LEOPOLD INFELD, AS I REMEMBER HIM*

Ryszard Gajewski

WaveBand Corporation, Torrance, California, USA

(Received June 29, 1999)

Reminiscences of Leopold Infeld as a teacher, a school builder, a writer and a political figure are presented by a former pupil. Also described is his little-known pioneering contribution to antenna theory.

PACS numbers: 01.60.+q

1. Infeld and Rubinowicz

Before I start sharing my reminiscences about Leopold Infeld it seems appropriate to pay tribute to another great of Polish theoretical physics, Professor Wojciech Rubinowicz. (He, incidentally, was my thesis advisor.)

In the 19^{th} century, Polish literature experienced the simultaneous eruption of two poetic geniuses, Adam Mickiewicz and Juliusz Słowacki. The two, now both revered as "sages", did not particularly care for each other, even though the younger Słowacki had a high regard for Mickiewicz. In fact, in one of Słowacki's poems he wrote, addressing Mickiewicz: "Farewell! We part not as foes, but as gods, opposite on their respective suns."

I think Infeld could have written the same words about Rubinowicz. (He wouldn't mind at all referring to himself as a god — no false modesty there!) Both Infeld and Rubinowicz brought to Polish theoretical physics the excitement of world class physics research of their days: Rubinowicz from his collaboration with Arnold Sommerfeld in Leipzig, and Infeld, from his work with Albert Einstein at Princeton. And just as Mickiewicz and Słowacki are justly considered the greatest Polish poets, all of the differences in their creative temperaments notwithstanding, so should both Rubinowicz and Infeld rightly be recognized as the founding fathers of the Warsaw school of theoretical physics.

But this year's anniversary belongs to Infeld, so on to Leopold Infeld, as I remember him. I will talk about Infeld as a teacher and a school builder.

* Presented at "The Infeld Centennial Meeting", Warsaw, Poland, June 22–23, 1998.

I will also talk about him as a writer. I will then discuss one portion of his scientific output that is not widely known but that played an important role in my own professional development. And I will also say a few words about Infeld as a political figure.

2. The teacher

I was a student of telecommunication engineering at the Warsaw Technical University when I heard that Professor Infeld was teaching a course in Electromagnetic Theory for physics students at the University of Warsaw. At the time, it was almost unheard of for Technical University students to take classes at the University of Warsaw. Still, EM theory was my favorite subject and the fame of the newly arrived Professor was such that I could not resist the temptation. I decided to just go to Infeld's class, sit in the last row and try my best not to be noticed ...

Infeld was an inspired, and inspiring, teacher. Lecturing mostly without notes, he would meticulously cover the blackboard with calligraphic formulas. He used tensor notation — at that time a novelty to me. (Infeld liked to quip that mankind can be classified into two categories: those who knew what a tensor was, and all the rest; "and — he would add — I don't much care about that rest.")

Perhaps the most striking aspect of Infeld's lectures was the constant dialog in which he would engage his students. As I found out in later years, this technique was not unusual in the West, but I had never before encountered it in Poland. Thus, every now and then he would interrupt the lecture, challenge the audience with a question and expect an instant response. Occasionally he would address the question not to the general audience, but to a specific individual: "And you, sir, what do you think the answer is?"

In most cases, the participants in the dialog were the few brightest students, all sitting in the front row. (They are all professors now.) Hiding in the back of the room I felt well shielded from being called to answer a question. And I was too scared to volunteer an answer even when I thought I knew it. But on one occasion I just decided to go for it. Infeld derived a formula, the implication of which should have been obvious (for the life of me I can't now recall what it was). He then turned to the class and asked: "Who is not surprised by this result?". There was a silence. Half paralyzed by fear I raised my hand. By then Infeld knew my face as that of an ever-silent backbencher. He turned to me with some amusement and quipped: "You? Must be, *nothing* can surprise you anymore!" I then gave him my explanation to which he just said "Very good!". I was on cloud nine.

Infeld took his teaching very seriously. Those of us who have ever taught classes know how much effort it takes to prepare a well-organized lecture (and deliver it without notes). But, in addition, Infeld had a very special gift: He knew how to present complex problems in the simplest of terms. He liked

to say that there are two kinds of teachers: those who, as they lecture, seem to be saying to the audience "Just look how smart I am!" and those others who seem to be saying "Just look how simple this is!". Infeld justly prided himself in belonging to that latter category.

