler was born on March 4, 1907 in Zhitomir. At the age of seven he lost his father and between fourteen and eighteen he was educated in the Comintern Children's Home in Moscow. In 1925 he was directed by the Khamovnik district committee of the VLKSM (All-union Leninist Young Communist League) of Moscow to the Sverdlov plant as an electrician.

In 1927 Veksler entered the Plekhanov Institute of National Economy. This institute was reorganized in 1930. During this reorganization, he went over to work as a junior laboratory technician at the All-union Electrotechnical Institute. Simultaneously, he continued external studies at the Moscow Energy Institute from which he graduated in 1931 as an electrotechnical engineer.

Of great importance for Veksler's entire creative career was the fact that he had successively held a series of scientific positions, from junior laboratory assistant to the director of a large laboratory, directing the Nuclear Physics Division of the USSR Academy of Sciences.

For almost twenty years he himself put together and constructed various devices which he had thought up, never avoiding any type of work. This enabled him to see clearly not only the facade of modern physics, not only its principles, but all that is involved in the final results, the accuracy of measurement, and all that is hidden behind the shiny panels of devices. It is very characteristic, although Veksler is not the only example of this in the history of science, that one of the greatest of contemporary physicists was by training an engineer. Not that one can apply to Veksler, in this connection, the usual standards. To him the formal course of studies was of very little significance. He studied and studied again throughout his life. Even during the last years of his life he studied carefully and reviewed theoretical papers in the evenings and during holidays. He also made use

of his numerous long journeys from Dubna to Moscow for talks on scientific subjects and studies.

His first scientific work done at the All-union Electrotechnical Institute was devoted to working out new methods and instruments for measuring the intensities of x rays. Veksler subsequently often returned to developing methods of observing ionizing radiation. The summary of this work is contained in the monograph "Experimental Methods of Nuclear Physics" published in 1940 in conjunction with N. A. Dobrotin and L. V. Groshev. Later (in 1949) he wrote (together with L. V. Groshev and B. M. Isaev) the monograph "Ionizing Methods for Investigating Radiation."

An important stage in Veksler's scientific biography was his transfer in 1937 to work as a doctoral student at the P. N. Lebedev Physics Institute of the USSR Academy of Sciences. A number of distinguished scientists who influenced Veksler considerably worked at that time at the Physics Institute. Veksler commenced his scientific work under the direction of D. V. Skobel'tsyn whom he considered throughout his lifetime to be his teacher. The small P. N. Lebedev Physics Institute led in those days an existence full of intense, friendly work. All scientific problems of the most diverse branches of physics were discussed by the entire staff, both junior and senior, and without regard to whether they worked in optics, nuclear, or theoretical physics. There were at that time as yet no sharp lines of division between physicists of various specialites which are so characteristic of our time and which often exert a bad influence on young scientists.

A breadth of scientific interests characterized Veksler; he was interested not only in cosmic rays—the main subject of his investigations for over a decade (1937–1947), but also in the most diverse branches of theoretical and experimental physics.

The investigation of cosmic rays was conducted in those days mainly in the mountains. In the Elbrus expeditions of 1937, 1938, 1939 and 1940 Veksler and the group which he directed employed proportional counters to investigate the heavy, strongly ionizing particles of cosmic radiation. Even the first of these experiments yielded data which served at the time as one of the arguments against the assumption that the penetrating cosmic-ray component consists of protons. Subsequent experiments with proportional counters yielded interesting information on the generation of comparatively slow mesons.

The war interrupted Veksler's cosmic-ray work. All his thoughts and deeds, just as those of the entire Soviet nation, were directed to the struggle with the fascist invader. During the war years he succeeded in utilizing the radio-technical methods used in cosmic-ray physics to solve certain important defense problems.

Starting in 1944, cosmic-ray work under Veksler's direction was resumed, now in the Pamirs. The work was carried out at altitudes exceeding 4000 meters, but Veksler seemed to take no notice of this. He surprised everyone by his endurance and hardiness in the mountains. The main direction of research was the study of nuclear processes caused by high-energy particles. The most important result of this stage of the work was the discovery of a new type of shower, subsequently called electron-nuclear shower, in which electrons are also produced together with the secondary nuclear-active particles. The study of the properties of these showers and the process of their generation resulted in an entire branch of cosmic-ray physics. Not only did intensive work on cosmic rays proceed in the mountains under expeditionary conditions, but discussions were also held on other problems of physics.

