Opening Speech

Dear Colleagues and Friends,

I was born 9 February 1943 in Pruszków near Warsaw. To be honest, it was not exactly the centre of Pruszków, but rather its suburb, formerly a village, called Tworki. This village is very famous in Poland because of its main element, namely the psychiatric hospital organized at the end of XIX-th century by Russian Emperor's power. Because of this it is a kind of proverb "to be from Tworki". So I am from there. More precisely, I was born in a home placed some 50 meters from the hospital territory. There are two kinds of people: ones consist of those who do not believe this story, the other ones claim that it is just seen from outside that something is incorrect with me. In any case I owe to Tworki my existence in a sense. Namely, my parents were born in Warsaw, but in the summer 1939 they moved to Tworki for some professional reasons, it was the place of work. After the Warsaw uprising 1944, when according to the Hitler command all Warsaw people were to be killed or taken to the concentration camps, we were not Warsaw citizens and because of this we avoided this tragic fate. The hospital region was then taken to be a kind of concentration camp for the Warsaw people removed from the capital which was later on systematically destroyed. In 1950 my parents changed their living place to Józefów at the opposite side of the river Wisła, in the region Otwock, in connection with the health problems of my mother. In years 1950-1956 I was a pupil of elementary school in Józefów and in the period 1956-1960 I attended the gymnasium in Otwock.

A new period in my life was begun in 1960 when I started the study of physics in the Department of Mathematics and Physics of the Warsaw University. This period was finished in 1965 by my MSc dissertation devoted to the quantum, classical, and quasi-classical aspects of the theory of angular momentum. This work was done under the leadership of professor W. Tulczyjew. After that I continued this investigation and begun the study of symplectic geometry also in the context of classical, quasi-classical, and quantum physics. The study was a bit disturbed in the unhappy 1968 year. Professor Tulczyjew decided then to remain at the West and I continued my study under the leadership of professor A. Trautman, enriching it by the symplectic analysis of the Dirac formalism in theory of systems with degenerate Lagrangians. I must say that my interest in the philosophy of sciences, first of all in the sense of Herman Weyl, suggested me to go in this direction. Unfortunately, the mentioned sad events in 1968 caused that I and the colleague who accompanied me, returned again to the Department of Mathematics and Physics. The agreement of the leadership of University was based on the assumption that

we will continue the teaching in philosophy to the end of our PhD studies. We have satisfied this formal requirement without engaging ourselves into the dominating ideological demands, and even in spite of them. In 1971 we have defended our PhD theses in the Institute of Mathematics and Physics. In the meantime I connected myself with Professor Henryk Zorski and in 1970 I was accepted as a member of his group in the Institute of Fundamental Technological Research of the Polish Academy of Sciences. All my scientific life was connected with the analysis of mutual relationships between theoretical physics and mechanics of continuous media and other disciplines of theoretical mechanics. First of all, I was interested in mechanics of affinely rigid bodies, i.e., ones homogeneously deformable. Let me mention that, it turned out later, such a model was studied by almost forgotten Russian XIX-century mathematician D. Seilinger. Besides, it was used by A. Eringen in his mechanics of micromorphic media, however with some mistakes. In my papers plenty of corrections was introduced, including the theory of affine bodies with additional constraints. In particular, discussed was the non-holonomic model of rotation-less motion. This is really interesting example of non-holonomic constraints, when the rotation-less behavior is not connected with the symmetry of the field of "placement". I have also formulated the affinely-invariant dynamics of the affine body, formulated in a completely geodetic case, without necessity of using potential to describe elastic vibrations. This resembles some aspects of the Maupertuis formulation of analytical mechanics.

Some of my papers have common points with the models of Kroener and Hehl which interpreted defects in continua, including disclinations and dislocations in the language of gauge theories. An interesting feature of those models is their underlying group structure similar to groups used in general relativity and its gauge corrections. In particular, the Poincare group is used, its covering by $\mathrm{SL}(2,\mathbb{C}) \times \mathbb{R}^4$), but also the full linear group, affine group, Minkowski-conformal group and its universal covering $\mathrm{SU}(2,2)$. There were also attempts to use the complex linear group $\mathrm{GL}(4,\mathbb{C})$. There is also a class of models based on the global action of $\mathrm{GL}(4,\mathbb{R})$ or, more generally, $\mathrm{GL}(n,\mathbb{R})$. All those gauge and tetrad models are also generally-covariant, i.e., invariant under the argument action of the space-time diffeomorphisms group. Although the mentioned models are different and have some specific properties, they have also some features which enable us to find rigorous solutions. It turns out that the differential second-order model invariant under $\mathrm{SU}(2,2)$ as a gauge group has certain interesting features like the unexpected relationship with the first-order Dirac model and, at the same time, it may explain certain apparently strange features of the standard model of electro-weak interactions. It is interesting to discuss further the relationship between gauge models of gravitation and the theory of defects in continua. Probably some new kinds of defects may be discovered due to this kind of analysis.

I was also dealing with the theory of non-holonomic systems both in the sense of d'Alembert and Vakonomic sense. Incidentally, I was one of the persons who were first aware of the difference between two approaches and I suggested to use the variational Vakonomic approach to the theory of optimal control. I have shown that the Vakonomy is interesting from the energy-saving point of view. Besides, it has certain other interesting optimality features. In my approach to Vakonomic systems it is possible to describe systems with constraints nonlinear in velocities and also to describe systems where constraints are imposed onto higher-order time derivatives of generalized coordinates, not necessarily on generalized velocities. It is also possible to consider systems with more general, e.g., functionally described non-holonomic constraints.