3. The school builder

Nothing mattered to Infeld more than to spot gifted young students and to nurture their professional careers. He certainly knew how much he himself had benefited when he moved from the provincial city of Lvov to the world centers of science. Perhaps mindful of that, he considered it most important for promising young physicists to do postgraduate work abroad, preferably in the West. At the time, travel to any of the countries of "rotten capitalism" was not only officially discouraged, but it was an impossibility for anyone other than dignitaries on official missions. Another problem, of course, was the money: At that time, foreign currency was simply not available in Poland. Infeld used his prestige and his considerable influence to impress upon the powers that be the need of sending young Polish theoretical physicists to the West for postgraduate studies. He then used his very broad connections in the Western world to secure for them the post-doctoral fellowships needed to support their studies. I think it can be stated with confidence that theoretical physicists were among the first, if not *the* first, scientists in Poland to be allowed, in numbers, to travel to the West, thus breaking the isolation imposed by the regime. And there is just no question in my mind that the credit for this goes directly to Professor Infeld.

In choosing the young people he would be sending abroad, Infeld was quite broad-minded: the candidate wouldn't have to be Infeld's "own" graduate student. He or she wouldn't have to work in any pre-determined field of theoretical physics, as long as the work was in the forefront of scientific research. In making this judgement, Infeld relied on his exquisite taste for good science. (That taste was very much in evidence at our Thursday theoretical physics seminars; Infeld amazed many of us by asking the speakers pointed questions on subjects far removed from his own field.)

As a base for his school building, Infeld established at the University of Warsaw the Institute for Theoretical Physics, of which he became the first Director. In this role he shone as a big-time research manager. His management philosophy was simple: "Bring in good people and stay out of their way." It worked.

The results of Infeld's farsighted strategy were not long in coming. In the late fifties and early sixties Warsaw became a thriving center of theoretical physics, hosting visits by leading theorists of the time, including Homi

Bhabha, Richard Feynman, Vitali Ginzburg, Robert Marshak, Roger Penrose, Abdus Salam, Igor Tamm, Victor Weisskopf, and many others. And Warsaw theoretical physicists became increasingly sought after at major research centers throughout the world.

4. The writer

Leopold Infeld enjoyed writing. Most of his literary output was in English. (He would remark with mocking modesty that in the history of world literature there were two Polish writers who wrote in the English language; the other one was Joseph Conrad.) As a translator of two of his books I had the opportunity to admire from up close the mastery of his literary craft: short sentences, rhythmic cadences and, above all, utter clarity of exposition. "The Evolution of Physics", co-authored with Einstein, is a true masterpiece. It set a standard for generations to come on how to popularize cutting-edge science. The other book, "Albert Einstein", pays a scientific homage to Infeld's teacher, collaborator and benefactor.

But popular science was not the only, and perhaps not even the most important, realm of Infeld's writing. Clearly fascinated by the subject of a young mathematical genius who was forced to fight the evil forces of the outside world (any autobiographical allusion there?) he wrote "Whom the Gods Love", a biographical novel based on the tragic story of Evarist Galois. I read it well before I ever met Infeld and count it among books that influenced me greatly.

And then there is "The Quest".

Infeld's most personal, autobiographical book was written in Canada at a time when the author probably never contemplated that one day he might be returning to Poland for good. So, the book is very frank, and occasionally quite unflattering, about some of Infeld's Polish acquaintances. While they are not identified by name, each is assigned a capital letter, making the book into a very realistic *roman a clef*. Decoding the *clef* became a favorite pass time for Infeld's friends and, I imagine, a bit of an obsession for those not favorably depicted. After his return to Poland Infeld did not boast about this book. As far as he was concerned, the fewer people knew of it, the better. I first learned about "The Quest" in the late fifties from Felix Pirani. When Felix found out that I hadn't read it, and that it was absolutely unavailable in Poland, he volunteered to get me a copy. So he did.

By that time I had already translated "The Evolution of Physics". I had every reason to believe that Infeld liked the translation. I also felt that he sort of liked me personally. So one day I came to his office, a book in hand, and asked for an autograph. "But of course" said Infeld, obviously assuming that I brought with me a copy of "The Evolution". Then he looked at the title: It was "The Quest". Startled, Infeld asked: "Where did you

get this book?" I didn't want to get poor Felix in trouble, so I mumbled something about "friends". Infeld took the book and wrote on the title page: "To my colleague Ryszard Gajewski, with a request not to show this book to anyone." He underlined the "anyone".

