DOROTHY HODGKIN
a life

GEORGINA FERRY

'Berry has brilliantly captured the flavour of a century of science' New Scientist
Dorothy Hodgkin
A Life

Georgina Ferry
For David, Edward, and William
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Preface to 2014 edition

Dorothy Crowfoot Hodgkin changed my life. Since this biography was first published in 1998 (following Dorothy’s death in 1994) I have been classified as ‘author’, ‘biographer’ and even ‘historian’, having previously been content with ‘science writer’ as a description of my activities. In 2010 I added ‘playwright’ to the list: I wrote and produced a short play about Dorothy, Hidden Glory, to mark the centenary of her birth.

I have written articles about Dorothy for newspapers, magazines and encyclopaedias, been interviewed about her on the radio, appeared in several podcasts, and given countless talks on her life and work to audiences from schoolchildren to Fellows of the Royal Society. As the only British woman scientist ever to win a Nobel Prize, she is always on the agenda when women’s representation in science comes into question.

2014 is designated International Year of Crystallography: the same year marks the 50th anniversary of the award of a Nobel Prize for Chemistry to Dorothy Hodgkin. I am absolutely delighted that Bloomsbury Reader has chosen this year to make the book available to new audiences through the wonders of electronic publishing. My thanks go to Stephanie Duncan and her team for giving the book a new lease of life, and bringing Dorothy’s story to another generation of future scientists. And I would like once again to thank the extended Hodgkin family, who made the book possible in the first place and have remained steadfast supporters of all my Dorothy-related activities.

Georgina Ferry
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Preface

Dorothy Crowfoot Hodgkin is so obvious a subject for a biography that I was astonished when I discovered, soon after her death in 1994, that none had been written. As Britain’s only female Nobel laureate, she holds a unique place in the history of twentieth-century science. A quintessentially English woman whose humanity recognized no national boundaries, her memory is cherished from Buffalo to Beijing, from Bucharest to Bangalore. Family, friends and colleagues are only too happy to talk about her.

But Dorothy herself was wary of ‘attempts on her life’, and I suspect that were she still living this book would not now be in print. It came about as a result of an article about her that I wrote for the magazine *Oxford Today*, published only weeks before her death. Soon afterwards her daughter Elizabeth Hodgkin invited me to visit, and we talked about the fragment of autobiography Dorothy had left, which Elizabeth and her niece Kate Hodgkin were trying to prepare for publication. It was clear that there was scope for a much fuller account, and without further thought I said I would be very keen to take this on.

I was enormously touched by the trust the Hodgkin family placed in me when they agreed to my suggestion. I never met Dorothy; I am not a chemist by training, and certainly not a crystallographer; this is my first book. To do justice to the woman and her science is a formidable responsibility. Given her own mixed feelings about biography – she certainly did not like the idea of a ‘life’ appearing in her lifetime, unless she had written it herself – I have little hope that she herself would approve the result. But knowing something of the nature of her reservations, I hope I have been able to avoid the kind of writing that caused her most grief.

She became very fed up with being treated as the token woman scientist in endless newspaper interviews – ‘It’s very boring if you always ask the same people,’ she told one surprised reporter. One of the most rewarding aspects of the research for this book was the number of other women who turned up as supporting characters – many of them scientists. In a similar vein, Dorothy had a horror of the term ‘role model’, and so I have not used it; however, she was glad that both men and women cited her example as a factor in the progress of their own careers, and any number of them feature in these pages. She vehemently rejected any suggestion that her gender was an obstacle to her progress. For the most part her life story bears this out, and I have tried to show what factors enabled her not only to achieve, but to be recognized for her achievements, at a time when women were not generally expected to have careers.

Today, even Dorothy’s greatest admirers would have to admit that her name does not resonate in the minds of the public like that of Marie Curie, or those of other Nobelists such as Albert Einstein, or James Watson and Francis Crick. One reason perhaps is that the nature of her science, X-ray crystallography, is less easily accessible, and its practical consequences less discernible, than the work of these others. She was, in the words of Lord Phillips, a former colleague, not just a scientist’s
scientist but ‘a crystallographer’s crystallographer’. The structures she chose to work on – penicillin, Vitamin B₁₂, insulin – were all medically important; but she chose them first and foremost because they were interesting scientifically, and potentially soluble with the methods at her disposal. It was the quest for exact and beautiful solutions to difficult problems that motivated Dorothy to surmount indifferent facilities, experimental setbacks, the demands of marriage and motherhood, and persistent physical pain, to become one of the greatest scientists of the century.

At the same time she wore her fame lightly. Unlike her close friend the double Nobel laureate Linus Pauling, who died just a few weeks after Dorothy in 1994, self-promotion was not part of her nature. For example, unusually for a scientist of such distinction, she never wrote a book. She never demanded, nor did she seem to expect, to be placed at the head of a grand and well-equipped laboratory. With a list of honours including the Nobel prize, the Order of Merit, the Lenin Peace Prize – and the Freedom of Beccles – she always gave her name as plain Dorothy Hodgkin, and insisted that the most junior of her colleagues call her simply Dorothy (following this precept I have done so throughout this book).

