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HOW I BECAME A BIOPHYSICIST – MY WAY

(Thirty Years of Polish Biophysical Society)

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First of all I need to answer the question if I really did become a biophysicist. To answer this question we should know what biophysics is. In the 21st century the answer to the second question seems simple as there are many specializations, institutes, departments or scientific projects having the word 'biophysics' in their name, so everybody must know what it is. When a group of enthusiasts in 1971 founded the Polish Biophysical Society the problem was even more complex than today, these enthusiasts were biochemists, physicists or biologists. Some of them were concerned with something we call today Medical Physics, like Ignacy Adamczewski, Medical University, Gdańsk. They lectured different subjects at different institutes and were joined by the enthusiasm about the mysterious biophysics. Late and unforgettable Adam Paszewski (Plant Physiology, MCSU, Lublin) suggested that a biophysicist is a person who claims so and can present two witnesses to confirm his/ her claim. Poland is a country respecting formal qualifications and everybody is labeled according to their formal education. About the education of biophysicists I wrote a long time ago in "Problemy" (Frąckowiak, 1967) where I compared the Dutch and American approach. In these two countries it is most important what a given person knows and what they can do and not which faculty they graduated from. In the USA the choice of subjects depends to a great degree on the subject of the thesis and recommendation of the supervisor. In The Netherlands students of different background (physics, biology, and chemistry) could work towards Ph.D. degree in biophysics in the same laboratory and under supervision of the same professor. Of course they had to supplement their knowledge accordingly. Thus, the definition of Adam Paszewski is close to these two approaches. However, in the time of great development of different techniques of measurements (all kinds of spectroscopies and structural studies) and much progress in the computation methods (quantum chemistry methods), this definition can be made a little narrower. It seems that a biophysicist is the person who tries to explain the processes taking place in organisms rather than the person who only describes their properties. The person who uses sophisticated equipment but describes the cell structure is rather a biologist. I am aware that this definition is very subjective. Those who want to go deeper into the matter should read a paper by P. A. Osmólski "Limits of Biophysics or Physics" (1992).

On the basis of the definition of Adam. Paszewski I became a biophysicist, because at the 10th meeting of the Polish Biophysical Society (PTBF) in Lublin, in 1998 I was appointed an honorary member of the Society, so there must have been there at least two witnesses confirming the fact.

The potential Polish biophysicists met, invited by Wanda Leyko, in Uniejów. I met Wanda Leyko at the 21st meeting of the Polish Physical Society (Poznań 1969). I was one of the organizers of this meeting and I gave a plenary lecture on photosynthesis. After the lecture a very nice lady approached me and asked if I would agree to cooperate with her, because, although she worked on other problems, she was very much interested in measurements of polarized fluorescence. I was just about to leave to New York for a few months but we agreed to meet when I was back. The cooperation started and since that time young people from Łódź kept coming to the Cieszkowski Residence where our modest laboratory was located. Soon they were ready to continue measurements in Łódź, but I am proud to say that Wanda Leyko and her students are still my friends. The idea of founding the Polish Biophysical Society emerged at the 2nd national biophysical symposium, organized by Adam Paszewski in Kazimierz on Wisła, March 16th-18th, 1970. The main initiators were

Wanda Leyko (Biochemist, U.Ł., Łódź), Adam Paszewski (Plant Physiology, MCSU, Lublin), Stanisław Przestalski (Physicist, Agricultural University, Wrocław) and Kazimierz Lech Wierzchowski (Biophysicist, IBB PAS, Warsaw).

