

**A TRIBUTE TO  
PROF. DR HAB. ANDRZEJ HULANICKI**

EWA DAMEK

Andrzej Hulanicki was one of the most distinguished Polish mathematicians of the second half of XX century. He was a member of the Polish Academy of Sciences, as well as an author of over eighty original research papers, which have brought him recognition both in Poland and abroad.

In the 1930s the Polish mathematical school was one of the top in the world. World War II, the post war isolation, the death or emigration of many mathematicians has changed this status. As soon as it became possible, in the second half of the fifties, Wrocław mathematicians and other scientists started to travel both to the West and the Soviet Union, in order to undo the isolation of Polish science.

The British Council offered stipends that allowed many to do this. With the aid of such a stipend Andrzej Hulanicki spent the years 1959-60 in Manchester, where there was a very good school of infinite groups. This was while Andrzej was pursuing his Ph. D. in the area straddling algebra, set theory, topology and measure theory. His experience from Manchester was most valuable to Andrzej. He was one of Wrocław's best young mathematicians and found himself in a place where nobody was interested at all in Poland's mathematics. Andrzej quickly realized what it means to be from a mathematical backyard. Since then he devoted his whole life to pull Wrocław out of this backyard. To do that he constantly pursued topics that were in the center of mathematical interest, and kept bringing to Wrocław mathematicians who talked about these subjects.

SCIENTIFIC RESEARCH

In Manchester, Andrzej learned well the theory of infinite non-abelian groups and the basics of harmonic analysis. In 1963 he spent 3 months in Moscow, which at that time was one of the most respected mathematical centers in the world. The theory of representations of Lie groups was a leading research subject there at those times. In this atmosphere one of the basic results concerning amenable groups was established by him: *every unitary representation of a locally compact group is weakly contained in the left regular representation if and only if the group is*

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Translated from the Polish original by M. Paluszyński and G. Weiss.

*amenable*. This theorem has become classic and is probably Andrzej's most often quoted result.

In 1970 Andrzej Hulanicki went to a congress in Nice, where he heard Elias Stein who was laying the foundations of analysis on nilpotent groups. This analysis, which was initiated with the representations of semisimple Lie groups in mind, has developed into a powerful theory, which has been supporting researchers for more than thirty years. Applying Andrzej's experience in the area of harmonic analysis on groups to these new topics was one of the best moves in his career: Functional calculus has emerged.

In 1981 Andrzej Hulanicki traveled to Chicago and St. Louis. In St. Louis he learned real analysis and in Chicago he met Eli Stein again, where he showed him his results in functional calculi. Stein received the subject enthusiastically. Their joint result was never published individually, but entered into Folland's and Stein's book "Hardy Spaces on Homogeneous Groups" as a separate chapter. This result has inspired numerous mathematicians, some of whom have obtained results Andrzej could not have even imagined. It was always like that with him: having a good idea which is a starting point for interesting investigations, which by far outreached what seemed possible initially.

In the beginning of the eighties, for the benefit of my Ph. D., Andrzej undertook the study of solvable groups of type  $NA$ . It is an important class of groups acting on classical objects such as *symmetric spaces, homogeneous spaces with negative curvature, homogeneous cones, bounded homogeneous domains in  $\mathbf{C}^n$* . It was a very natural effort. Analysis on nilpotent groups  $N$  was slowly becoming a mature theory, and the  $NA$  groups were the next step. At this time harmonic functions with respect to the Laplace-Beltrami operator were studied using the  $NA$  model. Andrzej suggested researching a wide class of the left invariant Hörmander type operators in the context of the general  $NA$  groups. This brought about a completely new viewpoint — for most of the  $NA$  groups the older methods of symmetric spaces do not apply.