There are many reasons why Dorothy deserves to be more widely known. Her distinction as a scientist should be enough. But to it she allied an active concern for international understanding that made her travel tirelessly in the cause of world peace, and promote scientific collaborations between East and West, North and South. At the same time she cared about people as individuals and showed it in great and small ways: giving money to Third World scientists to help them travel or train, sending letters of condolence or congratulation at every opportunity, asking after the children of colleagues and remembering their names. Modern science is often presented as the preserve of the coldly ambitious and ruthlessly competitive. If Dorothy’s life has anything to teach us, it is that there is an alternative approach.

My task as a biographer has been made easier by the wealth of material available concerning Dorothy’s life and work – she simply never threw anything away. (In the age of telephone and e-mail, today’s scientists will leave barely a trace for the biographers of tomorrow.) My first thanks are due to Luke and Elizabeth Hodgkin who have given me full access to all Dorothy’s surviving correspondence. This includes the almost daily letters she wrote to her husband Thomas during the many long periods when he lived elsewhere, letters that virtually constitute a diary of her everyday concerns. In the early days of my research Luke kindly allowed me to work on the letters at Crab Mill, the house in Warwickshire where Dorothy spent her last years; when this was no longer possible he allowed me to move them to the Bodleian Library in Oxford. For letters written during the last years of her life I am grateful to Dorothy’s neighbour and former secretary Irene Sabin, who allowed me to read her notebooks.

I owe an enormous debt to the work of Peter Harper and Paul Newman of the National Cataloguing Unit for the Archives of Contemporary Scientists at the University of Bath, who archived and catalogued Dorothy’s scientific correspondence and other papers while she was still living. The archive now rests in Oxford University’s Bodleian Library, where I have been grateful for the assistance of Steven Tomlinson, and of Colin Harris and the staff in the Modern Papers Reading Room.
Other institutions that have provided access to archives or photocopies include Oxford University, Somerville College, Lady Margaret Hall, Cambridge University Library, the Royal Society, the Royal Society of Chemistry, the Sir John Leman School in Beccles, the Rockefeller Archive Center in Tarrytown, New York, the Sophia Smith Collection at Smith College, Massachusetts, the National Archives and Records Administration at College Park, Maryland, and the Kerr Library, Oregon State University.

An invaluable reference was the collection of all Dorothy’s scientific papers and lectures in three volumes, which also include historical articles by some of her closest colleagues. This massive task was the work of Guy Dodson, Jenny Glusker, Sivaraj Ramaseshan and K. Venkatesan, and it was published by the Indian Academy of Sciences in 1994. To have these volumes always at my elbow when I needed to check a fact or a date has saved me endless trips to the library.

Finally, the memories of those who knew Dorothy provide the colour and personal detail often missing from the written record. I should like to record my thanks to the following, all of whom it was a pleasure to talk to or correspond with: the late Sir Edward Abraham, Margaret Adams, Jean Banister, Frank Barnaby, the late Sir Isaiah Berlin, Bi Ruchang, Sir Tom Blundell, David Blow, Derek Bryan and the late Liao Hongying, Sir Julian Bullard, Sir Bryan Cartledge, Chang Wenrui, Durward Cruickshank, Sir John and Rita Cornforth, Barbara Craig, Elisabeth Crowfoot, John and Sue Cutfield, the late Lord Dainton, Nesta Dean, Guy and Eleanor Dodson, Dong Yicheng, Jack Dunitz, Fan Haifu, Mike Glazer, Jenny Glusker, Gu Xiaocheng, Maggi Hambling, Marjorie Harding, Pauline Harrison, Mercy and Norman Heatley, Ruth van Heyningen, Christopher Hill, Edward Hodgkin, Elizabeth Hodgkin, Luke Hodgkin, Judith Howard, Louise Johnson, Olga Kennard, Sir Aaron Klug, Galen Lenhert, Liang Dongcai, Lin Zhengjiong, Barbara Low, Maureen Mackay, Jean Lady Medawar, Helen Megaw, the late Elisabeth Murray, Joan Payne, Max Perutz, the late Lord Phillips of Ellesmere, Flora Philpot, the late N. W. Pirie, Keith Prout, Sivaraj Ramaseshan, Sir Rex and Eva Richards, John Robertson, Joseph Rotblat, Diana Rowley, Irene Sabin, Fred Sanger, David and the late Anne Sayre, Tang Youqi, Baroness Thatcher, Ling Thompson, Jeannie and the late Ken Trueblood, Joan Turville-Petre, K. Venkatesan, M. Vijayan and Kalyani, M. A. Viswamitra, Wang Dachen, Bob Williams, Terry Willis, Wu Lingan.

I am particularly grateful to the Alfred P. Sloan Foundation whose generous grant enabled me to visit former colleagues of Dorothy’s in Bangalore and Beijing. In both places I was overwhelmed by the warm hospitality of my hosts, Sivaraj Ramaseshan and his colleagues at the Raman Research Institute and the Indian Institute of Science in Bangalore, Tang Youqi at Beijing University, and Liang Dongcai and his colleagues at the Institute of Biophysics in Beijing.

