BIOGRAPHICAL MEMOIRS

Herbert Marcus Powell. 7 August 1906 – 10 March 1991: Elected F.R.S. 1953

K.A. McLauchlan

Biogr. Mems Fell. R. Soc. 2000 **46**, 425-442, published 1 November 2000

HERBERT MARCUS POWELL

7 August 1906 — 10 March 1991

Biog. Mems Fell. R. Soc. Lond. **46**, 425–442 (2000)

H. M. Powell

HERBERT MARCUS POWELL

7 August 1906 — 10 March 1991

Elected F.R.S. 1953

By K.A. McLauchlan, F.R.S.

Department of Chemistry, The University of Oxford, South Parks Road, Oxford OX1 3QZ, UK

Marcus Powell was a secretive man blessed with genuine curiosity. Myths abound concerning him, many of which cannot be verified given the long interval since his death, and a problem for his biographer is to separate myth from reality. Maybe it is a mistake to try because its mere existence provides insight into the person he was. He was an observer of life and a sympathetic and amusing commentator on it, and he wrote unusually well. What of his personal writing remains reflects his sense of humour and his humanity, and quotations from it are provided without further attribution throughout this memoir. He was not a tall man (5 ft 2 in; 1.57 m) and 'when he went to Oxford he was unimaginatively called Tiny. This stuck and was used within the University and in the scientific world. Marcus, the name he liked, was kept for the few.' Where any confusion might arise we shall presume to use this name. Those who knew him outside his laboratory have only the fondest memories of him, but some academic colleagues occasionally found him difficult.

He was born in Coventry, the youngest child of Henrietta and William Herbert Powell, to whom a daughter, Christina, had been born two years earlier. William was born in Kidderminster. His profession was given on Marcus's birth certificate as a bicycle machinist. It was printed by use of a rubber stamp, which reflected the prevalence of the industry in Coventry at that time, bicycle manufacture having superseded the sewing machine industry to the extent that in 1906 a single company produced 75 000 bicycles.

William and Henrietta had married in Calne, Wiltshire, in August 1902. William was the sixth of eight children born to Charles and Eliza Powell, who registered a cross on the birth certificate. Charles was variously described as a gamekeeper and a farm labourer, and he died at the age of forty-seven, leaving his wife to bring up the seven children still at home, ranging in age from two months to twenty-one years. Eliza became a dressmaker, and the two elder remaining children a laundress and a housemaid. The eldest daughter, Annie, had left home

by this time and had married at some time; she attended his deathbed as Annie Shill, and possibly the wedding of William and Henrietta twenty-two years later as Annie Blackman.

Marcus's mother was the daughter of Henrietta and Eli William Carney of Calne. Eli left school at a very young age without learning to read or write and was successively a stable lad, a coachman and a travelling butcher ('meat hawker'), a business conducted from his own horse and cart. The horse was adept at finding the way home after the frequent visits that Eli made to the public house. Man and wife were, however, staunch members of the Salvation Army and Eli finally took the pledge and settled down to become a pork butcher and greengrocer.

Marcus's own account of his grandparents, written in 1966, is inconsistent with these facts. He refers to his grandmother as Mary Powell, 'faithful old soldier of The [Salvation] Army [who] took the War Cry but relied on others to read it to her', and her husband as 'Willie'. But his second grandmother was not called Powell and there is no evidence for a 'Mary' either. Willie is described as a gamekeeper who died when William was four years old, and fits the known history of Charles on both counts. One night Willie was in a tavern where he was persuaded to take the Queen's shilling, and found himself serving in the Crimean War. He survived and somehow during his army service learned to read and write. This anecdote seems more consistent with the identification of Willie with Eli, and suggests that Marcus might have conflated the histories of two grandfathers into one.

Of previous generations he wrote, 'our family never cared to look too closely into its tree but I confidently believe and hope that we are descended from Welsh cattle thieves—English cattle only. An early sign of scientific ability may be discerned in that grandfather could actually count the cattle.'

However, it is easily forgotten that in earlier days intelligent people educated themselves by their own reading and this was certainly true of William Herbert Powell, who provided just the environment for Marcus to flourish in.

The early years

'H.M. Powell started with the unfair advantage of the best parents in the world, and never tired of saying so.' They therefore deserve our attention.

Henrietta had been in domestic service in both Bristol and London before marriage and worked in the slums in London with the Salvation Army, to which William also belonged. They lived in Upper Stoke, near Coventry, which was then an isolated village, and half a mile away from their house was the tin Congregational chapel where Christina was christened. In those days Congregationalism was characterized by a rugged independence and rejection of all forms of authority, and it was their natural spiritual home. But by the time Marcus was born their own independence had grown, they had left the Salvation Army, and 'despite their own devout feelings and practices decided there was no value in the baptism of a child into a religion which he did not then comprehend'. So Marcus was never christened. His name resulted from a rare visit that his parents made to the theatre when his mother was pregnant, to see a play about the earliest Christian times. 'Some Roman in that play made a deep impression on Henrietta, and thus originated the name Marcus.'

The tolerant approach of his parents to life ensured from the start that 'restraints other than the proper disciplinary duties of parents' did not inhibit him. His father looked at him as a baby and predicted he would become a linguist.

William was an intelligent and inquisitive man who somehow saved enough to buy books, including a concordance to the Bible, a volume on natural history, a popular account of the Universe, a dictionary, editions of Shakespeare, Dickens, Scott and Wordsworth, and several second-hand fairly advanced books on chemistry. The house also contained a simple microscope and a small telescope.