This research area proved to be very rich, and it gave me a chance to stay in the midst of interesting topics. In the beginning of the nineties we thought that it would be a good idea to find an application to our  $NA$  groups somewhere, and Siegel domains fit ideally. R. Penney, whom Andrzej invited to Wrocław, proposed investigating the rather natural topic in this context: Hua operators. We wrote a joint paper with Penny, but soon it became clear that we need to leave the rigid framework of these operators. At that time Andrzej suggested studying a wider class of  $NA$  operators which fit wonderfully with our previously constructed theory of Poisson integrals on  $NA$  groups.

The idea proved to be another hit — by widening the class of operators we made observations thanks to which D. Buraczewski in 2003

solved the classical problem of the zeroes of the Hua operator system in the case of type II domains. The original problem was formulated way back in 1958. That was his Ph. D. thesis written under my supervision and distinguished by the Prime Minister's prize in 2003.

When the subject of Siegel domains slowly came to an end, in 2002 Andrzej invited a French probabilist Y. Guivarc'h, and immediately after this the  $NA$  groups reappeared. We started practicing affine recursions on them, and as a result, Dariusz Buraczewski gathered material for his habilitation. Andrzej's final paper, joint with Buraczewski, Guivarc'h, Urban and myself has just been accepted for publication.

### CONSTRUCTING A RESEARCH CENTER

In his pursuit of best research topics Andrzej Hulanicki not only travelled to good centers, but also methodically brought to us the best experts from abroad. Regular harmonic analysis conferences commenced in 1972 and were organized every two years, with the exception of the martial law period. The last conference, organized by Andrzej, took place after his death, in April 2008. Anyone, aged at least 45-50 years can imagine what it meant to organize such conferences in communist times, when communication and telephones all worked poorly; moreover conference centers had no idea how to deal with foreigners. Andrzej assigned tasks among his students and infected all of us with his unequalled enthusiasm. These conferences were very warm — warmth was the one thing we could offer our guests with no problem. So they kept coming — even the best. We had a Fields medalist.

Thanks to his contacts abroad Andrzej was able, as early as the seventies, to arrange for his collaborators to travel abroad for extended stays. These were of paramount importance for our mathematical development, but also have helped to put away money, for example for a flat. From among a few dozen who were dispatched abroad, all have returned, except for two. We returned, because we had a place to return to: a good, lively, developing harmonic analysis center, and its leader, always full of new ideas, full of energy, which we, the youngsters, could only envy.

When I was younger I often wondered about what sense the things I was doing meant. Watching Waldemar Hebisch — a student of Andrzej — obtain his fundamental results for the heat kernel, competing with the Paris school, which was the best at the time, I came to the conclusion that if it is worthy to practice mathematics at all, then it is worthy to do it in Wrocław. The center is good enough.

In 1987, when I departed for the U.S. for my first visiting position I had to (as everyone else) promise Andrzej that I will return. He told me then: "If you do not return, in twenty years there will be another Ewa here, and no one here to help her". "Another Ewa" is Romek,

Bartek, Darek, Monika, Julek, Mariusz. Had Andrzej not returned from Seattle some forty years ago, there would be no Waldek Hebisch.

He knew how to formulate good questions, which always stimulated new, interesting research. He explained to us that it is not only what mathematicians do in Princeton that matters. A good second league also counts. Numerous times he has changed the area of his research trying to keep up with the development of mathematics, passing from mature theories to new ideas, which he generously disseminated among his students. He was the advisor of seventeen Ph.D.'s, he has several mathematical grandchildren, and four grand-grandchildren (A. Hulanicki — T. Pytlik — K. Stempak — R. Kapelko, A. Nowak and A. Hulanicki — T. Pytlik — R. Szwarz — M. Zygmunt, A. Kazun). From among his mathematical descendants Płonka, Pytlik, Głowacki, Stempak, Szwarz, Hebisch and myself have the title of a Professor, and Dziubański, Zienkiewicz and Żuk have habilitations.