Finally I should like to thank Dorothy’s son and daughter Luke and Elizabeth Hodgkin, her sisters Elisabeth Crowfoot, Joan Payne and Diana Rowley, her brother-in-law Edward Hodgkin and her colleagues Margaret Adams, Tom Blundell, Guy and Eleanor Dodson, Jenny Glusker, Barbara Low, David Phillips, Max Perutz and Ken Trueblood for reading sections of the manuscript in draft. The faults that remain are entirely my own responsibility.
Georgina Ferry
May 1998
‘It was a rather rackety childhood in a way’

Cairo and Norfolk, 1910–1928

The house had four attics. The smallest one, at the back, was her private laboratory. It had a sloping roof, one small window, and a wooden cupboard in the corner which housed her collections – pieces of pot from her father’s excavations, flints from the Sussex Downs, birds’ eggs and fir cones. On the table stood a rack of test-tubes and other items of chemical hardware. There were bottles of crystals, powders and solutions for her experiments. Holding her breath, she turned the piece of platinum wire in the flame from the little spirit lamp, while a coloured bead gradually formed at its tip. Three little girls looked on in wonder, their eyes shining in the light of the lamp. She was eleven years old.

Dorothy Mary Crowfoot had begun her scientific career in a small private class for the children of parents of modest means and independent views. Miss Charlotte Mason of Ambleside had set up the Parents’ National Educational Union (PNEU – motto: ‘I am, I can, I ought, I will’) as an alternative to the schools provided by local authorities. It trained young women as governesses to teach a set syllabus to groups of children up to the age of twelve years, often in rented rooms or private homes. The syllabus included one-term courses in physics and chemistry at a time when ‘nature study’ was the limit of most elementary teachers’ scientific competence. At ten years old, Dorothy Crowfoot briefly attended a small class in the Rectory at Beccles, in Suffolk, taught by a Miss Fletcher who had been trained by the PNEU. Crucially, she was there for the term in which the class turned its attention to chemistry.

The progressive educators who designed the course had grasped the importance of practical demonstrations in catching the imagination of the young. Dorothy and her fellow students made solutions of alum and copper sulphate from which to grow crystals. Over the days that followed they watched as the solutions slowly evaporated. Gradually the crystals appeared, faceted like jewels, twinkling in the light. Dorothy was enchanted. ‘I was captured for life,’ she later wrote, ‘by chemistry and by crystals.’

The year was 1920. Although Dorothy herself identified that experience as the spark that lit the fuse of her lifelong passion for crystals, the conditions that allowed the fuse to burn were already well established. Scientific research was a far from obvious choice for a girl of her generation and background. Her parents had come from conventional, well-to-do families. Yet both valued learning and intellectual
enquiry above social position or convention. The examples set by her father and especially her mother imbued Dorothy with a fervent desire to find answers to questions through systematic investigation. Her first encounter with crystals was simply a signpost that set her out on one course among many others that she could have chosen.

There are many Crowfoots in East Anglia, possibly descended from Viking invaders. More or less continuously from the eighteenth century, elder sons of Dorothy’s father’s family practised as doctors in Beccles, a prosperous market town a few miles from the easternmost point of England’s coastline. There was also a strong clerical tradition among the younger sons. Dorothy’s grandfather, John Henchman Crowfoot, born in 1841, had studied classics at Oxford University before taking holy orders and travelling to India as a missionary. There he fell ill, and returned home to recuperate. During his convalescence in 1872 he met and married Mary Bayly, and recovered sufficiently to return to his ministry. A member of the Anglo-Catholic movement, he was Rector of the country parish of Wigginton in Oxfordshire when their first child, John Winter Crowfoot, was born in 1873; two daughters, Margaret and May, followed soon afterwards. The family later moved to Lincoln when their father was invited by Bishop Edward King to join the centre of Anglo-Catholicism at Lincoln Cathedral as a Canon, with responsibility for the theological students. Canon Crowfoot later rose to become Chancellor of the cathedral, a position he held until his retirement.

Like his father, John Winter Crowfoot studied classics at Oxford. An outstanding student at Brasenose College, he was awarded a senior Hulme Scholarship on his graduation in 1896. This enabled him to spend several months visiting Greece, Cyprus and Asia Minor (now Turkey), where he worked with the art historian Josef Strygowski on excavations of early Christian churches. Having grown up with the austere grandeur of English Gothic church architecture, he found the intricate and vibrant designs of the Byzantine mosaics a revelation. He was also captivated by the sights, sounds and peoples of the Eastern Mediterranean, steeped in the culture of the receding Ottoman Empire. On his return to England he took up a temporary post as a lecturer in classics at Birmingham University. But he soon abandoned a formal academic career for the opportunity to return to the Middle East. In 1901 he joined the British administration of Egypt, as a civil servant in the Department of Education. Egypt’s government at that time had recently passed from one colonial power, the Ottoman Empire, to a British Empire then in its most expansionist phase.

Although he had chosen to follow neither of the traditional family professions, John Crowfoot had inherited a strong sense of duty and service. After only two years in Cairo he was moved to Khartoum as Assistant Director of Education in the Sudan. Britain and Egypt had collectively moved to recover control of this vast country in January 1899, following General Kitchener’s annihilation of the forces of the Khalifa Abdulla al-Ta’aisha at Omdurman the previous September. The Khalifa’s downfall finally brought to an end a period of civil war between the peoples of the north and south of the country that had left it exhausted and economically bankrupt. The British dominated the Anglo-Egyptian ‘condominium’, and established a new administrative system in the northern part of the country that quickly acquired a prestige comparable
with that of the Indian Civil Service.

