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## In memory of Vladimir Vladimirovich Bronfman

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Viulen Veniaminovich (Vladimir Vladimirovich) Bronfman, outstanding school physics teacher and a legend of natural science teaching in Soviet schools at its peak in the 1970s, who together with N N Konstantinov organized the world-famous mathematics classes in Moscow schools No. 57 and No. 179, died on 16 September 2009 at the age of 84. Until the last day of his life, Vladimir Vladimirovich continued to teach physics, to improve the methodology of teaching, and to supervise the research work of his pupils.

V V Bronfman was born on 9 March 1925 in Moscow. His father headed the labor union of movie and photography professionals, and his mother was a nurse. In 1941, Viulen, still only a 16-year-old, was mobilized to dig foxholes near Moscow, and then in autumn 1941 to the State Union Plant No. 633 as a trainee mechanic. In February 1942, before reaching the age of 18, he was drafted into the army, served in the airborne troops, then moved to the engineering corps. He demobilized in May 1946. In September 1946, V V Bronfman enrolled in the City of Moscow V P Potemkin Pedagogical Institute (MGPI, now MGPU in Russ. abbr.) in the department of physics and mathematics. In 1950, he graduated from MGPI, majoring in physics, and was categorized as a 'teacher of physics'. After that, Vladimir Vladimirovich always worked in Moscow schools. He started at High School No. 12 and ended his career at the illustrious Gymnasium No. 1134.

In 1969, N N Konstantinov invited V V Bronfman, who by that time had become a well-known methodologist, to take part in a new project: the creation of specialized classes at school No. 57. It is here, at last given long-awaited freedom for his creativity, that V V Bronfman implemented his pedagogical ideas. The main point was that pupils were not supposed to listen to the teacher and learn by heart the ideas he presented, but that the teacher was to listen to what the pupil would say. Given a topic, pupils were supposed to reason it out themselves, starting with scraps of knowledge and observations, trying to figure out the way that the laws of physics could work, identifying logical contradictions in their constructions, testing their inferences by simple experiments, and discovering for themselves step by step the wonderful and elegant logic of the world around them. This approach anticipated in a miraculous way the basic approach of modern theoretical physics, for which inner logic and observations are no less important than laboratory experiments. V V Bronfman was convinced that constant verification of logical reasoning by observational and experimental data was the most important factor for building the physical picture of the world: every argument needs to be supported by some sort of real testing-preferably carried out by the



Vladimir Vladimirovich Bronfman (09.03.1925–16.09.2009)

pupils themselves. To create this educational environment, something unthinkable for a Soviet school was created: teachers, parents of schoolchildren, and active scientists built real laboratories filled with real physics instruments, and children were allowed to work independently in these laboratories, to think up and conduct experiments that would confirm or refute the arguments that pupils generated during discussions in classrooms. The process of education was not meant to be reduced to scholastic memorization, nor even to an imitation of research procedures—it was to be a part of research activities and the secret was in finding for children scientific tasks that would be manageable to the child but would nevertheless be a totally realistic study of nature; sometimes it would repeat something already known to adults but sometimes not. Nowadays, this method of teaching dominates our work with the best of our students and it constitutes the factor that determines the success of the young generation of Russian scientists; our hope of rebuild-

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ing scientific schools in this country and helping them achieve new brilliance is tied to this new generation. Those who are doing this job now, directly or indirectly, through the closest students of V V Bronfman, are using and extending the approaches laid by him.

V V Bronfman's life was by no means a bed of roses. He only spent four years at school No. 57 and left it in 1972, and then, after 12 years of extremely intense work at school No. 179 in the physics classes he had created, he had to leave there, too, in 1983. He was able to return only several years ago, to help restore this school to its former quality and glory. Vladimir Vladimirovich was not unduly worried by the ups and downs of his pedagogical career and assumed at all times that his duty was to carry Prometheus's flame of the Enlight-enment, regardless of all that fate threw against him, regardless of the political climate and the atmosphere of intrigue. This was what he instilled in his pupils; in the last two decades this belief in serving lofty ideals proved to be the guarantee of survival and rebirth of Russian science.

Vladimir Vladimirovich devoted the last ten years of his life to working in the Research and Education Center (NOTs in *Russ. abbr.*) that he created at the Institute of Theoretical and Experimental Physics (ITEP). In accordance with the aims formulated for the Center, he developed promising methodologies for teaching the natural sciences in the school of the future. This entire field—from mathematics to biology—sits on the foundation of quantum field theory. However, this basic knowledge remains a taboo for the traditional method of teaching, which feeds people a warped picture of the world and justifies this by the putative complexity of the theory of relativity and quantum mechanics.

During his work at NOTs, V V Bronfman was able to demonstrate to himself and to others that teaching natural sciences 'as is' to pupils of any age, beginning with primary school, is quite possible. Having seen through the eyes of the expert the unbelievable pedagogical consequences, he plunged into scrutinizing and detailing the appropriate techniques with his typical enthusiasm, training interested colleagues, developing programs of laboratory studies, creating software packages for computer experiments, and conducting practical tests in classes with children of different levels of preparedness. Another task put before the Center was to develop synthesized courses demonstrating the unity of the natural sciences and aiming at overcoming the specialization of education. Not only have a number of such courses been produced, but they are being practically embedded into teaching programs for schoolchildren and university students, first and foremost in the field of maximum importance at the moment—joint physics and biology education in the framework of so-called quantitative biology. V V Bronfman played an enormous role in bringing a number of educational courses to maturity: the Moscow City Scientific Society 'Searcher', physics battles, and festivals of entertaining science. It only remains for us to hope that his numerous disciples and comrades in arms will be able to progress in all those directions that Vladimir Vladimirovich opened up with his unrivaled enthusiasm and belief, and that the new ventures which he launched in recent years will blossom and come to fruition.

V V Bronfman was not simply worried by the present state of science in Russia: he attempted to support its competitiveness by practical steps, devoting all his energy to training talented young people, improving the level of qualification of teachers, and creating optimal conditions for transferring the latest scientific knowledge to schoolchildren. For many years, Vladimir Vladimirovich combined practical teaching with work on promising methods of training at the Institute of New Educational Technologies and the Moscow Institute of Open Education. On the whole, he published 15 methodological research papers and manuals, and prepared programs of courses and textbooks. His highest mark of distinction in the field of teaching in this country was the medal of Exemplary Work in Education (1980); he received two grants from the Soros Fund (in 1994 and 1997) and a grant from the Dynasty Foundation in 2004.

Several thousand students graduated from schools under Vladimir Vladimirovich's guidance. More than a half of his pupils entered institutions of physics, mathematics, and engineering orientations. Among his former students, we find 2 winners of international olympiads, 7 winners of All-USSR olympiads, several winners of All-Russia olympiads, and more than 100 winners of the Moscow city olympiads, plus around 25 DSc and 250 CandSc researchers, one full member and one corresponding member of the Russian Academy of Sciences, and 4 full professors in European and American universities.

Vladimir Vladimirovich was infinitely devoted to children, and generously shared with them his knowledge and his vision of the beauty of the natural world and of the most important science describing it — physics. Anyone who had the good fortune of talking to this wonderful person and working with him—his students, his colleagues, and his relatives — will keep the eternal memory of Vladimir Vladimirovich Bronfman.

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