Veksler published during those years more than twenty papers on cosmic-ray investigations, but his mind began already at that time to work in quite a different direction.

Veksler's co-workers were always surprised not so much by his astounding capacity for work as by his boundless imagination. In conversation with his students he would often say: "I have an idea which I should like to discuss." A heated argument would ensue. The idea was subjected to severe criticism. Soon the discussion would become more and more heated. All those present would try as hard as they could to refute the new assumption. The arguments would continue during the days that followed. At times, extensive theoretical work would be required to clear up the situation. After such work the discussion would be continued. Objections raised other objections. For us, Veksler's students, such a method of working out various physical ideas was excellent training. It gave us a great deal, but also required a lot from us. Not everyone could stand up to such work for many years, but one can cite numerous scientists who went through such a school of ideas with Veksler. Many of his students have now themselves become directors of large groups of scientific workers.

Above all, Veksler loved working with young people, particularly with young theoreticians. This is quite understandable. In the course of Veksler's rapid creative work ideas came up; some of these were even incorrect, but mostly they were very interesting and so unusual and fantastic at first sight that they raised the objections of many physicists accustomed to the traditional slow and "solid" scientific progress, and caused them even to sneer and be reluctant to argue the essence of the matter. Unfortunately, even some very good physicists received guardedly his most brilliant idea—the principle of phase stability—which led to a revolution in the methods of constructing charged-particle accelerators. For this reason he felt more at ease with young people who were still formulating their style of work. Of the older generation of scientists Veksler liked to seek advice on scientific matters from S. I. Vavilov and L. I. Mandel'shtam. He often recalled a talk with Mandel'shtam which took place shortly before Mandel'shtam's death in 1944 in which he (Veksler) told him of his idea concerning phase stability in accelerators. Mandel'shtam, at the time gravely ill, immediately grasped the important, revolutionary significance of this work.

Even when Veksler's work became generally recognized, he did not change his style of work. The noisy argument continued; bold, sometimes fantastic, ideas were proposed. But now he would say to his students: "Please do not say anything about this idea as yet, because nothing may come of it."

The first accelerator based on the new ideas was proposed by him at the beginning of 1944. This first accelerator, called a microtron, was for many years an amusing toy, a game of the mind, rather more suitable for lecture demonstrations than for work. Electrons of even small energies move practically with a constant speed almost equal to the speed of light. If the period of revolution of an electron in the magnetic field of the successive acceleration increases by an integral number of periods of the variation of the accelerating field, then the resonance will not be disturbed and the acceleration can proceed. It would be more correct to call this accelerator a relativistic cyclotron, since here the difficulty of supporting the resonance, which is essential in the cyclotron invented by Lawrence, has been overcome. The name "microtron" emphasizes only the necessity of using high-power microwaves. In 1944 it was difficult to see that the microtron will be successful, but Veksler hoped it would and often predicted a great future for it. Very recently the microtron experienced a revival. Owing mainly to the work of S. P. Kapitza, it was possible to construct a beautiful, compact device which has found application in many laboratories as a convenient injector of electrons and positrons.

In the same year (1944), analyzing the operating principle of the microtron, Veksler discovered the principle of phase stability which underlies all high-energy accelerators of protons which are operating, being built, or planned. Practically all cyclic high-energy electron accelerators also employ this principle. The principle of phase stability is a very important landmark in high-energy physics. One can say without exaggeration that the principle of phase stability is one of the greatest discoveries of the Twentieth century. From that time on all Veksler's thoughts were devoted to accelerators. He planned and built new accelerators, worked out new methods of acceleration, and with his inherent energy and breadth of mind went over into the new field of high-energy physics. Here, as never before, the attractive strength of Veksler's personality played an exceptional role. He had to set up entire scientific groups which were working out and constructing accelerators, and simultaneously teach others and himself high-energy physics. He had to teach engineers, experimental physicists, and theoreticians to work together. This required Veksler's entire experience, the breadth of his knowledge, and his ability to combine engineering, experimental, and theoretical problems.

An accelerator laboratory was established at the P. N. Lebedev Institute. A 30-MeV electron synchrotron, one of the first in the world, was started in 1947. An important role in the construction of this accelerator was played by one of his first, able students B. L. Belousov who perished young in an accident in the mountains.