Crowfoot’s role was to inspect schools throughout the country, from the élite Gordon College in Khartoum to small village schools that owed their existence to the commitment of local community leaders. As a result he became involved in the beginnings of a movement for girls’ education in the country. A remarkable teacher called Babikr Bedri, who had already established a school for boys in his home village, petitioned the Director of Education, James Currie, for funds to start one for girls, so that his eleven school-age daughters and nieces could be educated. Currie told him he ‘must be mad’ and thought no more of it. Two years later Bedri found John Crowfoot more sympathetic; the new Assistant Director promised to send him the princely sum of £10 to start the school. But Currie refused to honour the promise, and told Bedri if he wanted a school for girls he would have to fund it himself. He did just that, and within a year of its foundation the school received government recognition. The Bedri family and the Crowfoots were to become lifelong friends.

Before he left England, John Crowfoot had met Grace Mary Hood (known as Molly) at a ball in Lincoln. She fell for him at once, but the attraction on his side was less immediate. Molly was born in 1877, the eldest of six children of Sinclair Hood, squire of Nettleham Hall, a modest country estate in Lincolnshire. They were a striking family, all tall and athletic; Molly herself grew to 5 feet 9 inches. She had four brothers, who were handsome and talented; the eldest, Edward, became an officer in the regular Army, Ivo took holy orders, Alban was a gifted musician like his mother and the youngest, Martin, joined the Navy. Molly and her sister Dorothy (Dolly) were educated at home, and spent a year at a finishing school in Paris improving their French, music and drawing. Molly loved country pursuits, such as riding to hounds, as well as music and dancing. Her background had prepared her to be a good wife to a country gentleman – but she wanted more than this.1

Her mother, Grace, was friendly with Elizabeth Wordsworth, Principal of Oxford University’s first college for women students. Lady Margaret Hall had opened its doors in 1878, and Dame Elizabeth urged her friend to send Molly there. But by then Grace Hood was a widow (Sinclair Hood died in 1897), her heart was bad, and she didn’t like the idea of her elder daughter going off to Oxford. The official reason for declining the suggestion was that Molly’s short-sightedness would worsen with too much reading.

The first years of the new century must have been difficult for Molly Hood, disappointed in both her romantic and her academic ambitions. But she kept in touch with John Crowfoot, and her enquiring nature led her to broaden her education through her own efforts. Her horizons were already considerably wider than Nettleham’s 1000 acres and the neighbourhood beyond. The house, originally a modest stone village house, had been extended during the nineteenth century to include a massive hall to display papyri and other antiquities collected by Molly’s grandfather, William Frankland Hood. Frank Hood, as he was known, had travelled in Egypt in an attempt to relieve his tuberculosis, but he died young and his father mortgaged the property to build the hall as his memorial. Although she did not immediately see archaeology as a career she might follow herself, Molly acquired a more than common interest in ancient civilizations.
After Sinclair Hood died, the family commissioned the construction of a villa on the Italian Riviera, in the resort of San Remo near the border with France. They called it the Villa Lincolnia and there, like many other English families who could afford it, they would spend the winter months to escape the chill of draughty country houses. The girls accompanied their mother on the annual migration southward, where they joined enthusiastically in the activities of the expatriate community. Molly was a keen member of the Field Club, a natural history society run by a retired colonel.

In 1906 the club visited a cave some distance from San Remo in search of the blind beetles that were supposed to live there. But on hearing that it was also reputed to contain Neolithic remains, Molly decided to investigate further. ‘The journey from San Remo to Badalucco, accomplished by a local omnibus, took two hours, and the climb up from Badalucco to the cave about one and a half hours,’ she later recorded. The cave itself was long and low with a narrow, bottle-neck entrance that opened out on a near-vertical slope and had to be approached from above. Molly was not in the least daunted by the difficulties it presented. With the help of a local boy, Antonio Bianchi, she dug in the floor of the cave and found collections of human bones as well as worked flints and bone pendants, points and beads. She visited the site in subsequent years, and corresponded about her finds with leading specialists in prehistoric culture, concluding that the cave was probably a Neolithic burial place.

Molly’s summers in England were divided between Nettleham and London, where the family regularly rented a flat. In London she was taken up by Augusta and Louisa Strode, suffragettes and Christian Socialists who became close friends and inspired her to join their cause. They were at the centre of an artistic and musical circle deeply concerned with political and social reform.

In 1906 Molly finally managed to obtain some training. She would have liked to study medicine, but her lack of formal education and continuing parental opposition made this difficult. So she lowered her sights and went to the Clapham School of Midwifery in south London. A devout young woman from a High Anglican family, she had thought of becoming a missionary, but disliked the idea of preaching. Her qualification in midwifery gave her another idea. In 1909, writing to John Crowfoot, she mentions ‘Lady Dufferin’s Medical Mission to the Women of India’. She had already taken a personal vow to ‘be ready if called’ to some form of service, probably overseas; the idea of taking medical care to women in countries where the purdah restrictions meant that they could not see male doctors greatly appealed to her, and she gave the clear impression that that was what she was thinking of doing.

Finally her patience paid off. Having been posted back to the headquarters of the Egyptian Education Service in Cairo, John Crowfoot wrote to propose, in typically bluff style, almost ten years after their first meeting.

