

Memories of V. I. Ogievetsky

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In 1973 I was a graduate student at the Physics Faculty of the university of Sofia (Bulgaria). One of my professors had the idea to send me to JINR to get my master degree at the Laboratory of Theoretical Physics (LTF). This was an exceptional move at the time, JINR was a pure research institute and no students from the member countries were admitted. After all the administrative hurdles were overcome, the question arose with whom will I prepare my master thesis. I had already met prof. Ivan Todorov from INRNE, Bulgarian Academy of Sciences in Sofia. My university professor approached him with this question. Prof. Todorov, who had just returned to Bulgaria after many years spent at LTF, answered: "I will try to convince Victor Ogievetsky, who is one of the very best people at LTF, to take care of Emery". He succeeded and so, on September 23rd 1973 I arrived in Dubna, at the age of 22. I remember that date because it was the anniversary of a Bulgarian communist led uprising in 1923, so I was immediately taken to the dinner given by the Bulgarian community in Dubna. What an irony of fate, neither Victor Isaakovitch nor I were fans of communism . . .

I also remember that I was wearing a very long sheepskin coat. A relative of mine in Sofia had given it to me, to cope with the "Siberian winters" in Dubna. In this ridiculous outfit I came to present myself to Victor Isaakovitch in his office on the fourth floor of LTF. I was greeted by him with his notorious broad and very warm smile. This turned out to be more efficient against the cold Russian winters than my coat!

Victor Isaakovitch gave me a problem for my master thesis. I had to read a paper by a well-known American physicist on the representations of $SL(3, R)$ and try to apply in the context of Ogievetsky's approach to gravity as a nonlinear realization of symmetries. I had a very vague idea of group theory, yet alone the complicated representation theory of non-compact groups. I spent my days at the (excellent!) library of JINR, reading many books and trying to understand the paper Victor Isaakovitch had given me. After some time I reached the conclusion that the author had made a mistake and the most important series of representations did not exist. I could not believe

myself and did not dare go to Victor Isaakovitch with such an arrogant claim. So, I simply did not show up in his office for many days. One day we met at the institute canteen and he approached me, saying that he was worried that I might be ill. I had no choice but to tell him what I had found. I saw his face changing, his smile going away. He also could not believe that the American physicist had made such a mistake. He asked me to come to his office the next day, to discuss the matter. I could see myself packing my sheepskin coat and flying back to Sofia, after such a blunder at the very beginning of my work in Dubna. When I did go to his office the following day, the smile was back and even broader than usual: "I checked what you said, you are right!" This was the beginning of a very long and very fruitful collaboration (43 common papers!) with Victor Isaakovitch Ogievetsky, which laid the foundation and gave the main directions of my scientific career.

Throughout the years I learned so many things from Victor Isaakovitch that it is hard to give even a brief summary here. What I would like to tell are two stories of how Victor Isaakovitch failed to make two important discoveries, one with Igor Polubarinov and the other with myself.

The first story is about supersymmetry. Victor Isaakovitch was one of the pioneers of gauge theories in the Soviet Union in the early 1960's. He was one of the first to understand their fundamental role in particle physics. He told me that once he gave a talk on gauge theories in Moscow. After the talk a person whose name I will not mention approached him and said: "Why are you waisting your time with these gauge theories, they have no future!"¹ Victor Isaakovitch did not listen to him and continued his pioneering studies. Together with Igor Polubarinov he developed a very original (for the time, today it is in many textbooks) approach. The idea is that every gauge theory is the theory of consistent self-interacting field with a given spin and zero mass. Thus, the theory of a spin one particle described by a vector field is Maxwell (or Yang-Mills) theory, that of spin 2 is Einstein's gravity theory. This approach starts from the first principles of quantum field theory and needs no geometric notions of local gauge symmetry, as these theories are usually presented. In fact, the gauge group comes out of this analysis as a corollary, not as an input. Having made such a profound observation about the the underlying principle of gauge theories, Victor Isaakovitch asked himself the logical question: between spins 1 and 2 there is also spin 3/2. Is

¹Ironically, a few years later the name of that person became associated with one of the basic tools of gauge theories...

there a gauge theory which will make a spinor-vector (or Rarita-Schwinger) field consistently self-interact? If so, what is the symmetry group that will have to be gauged? Clearly, since the field of half-integer spin is fermionic, so must be the group parameters. Is there such a group? Victor Isaakovitch went around Moscow asking all of his acquaintances if they knew a group with fermionic parameters. People like I. M. Gel'fand and F. A. Berezin did not know the answer. Victor Isaakovitch failed to ask only one person, Yu. A. Golfand, who he met regularly at the seminars of the theory group of the Lebedev Physics Institute (FIAN). He did not know that Golfand and Likhtman from the same institute had invented what is now called the Poincaré supersymmetry algebra in 1971!

The other story, which is in a way the continuation of the first, is about my work together with Victor Isaakovitch on supersymmetry in 1974-76. I was very lucky in many ways, one was that thanks to prof. Ivan Todorov I did go to one of the brightest theorists in Dubna, another was that the beginning of my career coincided with the discovery of supersymmetry. This happened just after my master thesis, which I defended successfully half a year before its term. Victor Isaakovitch and my Bulgarian friends made it possible for me to stay on in Dubna, now as a research assistant.² When the first Wess-Zumino paper on supersymmetry came out in early 1974, it was immediately clear to Victor Isaakovitch that this was THE symmetry he had been looking for. He put me on a project, in which we developed further the Ogievetsky-Polubarinov approach to gauge theories, adapting it to superfields. He thought that his dream of a self-interacting spin 3/2 field will finally be realized. In 1975 we wrote together a paper on the Rarita-Schwinger superfield, containing particles with spins 3/2 and 1. We found the free theory Lagrangian and equations of motion, but when we tried to make the superfield self-interact, we hit an obstacle. After analyzing our failure, we concluded that we should combine the spin 3/2 field not with spin 1, but rather with spin 2 (graviton). Such a supersymmetry multiplet (2,3/2) existed and was described by an (axial) vector superfield. We started working hard on the vector superfield equations of motion and self-interactions, but we were too slow. Probably our main mistake was to insist on the (beau-

²I left Dubna in 1983, against my will, because the Bulgarian Communist Party decided that Bulgarians may not stay abroad for more than 6 years. The director of INRNE, Bulgarian Academy of Sciences tried in vain to convince a high-ranking Communist Party official that scientists should not be treated on the same footing as, say, embassy personnel. No way, the Communist Party knew better!

tiful!) superspace formalism, and this is what slowed us down. Other, more pragmatic physicists worked out the component field formulation in terms of a gravitational field and a Rarita-Schwinger field, and this is how supergravity was born in 1976! A year later we did find an elegant geometric formulation in terms of our vector gauge superfield but it was already too late, the discovery had taken place.

Apart from physics, I learned a lot about life and human relations from Victor Isaakovitch. When I arrived in Dubna at the age of 22, both my parents had died. In a way, Victor Isaakovitch took the role of a step-father for me. But this story is too long and too emotional to be presented here . . .

In conclusion, Victor Isaakovitch was a representative of the best Russian tradition of creating scientific schools of people with whom the Teacher will maintain good working relations for many decades. More than this, Victor Isaakovitch's school was a kind of a family, and this very human aspect of our collaboration was not the least important one!