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PERSONALIA

IGOR' EVGEN'EVICH TAMM

(On the occasion of his seventieth birthday)

V. L. GINZBURG, A. D. SAKHAROV, and E. L. FEĬNBERG

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IT seems impossible to us to begin this article with the traditional cold statement that "Academician Igor' Evgen'evich Tamm, the outstanding Soviet theoretical physicist, is about to celebrate his seventieth birthday"; I. E. Tamm is far too well known among physicists; he is far too popular among the broadest circles of our society, where he is appreciated not only for his great scientific achievements, but for his civic activities, which command general respect; and too many people who are not in close contact with him nevertheless hold him in personal affection and esteem. Finally, he brings too much passion and enthusiasm to everything he does, whether it be scientific work or mountain-climbing, publicizing the achievements of biology or combatting all forms of pseudo-science, working to bring the peoples of the world closer together, or simply attempting to redress some wrong that comes to his notice.

Nevertheless, we shall briefly outline his major scientific achievements and the main events in his life.

Tamm was born on July 8, 1895. He spent his childhood in Elisavetgrad (now Kirovograd), where he was graduated from secondary school in 1913. During his school and university years (one year in Edinburgh, 1914—1918 in Moscow), science does not appear to have played a major role in his life. That is readily understandable, seeing how public-minded he still is today, half a century later. It is not surprising that in 1915 he should have gone to the front as a volunteer medical worker, and that in 1917 he should have turned up as a member of the Elisavetgrad Soviet and been a delegate to the First Congress of Soviets in Petrograd. At about that time, however, his interest in science began to gain the upper hand. From 1919—1920 Tamm taught physics at universities in outlying districts and in 1924—when he was already 29, extremely late by modern standards—he published his first scientific article, "Electrodynamics of the Anisotropic Medium in the Special Theory of Relativity."

In his early scientific activity Tamm was guided by L. I. Mandel'shtam, with whom he continued to maintain close contact and a warm friendship.

Since 1922, Tamm has lived in Moscow, and his life's basic organizational framework has been furnished by his work in Moscow University from 1924 to 1941 as head of the chair of theoretical physics and in the Lebedev Physics Institute of the USSR Academy of Sciences, where he had headed the theoretical section since 1934.

There is little point in giving a detailed description of Tamm's career and his scientific work. Indeed, such a list of facts cannot be established with any precision, for errors are bound to creep in. Tamm has never kept a personal file. He simply puts aside things in which he has lost interest and is even apt to forget articles he once published: he was engrossed in the subject at the time, and is no longer. This trait of his, like many others, make him akin in spirit to Pasternak's famous poem:

Celebrity I find unseemly.
That's not the engine that uplifts.
Do not accumulate a file
Or tremble over manuscripts!

To give oneself is creation's aim,
Not noisy fame and not success.
To be a legend on all lips
Is shameful for the meaningless.

No, you must not be a pretender,
But modest live and so rejoice
To find yourself beloved of space
And hear the waiting future's voice...

We shall therefore confine ourselves to Tamm's major efforts and accomplishments. First of all, we must note one trait which is typical of his scientific activity: Tamm has always been drawn to and engrossed by the most topical, the most important and the most difficult problems facing science in any given period. He has basically always worked on such problems, in particular on the formulation of new principles of theory. Quite recently he wrote: "It is my dearest wish to live to see the day when a new theory will have been evolved, and to be in sufficient command of my faculties to be able to understand it."

Tamm has published some sixty scientific articles over a period of forty years. That means that there were years when he published little or nothing. Years of outstanding achievement alternated with years of silence, when he revealed only to a close circle of intimates the arduous work he put in, the failures and disappointments which crossed out years of labor, the many new ideas he tested out in his attempts to solve the most complicated problem known to physics in the

past four decades—the problem of elementary particles and their interaction. Such ups and downs must be typical of true creativity:

> In destiny and not in work
> Let any gaps that are, be found.
> Cross out whole pages, chapters, books
> In your life's negligible round
>
> And plunge into obscurity
> And hide your motions, hide your face,
> As a locality will sink
> In mist and fog, and leave no trace...

Even when Tamm abandoned his main line of work because some other problem caught his interest, the problem turned out to be one of primary importance. He would solve it with relative ease and attain outstanding results.

That happened in 1936—1937, when he became interested in the paradoxical experiments of P. A. Cerenkov and when, together with I. M. Frank, he gave a theoretical explanation of a mysterious phenomenon whose very existence most physicists then doubted, while some even made fun of the experiments. This brilliant theoretical study started an entire trend. It probably brought Tamm his greatest fame, since for it he received first a State Prize of the USSR and later (in 1958) a Nobel Prize. Tamm himself, however, did not pursue this line of inquiry, although he would certainly have found a number of problems to interest him and might have done further significant, useful and reliable research, as was in fact done by other physicists. Instead, he again turned to nuclear forces and the physics of elementary particles, which had captured his imagination, although success in this field was far more difficult of attainment.

> ...Others along the living track
> Will follow where you set your feet,
> But you must not discriminate
> Between a triumph and defeat...