Powell was stimulated intellectually from the first. His sister started school, and in play taught him how to read and write so that he rapidly became bored at home, although by this time he had already taught himself to draw. Christina therefore asked the school if they would take him at the age of four, and despite pressure of space they did. For seven years he attended it, and went every Sunday morning and afternoon to the Congregational Sunday School where both his parents taught. On Sunday evenings, as in many homes at that time, no games were played and the only entertainment was to be tested on the details of the engravings in the Family Bible. However, once he was seven years old the whole family attended the evening service. On the way home, often in the dark, his father used the telescope to introduce him to the remarkable knowledge of astronomy that he had somehow acquired.

Deep in the country, his interest was excited by the nature surrounding him and he studied and drew it. On wet Sunday nights his father would stay home with the children and bring out the microscope, decent to use on the Sabbath since the hand of God was apparent in all they investigated. Illumination was with an oil lamp. But each session ended with a prepared slide on which there was a microphotograph of a drawing of Christ. Powell considered that his youth was the period when he developed his inherent interest in the great and the small in nature, related in a way embodied for him in the Welsh phrase ‘Y mawr a’r bach yn y greadigaeth’.

The idyllic surroundings changed abruptly in 1914 when a railway line arrived and 600 houses, hostels and a shopping centre started to be built to accommodate munition workers at nearby factories. The skins of the girls filling shells with high explosives became yellow and they were made to rest one week in every three or four, besides being provided extra milk to drink. The school increased in size from 100 at the start of the War to nearer 1000 after it.

Powell reached the top academic class in 1916 at the age of ten. He benefited from an eccentric and tough Irish teacher brought in to ‘put a stop to riotous behaviour’. ‘Moggy’ Maguire eschewed the normal timetable. Every day he would simply set certain tasks—arithmetic, hand-writing, copying of maps, and so on—that the students had to do ‘in their spare time’. Twice a week he taught drawing and painting, using a palette of just four pigments. Marcus soon showed that he could accomplish all the tasks set, and quickly. This led to his being made to teach schoolmates who were up to two years older, and to his missing some of his own lessons. Powell ran errands for Moggy, including buying bottles of Scotch and helping on the allotment on which the school grew some of its own food. Despite, or perhaps because of, the lack of formal schooling through which necessity made him work independently, he sat for and won the Governor’s scholarship at the King Henry VIII School in Stoke. It was worth £5 a year in addition to fees, and he was eleven years old. J.W. Linnett (F.R.S. 1955) joined the same school two years later.

Scholar and student

King Henry VIII School, then as now, was a scholarly school and enabled Powell to begin to learn, among other things, languages, mathematics and science. By the age of fourteen he was in form IV and his fortnightly progress cards showed that he headed the form in all five subject categories that he took, and after one term he was promoted to the next year. Not long afterwards he jumped another year, leaving him with a great deal of catching up, despite which he was already performing well in French and German, but not so well in Latin. He then overheard Welsh being spoken outside school and started to study it independently.

However, it was his English teacher who had the greatest influence by encouraging him to read widely; Powell started to write both prose and poetry of his own. 'But he had a sensitivity for poetry, which later he read in several languages, and had the sense to destroy all his own efforts'. One, however, survived in the pages of the School Magazine, The Coventrian, in 1924:

The chemist's dream

(after an overdose of laughing gas in the laboratory)

When chlorine and his comrades found a cool umbrageous nook,
They formed into a family (see Mellor's learned book):
But though often I have wondered where the four have pitched their tents,
I have only just discovered where they live, these halogents.
For I dipt into a test-tube far as human eye could see,
And I heated up a gramme of fulminate of mercury.
I awoke upon a grassy bank beside the river Pharphar
In a scene that would have gladdened G.S. Newth or Bruce and Harper.
In the flowing river sported hippopotpermanganates
And held discussions with their comrades, the crocodichromates
On dimethyl nitrosamine and the chlorotoluenes,
And things with names you could not print in fifty magazines.
It is in this gorgeous country that the methyl orange grows,
With the scarlet raspberylium as everybody knows.
All along the river's brink grew many palms of iodates
And other things they gave you free were nuts and jam tartrates.
So there you eat and drink away until the daylight closes
And then retire to sleep upon a monosaccharoses.
But upon looking up around I saw an Eastern butylene
Against a palm tree by my side, I thought 'twas Miss Bromine.
To my question she made answer that her name was Silicate;
So I went away complaining at ironickle sulphate.
I turned and asked her if she knew the halogen's address
And nearly fell into the river when the answer came 'Ah , Yes'.
Then I paid a call on fluorine, the youngest halogen,
But quite forgot its affinity for men.
Thus I became a fluoride but being none too stable,
They sealed me up hermetically and pasted on a label.

His play on words, and puns, developed into an art form in future years but the style is quintessentially Powell's.

When not quite sixteen he was awarded First Class honours in the Cambridge Local Examinations. He gained distinctions in Latin and in four different aspects of drawing, but not in chemistry. The School had just started an Advanced Level Course but only in modern studies; there was no science side. Marcus pursued English language and literature, French and modern European history, which he did not find interesting. He also kept up his German, his mathematics and Latin unseens and he read science for his own satisfaction. After a year he requested that he be allowed to drop modern studies and work on chemistry, physics and mathematics with a view to applying for the Sir Thomas White closed scholarship to St John's College, Oxford. He did this on his own for two terms and continued his language studies.

