

## An outstanding scientist and great humanist

*An obituary of Dorothy Crowfoot Hodgkin by M. Vijayan*

Professor Dorothy Crowfoot Hodgkin, who passed away on 30 July 1994, at the age of 84, was an outstanding scientist, great humanist and above all a splendid human being. Among her peers in the scientific community, there would have been others who were respected as much as Dorothy was but perhaps none who was loved more than she was.

Dorothy was born on 12 May 1910, in Cairo where her father, John Crowfoot, was then serving with the Egyptian Ministry of Education. She had most of her secondary education at Sir John Leman School in Beccles, Suffolk, England. Subsequently, she joined Sommerville College at Oxford in 1928. At a time when very few women studied science subjects, she took her basic degree in Chemistry. It was during this period that Dorothy carried out her first X-ray studies, those on thallium dialkyl halides, with H. M. Powell.

She moved to Cambridge in 1932 to work with the legendary J. D. Bernal for her doctorate degree. It was during her stay at Cambridge that Dorothy was involved, along with Bernal, in recording the first X-ray diffraction pattern from a protein (pepsin) crystal. That indeed marked the beginning of macromolecular crystallography which dominates structural biology today. After returning to Oxford in 1934 she crystallized and X-ray photographed insulin, the second protein to be so studied, all by herself in the mid-thirties. This she reckoned as the most exciting event in her life. She often narrated how she walked around the streets of the town in pure delight the day she developed the first diffraction photograph of insulin. At a time when the solution of the crystal structures of even simple molecules was considered a great challenge, it was an act of great courage on the part of pioneers like her to have taken on protein structures. It took decades for their efforts to fructify, but when they did, the results changed the face of modern biology.

While at Cambridge, Dorothy, along with Bernal, was also involved in X-ray measurements on sterols which she continued in Oxford. She and her associates

determined the structures of a number of steroids including cholesterol, over the years.

During the war years, Dorothy was primarily occupied with the structure analysis of penicillin. As is well known, penicillin, the first of the antibiotics to be used, was discovered in 1929 by Alexander Fleming and isolated by Howard Florey and Ernst Chain in 1941. The structure of this vitally important compound was obscure until it was established by Dorothy and her colleagues through monumental crystallographic ef-



Dorothy Crowfoot Hodgkin (1910–1994)

forts in 1945. Subsequently she went on to study derivatives of penicillin and related compounds such as cephalosporin.

The structure solution of penicillin, when it happened, was indeed a triumph of X-ray crystallography in Dorothy's hands. But still greater things were to come. In the late forties she began to work on vitamin B<sub>12</sub> which prevents and cures pernicious anaemia. Very little was known about the chemical structure of this large organic molecule at that time. The determination of this structure, and those of several related compounds by Dorothy and her colleagues is considered to be the most brilliant application of the X-ray crystallographic approach. She was awarded the Nobel Prize in 1964 for this

achievement.

In addition to cholesterol, penicillin, vitamin B<sub>12</sub> and compounds related to them, the structures of a large number of other important compounds have been determined by Dorothy and her colleagues at Oxford. During all this endeavour, her first love, insulin, continued to receive her attention. The work on insulin gathered momentum in the sixties and its complete three-dimensional structure was determined in 1969. According to Dorothy, her joy when the structure was solved during that summer was second only to that she felt when she beheld the first X-ray diffraction photograph from insulin crystals in the mid-thirties. The work on insulin has been a saga of perseverance. The other members of Dorothy's insulin group when the structure was finally solved (Eleanor and Guy Dodson, Tom Blundell and myself) were not even born when she started her work on it! Her scientific endeavours after 1969 have been primarily concerned with the refinement of the structure of insulin and studies of its many forms.

The honours, awards and degrees she has received are too numerous to be listed here. The Nobel Prize has already been referred to. She was elected at the early age of 37 to the Royal Society which conferred on her several medals over the years. She has been keenly interested in education and was the Chancellor of the Bristol University for about two decades. She was enthusiastic about popularization of science and was the President of the British Association for the Advancement of Science during 1977–78. She took keen interest in the development of crystallography and the well-being of crystallographers. She served as President of the International Union of Crystallography during 1972–75. She was honoured by the Order of Merit, the highest civilian honour in the United Kingdom, in 1965. She was only the second woman, after Florence Nightingale, to receive this honour.

An important feature of Dorothy's research endeavour has been its international character. Of the hundred and odd scientists who have worked in her laboratory



at different times, only about 25 came from UK. There were about 20 from USA, 10 from Australia, 7 from India (K. Venkatesan, B. Basak, S. Ramaseshan, M. A. Viswamitra, Kalyani Vijayan, M. N. Sabesan and myself), 6 from Canada and 5 from New Zealand. The other countries from where her colleagues hailed include Sweden, Switzerland, Italy, Chile, Denmark, New Guinea, Germany, Holland, Yugoslavia, China, Japan, Poland, France, Nigeria and the USSR. The relationship among her and her colleagues has been so close that they virtually belonged to an international joint family presided over by the benign and motherly figure of Dorothy. She travelled widely, helped, advised and encouraged crystallographers and scientists in different parts of the world. She has exerted a tremendous influence on the scientific communities in different countries including India. She visited India several times, delivered the Azad Memorial Lecture in 1973, held the Raman Professorship of the Indian Academy of Sciences and has

been an honorary fellow of the Indian Academy of Sciences.

In addition to her efforts to promote international understanding through scientific and related activities, she has also been seriously involved in the campaign for peace and disarmament. She has been an ardent supporter of national liberation struggles and a champion of the development of the third world. She was elected President of Pugwash in 1976 and continued in that capacity for several years. Indeed, there are only very few who have contributed as much as Dorothy has done, in her own chosen field of professional activity as well as outside it, to promote international understanding and goodwill among different peoples of the world.

It is difficult to adequately describe her legendary achievements, but it is still harder to describe her personality in a few words. She was warm, simple, affectionate and caring. She had a full family life. She married Thomas Hodgkin, a distinguished scholar and wonderful human being, in 1937. They raised three

children, Luke, Elizabeth and Toby. The houses in which they lived in Oxford at different times and their country home at Ilmington, Warwickshire, radiated warmth and hospitality. They kept an open house and the guests included the powerful and the famous, revolutionaries and refugees and their own innumerable students, colleagues and friends. To her students and colleagues, she was a teacher, mother, friend and guide, rolled into one. My wife Kalyani and I had the privilege and the good fortune to belong to this band. To us, she gave her indulgent affection and care in abundant measure.

Einstein said of Mahatma Gandhi: 'Generations to come, it may be, will scarce believe that such a one as this ever in flesh and blood walked upon this earth.' This is true about Dorothy Hodgkin to a large measure.

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