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Meetings with Dorothy

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Dorothy Hodgkin (née Crowfoot) is a remarkable person and an eminent scientist, who has done much for the glory of her homeland, England, and is well-known for her scientific and humanitarian activities throughout the world. Her personal example and extensive contacts have deeply influenced the development of X-ray crystallography of biological molecules in many countries, including Russia.

In the after-war years, John Bernal often visited the Soviet Union in connection with his scientific work and the world peace movement. On these trips he never failed to visit the Institute of Crystallography of the Academy of Sciences. In 1952 he brought Dorothy with him. She was to speak at the seminar conducted by academician A. V. Shubnikov, the founder and the first director of the Institute. What the audience saw was a woman with a beautiful and intelligent face, who was rather awkward at first, but then went on to speak with mounting enthusiasm about her remarkable work on penicillin and vitamin B_{12}. Whisper went among the audience – it was she who was the first to obtain, together with Bernal, an X-ray pattern from a protein crystal (Bernal, Crowfoot – Pepsin, 1934). Since then, scientists from the Institute of Crystallography and other Institutes of the Academy often met Dorothy both in Moscow and Oxford, and enjoyed her constant attention and support. Her small laboratory in Oxford received post-graduate students from many countries, including those from Moscow.

At that time I was engaged mainly in electron diffraction studies, and later in diffraction of X-rays by high-polymer molecules. But by the end of the sixties I became increasingly more interested in biocrystallography: we started investigations of amino acids, peptides and proteins. Dorothy suggested an interesting topic – deciphering the structure of gramicidin S, discovered by Soviet scientists. Without X-rays, by just considering the chemical formula of this antibiotic, she predicted the conformation of this cyclic decapeptide based on the interbinding of hydrogen bonds. X-ray patterns from this structure (very complex for that time) were analysed by Galina Tischenko – a scientist from the Institute of Crystallography, first in Moscow and then for some time in Oxford with Dorothy. But gramicidin defied solution. It was achieved only in 1989 in collaboration with Dorothy's pupils from York University, and the molecule was just as predicted by Dorothy, but instead of being planar it turned out to be slightly twisted.

The triumph of penicillin, and then vitamin B_{12}, made Dorothy famous all over the world. In 1964 she became a Nobel Prize Winner.

I have met Dorothy many times during her visits to Moscow and on trips to England, at the International Congresses and meetings. The reports she presented at biochemical and crystallographic meetings, e.g. at the VII International Congress of Crystallographers in Moscow (1966), were always brilliant. I have often visited her at her old and rather long two-storey cottage in Ilmington, a small village about 30 miles from Oxford. This is how they lived, the furniture served till it almost fell apart, dinner was always announced by a gong, all rooms were overfilled with books. In Dorothy's husband Thomas' study, the table could be reached only by complicated maneuvering through mountains of books piled right on the floor.

I remember how Dorothy, sitting on the old sofa, talked about her family and the way its members rose to the heights of academic career from their rather

ordinary middle-class background – her father was an archaeologist and historian, her husband, an archaeologist too, and Alan Hodgkin – a famous physiologist.

Naturally, their selfless devotion to science was nourished by a powerful intellect, unrestricted by dogmas and paradigms. All the force of Dorothy's mind was directed at what she had set to achieve, once and for all – determination of the molecular bases for life processes. X-ray crystallography became a means to this end. One cannot fail to stress her unvarying persistence in following her goals. As early as 1935, Dorothy started the study of insulin structure. Still, in the world of science, being the first to begin does not mean you will be the first to achieve something. The first structure determinations of proteins already appeared, while the structure of insulin remained unresolved. And then at the VIII International Congress in Stony-Brook (USA, 1969) Dorothy came up to me, her face glowing with excitement: 'Did you hear the news? Insulin is solved'. Everybody was glad for her success, which she shared with her pupils, many of whom have now become eminent scientists. At present many modifications of this remarkable molecule have been studied in different laboratories of the world (first of all, in England) by the method of X-ray diffraction, to a very high resolution of 1.0 Å.

Once after the appearance of the remarkable works of Kendrew and Perutz on myoglobin and hemoglobin, I asked Dorothy if one could make generalizations on the structure of protein molecules. 'No', she replied, 'it's not time yet'. And added thoughtfully: 'If we had at least ten structures, then we could probably make some conclusions'. And what can we say now, when thousands of such structures are deciphered? Basically, the answer is the same – we must go on working. Interaction of proteins with other biomolecules, the mechanism of their action, protein engineering, fighting disease at the molecular level, computer designing of drugs – such are the new problems that have sprung on the basis of earlier solutions. The collective wisdom of the world scientific community points to the directions in which the efforts and finances of their governments and companies should go. While in the first years after the Second World War there were only 5–7 biomacromolecule structure laboratories in the world, now their number exceeds one hundred. Physics was traditionally considered the queen of sciences, but will she probably have to share the crown with molecular biology in the 21st century?

I became convinced soon that Dorothy not only has a deep and astute mind, but a character full of firmness and determination. Her devotion to science is selfless, and she completely abandons herself to work. Her contacts with scientists in England and many other countries, like China, USA, Holland, Sweden, Russia, were most extensive. This has always kept her in good form, scientifically, and ensured the support and assistance of scientists in her work.

Science is definitely Dorothy's true calling, but she is also a humanitarian and a prominent public figure. Her attraction to ancient civilizations of the Orient and Africa is well-known. The contacts between the Russian and English crystallographers, initially established mostly through Dorothy's efforts, grew increasingly wider and firmer. We have traditionally close ties between the scientists from the Institute of Crystallography of the Russian Academy of Sciences and crystallographic laboratories in London, Oxford, York, and Cambridge.

The world's estimation of Dorothy's achievement brought her many awards and honors. In 1976 she was elected foreign member of the USSR Academy of Sciences. In 1982 she received the highest award of the USSR Academy of Sciences – the H. V. Lomonosov gold medal. She came to Moscow for the official ceremony and made a brilliant report at a session of the Academy.

In 1969–1975 Dorothy was the President of the International Union of Crystallography, and I, member of its Executive Committee. I discovered then that for all her kindness, Dorothy is an excellent organizer who could pass important resolutions among her not always agreeing colleagues. In 1976–1988, Dorothy was the President of the Pugwash Movement of scientists for peace, and worked in close contact with her Soviet colleagues.

In 1988 a delegation of the USSR Academy of Sciences came to England on the invitation from the Royal Society and was then received at 10 Downing Street by Prime Minister Margaret Thatcher. After talks at the first floor assigned for official receptions, we were led to the second floor that housed her study and a collection of portraits and sculptures of famous figures from England's history and science (the third floor, as it is well known, is the Prime Minister's private quarters). Above her writing table there was an excellent water-colour of Dorothy Hodgkin. In her college years Thatcher had been her student, but had then preferred a political career to that of scientist. However, even as a Prime Minister she did not break her contact with Dorothy.

There is another excellent portrait of Dorothy Hodgkin at the National Portrait Gallery in London. It shows Dorothy in the midst of scientific research: her wonderful blue eyes shining with excitement, and her hands raised to a model of some complicated structure.