My dear Molly
Will you marry me? I do believe that I could make you happy if you would let me try, and forget a good deal that has passed … I will tell you all you want to know when you have answered my question.

Molly accepted him by return of post, before turning to John’s mother to find out a little more about her prospective bridegroom. The reply might have made a less
determined woman have second thoughts. Mary Crowfoot began by warning in a roundabout way that her son probably did not share Molly’s strong religious convictions.

His is a rather complex nature – he doesn’t take anything for granted in a nice easy-going way, and on many points where you would have no difficulty he would still say he ‘didn’t know’ – but it is a reverent nature, and he will always respect another’s beliefs … I do believe him to be really a good and true man – and he is loving and tender, but not very demonstrative – rather a quick temper – and a little extra particular about little things – but that is all to the good … You will bring him a wealth of love and a stedfast heart – and real helpful gifts too.5

John and Molly, aged thirty-six and thirty-two, were married in fine style at Nettleham by the Bishop of Lincoln in July 1909 and immediately left for Cairo together.

Dorothy Mary Crowfoot was born on 12 May 1910. Her sister Joan followed in 1912, then Elisabeth Grace (Betty) in 1914. For the first four years of Dorothy’s life the family enjoyed a life typical of the many English expatriates administering outposts of empire around the world. They lived comfortably in Cairo, ‘within sight of the Pyramids’; the ready availability of domestic servants meant that there was plenty of leisure time for social visits and entertainment. It was a small community of civil and military officers and their wives, and guests at dinners and parties might include Lord Kitchener himself, who became British Agent and Consul-General in Egypt in 1911 (the title by which his predecessor Lord Cromer had effectively ruled the country from 1883 to 1907). The nature of John Crowfoot’s work meant that he travelled widely around the country, and he found time to extend his archaeological interests to the civilization of Ancient Egypt.

Following the conventions of the time, Molly brought an English nurse, Nelly, out from Nettleham in time for Dorothy's birth; but shortly after Joan was born she took up another offer from an Egyptian family. Walking in the public gardens and wondering what to do, Molly came upon an English girl sitting in a state of despair. Katie Stevens turned out to be a children’s nurse who had arrived from England to find that there was no job for her as her prospective employer had suffered a miscarriage. Molly engaged her on the spot, and she stayed with the family for nine years.

They all returned to England for three months of each year to escape the hot, dry Egyptian summers. But this orderly pattern of life ended with the outbreak of war in 1914. Believing Britain to be safer than any overseas dependency, Molly took Katie and the three girls (Elisabeth was then only a few months old) back to England. She rented a house for them in the south coast town of Worthing, where her husband’s elderly parents had moved for their retirement. She herself ‘wangled a flight on an Air Force plane’6 to Cairo, and returned to be with her husband. In 1916 he was promoted to succeed Currie as Director of Education in the Sudan, and they moved to a new home in Khartoum.

For the rest of Dorothy’s childhood, she and her sisters never lived under the same roof as both their parents for more than a few months at a time, with long gaps in between. Dorothy later saw the self-reliance engendered by this separation as ‘the origin of her independent spirit’. It is worth remembering, however, that for the substantial number of families who were involved in civil, military or commercial activities throughout the Empire, such family dislocations were far from unusual. John
and Molly Crowfoot were not neglectful parents: duty and economic necessity kept Crowfoot in the Sudan, love and duty kept his wife with him, they felt that the children’s well-being was best served by their remaining in England.

Dorothy remembered the war as ‘a quiet time’. Canon Crowfoot’s memory was failing; their aunts May and Margie visited with their families from time to time. When the Crowfoot children were old enough they went to a small local school; they made expeditions to the South Downs to collect flints, and spent Sundays ‘playing holy games with our grandparents’. But their day-to-day care was still in the hands of Katie Stevens, a warm and devoted young woman who was well aware that she had to substitute for their absent mother as best she could. She sent regular reports on their well-being to Molly, including some anxiety about seven-year-old Dorothy’s tendency to exhaust herself: ‘She was trying to do too much, even in her sleep she was at school.’ There were frequent trips to the beach, within earshot of the trenches across the Channel, an early memory for Elisabeth Crowfoot.

Almost the first thing I remember hearing is Katie on the beach at Worthing saying ‘Don’t worry Betty, it’s only the Navy practising at Portsmouth.’ It didn’t occur to me until years later that all along the South coast you could hear the guns in France.

In the entire four years of the war, the girls saw their mother only once, when she visited England for a few weeks ‘to make sure we were all right’. Molly accompanied her husband on his tours of the Sudan, visiting schools; she impressed the Sudanese with her skill as a camel rider. But for much of the time she was left to her own resources, while John undertook wartime intelligence work, for example, or returned to headquarters in Cairo. She was an accomplished botanical illustrator, and occupied herself collecting and drawing flowers; she later published her work privately as *Flowering Plants of the Northern and Central Sudan*. She also became interested in traditional weaving techniques and taught herself to use the primitive looms used by the local women to weave cotton. Liking to have children around her, she taught embroidery and botanical drawing to the daughters of her Sudanese friends in Khartoum, sending her carriage to collect them every afternoon. It was a long way, in every sense, from the carnage of the trenches that was laying waste to a generation in Europe.