When in February our government's minister has announced a new policy of concentrating funds on a limited number of prominent centers, purportedly to catch up with the world's science, Andrzej got mad. Not because of the particular assignment of funds, but because of this illusion of the great leap. Only great leaps mattered, disregarding the fact that scientific standing is built through decades, and not through incidental, poorly thought actions. With few exceptions, Polish science belongs to the world's second league, and it is this solid, sometimes very good second league that should be developed. If we did not have a good, second league harmonic analysis group built by Andrzej, we would not be able to make contact with mathematicians who visit us under the framework of the Transfer of Knowledge grant, we would not be able to understand the things they can tell us. You build the kind of science that you can build, you develop the center, maintain contacts, groom the young, and then advances can happen.

Of primary importance is a good seminar. Since I remember Andrzej Hulanicki's harmonic analysis seminar was not only lively, but also mandatory. As any other responsibility it generated the sense of meaningfulness. Not one of us could count on the Master's letter of recommendation if he or she had skipped the seminar. The fact that you do not understand was not a good excuse. Firstly, after few years of not understanding one starts to understand some, and secondly we went a long way so that the young people could, eventually, understand. We were not afraid to ask silly questions, which relaxed the audience wonderfully.

The ability to collaborate and the ability to extract necessary information are very important to mathematics. Success depends on this. Both require certain psychological qualities, like openness, the ability

to act unschematically, the ability to listen, and to keep one's ambitions under control. We do not learn these from books, we learn from our colleagues. I learned from Andrzej.

In the nineties Andrzej Hulanicki was the chief creator of the European programs in our Institute. These were the two Tempus programs, three Harmonic Analysis networks, and in 2004 we were awarded the Transfer of Knowledge program. In the beginning of the nineties our friends in the West offered us access to the networks as soon as it became possible for the Eastern bloc countries. Undoubtedly, this was the fruit of Andrzej Hulanicki's activities throughout the previous thirty years. In 2002 the Université d'Orleans awarded Andrzej an honorary doctorate — a symbolic recognition of the international community for his contribution to Mathematics.

In the past fifteen years Andrzej Hulanicki has supervised a substantial remodelling of our Institute's building adding, among other things, hotel rooms. They brought an entirely new quality: we can now invite specialists for extended stays and fund positions of post-doc type, both of which wonderfully enable us to extend our scientific horizons.

For Andrzej a career was not a thing in itself, it was part of a larger construction, a kind of a by-product. He always explained to me: think about the cause for which you work, things will be easier then. It is 100 % correct. Of course we all pursued our careers, Andrzej cared a lot about promoting the young, but it was always in connection with assuming responsibilities for the group, Institute, the University. In Andrzej's group there was simply no place for unruly ambition.

He usually set the crossbar a little higher than we thought we could clear, but he knew what he was doing. We managed, and we saw that we can achieve more and more. He was a great authority to us. In the Institute people referred to him as the "superchief".

He was uncommonly rational. He despised fears, irritation and exposing bad emotions. Having collaborated with Andrzej for over twenty years I have learned to be calm and to treat problems as something natural, something to be resolved, and not something to cause "unnecessary irritation". We all talked to him about our problems: mathematical or otherwise. He would always listen, he would always talk, and he would always advise. He would often say things I did not want to hear; we argued, but at the end I knew what I needed to do. The solution came about through this talking. I have not met anyone as open on people, as interested in them, as cordial and as helpful.

He so much wanted to be needed. In January we met on Professor Kołaczkiwicz's trial. Each of us wanted to avoid the traffic, so we both arrived long ahead of time. We sat in the cafeteria. At that time I was writing my opinion about Dariusz Buraczewski for The Prime Minister's award. I did not want to bother Andrzej with that. "Show me what you have written. If you want I can do the corrections." Again

it was like it has always been, like when we were writing the Transfer of Knowledge program application. I wrote the first version, and Andrzej improved the language, and threw in his ideas. I have accepted all his corrections about the opinion of Buraczewski.

I last saw Andrzej on March 12. He had already taken strong medications and did not feel well. I visited him at his house, we talked for 2 hours, he talked how much he wants to be needed, how he suffers because of his weakness. Calmly, manly, with no hysteria. I was saying that the period is rough, but the medication will work, and that he will return to activity; for the moment, he has to weather these bad times.