He went to Oxford for the Entrance Examination but made little impact with his science papers. However, he complained that the translation paper was from French and German only, regretting that there was no Latin. This intrigued M.P. Applebey, the Chemistry Tutor in the college, who enquired into his background. It emerged that he was largely self-taught, that he already had a particular interest in crystals, knowing the seven systems and having built a set of crystal models, and had the ambition to undertake studies of crystal structure with the methods being developed by the Braggs. Applebey could not have hesitated before awarding him the scholarship.

Nevertheless, Marcus was no swot. Rather, he pursued his own interests alongside all the other opportunities provided by the school. He played rugby, mainly at scrum half for the 1st XV, gaining both his Colours and his Honours Cap. He took part in debates, notably one on Trotsky and his colleagues, in which the school magazine names him as Comrade Powell, the Parliamentary Secretary of the Democratic Opposition. An elaborate charade that included the democrats proceeding to the station in an open carriage to meet their leader (a Russian-speaking master) ended with them singing the 'Red Flag'. He was also Games Secretary and a Prefect.

At Oxford he maintained strong contacts with the school, was a long-serving and stalwart member of the Old Coventrian's Society (O.C.'s) within the university, and served as both its treasurer and president. He contributed regularly to the magazine in an unmistakable style of erudite humour, often poking fun at the Establishment and obviously enjoying the company of his school friends. He became adept at punting and he played rugby for the college. He involved himself in debates, once toasting 'the Weed' (churchwardens were supplied at each meeting) and somehow introduced papyrus into the discussion, allowing him to make a clear distinction between the Weed and the Reed, one of which should be smoked and one not, further evidence that his brand of humour was established early. He later amazed the O.C.'s, and Oxford science, by producing a 16-inch crystal that he had grown; this became something of a talisman for some years before being given to the Museum. Previously it resided in a glass case, and he was accused of crystal gazing at it.

He acquired a reputation for working in the laboratory all night, which, when he was taxed with it, he put down to someone's having locked the door. Nevertheless, the rumour long persisted. He continued his association with the O.C.'s for many years, his attendance at its meetings only falling off after a visit to Germany in 1930 and his first marriage in 1932. The last editions of the school magazine to mention him pay full tribute to his leadership and energy.

However, throughout his undergraduate career the independence bred into him by his parents surfaced periodically, and he seems not to have been a particularly docile member of

his college. In 1926 he had a run in with the Proctors near the Lamb and Flag, but made his escape by bicycle. When feeling poor, he adopted the slogan 'halls for sixpence' but then found he could eat for fourpence in Walton Street. In 1927 an unrecorded offence led him to be exhorted by the Vice-Chancellor and Proctors to observe the statutes of the university.

'Nothing greener ever went to Oxford' but 'he had knowledge of many things his fellow undergraduates had not. He knew the life of the slums and had witnessed streetfighting between women. He knew plenty about drunks and rowdies, and had seen cruelty to children and animals.' He heard at first hand about baton charges against striking miners and witnessed honourable men begging to charities for a few pounds to support their families. The General Strike occurred while he was in Oxford. He turned to the Socialist Left and finally rejected the religious beliefs that he had been brought up with. However, throughout he was honest in his attitude and contributed as was his wont to the society he found himself part of. He enjoyed a full college life and one is struck that this short man of unusual ability seems never to have attracted the jealousy or ire of his schoolmates or undergraduate colleagues.

He benefited in Oxford from a four-year course, having been introduced in 1921, the fourth 'Part II' year being spent, as it still is, wholly in research. During Part I he took the optional special subject of crystallography under the tutelage of T.V. Barker. Barker had worked with J.R. Fedorov in St Petersberg and after the latter's death from starvation during the Revolution expanded his ideas into what became the Barker Index. In the year that Powell entered the university, 1924, Barker visited the University Physical Laboratory in Berlin to gain experience with X-rays, but the first record of X-ray equipment in Oxford is in 1928. In Part II Powell worked with his tutor, M.P. Applebey, on different forms of lead monoxide, a problem attacked with the use of a microscope and arguments based on morphology. They published their results in Powell's first paper in 1931 (1). The work was done in the Department of Mineralogy and Crystallography, situated, as was the Old Chemistry Department, in the University Museum, then the centre of all Oxford science.

He graduated in 1928 with a First Class honours degree, one of fourteen awarded that year in chemistry. Among his contemporaries were R.P. Bell (F.R.S. 1944), H.M.N.H. Irving and L.E. Sutton (F.R.S. 1950). His Part II work was extended and submitted for a BSc, which was awarded in 1931.

Career in Oxford

As with R.P. Bell, Powell did not supplicate for a doctorate. In 1929 Barker resigned his readership in crystallography to become Secretary of the Chest, but by this time Frederick Soddy, F.R.S., then Dr Lee's Professor of Chemistry, had appointed Powell as a departmental demonstrator, following advice from H.L. Bowman, Waynflete Professor of Mineralogy and Chemical Crystallography (there is some inconsistency in the record here; Bowman might have made the appointment at Soddy's recommendation). In a letter dated May 1929, Soddy wrote, 'I have formed a very high opinion of Mr. Powell's activities. I like his influence in the laboratory and he evidently has the confidence of his students as he has of his colleagues in the Department. In manner Mr. Powell is quiet and purposeful, reminiscent perhaps of the type one meets more frequently in Continental than in British laboratories.' This was praise

* Numbers in this form refer to the bibliography at the end of the text.

indeed from a man not noted for his sympathy to others. Powell kept in touch with Soddy throughout his life and a 1951 letter thanks Powell '…for your charming gift. I never expected to live long enough to handle and see a compound of argon' (a clathrate).