But even at this distance, Molly could not escape the tragedy of war. All four of her brothers died either in action or as a result of war injuries. Edward and Ivo were killed in France. Martin was invalided home to hospital in Lincoln after an attack on his ship. Severely shell-shocked, he discharged himself and set off on foot, possibly in an attempt to reach Nettleham; he was found dead of hypothermia. Alban, the musician, was badly gassed and survived in poor health until 1921.

The loss of her beloved brothers brought the senseless waste of war into sharp focus for Molly. But she did not give herself up to despair. She later told how, sitting in church soon after the war ended, she had been pondering the futility of their deaths, the failure of such a sacrifice to ‘make the world a better place’. All at once, she thought she heard Ivo’s voice saying, ‘But that wasn’t our job, that’s your job.’ The experience confirmed Molly’s already strong sense that she had a calling, that she could make a difference to people’s lives: a sense that was perhaps her defining
characteristic, and which she communicated to her eldest daughter.

The loss of the Hood uncles had another consequence for the Crowfoot girls; they were left in an extended family dominated by women. At Nettleham Hall and San Remo their grandmother presided, together with Aunt Dolly. John Crowfoot had no brothers, and his sisters Margie and May often deputized for the absent Crowfoot parents. Of their own parents, the girls saw a great deal more of their mother than of their father. Anxious to re-establish the bonds within her own family, Molly set out for England just before the armistice was signed. She arrived in Worthing and stepped off the train with a new baby (another girl, Diana) in her arms. Soon afterwards John Crowfoot joined her, and they rented a house for a holiday together at the foot of Cissbury Hill in Sussex. Only Dorothy remembered her parents well, Joan a little; Elisabeth’s affections, by her own account, were entirely directed towards Katie. They needed time to re-establish themselves as a family.

In Cairo Katie had had a sweetheart called Jimmy Collins, who was a corporal in Kitchener’s personal escort. He had been a regular visitor to the Crowfoot household, amusing Dorothy and Joan by leading them round the yard on the back of a pony. But he and Katie had lost touch when he left the Army with tuberculosis and went to Australia. He joined the Army again on the outbreak of war, was wounded at Gallipoli and sent to a London hospital for treatment. Aunt Dolly, who was a volunteer nurse, saw his name on a list and went to see him. Through her efforts Katie and Jimmy were reunited, and they married in Worthing before Jimmy returned to active service. (Dorothy and Joan came to the wedding, while Elisabeth was left outside the church in her pram, in the care of a policeman.) After the war was over, Jimmy went back to Australia to be demobbed. Once again Aunt Dolly took it upon herself to intervene. In 1919 she bought Katie a ticket and sent her off to Australia to join her husband. Katie later told Elisabeth Crowfoot that he had never expected to see her again; for her own part, she deeply regretted leaving the Crowfoot family.

After this Molly did without the services of a children’s nurse for a time. Dorothy took the role of eldest daughter seriously, acquiring increasing levels of responsibility until her sisters were all grown up. Although at the time the younger ones slightly resented Dorothy’s being ‘so good’ all the time – they did not always find it so easy to stay out of trouble – they grew extremely fond of ‘Dossie’, as she was always known. She showed them many little kindnesses. A few years later, when Betty was disappointed at being left behind while Dorothy and Joan went to visit their parents in Khartoum, Dorothy made her a little book, handwritten and illustrated, called The Tale of the Sudanese Tree Fairies (‘To my sister Betty: This book was written in spare time on board ship when somebody else hadn’t bagged the writing table …’) Her mother in turn showed Dorothy special attention, for example taking her on a trip to Iona in the early 1920s.

Molly decided to stay with her daughters for a while, and life, in Dorothy’s words, ‘became much more memorable’. Before the war ended she had just started at a PNEU school in Burgess Hill in Sussex, but Molly had other plans for her daughters’ education. After her husband returned to Khartoum she took them back to her childhood home at Nettleham in Lincolnshire. The house, at the top of a small hill, had views across open parkland to the spire of Lincoln Cathedral three miles away, and the
grounds were an excellent children’s playground. There were hazards, however; it was all too easy to slip in leather-soled shoes on the polished wood staircase in the imposing front hall. Rather than sending the girls to school, Molly chose to teach them herself, adding two cousins who lived in Lincoln, Evangeline and John Aston, to the group. Not having been formally educated herself, she devised her own methods, and taught all the subjects she knew.

For nature study they went for walks and collected specimens in the local fields. For geography they made relief maps out of mud on the floor of the greenhouse. They read adventure stories by Stevenson and Henty, and learned by heart the poems of Tennyson and Longfellow. For history they made their own books covering different periods – the Roman and Saxon invasions, or the early kings of England. Those of Dorothy’s books that still survive consist mostly of stirring poems with full-page pictures and decorative borders illustrating the clothes, artefacts and conditions of the period. They brim over with a sense of enjoyment in learning. Molly dressed the girls in loose tunics of Sudanese cotton with embroidered necklines, giving them a faintly medieval look. It was a blissful time – Dorothy’s cousin Evangeline called it ‘the happiest year of her life’.

