Pioneering women chemists of Bedford College

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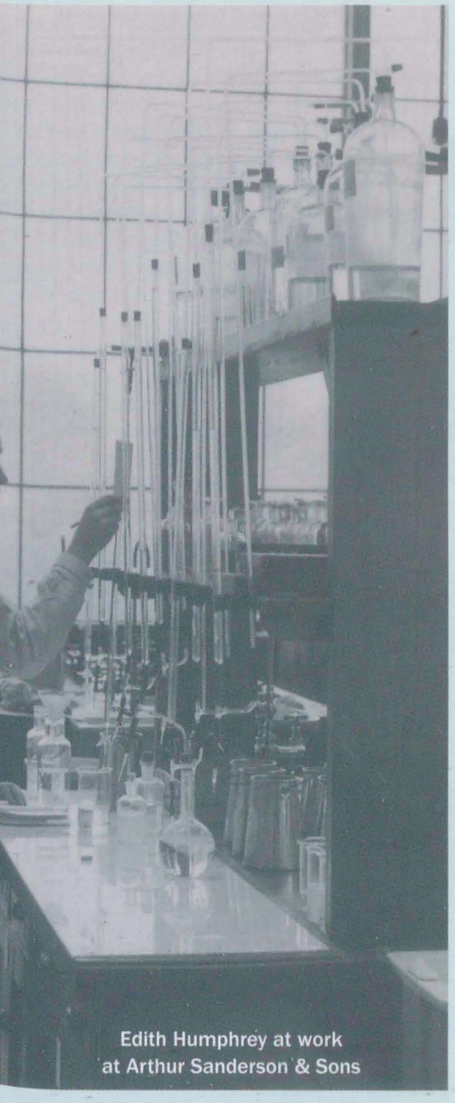
In the early part of the 20th century, a few institutions seemed to have been havens for women interested in chemistry. One was Bedford College, a women's college of the University of London. Now merged with Royal Holloway College, London, Bedford had a dedicated and vibrant chemistry department which produced some outstanding women chemists.



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Edith Humphrey at work at Arthur Sanderson & Sons

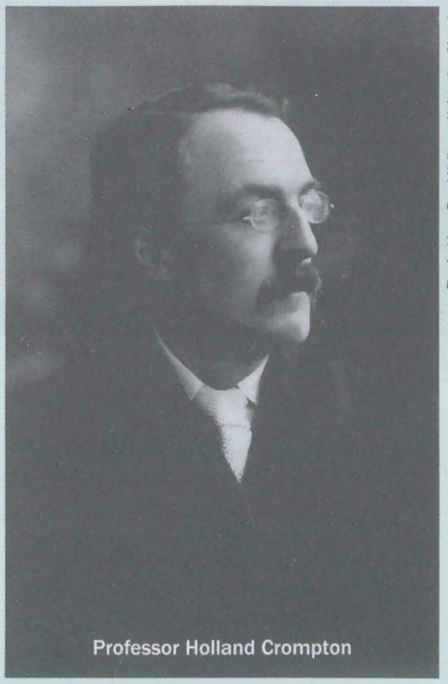
BEDFORD COLLEGE WAS FOUNDED AS A ladies' college in Bedford Square, London in 1849 though it was not until 1880 that the first Bedford students graduated with University of London degrees. Chemistry began to flourish in the late 1880s with the appointment of organic chemist Holland Crompton and the construction of the first university-level chemistry and physics laboratories for women in London.[1,2] In those days, it was unthought of for a woman to aspire to a senior rank in a university chemistry department. Instead they assumed subordinate roles, for example as supporting instructors.

Early pioneers

In 1898 Bedford appointed its first woman chemist – Barbara Tchaykovsky – as an assistant lecturer.[3] Tchaykovsky had been educated at the North London Collegiate School for Girls (NLCS), one of the first girls' schools in the UK to include science in the curriculum. (Science was not taken seriously by most girls' schools in the UK until well into the 20th century. Not surprisingly, there was a steady flow of science students from the NLCS to Bedford College.)[4] Tchaykovsky was a Bedford graduate, having completed her BSc the year before her appointment. She did not, however, stay long at Bedford, deciding instead to pursue a medical degree at the London School of Medicine for Women.

In 1906 Crompton was joined at Bedford by physical chemist James F. Spencer. By 1921, the chemistry department had grown to a substantial size with Crompton, the head of organic chemistry, having two demonstrators while Spencer, now head of inorganic and physical chemistry, had a junior lecturer and two demonstrators. The incumbents of the positions changed periodically until the hiring of organic chemist, Mary Stephen Lesslie in 1927, and physical chemist, Violet Corona Gwynne Trew in 1930. These women were the anchors of the Bedford chemistry department for the next 40 years.

