ANDRZEJ BIALAS: SOME SHORT STORIES

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Dedicated to Andrzej Bialas in honour of his 80th birthday

In anecdotal fashion, I discuss some of the contributions of Andrzej Bialas to science and the education of young scientists.

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1. Some physics

This talk is for the celebration of the 80^{th} birthday of Andrzej Bialas. As such, this talk will be mostly serious.

I met Andrzej Bialas for the first time at Quark Matter Formation and Heavy-Ion Collisions organized by Helmut Satz in Bielefeld, Germany, in 1982. Andrzej gave a talk about particle formation in high-energy hadron–nucleus collisions [1]. This meeting was among the first where ideas concerning possible experiments for ultra-relativistic heavy-ion collisions were seriously discussed.

A few years before, I had estimated the energy deposition in ultra-relativistic heavy-ion collisions [2], and Andrzej's work on formation time and hadron multiplicities were a crucial ingredient [3]. Formation time of hadrons was needed to understand in what space-time region matter was formed, I also had needed to understand the wounded nucleon model, as this provided an estimate of the multiplicities of produced particles. At that time, there was no data on ultra-relativistic heavy-ion collisions, so the mutiplicities of produced particles were based on theories tested for proton–nucleus collisions. The work of the Polish theorists Czyz and Bialas [3], and the experimentalist Busza [4] and Bjorken [5] provided a deep understanding of proton–nucleus collisions. The wounded nucleon model remains a viable theory which is correct and useful now, 40 years after its invention.

I got to know Andrzej at Bielefeld, and invited him and Krzysztof Redlich to a meeting I had arranged in Seattle in 1983. I do not know how Andrzej got to the meeting but I know how it worked for Krzysztof. At that time, there was very little money for travel, and even without money it was difficult to get permission for travel. When Krzysztof was given permission, he received a round trip ticket to Montreal, Canada and almost no travel money. Somehow the authorities had heard that Montreal was in Canada and Seattle is close to Canada so a person with some initiative could get to Seattle, and in any case LOT flew to Montreal but not Seattle. Krzysztof told me that when he was given the ticket and permission, it was such a rare occurrence that one could not turn it down. He arrived in Montreal, heard some people in the airport speaking Polish and they lent him the money for a ticket for the roundtrip fare from Montreal to Seattle. In Seattle, he arrived at night, somehow found his way on public transportation to the University, a janitor let him into the physics building and helped him find my phone number. Late in the evening I went to the University picked up Krzysztof and put him up in my home until the meeting began in a few days. I had not even known that Krzysztof was able to come to the meeting.

2. Some fun

My friendship with Andrzej has drawn me and many others to attend the wonderful meetings he and his colleagues founded at Zakopane. Through these schools I met many good friends, learned many new concepts and developed new ideas. The Kraków School of Theoretical Physics had its origins with Andrzej and his colleagues from the Jagiellonian University. The School is a place where one enjoys the company of good scientists and the beauty of the Tatra Mountains. During the time I first started going, Zakopane was a place where scientists from Poland, the U.S., Western Europe, Eastern Europe, Russia and Asia could all meet. It was almost unique in that way. Given how hard it was to travel for scientists from Russia and Eastern Europe, this meeting played a very special role. At the time I began attending the schools, Zakopane was a quiet mountain town, and the trails in the mountains were not full of people. I fondly remember the first meeting, and my wife Alice and I with a group led by our Polish colleagues, climbed to the Giewont, and sitting under the cross enjoyed the incredible view.

My first visit was shortly after the crushing of Solidarity. It was a very dark time, with little in the shops. Alice was absolutely amazed with how well our Polish friends took care of us, and we grew to really love the Polish soups, and the comradery around the dinner and lunch tables. Although resources were scarce, personal kindness and intellectual excitement about science and politics was abundant. I met my good friend Atsushi Nakamura at this meeting. I was totally amazed by this lone Japanese physicist who

had read much of the history of Poland, and while in Kraków and Zakopane knew all of the places of historic interest. Years later, while Atsushi, Alice and I were attending the Zakopane meeting, Alice heard wonderful music, and she searched out its source discovering Atsushi playing the panpipe. We found out he is considered one of the top two panpipe performers in Japan. He later played his panpipe at the party held for the Zakopane meeting.

I also became good friends with Michał Praszałowicz. During the meeting, Michał one night went to town and come back with cases of Żywiec beer and I think also some Pilsner Urquell. Students and professors alike sat late into the night enthusiastically exchanging stories and ideas, and drinking a lot of beer. I do not know how Michał got the beer, and perhaps it is better not to ask too many questions. (Michał has recently explained to me how he was friends with an owner of a local store, and she supplied beer for the meeting for many years.) I remember also that Michał was able to find almost limitless supplies of Russian champagne at a meeting we attended in Leipzig, Germany. He is indeed a talented man.