At the same time, before work on the small synchrotron was completed, planning started and equipment was prepared for a 270-MeV electron accelerator which was set up in Moscow in 1949. A large group of young physicists took over enthusiastically the operation of this accelerator.

In 1949, Veksler and his students started, practically simultaneously with the work abroad, to study the process of photoproduction of mesons and photonuclear reactions. During this period Veksler concentrated his attention on photomeson physics. He stated a number of ideas which were used by his students as the basis for the experimental methods. The main result of the investigations of this period was the proof of the isotopic invariance in studying photonuclear reactions—a result which has now entered the textbooks. A long time after Veksler left photomeson physics his students and co-workers continued to develop his ideas. At present this group, trained by Veksler, has obtained most important results in pion physics in the energy region near the meson photoproduction threshold, as well as on a photonuclear reactions.

In 1949 V. I. Veksler and S. I. Vavilov initiated work on the planning of a large proton accelerator, the 10-BeV proton synchrotron in Dubna. At the same time, it was decided to construct in Moscow a 180-MeV accelerator model. The construction of a contemporary accelerator installation is in its scale similar to the construction of a large plant, and in its complexity, unusual nature, and accuracy it exceeds all that is known at the given moment. Only scientists who have themselves participated in the construction of large physics installations can imagine the work of the director and the volume of difficult, often overwhelming work which falls on the shoulders of the scientist. It is most difficult during this time to continue with one's creative, scientific work. But precisely during these years Veksler brought forward a new method of accelerating which he called coherent acceleration. For a long time a nonresonant acceleration method has been sought. It is even difficult to count the number of correct and incorrect ideas which were discussed and rejected in this connection. In 1948 a stochastic method of particle acceleration was considered (in conjunction with A. A. Kolomenskiĭ and É. L. Burshtein). In this method the motion of the particles and the change in the accelerating field were not synchronized, as is usual. The particle fell into an accelerating gap at the right instants (when it was accelerated), or at the wrong instants (when it was slowed down) completely randomly. It was nevertheless shown that most of the particles will on the average be accelerated. The correctness of this idea and its usefulness in certain accelerators has been experimentally confirmed.

Between 1951 and 1955 a series of new ideas appeared on nonresonant acceleration. In all those hypothetical accelerators the particles themselves take part in producing the accelerating field; for this reason this field is always "right," i.e., it always accelerates the particles. For example, an electron flux will carry behind it a bunch of protons as long as their velocities are not equal and the proton energy does not become larger by about a factor of 2000 than the energy of the electrons. This means that using a beam of electrons with an energy of several million electron volts, one could in principle attain a proton energy of several billion electron volts. Even more striking results can be expected in the collision of an electron bunch moving with almost the speed of light with a proton bunch at rest, if the electron bunch is heavier than the proton bunch. Finally, one can construct an accelerator intended not for accelerating individual particles, but for accelerating pinches of quasi-neutral matter (plasma). This method has been called radiational acceleration.

Naturally, great difficulties (some of principle) stand in the way of constructing such accelerators. But based on the principles enumerated above, work is being carried out continuously on the construction of new, specific installations.

As has already been mentioned above, at the time when new methods were proposed and worked out, the work of building accelerators continued. The 180-MeV proton-synchrotron model commenced operation in 1953 (at present this setup works in the electron accelerating mode up to an energy of 700 MeV), and in 1957 one of the largest (at that time the largest in the world) proton accelerators was put into operation. This history of the building of the large accelerator should be told separately. This history would be Veksler's biography for a period of almost five years. Here one could tell of friends and students who arrived together with their teacher in Dubna and now work there successfully. This would be a most instructive history for physicists working in the field of accelerator technology and high-energy physics. It would be a history of successes and failures, searches, disappointments and discoveries, which constitute the life of a scientist. However, in the life of a scientist everything changes: again Veksler's attention was concentrated on high-energy physics. In 1954 he was appointed director of a newly created laboratory which subsequently during the organization of the Joint Institute for Nuclear Research was called the High-energy Laboratory. Again in a new place a youthful group had to be created to work in the field of elementary-particle physics.

The work on the proton synchrotron started with the same enthusiasm, arguments, proposals, and new ideas. The extensive experience gained in the investigations of cosmic rays, photomeson reactions, and accelerators was of course very useful. However, Veksler learned again, and consulted his friends, theoretical and experimental physicists.