Lesslie was educated at Morgan Academy, Dundee and graduated with a BSc, MA, and PhD from Dundee University College of the University of St Andrews (now the University of Dundee).[5] As a demonstrator, most of the organic chemistry teaching was her responsibility. With the arrival of Eustace E. Turner in 1928, who replaced the retired Crompton, the load was eased slightly and, in addition, Lesslie and Turner formed a research partnership that blossomed over the following decades. From 1928 to 1956, Lesslie coauthored a total of 25 research publications with Turner, the majority of which were on organic stereochemistry and the resolution of isomers, particularly those of substituted biphenyls. Lesslie was promoted to the rank of junior lecturer in 1932 and to senior lecturer in 1947. Despite gaining a DSc in 1950 from the University of London, Lesslie never received professorial status. Neither did she marry, though according to her: 'It was not for want of asking!'[5] Instead she dedicated her life to the cause of chemistry and to her students.[6] She retired to Dundee in 1968 where she survived for another 20 years, dying at age 86.



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Professor Holland Crompton

We know much less about Violet Trew. Trew was educated at James Allen Girls' School, Dulwich, completing her BSc at Bedford in 1926 and a PhD in 1928 (Bedford's first internal doctoral degree in chemistry). She taught most of the inorganic and physical chemistry in the department. When Margaret Jamison arrived at Bedford as an undergraduate, she commented:[2]

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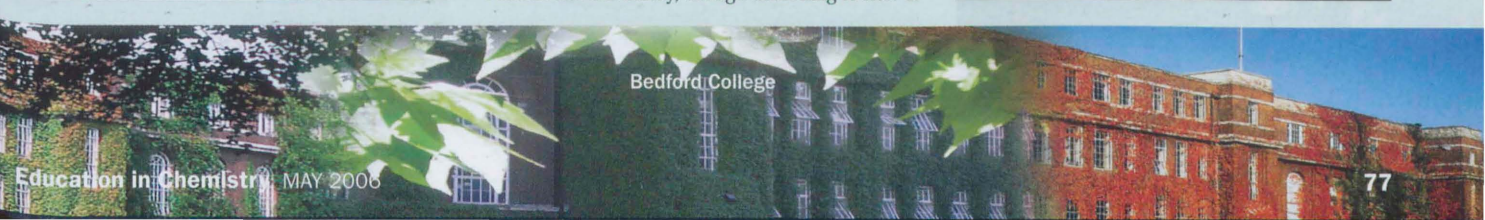
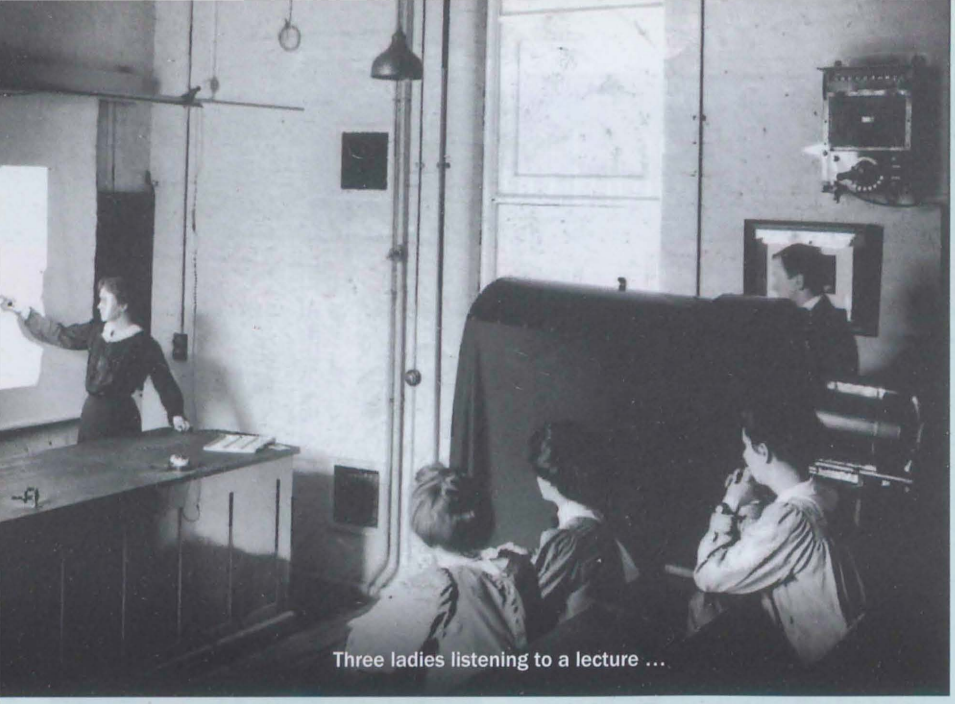
Professor James F. Spencer



Bedford College



Three ladies listening to a lecture ...