How come that I joined this renowned group? During the war, when I was a student of the underground high school, working at the same time as a kitchen help in a canteen for German railway workers, I decided to study physics and biology. I was not encouraged by my first results. My tutor (who was also my supervisor in the underground resistance work as a coder in Home Army headquarters of Chief of Staff for Wilno region) Marta Skorko, was of the opinion that biology is simple so she asked me to study a certain book and take an exam with a certain biology professor. This professor was of quite a different opinion and said that without her tutorship I will never be able to pass the exam. Finally I passed the exam with 'good'. After the war I started my education from physics and I realized that I had enough work with one discipline. I came back to biophysics only after receiving my Ph.D. degree. My supervisor, father and boss, Aleksander Jabłoński, suggested that I should test his theory on luminescence of dyes. I was not too enthusiastic about it, but in the meantime I got hold of the book on photosynthesis by E. I. Rabinowitch and I started studying chlorophylls. My supervisor was not very happy and my students were called 'nettles' because they had to collect nettles and work on chromatography. We used to make strange things with the chlorophylls: we studied their aggregation in different solvents, yield of their fluorescence under Stokes and anti-Stokes excitations, polarization of their fluorescence in ordered systems and other strange parameters. We were mainly concerned with the process of the excitation energy transfer – a very important problem in photosynthesis, and we were very cautious with biological interpretations. Finally my Boss broke down and agreed to my habilitation (1964) in the subject related to the chlorophyll studies. I sent copies of my papers to E. I. . Rabinowitch and asked him to allow me to work at his lab in Urbana (Ill.USA). To my surprise he invited me and after the habilitation procedure I left on Batory to the States. E. I. Rabinowitch was a great photochemist – he headed the photosynthetic laboratory after R. Emmerson who died in a plane crush. My new Boss preferred the subject of electron transfer in systems modeling the reaction centers over the studies of whole complex biological systems. His lab was full interesting stuff like cultures of algae and photosynthetic bacteria. The next building hosted a lab of Gregorio Weber, at which I measured polarization of fluorescence of my samples and listened to seminars. I was an eager participant of all seminars and at the seminars in our laboratory I very often reported my results because E. I. Rabinowitch believed that 'ladies first', and then he discussed my results so profoundly that my colleagues were glad they did not have to report their results. Although E. I. Rabinowitch suggested that I could move with him to Albany (NY, USA), after one year I came back to Toruń, but on my way back, to satisfy his wish, I took part in a conference on photosynthesis organized by J. B. Thomas (Utrecht) in 1965 in Holland, at which I reported the results obtained at E. I. Rabinowitch lab. During this conference I met Jan Zurzycki from Jagiellonian University Jan Zurzycki presented a fascinating film showing chloroplasts moving under the effect of light (Frąckowiak, 1966). There were only two of us from Poland. Jan Zurzycki suggested cooperation in a project on photosynthesis. I gladly agreed because I felt that if I wanted to continue the study of photosynthesis I must have some contact with Polish and European plant physiologists. My work in the project proved very beneficial, each year we had a conference in a different country from the communistic block to which some scientists from Western Europe were also invited. Very soon Jan Zurzycki divided the project into two parts and I was appointed in charge of one of them. I started the cooperation with the Institute of Photosynthesis and Soil Sciences, AN USSR (Puszczino), with Hungarian scientists from Szeged, and with German scientists. I very much appreciate the help of A.A. Krasnowskij from Moscow. P. Hoffman (East Germany) rightly called our project "A green island on the Red Sea".

Although Jan Zurzycki formally was not a biophysicists, he indeed worked as one. In 1971 he persuaded me to organise a conference in Kiekrz near Poznań, at which I reported my work on the application of the polarised light in biological studies. You should remember that the Polish Biophysical Society was nonexistent then. However, biophysicists were already there, for instance in Warsaw D. Sugar, whom I met having come back from the USA. When I came back, some most powerful organisation let me know that me and my husbands' work in Toruń would no longer be tolerated, so we moved to Poznań. I got myself employed at the Agricultural University, because I believed that photosynthesis must be important for agriculture. After 5 years of work, after having organized a laboratory and having promoted 5 doctors, the same organization made me leave