Powell first lectured to undergraduates in 1930, when he was also absent for half the year learning X-ray analysis in the Mineralogy Institute of the University of Leipzig. The first crude working X-ray apparatus in Oxford was built by Powell in 1929–30 but when his first research student, D.M. Crowfoot (later D.M.C. Hodgkin; F.R.S. 1947), joined him in 1931 they still initially used classical crystallographic methods. The X-ray apparatus was properly installed and working in a basement in the Museum in 1932. Powell had glass-blown and made the tube himself. The electricity supply to the basement was 100 V DC and this required 'a rotary converter of unspeakable parentage, innate delinquency and life-long vicious criminality' to be usable. This was replaced when AC became available a little later. The whole apparatus remained in use for some time, even being rescued from disposal by Dorothy Crowfoot for her own use when Powell eventually obtained commercial equipment in 1935. She once told me that she was not at that time allowed to use the modern apparatus. The research in the laboratory seems to have been funded initially by some of the income from Barker's books and then by a grant from ICI Ltd.

Powell remained a departmental demonstrator in the Department of Mineralogy until 1934, when he was made a university demonstrator and lecturer in chemical crystallography, which he remained until 1944. The accident of history that gave Powell his appointment in mineralogy and crystallography rather than in chemistry had a profound effect on his life. Whereas his contemporaries Bell and Sutton were rapidly elected to Fellowships of colleges, Powell was not. This was because colleges elected Fellows in subjects that were financially self-supporting in terms of fees, and mineralogy and crystallography never became a major honours school. Similar considerations in other subjects helped to create an underclass of academics who never enjoyed the social advantages of college life around which all Oxford revolved (and incidentally made them rather worse paid), a shameful situation only partly resolved by statutes of entitlement to Fellowships during the 1970 period. Whereas most academics gathered in Common Rooms, those excluded met in public houses, notably the Lamb and Flag, and later the King's Arms, although some of the privileged found the pubs as congenial as the colleges. Indeed, for a period the centre of power of the university seemed to be located at lunch time in the back bar of the King's Arms, where the doyen of local journalists, Ralph Brain ('Brain of Oxford') from the *Oxford Times*, received a stream of inside information that was syndicated widely.

Powell and N.V. Sidgwick, F.R.S., met outside the college system and began to collaborate in research. Powell formed an equally natural and productive friendship with W. Hume-Rothery, F.R.S., whose deafness presented no barrier between them.

H.L. Bowman retired in 1941 and the university undertook a review of the department. In 1942 it was proposed to terminate the Waynflete Chair and replace it with two readerships, one in mineralogy and one in crystallography, appointments that were finally made in 1944; each interview of the five candidates for the crystallography post lasted just ten minutes. Crystallography had appeared in the title of the department only in 1927 but the increasing application of X-rays to chemical (Powell) and biological (Crowfoot) problems inevitably caused it progressively to dominate mineralogy. In 1946 it was split off and became a part of the then Department of Physical and Inorganic Chemistry under the Dr Lee's Professor, C.N. (later Sir Cyril) Hinshelwood, F.R.S. Powell was re-elected Reader in 1951 and in 1958,

and was awarded a rare *ad hominem* chair in Oxford in 1964, becoming the first Professor of Chemical Crystallography. Being a personal chair this was not refilled on his retirement in 1974, leaving Powell probably the only person ever to hold this title in the university.

His estrangement from the college system finally ended in 1963, when he was elected a Professorial Fellow (while a Reader of the University) of Hertford College, with which he had had no previous connection. He became the second to be associated with a professorship in chemistry at the college, his predecessor having been Robert Plot, F.R.S., who was appointed the first Professor of Chemistry at the university in 1683. Plot matriculated at Magdalen Hall, from which the re-founded College later sprang. Powell formed a debating society in his honour, which he christened 'The Plot', and furnished it with an edition of *The natural history of Oxfordshire* as an insignium of office for its president. It met to discuss the social implications of science and was addressed by, among others, C.A. Coulson, F.R.S., R.V. Jones (F.R.S. 1965) and F.S. (later Lord) Dainton, F.R.S., all at Powell's personal invitation. Plot and Powell were kindred souls. The *Natural history* volume is full of beautifully drawn observations of nature, and of anecdotes of the period. It contains a phrase that could easily have been written by Powell, commenting on a discovery in an Oxfordshire churchyard: 'Now how elephants should come to be buried in Churches is a question not easily answered…'.

Powell took to college life with delight, entirely without rancour at his previous shabby treatment within Oxford. Most unusually he published a major review with the college rather than the department as his address. As Junior Fellow he served his younger and much less distinguished colleagues in the Common Room, he participated in all aspects of college life and he served the college in many ways. He was delighted to meet and talk to undergraduates and graduates, with whom he was always polite and interested. He became Dean of Degrees at about the time that he retired and continued to be so for several years afterwards. However, he suffered from having to wear full academic dress in the heat in degree ceremonies held during the summer. He was once observed to be wearing a gown onto which two severed arms of an old suit had been stitched so that it appeared he was wearing a jacket under the gown.

He was a continuous source of delight and information to the other Fellows, who respected his highly diverse learning, scholarship and skills, and who enjoyed his gentle humour.

Myths and truths

Powell was a true polymath, but a mischievous one. He was amused to encourage stories about himself, some of which have demonstrable elements of truth and some not. But nothing was done for self-advancement and he was always considerate and attentive to others.