Another part of my activity was connected with foundations of analytical mechanics, symplectic geometry and theory of integrable systems, including the degeneracy analysis and the theory of Bertrand models. Besides, I was also doing with foundations of quanta, and first of all with the quasi-classical problems. I discussed in particular the problem of the connection between symmetry and information properties of the quantum and quasi-classical systems. In the last years I was also studying some problems touching the decoherence and measurement paradoxes of quantum mechanics. My model is based on essentially nonlinear, therefore non-perturbative nonlinearities. It is well known that there were many nonlinear models supposed to be able to explain the problem. Nevertheless, almost all of them were based on the non-essential, very often perturbative-type nonlinearities, rather artificial from the geometric point of view. My model is essentially nonlinear and its geometry-based nonlinearity has no status of the correction to any linear background. It is structurally similar to affinely-invariant models of the dynamics of affinely-constrained motion. Because of all those features, it seems that my model has a good chance for explaining various paradoxes of quantum mechanics. By the way, let me remind here the opinion of R. Feynman, according to which nobody does understand quantum mechanics. My essentially nonlinear Hamiltonian model based on the concept of dynamical scalar product which introduces nonlinearity, has a chance to offer some solution of paradoxes. Besides, I was also doing some other fundamental problems of quantum mechanics, together with my last PhD students: B. Gołubowska, V. Kovalchuk, A. Martens, E. E. Rożko.

In spite of being formally employed at the Institute of Fundamental Technological Research of the Polish Academy of Sciences, where in principle there are no formal teaching duties, I was also deeply involved into teaching process. It was active at the PhD process of our Institute, Department of Physics of the Nicholas Copernicus University in Toruń, Department of Physics of Warsaw University and the Department of Physics of University in Białystok. I was teaching the classical and quantum physics, mathematical analysis, field theory, and philosophy of sciences.

What concerns my organization activity, I was included into leading of various conferences, first of all in the realm of mathematical physics. For instance, during some time I was a member of the Organizational Committee of the annual Symposia in Mathematical Physics in Toruń, Euromech 373 in 2012 in Sofia, Congress of Mathematical Physics in Warsaw 1976, Symposia in Velikie Luki in Russia, and so on. I am a member of the Scientific Council of the journal Reports on Mathematical Physics in Toruń and Journal of Geometry and Symmetry in Physics in Sofia.

What concerns international cooperation, I was a Polish leader of three agreements with Bulgaria, namely with the Institute of Biophysics and Biomedical Engeneering, professor Ivaïlo M. Mladenov and dr Mariana Hadzhilazova. I was also a Polish leader of three agreements with Russia, namely with the Computing Center of the Russian Academy of Sciences, professors A. Burov and S. Stepanov. I am also cooperating with the University of Florence, professor P. Mariano. For many years we are cooperating also with professor F. Schroeck Junior, Department of Mathematics, University of Denver, USA. Nowadays we are finishing a book concerning the phase space relationship between the classical and quantum levels of description. For many years I was co-working with Professor K. Hellwig from Germany, Technical University of Berlin (formerly West).

I was a fellow of the Alexander von Humboldt Foundation in Germany, where I collaborated with professors H. Doebner and K. Helwig. According to the principles of this Foundation, formally I am still a fellow. I was a leader of a few research grants, in particular, three PhD grants.

In 70-s I was awarded by the Scientific Secretary of the Polish Academy of Sciences for my book in Polish, “Geometry of Phase Spaces”. I was also granted by the Committee of Philosophy of the Polish Academy of Sciences. In 2002 I was awarded with the Golden Cross of Merit by the President of the Polish Republic. My 800-page book about Phase Spaces, published by J. Wiley and Sons, belongs to the world classics. Besides I am author of a few chapters between 100-150 pages in some scientific books. My first book, popular one about quantum mechanics was published when I was 26 years old.

During many, many years I was the leader of the Laboratory of Analytical Mechanics and Field Theory in the Department of Continuum Theory of the Polish Academy of Sciences. During five years I was the leader of that Department. During a few cadences I was a chairman of the Commission Mechanics II in our Scientific Council.

I was a supervisor of eleven defended PhD procedures and some of them were distinguished by Scientific Council.

Let me stop this praising myself. If there is anything valuable in my activity and results, it must be said explicitly to whom I owe this. First of all, everything began

from my Teachers in school and University. I have learned from them the love to mathematics, first of all, to geometry as one of the most fundamental languages of sciences. And I must say this concerns, first of all, the problem of the mutual interplay of metrical and affine concepts. Therefore, I am very grateful to my teacher of mathematics in gymnasium, the late professor Wierzbicki who taught me to be in love with mathematical books. I also owe very much to my former boss in the Institute of Fundamental Technological Research, the late professor Henryk Zorski. He was the first to understand and estimate my ideas. He accepted me as a co-worker. And I am also grateful to professor W. Tulczyjew who taught me geometry as a subject in itself and as a universal language of physics. And further, I would like to thank also my young co-workers and PhD students. But first of all I must thank my best friend and wife Anna, and my two daughters, Łucja and Julia. Anna was so kind to sacrifice everything, first of all her private life to me and to my scientific work. I am afraid she overestimated the value of my ideas. And my daughters gave me an additional motivation for my activity. And finally, I must remind my late Mother who convinced me to learn and become scientist. And some special thanks are also due to my father for everything.

Some special gratitude is also to be expressed to professors Mladenov, Burov, Stepanov, Hellwig, Mariano, Schroeck. If I did not lose the rest of my believe in myself, it is due to them.

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2 January 2015, Warsaw, Poland