This idyll came to an end as Dorothy approached the age of ten. Having considered, and rejected, the possibility of making Nettleham their permanent home, her parents put some serious thought into the future. John Crowfoot expected to retire from the Sudanese service within a few years, and felt the need to establish a permanent base in Britain for the family. He also recognized that his daughters’ education to date had been somewhat hit-and-miss. Molly wished to spend at least part of the remaining years of his posting at his side, and to return to her friends and interests in the Sudan. They decided to put down roots near Beccles, where John’s father had grown up and his cousin Amy’s husband, Harry Wood-Hill, practised as a doctor. Apart from the family connection, the town possessed an excellent new, statefunded secondary school, the Sir John Leman School. The original Leman School had been founded in the seventeenth century by a successful fishmonger, to educate bright boys from humble families. On the suggestion of John’s uncle William Crowfoot, the school newly built by the local council adopted the same name. John Crowfoot himself had been educated at a public (fee-paying) school, Marlborough College; but according to Dorothy, he felt that as a Director of a government education service, he ought to make use of the education provided by the government in his own country.

In 1920 they came to lodge at St Mary’s, a pleasant house on the outskirts of Beccles, while they searched for a home. Within a year they had rented The Old House in the village of Geldeston, a few miles north on the other side of the border with Norfolk, but within cycling distance of the town. The large house of mellow red brick, dating from the seventeenth century, was surrounded by a walled garden, and a magnificent cedar stood on the front lawn. The garden stretched down to a small river, ideal for boating. Despite a rumour that it was haunted, the house, with its attics that gradually filled with the souvenirs of their parents’ travels, became the Crowfoot girls’ first and only real home. Molly, meanwhile, finding the village population without any real leadership, set about running everything.
It was during this settling-down period that Dorothy attended the little PNEU class at the Rectory in Beccles where she had her first taste of chemistry. As soon as they moved into The Old House, she commandeered one of the attics as a laboratory, and began to undertake her own experiments, using material bought from the local chemist with her pocket money. ‘He didn’t seem to have rules about what he would allow ten-year-old children to buy,’ she later remembered. At the time it didn’t occur to her to be surprised. Rules, apart from essential good manners, were not a dominant feature of the Crowfoots’ upbringing. For example, when their parents were at home there were no set bedtimes; at ten and twelve years of age, Joan and Dorothy would sit up till nearly midnight ‘while their father read Ibsen and Plato etc to them.’ The girls were free to mount expeditions on the river by boat, by themselves, or to make forays into the surrounding countryside to watch birds or pick flowers. The worst offence they could commit was to be unoccupied.

Molly Crowfoot stayed long enough to establish a comfortable home at The Old House, but within a year or two she took to spending half the year in Khartoum, leaving the girls to board with friends or relatives in Beccles while she was away. Her letters home are filled with details of her busy social round:

Last night we dined with the Sterrys and afterwards went on to a reception at the Palace … Last week I went to Buri, to the house of Sh[ei]k Saleh Suwar ed Dahab, to see the beginning of Babikr’s wedding … At night Mrs Hunt and I went out again to visit the bride. It really was amusing – the women who weren’t quite sure where the house was and we wandered about Buri in the dark, falling into gadwals [ditches or small streams] – At last we found the place and the bride came and danced for the bridegroom, and he waved his hand above her head and all the women trilled – and then they veiled her up again – and home we went to bed … Your lovely basket Dorothy came today – it is a really fine piece of work – I am awfully pleased with it. Love and kisses from both of us, yr loving Mum.

In 1921 Dorothy entered the Leman School. It became another fixed point while her parents continued to come and go at more or less regular intervals. The school was housed in a substantial brick building surrounded by playing fields. Today, with greatly expanded premises, it flourishes as a local authority comprehensive school with more than 1300 children. When Dorothy joined it had around 130 pupils, rather more girls than boys ‘owing to the tendency for parents to send boys away to more prestigious schools’. Boys also had the option of the boys-only grammar school in the next town, Bungay. Most of the children came from the families of tradespeople in the town, or of farmers or fishermen in the surrounding area. To pass the School Leaving Certificate was regarded as the height of ambition, and only a dozen or so achieved that each year. But the school had a strong sense of purpose, and some excellent teachers. Dorothy quickly found that her knowledge of English, history, drawing and nature study was more than adequate, but that she was very behind in mathematics.

The science teaching was a disappointment at first. Chemistry was not taught at all during the first year. The school also lost its only physics teacher, as a result of funding cuts, within a year or two of her arrival. Chemistry classes from the second year onwards were, as Dorothy told listeners to a schools radio broadcast years later, ‘the prerogative of the boys’. But after a struggle to persuade her teachers that they would do themselves justice in a ‘boys’ subject’, she and her particular friend Norah Pusey were allowed to join the boys’ class ‘since we both wanted to take up science seriously.
and go to the University’. A photograph taken at the time shows the two of them just visible in the back row of a teaching laboratory otherwise filled with boys.

It was common in those days, and for a long while afterwards, for girls in mixed schools to be actively steered away from physical science and towards more ‘suitable’ subjects such as physiology, languages or needlework. But it is surprising that this should have happened at the Leman School, for a simple reason: the chemistry teacher was a woman. Criss Deeley had graduated from Birmingham University with a first-class degree in chemistry in 1906. She taught chemistry and mathematics (and needlework!) at the Leman School from its opening in 1914 until 1939; Dorothy found her a ‘marvellous teacher’, and her love of the subject grew. Miss Deeley in turn found Dorothy a ‘dear, loveable girl, a “good sweet maid” as well as being clever.’