again. This time I got to the Poznań University of Technology, where I worked till retirement. The beginning was difficult. The rector asked me if I could lecture in physics, because he heard I was a biologist, fortunately my habilitation dissertation was in physics and I taught physics in Toruń. When I assured him that the photosynthetic bacteria do not pose health risk to the workers, he agreed to employ me. So at that time it was more practical to be a physicists and not a biophysicist. However, I cannot deny good sides of being a biophysicist: for many years I took part in typically biophysical projects coordinated by different centers, e.g. "The effect of physical and chemical factors on the structure and biological properties of macromolecules", the Łódź University, "Physiological backgrounds of plant production"- the Plant Physiology Division at the Polish Academy of Sciences, Kraków, "Mechanism of photosynthesis and photosynthetic productivity" –the Institute of Ecology, Polish Academy of Sciences, and others. Thanks to the projects we could have financed our study or organization of international symposia. After the foundation of the Polish Biophysical Society we could get support also from this organization. The most successful symposia in my opinion were: "Pigment-Protein Complexes in Photosynthesis" (Poznań 1974), "Polarised Light Spectroscopy of Biological Systems" (Kołobrzeg 1980) and "Photobiology and Biotechnology" (Poznań 1989). Among the participants were: G. Paillotin (Saclay, France), M. J. Stillman (London, Canada), J. C. Goedher (Holland), B. Norden (Sweden). I mention these names as these scientists started the long-term cooperation with us which has continued till today and which has proved highly fruitful for our research work. For many years young research workers from Poland (Poznań and Lublin) could work at the Centre of Photobiophysical Research in Rivieres in Trois (Canada). We also had less formal cooperation with some laboratories in England, Canada and the USA, and of course the cooperation with scientists from communist countries.

WHAT WAS THE SUBJECT OF THE BIOPHYSICAL RESEARCH AT THAT TIME?

I should explain that I decided to omit all the titles because I do not remember who and when received the title of professor, moreover, nobody says today Dr Nicolaus Copernicus. Many biophysicists have died, but I will not write about them, because at that time (the 70s and mid 80s) we were all young.

I will start from Poznań, because I know best what was going on there. In the years 1966-1971 I supervised a group of workers at the Agricultural University, studying primary processes of photosynthesis, continued later at the Poznań University of Technology. We studied the interactions between the photosynthetic pigments (chlorophylls, carotenoids) in model systems (polymers, solutions, liquid crystals) and in organisms (photosynthetic bacteria) or their fragments. We used the absorption, emission and photoacoustic spectroscopies of polarized light, we measured photopotentials, we were interested in the processes of excitation energy and electron transfer in photosynthetic systems. The outcome of the study and international cooperation was 24 Ph.D. theses and 8 habilitation dissertations. At present there are four professors at the Polytechnic who started working in biophysics under my supervision. In the years 1978-79 and 1984-86 I was a vice-president and in the years 1986-89, a president of the Polish Biophysical Society. In July 1989, I organized the Meeting of the Society, at which S. Łukiewicz and T. Sarna were elected the president and vice-president, respectively, so the Board moved to Kraków. I cannot give a chronological list of all the cities hosting the Board, not the names of the subsequent presidents. I remember that in the years 1978-80 the president was T. M. Wilczok (Sileasian Medical University), and in the years 1983-86, St. Przestalski (Agricultural University, Wrocław). I hope that on the occasion of the jubilee we will be able to complete these historical data together. In the 80s our journal had some serious financial problems and to save it we founded a cooperative and invested some serious sums in it. The journal at the beginning issued in Polish as "Zagadnienia Biofizyki Współczesnej" appears till today, recently in English and is much better edited. Its title has been changed into "Current Topics in Biophysics" and its excellent current chief editor is A. Dobek (AMU, Poznań). From 15 years P. Jaśkowski has worked hard as coeditor of our Journal. As to our cooperative we went bankrupt and we will never get our money back but on the other hand we hope that the *Current Topics in Biophysics* will soon be included in the list of journals of Institute of Scientific Information in Pheladelphia.