He was a natural linguist, as his father had predicted he would be. At school he learnt French, German and Latin, and in his spare time then and later taught himself Welsh. Some of his writings quote Erse. He spoke two different dialects of Chinese—Mandarin and Cantonese—and he translated from Japanese. He wrote an extraordinary article explaining how a chemist with no knowledge of that language could read a Japanese scientific paper by using cryptographic techniques (5). Remarkably this was published in *Proceedings of the Chemical Society* and generated a long correspondence with people from the Eastern Bloc who, having no opportunity to receive the papers in translation, had worked out how to do the same. He spoke Russian fluently and talked knowledgeably with experts on Central European languages within college on Russian history and culture. In my hearing he greeted

the (only) Ambassador of Outer Mongolia to the West in what was presumed by the listeners to be the Ambassador's own language. As with his Chinese, this made him a particularly appropriate member of an official party from The Royal Society to visit China in 1962. His colleagues were Sir Lindor Brown, F.R.S., Sir Gordon Sutherland, F.R.S., Dr H.W. (later Sir Harold) Thompson, F.R.S., and Dr C.H. Waddington, F.R.S. Once with two weeks' notice he delivered a lecture in Romanian, not previously one of his languages, having been invited at the last minute to that country by the British Council. He learned Dutch in 1928 and there is even an extant postcard that he sent to a colleague that displayed a small interest in Cherokee. He is reputed to have had seventeen languages overall; this seems wholly credible. His papers contain the draft of an unpublished introductory text on translating Russian.

His interest in languages went beyond simply learning them and concerned their structure *per se*. As with John Wilkins, F.R.S. (also with Magdalen Hall connections) in the seventeenth century, when such things were fashionable, he became involved with the representation of languages and attempted to develop 'a method of direct universal communication' between different peoples. It was based on non-language-specific symbols, pictograms, and so on, and became becalmed in the complexity of expressing moods and opinions. It was pursued over a long period before 1966. None of this work was published, but after Powell died it was assessed by a linguistic expert. He commented that there was no evidence of Powell's having read any of the existing literature on linguistics or conceptual analysis, nor of acquaintance with the linguistic philosophy of the Oxford School. It was completely original.

Throughout his life he was an accomplished artist, mostly in pencil but occasionally in charcoal and watercolours. He had a particular liking for portraiture and throughout his career drew his colleagues. In this way he extracted more amusement from tedious college meetings than most. On the retirement of his long-term assistant in crystallography, Frank Welch, Powell presented him with a portrait that he had drawn. His method was to draw from photographs that he himself took. Hertford College has two fine portraits, one of its Visitor, Sir Harold Macmillan, O.M., F.R.S., and the other a self-portrait (reproduced at the start of this article with permission from the Principal and Fellows of the College). Both were drawn after Powell's retirement, when he took to accepting commissions, but few of his older drawings seem to exist apart from some done as a schoolboy.

A recurring myth for which there is little or no evidence is that he was a successful writer. He admitted to one published co-authored detective story but was believed to have written more; he was reputed to have written early science fiction and he was thought to have written novels and novelettes. His name does not appear in the catalogue of the British Library or of the Bodleian and no *noms de plume* are known. However, his papers contain the drafts of no fewer than ten complete short stories ranging in length from six to sixty-six pages. All are based on his observations of his fellow beings and are to an extent biographical; several are indeed science fiction (e.g. 'Amphigouri or The January Black Melon', 'Boustrophedon or The Zemponi'), others involve crime in its broadest antisocial sense, and yet others are ghost or simple tales. One was entitled 'Just for fun, a supposed tale of the future, one of the products of being bashed on the head'. This refers to an accident he had on his bicycle that left him concussed for some time. He once offered them to a publisher, who had requested that he write a scientific book. He declined that invitation but wrote saying, 'some things can be written more quickly and there is often an hour between Oxford and Paddington. So I have frequently thought of my fellow travellers; how I might make them laugh, or shudder rarely, instruct them sometimes and keep them wondering happily.'

Also in his papers are remnants of two further short stories, which are typically beautifully written, with wonderful command of language. Both seem very early. One starts:

> I have long ceased to be surprised by the apparent lack of discrimination by men and women in the choice of a mate; the influences at work seem too frequently capable of deflecting an otherwise sound judgement that many ill-suited pairs must be regarded as part of the natural pattern of human organisation….

His first marriage (see below) was not a happy one. The second contains the passage:

> It would be inappropriate if I add that, at that time, it was all Greek to me, for my father, the younger son and in the main dependent on a none too profitable College living, had contrived to send me to a seminary of vaguely aristocratic pretensions where a pupil acquired a passable knowledge of the language; it was one of the many influences misapplied in this case to the befuddling our brains during the slow and invisible distillation into them of all manner of humbug and prejudice, including the certainty that Natural Sciences were not fit subjects for contemplation by any real gentleman; Chemistry could only be compared with the trouble with the drains and should be left to the same people; Physics, like nonconformity, was in some way associated with the sons of the drapery business, and Biological Studies, in so far as their existence was appreciated at all, were at the best indecent and often positively ungodly.

He was above all a fond observer of the world around him, and of its foibles. Several passages in his writings have reduced his biographer to outright laughter, but none is critical or harsh.

However, not all of his work was literary and in 1955 he wrote extensive parts of an introductory text on science and mathematics, written largely on the basis of experiments and observations that could be done in the home. It was also never submitted for publication. After invitations from the publishers of magazines and encyclopaedias, he wrote biographies of W.H. Bragg, F.R.S., Max von Laue, For.Mem.R.S., Otto Diels, R.V.G. Ewens and H.G.J. Moseley. For many years he was a member of the Delegacy of Local Examinations.