She was happy at school and despite her shy, quiet demeanour she soon made friends among the girls. The boys were a different matter. Although the school was mixed, mixing was discouraged. Boys and girls had separate entrances, separate playgrounds and separate dining halls, and although they sat in the same classes, they were kept to separate sides of the room. A classmate, Edmund Wurr, corresponded with Dorothy towards the end of her life. He had been known at school as ‘Buzzer’, but she confided: ‘You were far too eminent, it seemed to me when I was at school, for me ever to know you by that name.’ Soon her sister Joan joined her, and they would cycle the 3 miles together, crossing the bridge over the River Waveney with their schoolbags on the handlebars.

Dorothy worked hard to make up the gaps in her education, but her years at the Leman School were not entirely uninterrupted. A surviving diary shows that in 1923 she spent the entire spring term with her maternal grandmother at the villa in San Remo. Why she did this is not clear. Certainly when she was older her parents frequently expressed anxiety about her health, but the diary gives no indication of sickliness; perhaps they felt she was working too hard and needed a break. While in San Remo she intermittently attended a French convent school, but her grandmother’s requests that she watch games of tennis or go to parties apparently took priority. The diary stops abruptly two days after Dorothy’s return – two days for which the only entry was the subdued but refreshingly normal ‘Went to school all day’.

Her parents took the view that school was just part of a much broader range of educational influences. At the end of the same year, Dorothy and Joan were summoned to spend Christmas and the whole of the following term with their parents in Khartoum, so that they could experience a different way of life before their father’s expected retirement. The journey out proved to be an eventful one. First they almost missed their ship in Crete because Molly, who was travelling with them, took them to visit Sir Arthur Evans’s excavations of the Minoan palace at Knossos during a brief stop at Heraklion. When they returned to the harbour the ship had left the quayside, and they had to pursue it in a small boat and be taken on board over the side. Then Dorothy became very unwell, and spent most of the train journey from Alexandria to Cairo being sick out of the window. It turned out that she had measles; Joan went down with it a week later, and they had to spend Christmas isolated in a little flat in Cairo rather than at their parents’ home in Khartoum.

They resumed the journey three weeks later, and now Dorothy was well enough to
appreciate the unforgettable landscapes unfolding outside the train window as they travelled southwards. ‘I can still see Abu Simbel by night on the banks of the Nile, and the many mirages in the sand outside Khartoum,’ she later wrote. They arrived to a lifestyle in complete contrast to that of the village community of Geldeston. Their parents’ house on the banks of the Nile was large and cool, surrounded by gardens with green lawns, rose bushes and banana trees. It had a verandah floored in coconut matting, where the girls slept out on hot nights. John and Molly entertained frequently, and the guest list was long and eclectic. Dorothy remembered handing cakes to the country’s three religious leaders, Sayed Abd al-Rahman al-Mahdi, Sayed Ali al-Mirghani and Sherif Yusuf al-Hindi. Others who came included the first intake of students at the new Medical School, established largely at John Crowfoot’s instigation, and the formidable Wolff sisters. On her own initiative Molly, appalled at the traditional childbirth practices and female circumcision that she had witnessed, had invited two of her former classmates at Clapham to come and train local Sudanese women in midwifery. Mabel Wolff and her sister, known as ‘Bee’ and ‘Gee’, trained more than 200 midwives by 1933.

The girls went with their mother when she returned social calls. They were with her when, visiting the tent outside Khartoum where Sherif Yusuf al-Hindi lived, she admired an intricately woven camel girth. With the traditional courtesy of his people, he immediately gave it to her. But Molly’s interest was more than purely aesthetic. With Sherif Yusuf’s help, she arranged to bring the woman who had made the girth into Khartoum. Sitt Zeinab, having travelled for days on the back of a camel, set up her loom in a courtyard and Molly, her daughters and their friends watched her at work in the weeks that followed, learning the technique themselves.

Molly recognized that traditional weaving techniques could have very ancient origins and shed light on the textiles of the early Egyptian civilizations. Back in England she herself wove a replica of the complex girdle of Rameses III and in subsequent years became an international expert on ancient textiles. Towards the end of her life she would answer anyone surprised at her lack of academic training that ‘if you spend 25 years working on anything you become the world expert’. It is perhaps no coincidence that despite very different educational histories, all four of her daughters became experts in different fields.

Formal education was not entirely forgotten amongst this whirl of social engagements. The wife of the Arabic scholar Dr S. Hillelson was a mathematics graduate, and she gave lessons to the Crowfoot girls so that they should not fall even further behind. They also learned to write the Arabic alphabet with reed pens. But the most important lesson for Dorothy came as a result of a social visit.

The pharmaceuticals magnate and philanthropist Sir Henry Wellcome, anxious to assist with the reconstruction of the country after the devastation of the war, had established a research laboratory for tropical medicine, agriculture and mineral resources in 1903, in a wing of Gordon College in Khartoum. The government chemist Dr A. F. Joseph, a close friend of John Crowfoot, worked in the soil science department of the Wellcome Laboratory and Molly took the two girls to visit him there. Just as they arrived a geological expedition returned with small nuggets of gold they had found in a stream. ‘To amuse us children, they threw their gold into a basin of