The main subject of the biophysical studies at the A. Mickiewicz University, Poznań, was the nonlinear effects in biologically important molecules and the method used was based on the optical Kerr effect. The outcome was the information on the shape and size of macromolecules and relaxation times in chains of macromolecules. After

A. Dobek's return from Sacley, the studies of photosynthesis at Adam Mickiewicz University in Poznan have flourished.

At the Poznań Agricultural University since 1977 the studies concentrated on chemiluminescence of heme proteins and humic acids (J. Sławiński and D. Sławińska).

At the Medical University in Poznań F. Jaroszyk has started studies of dielectric and pyroelectric properties of collagen and in a different field – investigation on improvement in diagnostics of hearing. Although his acoustic interest formally belonged to the medical physics, F. Jaroszyk has been closely related to the Polish Biophysical Society and for many years he was chief editor of *Current Topics in Biophysics*.

At the University of Economics , the Faculty of Commodity Sciences, the studies concerned spectroscopy of biological molecules (J. Kozioł, A. Koziołowa) (Wróbel, 1985).

In Lublin, at the Maria Curie-Sklodowska University (UMCS), at the Plant Physiology Division, (A. Paszewski, T. Zawadzki, A. Teske) the study concentrated on electrophysiology of plants: action potentials, relation between biopotentials and plant metabolism. T.Baszyński and his group worked on the membranes of the photosynthetic apparatus (interactions between lipids and proteins, reconstruction of membranes).

At the Faculty of Physics at UMCS a research group initially (1967) headed by Jadwiga Skierczyńska, later by J. Sielewiesiuk started working on methods of measurements for plant electrophysiology but later developed original studies of the Langmuir-Blodgett layers, liposomes and the model membranes. The study was certainly boosted by the visits of the members of his group at the Centre of Photobiophysical Research in Trois Rivieres, Canada. At present, the achievements of this group are well recognized and appreciated in the world (W. Gruszecki, J. Siewielesiuk and S. Krawczyk). The biophysical studies initiated by T. Baszyński were continued at the Lublin University of Technology (E. Śpiewla –the effect of mechanical and chemical factors on plants) and at the Agricultural University at which H. Gawda studied submicroscopic structure of cell walls in plants and the influence of different factors on this structure (Paszewski & Śpiewla, 1986).

At the Biophysics Laboratory at the University of Łódź, Wanda Leyko, one of the founders of the Polish Biophysical Society, supervised studies on lesions of macromolecules (haemoglobin and DNA) and cell membranes (mainly erythrocytes and lymphocytes). Her group studied the effect of ionising radiation on the appearance of free radicals, developed the application of EPR and the method of fluorescence markers. The studies were later continued by former W. Leyko's students: G. Bartosz, M. Koter and M. Bryszewska. The University of Łódź is the host of symposia on free radicals; For instance, in 1998 r the 4-th Symposium on Free Radicals in Biology and Medicine took place there. The results on the role of free radicals in all kinds of diseases and enzymatic mechanisms protecting against the harmful effect of free radicals have bring significant contribution to medical science. In Łódź there were many other laboratories working on biophysics: T. Krajewski (Biochemistry, UŁ) worked on the effect of UV irradiation on the blood cell membranes, Z. Walter studied the effect of physical and chemical mutagens on the genetic material of cells, R. Gondko organised a modern analytical laboratory highly appreciated by everybody working in biophysics. At the Institute of Physics L. Wojtczak worked on the models of transportation through biological membranes. The application of physical methods in medicine was developed at the Medical University, (J. Jatczak), while the work on the radiation cryochemistry (A. Płon-ka) and structural changes in membranes by spectroscopic and structural methods was conducted at the Technical University in Łódź (Cz. Balcerzak). The application of photochromic molecular probes for determination of the liquid crystal structure was the subject of the study guided by M. Kryszczak at the Centre of Molecular and Macromolecular Research, at the Polish Academy of Sciences (Walter & Bartosz, 1986).