Powell had a penchant for writing spoof articles and letters to *The Times* and *The Guardian* and also to chemical journals. He used *noms de plume* of both sexes and most seem untraceable despite being in the memory of his older surviving colleagues. He delighted in pricking inflated egos and debunking nonsenses as he saw them. A letter to *The Times* was written in the name of a fictitious Bishop and provoked a continuing erudite correspondence with him always ‘tongue in cheek’. A letter to *The Guardian* described Eskimo as a ‘glutinous language’ in which complex (and imaginary) words were constructed by stringing simpler ones together. It was signed as though from a Chinese, with a Kanji symbol which translated as ‘a leg pull’. But the Editor wrote to him apologizing for its poor reproduction in print. He wrote an article for *Chemistry and Industry* in which, just after they became required by editors, he included as many keywords as he could in the title. It started apparently as a serious paper but followed a Lewis Carrolian logic to produce a nonsensical conclusion from some unexceptionable basic tenets. Anyone reading it should have recognized it for what it was, but to his delight he received, under his *nom de plume*, over six hundred reprint requests from those who had not. Sometimes he signalled his spoofs more obviously. In 1966 the Chemical Society invited him to write an article for *Chemistry in Britain* (6) that gave an account of famous hoax papers, the first by one S.C.H. Windler published in *Annalen* in 1840 immediately before a serious paper by Regnault. Powell’s paper was entitled ‘Colour in chemistry’, by A.H. Oakes, H.A. Dubois, Isa Benzieher and Owa Tatodo.

What Powell did during World War II is difficult to establish. Myth, and the Japanese anecdote given above, associates him with decryption and in many ways, with his command of language and mathematics, it would be surprising had he not been. In direct reply to a question from his biographer he implied that he had been involved, but specifically said this was not at Bletchley. He also said that there were units working within Oxford itself and he was observed by his chemistry colleagues who were members of the Home Guard to enter a certain College regularly, which they did not know why they specifically were required to guard, and which there was no obvious reason for Powell to go into. But any knowledge of him in this context is denied by the Ministry of Defence, the Army, the Navy, the Air Force and the Secret Services.

What is certain is that he advised Oxford City Council on defence against gas warfare, having been trained in it in 1939; that he did some work on mustard gas; and that he worked in his laboratory in 1944 on what are coyly referred to as 'some molecules used for war purposes'. Some of his samples were obtained from Porton Down and he was constrained by the Official Secrets Act. The work involved distinguishing between *cis* and *trans* forms of certain molecules, and it is not difficult to guess what they were associated with. He also joined Hinshelwood in an unsuccessful attempt to improve the efficiency of gas masks by adding copper to the charcoal.

Powell and Hodgkin

After her Part II with Powell, Dorothy Crowfoot moved to Cambridge to work with J.D. Bernal (F.R.S. 1937) before returning to the Department of Mineralogy and Crystallography. For almost forty years the two shared restricted research space and some equipment before, shortly before retirement, Dorothy moved to be closer to the Molecular Biophysics Laboratory of D.C. (later Lord) Phillips, F.R.S. Throughout the period Powell was nominally her superior in the administrative sense, being for much of the time the Head of the Sub-Department of Chemical Crystallography; however, such rank has never enjoyed much respect in Oxford. Both were well liked, admired and respected by their many mutual friends and it is a surprise to discover that these two very agreeable, educated and civilized people actually did not get on well together. This is particularly surprising because each had only admiration for the other's work and Marcus was extremely proud of Dorothy's achievements.

Their work was entirely complementary except for a brief period during World War II when both worked independently on the structure of penicillin with different preparative groups in Chemistry. Here Dorothy solved the problem but only after Wilson Baker (F.R.S. 1946), with whom Powell was more strongly associated, realized that the molecule contained a sulphur atom that had previously escaped attention. Dorothy will always be remembered as one of those who launched structural biochemistry, but Powell's work on inclusion compounds had major technical spin-offs in chemistry and materials science and has been equally influential in fields that have lacked the public recognition of modern biology.

Their differences developed from the start when Powell presented Dorothy's Part II work to the male-only Alembic Club, a chemistry club within Oxford. She greatly resented not being allowed to do it herself, but this was scarcely Powell's fault, it then being the rule. Indeed, he may well have thought he was honouring her by presenting the work they had done together. 'But', he wrote, 'it was cruel and Dorothy was hurt by it.' During the war,

J.D. Bernal's equipment was removed from Birkbeck College to Oxford for safekeeping and made available entirely to her, relieving the competition for instrument time. This was stipulated by Bernal on condition that she supervised Bernal's research students. She also obtained a grant from the Rockefeller Foundation in 1941 to extend it. However, at the end of the war she felt able to give the equipment away and it left Oxford, causing some friction between them. In time she came to admit that the deterioration in their relationship was largely due to her demands and lack of sympathy for someone who had to accept the responsibility for the laboratory, and she felt she could have been kinder to him. But she seems not to have realized his extremely difficult home circumstances (see below) and she was highly critical of his visits to public houses. All this seems very strange to their friends, who remember both as sympathetic and thoroughly considerate people who both cared deeply about the welfare of those around them, although less openly in his case than hers.