Large groups from various laboratories in this country and abroad were attracted to the work on the large accelerator. Nevertheless, the main burden fell on the young people, Veksler's students. To become familiar with a completely new accelerator, the like of which did not exist anywhere else, was a very difficult and, what is most important, time consuming task. But soon the difficulties, chagrin, and failures remained behind, and together with the new physical results there matured a large, youthful, gifted team which considered high-energy physics and accelerators as a familiar, kindred matter. The difficulties were, therefore, not frightening, increasingly bolder problems were set and answered, and more and more interesting results were obtained. Now Veksler spent more time with co-workers working in the field of high-energy physics and devoted less attention to his other students. The results of experiments, their interpretation, and the setting up of new experiments were discussed.

After the discovery of the antisigma-minus hyperon, attention was focused on the detailed study of production processes of strange particles by negative high-energy pions. A series of important laws governing these phenomena was explained.

Of great interest are the data on the investigation of resonance interactions of elementary particles. Work in this direction attracts now most attention in high-energy physics.

A considerable amount of investigation was carried out into the physics of K mesons (observation of the rapid increase of the production of K-meson pairs with energy, establishment of a number of laws of K-meson decay, the investigation of the interactions of K mesons with nucleons, etc).

One must note the investigation of the fundamental process of elastic proton-proton scattering in the 3–10 BeV region of energies. An original method, worked out in the laboratory, made it possible to obtain the angular distributions of the cross section of this process in the region of very small angles where there were practically no data. The results of this investigation showed that the widely current naive concepts on the mechanism of the proton-proton interaction in this energy region were unsound. Many other results were also obtained.

Veksler was an active participant and organizer of a number of international conferences on high-energy physics and accelerators. He did much to organize international collaboration in these branches of physics. For some years he was a member, and subsequently also the chairman, of the International Commission on high-energy physics.

The growth of his scientific authority in this country and abroad, the prizes and distinctions which he received during the last years brought no change in his style of work and his attitude towards students, but were probably a heavy burden compelling him to work even more persistently and intensively.

Veksler was decorated with three Orders of Lenin, the Order of the Red Banner of Labor, and with medals. On December 4, 1946 the Academy of Sciences elected him as a corresponding member and on June 20, 1958—an academician. He received the Lenin prize and the State prize of first order. In 1963 he was awarded the international "Atoms for Peace" prize.

He initiated the organization of a new journal "Nuclear Physics," whose chief editor he was to the last days of his life.

For more than twenty years he was a member of the editorial board of "Uspekhi Fizicheskikh Nauk." He liked this journal very much and regardless of how busy he was helped the editorial board to make it even more interesting.

The last three years of his life were filled with very intensive organizational and scientific work. On July 4, 1963 he was elected to the post of academician-secretary of the Nuclear Physics Division of the USSR Academy of Sciences. He gave much of his strength and energy to extend scientific investigations in nuclear physics and worked out new plans.

Continuing to work in the field of high-energy physics, he gave again more and more of his time and attention to his lifetime task of creating and working out new method of acceleration.

So far not all of his manuscripts have been published. Being very exacting towards himself, he did not necessarily attempt to publish all his thoughts and ideas. An important task of the USSR Academy of Sciences is the publication of Veksler's collected works.

Soviet and world science lost in the person of V. I. Veksler one of its leaders.

Translated by Z. Barnea

Letter to the Editor

ON THE GALVANOMAGNETIC "PARADOX"

(Reply to Letter to Editor by T. S. Zhuravleva)

T. S. Zhuravleva's Letter [UFN 87, 582 (1965), transl. 8, 914 (1966)] concerning my article "A Hall-effect Problem" [UFN 82, 161 (1964), transl. 7, 49 (1964)] is the result of insufficiently attentive reading of my paper. In spite of T. S. Zhuravleva's opinion, it is nowhere stated in the paper that the action of the secondary Hall emf violates any law or is paradoxical. To the contrary, the whole article is devoted to proving the regular character of this phenomenon in all cases, and the word "paradox" is printed in quotation marks throughout. Is it necessary to explain that the opposite is meant in such cases? In my opinion such comments are unnecessary.

I chose to name this experiment "galvanomagnetic 'paradox'" by analogy with other names of well-known demonstrations: the hydrostatic "paradox," "London" fog, etc.

V. Serkov