I remember Andrzej Bialas would have his famous Polish lessons during the meeting. I think that years lesson was about the many possible meanings of *nie ma*. It was appropriate for that time, and reflected the incredible ability of Polish friends to turn a very difficult situation into a funny joke. We learned phrases such as:

— *nie ma piwa*: there is no beer, (but there is always beer);
— *nie ma wyjścia*: there is no exit (that is an all too true statement about politics);
— *nie ma głupich*: here is no one that stupid (but of course there was, but he was not named).

The next time I went to Zakopane it was 1988. The communists were still in control but their influence was waning. I had to return to Warsaw with my wife Alice on the night before the local elections. Many people were required to return home to vote. The train was completely full of drunken people, and there were campaign handbills all around. The handbill had on one side a picture of the candidate and on the other a description of what the candidate would represent. The handbills were about the 6 cm by 10 cm. The day after the voting took place, I admired the election officials very much. The handbills were made just the right size to fit into the toilet paper dispensers, providing an ecologically sensitive and politically correct solution to the perennial shortage of paper at that time. I estimated there would be no shortage of toilet paper in Warsaw for several weeks.

I think it was at that Zakopane meeting that Andrzej gave us a lesson about selling and buying goods in the Polish newspapers. Anything of any value was at that time bought and sold in foreign currency. It was at that

time illegal to say that you were willing to buy something with foreign currency. So it was disguised by a phrase such as: "Person recently returned from abroad wishes to buy a refrigerator" meaning the buyer would pay with Dollars or Deutschmarks or Swiss Franks. Andrzej read a few examples of such ads and ended with one that simply said "Person partially returned from abroad wishes to buy..."

3. Some things serious

Although Andrzej has a wry sense of humor, he is a serious man with strong ties to his family and religion. I remember a conversation we had at one Zakopane meeting about truth. I was arguing that truth is an abstraction, never complete, since it is scientifically defined as those things that have not been falsified. There are, of course, an infinite number of ways one can imagine to falsify a concept, and therefore truth is an abstraction. Andrzej thought little of this sophistry. He believes that there are true things, and there is an absolute concept of truth.

That conversation forced me to re-evaluate many things, and to understand that scientific concepts are quite different from beliefs. As a young scientist, I had convinced myself that the only concepts I could rely upon were those based on science. I began thinking about all the things in science which we believe that are incapable of falsification. We believe there are simple underlying laws of nature that may be expressed in elegant terms by mathematics. We believe that all phenomenon in nature may be ultimately described by such laws. We believe the laws of nature to be immutable. These concepts are all abstractions and not falsifiable, yet most of us believe them strongly.

Very important in all of this is the predictive power of scientific laws. Who cannot be in awe of the predictions based on quantum electrodynamics for $(g-2)$ of the electron and muon? We all believe that laws of physics can make predictions, yet we also know we have no means to scientifically demonstrate that this should be so. In this sense a scientific law is transcendent over the phenomena from which it is abstracted.

But having a set of beliefs that are very strong and not scientific, one also has to admit that there are many other areas where belief is of fundamental importance, and ultimately how little of what we deeply believe is rational and scientific. Sometimes rationality serves only as a way of evaluating and comparing beliefs. Rationality is also very powerful in demonstrating when concepts are not true, and sometime wrong concepts can disguise themselves as beliefs, even though they are demonstrably wrong. One can understand the futility of finding an absolute set of beliefs, but, at the same time, being

respectful of the universality of many of them. Perhaps someday we might have a language like mathematics or logic that can evaluate beliefs with the same strength we now can abstract truth from falsifiable concepts.

There is no doubt something much deeper in all of this that is tied to how we conceptualize the simplicity of nature, our consciousness, existence and our demise, but this is much more personal. It has been the subject of many religions for a long time.

4. Oh my God: Andrzej is 80

So Andrzej, how did we get so old? Are we like the typical attendee at a 50 year school reunion who is shocked and surprised to see all of the old people there? Or do we accept this as the natural course? Perhaps we can take some comfort in being better able to think about ourselves and our friends with a balanced perspective? Do we learn to accept strength and weakness as a Yin and Yang, as different manifestations of the same essence? Or are we simply just getting old, and comfort ourselves with philosophical nonsense?

For you, I think there is great comfort in the people whose lives you have positively affected. I know this from the young scientists you have trained. You made physics thrive in Poland in the difficult and unfortunate times. You have fostered strength of character and intellectual honesty in the young scientists you have influenced.

This talk was given to celebrate the 80^{th} birthday of in Kraków, Poland, July, 2016. My wife and I thank Andrzej for the friendship and hospitality he has given to both of us during many visits to Poland, and most important, for his friendship. I gratefully acknowledge Michał Praszałowicz, who organized this meeting, and invited me to give this talk. This manuscript has been authorized under Contract No. DE-SC0012704 with the U.S. Department of Energy.

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