A similar situation obtained in the post-war years, when Tamm took up the problem of thermonuclear fusion. His students and friends were always strongly influenced by him, both in scientific matters and in many other respects. The years which Tamm devoted to work on thermonuclear synthesis are engraved in the memory of one of the present authors (A. D. S.), who was fortunate enough to live and work side by side with him. In particular, they began a joint investigation of the theoretical aspects of controlled thermonuclear reactions in a strong magnetic field, and took part in other studies associated with the problem of thermonuclear synthesis. During this period Tamm was accorded high honors, inter alia the title of Hero of Socialist Labor. However, he soon turned his attention to the problem of isobaric states of nucleons and the interaction of relativistic particles, and, along with many disappointments, also reaped considerable success, which, however, brought him no honorary awards.

His theory of the Vavilov-Cerenkov effect and his studies on thermonuclear synthesis are undoubtedly of very great importance; yet they hardly can be said to occupy the first place among Tamm's many scientific contributions.

Thus, back in the early thirties, when a basic problem in physics was to find an explanation for the forces which retain the nucleons in the nucleus, Tamm advanced the first theory on the subject, which has served as a jumping-off point for all subsequent studies. He sought an explanation for these forces in the process of beta decay. Tamm's achievement was that from the possibility of decay of particles he inferred the inevitability of existence of exchange forces between the two particles involved (1934). However, from his findings Tamm himself concluded that while these beta forces certainly exist, they are too weak to explain nuclear interaction. Nevertheless, his outline of a quantitative theory of beta forces has served as a prototype for all subsequent interaction theories. Only a year later, using Tamm's work as his point of departure, Yukawa predicted the existence of the meson as bearer of the requisite strength and range.

Earlier still, in the late twenties, the main problem was, of course, the development of relativistic quantum mechanics. Dirac, who had derived the relativistic wave equation for the electron, was himself perplexed by the negative energy levels inevitably following from his theory and—after the introduction of the occupied background—relating to the existence of the positron. Before the positron was detected experimentally, many attempts were made to eliminate these levels in order to do away with the necessity for the positron. Tamm's great contribution was the consistent derivation (1930) of a formula for the scattering of light by the electron ("Klein-Nishina formula"), which showed that in Dirac's theory the negative energy levels are an essential element, without which even the nonrelativistic limit expression (Thompson formula) cannot be obtained. Consequently, attempts to banish the positron were seen to be hopeless. This appears to have been the first consistent quantum electrodynamic calculation of the relativistic effect, carried out in a way that was used for the next twenty years, until the development of the theory of renormalization, which actually merely introduced greater precision.

In the early thirties, when the formalism of quantum mechanics became available, many theoretical physicists were engaged in testing it by working out applications for it, particularly applications to the theory of metals. Tamm discovered theoretically exotic surface electron levels—Tamm levels—which attracted great attention a quarter of a century later in connection with the theory of semiconductors.

Tamm's principal achievement in the post-war

period (not counting the above-mentioned study of thermonuclear fusion) is probably the development of the method—later used in hundreds of investigations—of cut-off equations in the theory of interaction of relativistic particles; it is known as the Tamm-Dancoff method, because Dancoff also proposed it in the United States, five years after publication of Tamm's study. As became clear subsequently, it is a variant of the V. A. Fock method which was formulated in the early thirties but failed to attract the attention it deserved. Mention must also be made of the concept and the phenomenological theory of isobaric states of nucleons. When Tamm and his collaborators were developing this theory (1954—1955), it was harshly criticized by friend and foe alike on the ground that the resulting lifetime of the isobar was too short for such a particle to have an independent significance. However, after a great many nuclear resonances were detected experimentally, basically that very concept gained general acceptance.

But then, outstanding theoreticians had regarded the idea defended by Tamm in 1934 that the neutron, which has no electric charge, nevertheless has a negative magnetic moment, as a pardonable but self-evident aberration on the part of a good physicist. As we now know, Tamm was right.

And now, in the mid-sixties, Tamm is giving himself heart and soul to working out an idea by which he is fascinated and on which he reported in the "New Ideas" section of the International Conference on High-Energy Physics held at Dubna in August 1964. This is an attempt to eliminate disagreements on the basis of the idea of quantization of space-time, making use of four-momentum space. He was not accorded an enthusiastic reception (but then all other theoreticians who proposed various ways of remedying the fundamental defects of the theory of elementary particles met with a like fate). It is premature to say what the outcome of his efforts will be. But Tamm has considerable experience of defending his own views against criticism and later seeing them proved right. The long nights he spends at his desk and the thousands of pages he covers with calculations are proof of his singleness of purpose and capacity for work, now as in the past.

This brief description of Tamm's main work may well be too subjective and have left out many interesting studies he has carried out.

The public esteem in which Tamm is held is not based solely on his scientific work. His activities as educator have also played their part (he is the author of the book "Fundamentals of the Theory of Electricity," which has been reprinted in a dozen editions both in the USSR and abroad; for many years he has headed chairs of theoretical physics in the Moscow State University and the Moscow Engineering-Physical Institute and taught at the Moscow State University; and he has trained dozen of students who are now scientists in their own right). In essence, there is no difference between the ardent university student who voted at the First Congress of the Soviets against the Provisional Government and the gray-haired academician who today mercilessly exposes the falsity of pseudo-science at a general meeting of the Academy of Sciences. Apparently even half a century ago Tamm knew something that was to be written only many years later:

> ....And never by a jot or tittle
> Distort what you personify.
> Live, be alive, and that is all;
> Live, be alive, until you die.

Translated by Mrs. Valentine Rosen