At the Agricultural University in Wrocław, the studies, initiated by S. Przestalski, concerned the transportation of different substances through biological membranes or their models. A similar range of problems- experimental study of transportation through membranes, the effect of various factors on membranes and mathematical modeling of the transportation effects was studied at the Technical University (J. Gomułkiewicz) and at the Medical University (S. Miękisz) in Wrocław.

In Olsztyn, at the Physics Department of the Agricultural University, R. Drabent initiated the studies of the spectroscopic properties of flavins, mostly in the model systems (foils, solutions and liposomes) (Siódmiak ,1986).

In Szczecin, till 1986, research work related to biophysics was conducted at almost all universities: Medical, Technological, Agricultural and Pedagogical. The research concerned different problems bordering on biophysics, biochemistry and physiology. At the Department of Anatomy and Embriology of Fish, Agricultural University,

A. Winnicki worked on typical subjects related to the sea, like the effect of magnetic field on the early developmental stages of salmonids, and at the Department of Fish Physiology R. Węgrzynowicz worked on the effect of changes in temperature and magnetic field on physiological processes in fish. Other subjects studied at the Agricultural University included the luminescence of plants and properties of humus substances. The majority of research work in Szczecin at that time was directly related to solving practical problems (Gołębiowska & Puzyna, 1986).

In Kraków biophysical research was conducted at the Institute of Molecular Biology, today named after J. Zurzycki, whose works I have mentioned earlier. The investigations of photosynthesis are continued by St. Więckowski and K. Strzałka. The group headed by S. Łukiewicz studied the protective effect of melanins in the processes of lipid peroxidation, and neoplasmic tumours stained with melanin, resistance of some melanomas to irradiation. They used NMR tomography and EPR combined with electrochemical stimulation of the sample studied. T. Sarna supervised investigation of the properties of melanins, their interactions with different molecules and their biological function.

The works of F. Górski who studied thermodynamics of biological processes and J. Zurzycki and W. Korohoda concerning photobiology certainly belonged to the field of biophysics, though their authors had no contact with the Polish Biophysical Society. At the Medical University in Kraków R Bilski studied changes in electric properties of tissues in different pathological states under certain physical factors. At the Agricultural University the studies concerned different photosensitising substances and natural plant photoprotectors, and problems related to the natural environment protection. At the Academy of Mining and Metallurgy R.Tadeusiewicz worked on theoretical modeling of the functions of the nervous system. The Polish Society of Medical Physics gathered people working on radiological dosimetry and the application of physics in diagnostics and medical therapy, e.g. the application of the Moesbauer effect in diagnostics (A. Hrynkiewicz).

At the Institute of Zoology of the Jagiellonian University worked J. Twardowski, formally not a member of the Polish Biophysical Society but deserving much credit for development of the field as he edited the five volume book 'Biospectroscopy' (Mroczka, 1987).

At the Silesian Medical University, T. M. Wilczok, an active member of the Polish Biophysical Society, worked in molecular biophysics and studied the role of melanins in living organisms.

Warsaw has always been a centre of biophysical research (David Shugar, K.L. Wierzchowski) having a large Institute of Biochemistry and Biophysics of the Polish Academy of Sciences, which can boast of some excellent works on nucleic acids. However, unfortunately, there is no Warsaw branch of the Polish Biophysical Society. Nevertheless, K. I. Wierzchowski has been for many years a member of the editorial board of our journal and both he and Prof. Sugar have expressed great support to the Society. We have been meeting the biophysicists from Warsaw at many meetings and conferences in and out of the country.

In the years 1970-1990 all Polish biophysicists, photobiologists and photochemists worked in cooperation and developed close contacts through meetings organised by different Societies (Polish Physical Society, Polish Biochemical Society, and Polish Biophysical Society).

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