Why am I telling the story of one autograph in such detail? Because years later, in 1967, the Polish security police came to search my apartment. It was an extensive and very detailed search. They went through every letter, every note, and every book. And when the search was over, they took away boxes of stuff they considered suspicious. Among the items they took was the autographed copy of "The Quest". Clearly, they thought, if Infeld did not want the book to be seen by "anyone", some sinister secrets must be lurking there. And learning other people's secrets is, by definition, the business of any secret police. How disappointed they must have been to find out that all there was to it was a bunch of juicy gossip, understandable to only a few.

And, no, to this day I have not recovered my book! As a mathematical physicist might put it, the ways of the secret police are invariant under political transformations ...

5. The electrical engineer

I did my master's thesis under Professor Rubinowicz. It was on the subject of pulse propagation in electromagnetic waveguides. As I was looking for a topic for my Ph.D. thesis, Professor Infeld brought to my attention a paper he published while in Canada. It was on steady-state radiation of a dipole placed in a waveguide. He explained that what motivated him to work on this subject was its relevance to radar technology; he wanted to make a contribution to the allied war effort. He gave me a reprint. The work was simple, elegant and, I now believe, much ahead of its time. Radiation from a dipole placed in a perfectly conducting waveguide of rectangular cross section was represented as equivalent to the radiation in free space from an infinite array of dipoles formed by the original dipole and its consecutive reflections in the waveguide's walls. The problem was reduced to summing up the contributions from the infinite set of dipoles. Eventually, my own thesis described the transient radiation of a dipole inside a waveguide, thus combining the two approaches, that of Rubinowicz with that of Infeld.

Of course, these days theoretical physicists do not work on waveguide problems; those are considered the domain of electrical engineers. Also, nowadays, nobody would treat a practical problem analytically. Using available software, and with enough computing time, one can calculate the radiation of any antenna in the presence of conductors of any shape. (That is, incidentally, very close to what my company, WaveBand Corporation, does for a living!) But it should be noticed that Infeld's infinite array of in-phase

dipoles can be viewed as a precursor of the phased array antenna, now commonly used to steer beams of electromagnetic radiation. The difference is that the phased array is finite, and that its dipoles do not radiate in phase.

6. The political figure

Infeld moved from Canada to Poland at the height of the cold war. In those days, such a move was by itself a powerful political statement. No wonder that the Polish communist party and the government decided to make political hay out of Infeld's move. In that Infeld was a willing participant, sometimes enthusiastic, sometimes less so.

I believe that in accepting the political celebrity status that was offered to him, Infeld, quite consciously, struck a Faustian bargain. He agreed to allow his name to be used by the communist propaganda, especially in the international arena. In return, he was given the status and the resources necessary to promote the careers of promising young theoretical physicists. And if there were some perks of power thrown into the deal, he didn't mind them at all. Thus, he thoroughly enjoyed having on his desk a "government phone", allowing him to dial directly every dignitary of the communist establishment.

I did not talk politics with Infeld when he was at the height of his political power. I did toward the end of his life. He was utterly disillusioned with the regime, disappointed in its policies towards science and culture, disgusted with the raging official anti-Semitism. Despite failing health, and at a considerable personal risk, he was willing to publicly join in major initiatives protesting the policies of the government. Those initiatives were the precursors to the formation of the Worker's Defense Committee which, in turn, was the precursor to Solidarity. And the rest, as they say, is history.

7. Conclusion

I want to end these remarks on a very personal note. Looking back on my life I can think of three, maybe four, persons who influenced me most, made me — for better or for worse — who I am today. One is my late Father. Another, without question, is Professor Infeld. He unveiled to me the beauty of Relativity. He taught me how to teach. He taught me how to invest in young talent. He helped launch my professional career as a physicist. But there is one particular event I will never forget: In 1967 I was detained for 24 hours by the security police. Family and friends were terribly worried about my fate. As soon as I was let go, I went to the Institute. As I entered, Infeld saw me in the hall. He didn't say a word, just approached me, embraced me and kissed me on both cheeks.

Yes, to me, and to many others, he was like a father!