Societies and recognition

Powell was long a member of the Mineralogical Society and served on its Council, as he did on that of the Chemical Society. He was awarded the Tilden Lectureship in 1953. He belonged to the Chemistry Crystallography Group of the Royal Society of Chemistry and the International Society for Chemical Crystallography. He was comparatively disinclined to attend conferences, although when he did so was renowned for the quality of his presentation. He attended the 1948 meeting of the International Society held at Harvard, crossing the Atlantic with his colleagues in the *Queen Elizabeth*, and several subsequent meetings of that Society. He travelled when it interested him in the widest sense—to Holland, Italy, Japan, China, Russia, the USA and Yugoslavia, for example—and always prepared carefully before doing so, providing lists of people that he would like to see and places where he would like to go. On his first visit to China he expressly asked to visit a completely undeveloped village far from big cities, similar to that in which he had been brought up.

He enjoyed major international recognition with conferences arranged in his honour, including a retirement symposium in Oxford attended by all the outstanding figures of the day in his field, and a substantial two-volume book on inclusion compounds (Attwood *et al*. 1984) was dedicated to him. For this he was first asked to provide a paper, then an introduction, and then to edit the whole publication; his correspondence with his old friend Wilson Baker on this is full of humour as at each stage he realized that his commitment was being increased without his prior agreement, although he did not in fact edit the book.

His papers contain the texts of many invited lectures delivered over a long period of time and in many countries, besides the script of a film made by the ICI film unit in 1965. His style was always to combine science with literature or classical allusion. An example taken from the start of a 1958 lecture to the British Association reads:

> During the next half an hour, devoted to the question of how molecules fit together, there will be no disclosure of the secret of life and death. This was known to me for a few days—a hazy horizontal period after a concussion of the brain—but with recovery, or the delusion of it, the knowledge fades and I regret [an allusion to the bicycle accident mentioned below]. Although our life is composed of something more than one hundred and one elements, or we should never laugh, we are in a physical sense composed of very little other than the molecules which some elements form.

Similarly, a text begins:

> I do not know how you come to be reading this first sentence. Perhaps it is for the sufficient reason that you are interested in natural science, as you might be interested in roses or Chinese pottery.

He was elected a Fellow of The Royal Society in 1953. His proposers were C.N. Hinshelwood, D.C. Hodgkin, W. Hume-Rothery, H.W. Thompson, E.J. Bowen, R.P. Bell and K. Lonsdale.

His science

Powell's name will always be associated with inclusion compounds and with the name 'clathrates' that he coined for them. However, he made other major contributions to structural chemistry that illustrate the wide interest he had in his subject. One of these, which was published in N.V. Sidgwick's Bakerian Lecture of 1940 (4), was the Sidgwick–Powell theory of chemical structures based on the repulsion of electron pairs, which was by far the best means for predicting the structures of compounds then known. It is now taught to every schoolchild studying chemistry, although at the time it made comparatively little impact. The theory awaited its rediscovery by R.S. Nyholm, F.R.S., and R.J. Gillespie before it became widely used.

A second major contribution was made with W. Hume-Rothery (3) in predicting the superlattice structures of stable metallic alloys, leading to the Hume-Rothery rules, which long formed the basis of metallurgical science.

His crystallographic research was strongly influenced by the chemistry going on around him in Oxford. Two topics, the structure and constitution of cyanides and related compounds and the nature of solvates and molecular complexes, remained with him throughout his career.

His first X-ray work, with Crowfoot (2), involved organometallic salts of thallium at a time when the first organic structure determinations were becoming possible; but the structure was deduced mainly from consideration of lattice geometry. This and later research of the prewar period was done to establish the characteristic bond lengths and bond angles of molecules, and the coordination numbers of atoms. With the instinct that he had, Powell focused on compounds with unusual stoichiometries. He realized that even-numbered coordination numbers were derived from highly symmetrical geometric structures such as tetrahedra and octahedra, but that even these could not be stacked to fill all space. He became fascinated by odd coordination numbers, especially because the rotational symmetries 5 and 7 are not found in crystallography. He therefore studied, among others, PCl_5, which was shown to exist as a 4-coordinated cation and a 6-coordinated anion in the solid state, and PBr_5, which was shown to exist as PBr_4^+ and Br^-. The discovery of true 5-coordination in nickel and platinum compounds came later.

A study of $Fe_2(CO)_9$ proceeded in the same mould and here it was found that three of the CO groups formed ketonic bridges between the two carbon atoms, leaving three terminal groups on each. This was the first experimental demonstration of such a structure, which had been postulated previously. For the first time Powell used the armoury of crystallography of that period: Weissenberg photographs, estimation by eye of intensities by comparison against an intensity scale established with timed film exposures, and Patterson and Fourier syntheses with Beevers–Lipson strips.

A series of investigations was undertaken into the structures of the 'molecular compounds' of polynitro compounds with aromatic hydrocarbons and related substances. A study of the complex between *p*-iodoaniline and 1,3,5-trinitrobenzene was the first of a charge transfer complex and it established the existence of stacks of alternate parallel donor and acceptor molecules with approximately van der Waals separations. This showed that suggested structures containing covalent bonds were incorrect. It provided one of the first applications of Fourier sections and lines being calculated from three-dimensional X-ray intensities.

From his earliest interest in chemistry, Powell was concerned with the occurrence of dots in chemical structures, such as $Ni(CN)_2.NH_3.C_6H_6$ ('Hofmann's compound') and $3C_6H_4(OH)_2.SO_2$, and in solvates in general. They were used in denoting the chemical composition of a compound but clearly had no normal bonding significance. During Powell's study of tetramethyl ferrocyanide during his undergraduate period, his supervisor, T.V. Barker, pointed out that the packing of regular octahedra implied some tetrahedral holes. Powell realized that the solvent molecule could enter these holes but was unsuccessful in the pre-X-ray days in Oxford in trying to demonstrate this. A full structure of $[Fe(CNCH_3)_6]Cl_2.3H_2O$ done almost twenty years later suggested very strongly that the water molecules were also trapped in voids inside the crystal, although this was not stated in the original paper.

His experience with solvates and crystals containing caged structures and his intrigue with the 'enigmatic dot' in the formulae of molecular complexes prepared him for the major discovery of his scientific career, the inclusion compound. As so often, the breakthrough came by accident. 'Students, from time to time, in an excess of zeal or through forgetfulness, repeat what Clemm did in 1859. They overdo the reduction of quinone to quinol and end up with the spectacular yellow crystals of the addition compound with sulphur dioxide.' One of his research students, D.E. Palin, did exactly this and was set the task of obtaining a diffraction pattern from a crystal; the enclosure of the SO_2 molecule within the structure of the quinol became obvious. Slightly later the holes in the structure of Hofmann's compound that enclosed the benzene molecules were identified. A happy coincidence had Wilson Baker supply crystals of tri-*o*-thymotide solvates, which also turned out to be inclusion compounds. Powell then demonstrated that the structures accomplished enantiomorphic selection of racemic sec-butyl bromide. With the basic principles established, a whole series of inclusion compounds was subsequently found, involving many host crystals. They had mostly lain unrecognized in the literature. Some, such as Dianin's compound, were obvious candidates, but the host quality of urea was an accidental discovery. The cyclodextrins were the first case of enclosure by a single molecule with a hole at its centre. Several were natural products. 'Some compounds, the gas hydrates, intercalates of layer structures, zeolites, and the choleic acids may be regarded as confirmed suspects or founder members [of the inclusion compound club].'

The clathrate work provoked wide academic and industrial interest. He corresponded with many of the major chemists of his period, and cooperated in research with them. Reading this correspondence and the literature of the period leaves little doubt of the enormous significance of his discovery of inclusion compounds. He also became involved with purifying and separating the rare gases by forming specific inclusion compounds of them. This led to one full patent and a provisional one with BOC Ltd, both granted in 1952.

It was fortunate that the discovery was made by a true scholar with the knowledge and ability to supply a beautiful, and appropriate, name for the inclusion compound. He resorted

to Plautus for the word *clathratus*, translated as 'closed or protected by cross-bars of trellis' and Pliny for *clathri*, 'a trellis which encloses anything generally', and named such compounds 'clathrates'.

Powell continually brought his delight in crystals and form to non-specialist audiences and wrote a number of popular articles, often in the form of an imagined narrative in, for example, *The Times Science Review*.

Marriage

Powell married twice. His first wife was Winifred M. Timms in 1932. It is not known how and where they met and the marriage came as a surprise to his contemporaries. Their only child was still-born. Little is known about his wife. In the later years difficulties in his home life caused him to be more likely to be found in the Lamb and Flag in the evening than at home. He certainly liked a pint of beer but his drinking was always moderate. He twice fell off his bicycle on the way home, once sustaining a serious head injury that affected his mental powers for some months. This happened in 1943 and, somehow appropriately for Marcus, was due to an unfortunate encounter with a black cat during the blackout. The marriage ended in divorce in 1972 but they had separated some time before.

In October 1973, in Oxford, he married Primrose Jean Dunn, a hairdresser. This was the very happy marriage that he deserved; they enjoyed each other's company and travelled widely until his death. At his funeral this period was correctly referred to as his 'primrose years'.

Acknowledgements

Much of the research for this memoir was done by Sir Gordon Cox, F.R.S., who would have written it save for his untimely death. His papers were provided to the Society and to the very grateful author by his wife, Professor Mary Truter. The Archivist of the University of Oxford, Mr Simon Bailey, gave considerable help, not least in drawing attention to the sorted collection of personal papers of Powell's that form part of the Contemporary Science Archives held in the Bodleian Library. I also thank the following for their generous and most useful input: Mr I.D. Goode, Dr S.C. Wallwork, Dr J. Robertson and Dr A. McHardy. An article by Dr Wallwork concerning Powell's science has been heavily drawn upon (Wallwork 1985). Several others should be thanked who provided information to Sir Gordon Cox but whose names are largely lost. However, among those is certainly Mr Frank Welch.

References to other authors

Attwood, J.C., Davies, J.E.D. & MacNicol, D.D. (eds) 1984 *Inclusion compounds.* London: Academic Press.
Wallwork, S.C. 1985 *J. Inclusion Phenom.* **3**, 215–219.

Bibliography

The following publications are those referred to directly in the text. A full bibliography appears on the accompanying microfiche, numbered as in the second column. A photocopy is available from The Royal Society's Library at cost.

(1)	(1)	1931	(With M.P. Applebey) The polymorphism of lead monoxide. *J. Chem. Soc.*, 2821–2829.
(2)	(2)	1932	(With D.C. Crowfoot) Layer chain structures of thallium di-alkyl halides. *Nature* **130**, 131–132.
(3)	(8)	1935	(With W. Hume-Rothery) On the theory of superlattice structure in alloys. *Z. Kristall.* **91**, 23–47.
(4)	(20)	1940	(With N.V. Sidgwick) Stereochemical types and valency groups. The Bakerian Lecture. *Proc. R. Soc. Lond.* A **176**, 153–180.
(5)	(78)	1960	Japanese chemical writing—read it yourself. *Proc. Chem. Soc.*, 138–144.
(6)	(–)	1966	Colour in chemistry. *Chem. Br.*, 542–546.