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On our first morning in 1932 we assembled in the inorganic laboratory, each to be allotted a cupboard (personal territory) and given, by Dr V C G Trew, a tube containing a powdered mixture whose composition we had to identify. We set about a regular series of tests; qualitative investigations such as fusion on a charcoal block using a blowpipe to get maximum heat, or bending platinum wire and forming a borax bead whose colour, after fusing with our mystery mixture, could (with other diagnostic tricks) lead to the identification of four or five components.

The physical chemistry lab was also under Trew's command, the experiments being done on Saturday mornings. Her speciality was magnetochemistry. While her early research papers were coauthored with Spencer, she published much of her later work with her as sole or senior author. In total she published 16 papers, mainly on the diamagnetic susceptibilities of organic liquids and of solutions of ionic compounds. Trew, too, was awarded a DSc from the University of London. She retired in 1969 and died in 1995 at the age of 92.

Although we have highlighted Lesslie and Trew, Bedford was fortunate in acquiring a stream of talented women staff who continued the tradition of excellence. The two stalwarts of the next generation, both alumna of Bedford, were Margaret Manderson Jamison (Mrs Harris) who was first appointed in 1938 and Dorothy Muriel Hall (Mrs Hargreaves), appointed in 1944. Women also filled the lower ranks within the department.[7] The early volumes of the *Bedford College Magazine* provide an insight into the enthusiasm for chemistry that prevailed at the institution (see Box).[8–11]

The forgotten pioneers

Among the many talented Bedford chemistry alumna were: Edith Ellen Humphrey,[12] a pioneer of coordination chemistry and two fellows of the Royal Society – Helen Archbold and Rosalind Henley.

Edith Ellen Humphrey

Born in 1875, Humphrey attended the North London Collegiate School for Girls and entered Bedford College in 1893. Following completion of her BSc degree in 1897, she applied for and was accepted to do a PhD at the University of Zürich. Zürich first admitted women in the mid-1860s and it had become a haven for women students from all over Europe.[13] It was her thesis work with the inorganic chemist and founder of the modern theory of coordination compounds, Alfred Werner, that was to enter her in the annals of the history of chemistry. Humphrey was the first of Werner's students to synthesise geometric isomers of octahedral complexes. In fact, she synthesised two forms of $[Co(NO_2)_2(en)_2]X$ for the series $X = NO_2$, NO_3, Cl, Br, I, $\frac{1}{2}PtCl_4$, and $\frac{1}{2}PtCl_6$. The formation of these isomers supported Werner's contention that cobalt(III) was octahedrally coordinated. Werner was so impressed with her careful, painstaking work that, for her last year, he took her on as his personal assistant, the first woman to be chosen for this prestigious post.[14] Apart from the prestige, the impoverished Humphrey was relieved to have, at last, some income to live in the very expensive Switzerland.

We now realise that the compounds Humphrey synthesised were even more significant. As early as 1899, Werner had considered the possibility

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Undergraduate student life

Chemistry had the largest enrolment among the sciences at Bedford.[8] Some of the reports highlight the differences from today's chemistry. For example, during those early years, danger was regarded as an intrinsic part of laboratory life as the following commentary from an 1898 issue reveal:[9]

A certain amount of excitement was caused one afternoon by the fact that one student was suddenly seen to be in flames. However, she lay down quite calmly, and was immediately knelt upon by her nearest neighbours, so that all danger was over before most people knew what had happened and they only caught a glimpse of her as she lay 'smiling and smouldering' on the floor. We consider the behaviour of those concerned a credit to the College and to the cause of women's education.

Explosions also seemed commonplace according to a subsequent remark in 1900:[10]

At present, one's life is a series of adventures in the Chemistry Laboratory, for bits of flying glass are as plentiful as the smuts on the window-sill.

While drinking and eating in the lab was taken for granted:[10]

Undergraduate chemists on the whole, seem to enjoy life in all places and at all times, be it at their work, or having tea-fights in the chemistry laboratory, when beakers take the place of cups, and flasks do for kettles. Some say that tea-cakes cooked on asbestos have a very savoury taste.

And the unique appearance of chemistry students was observed:[11]

This science [chemistry] indeed leaves a hall-mark upon its devotees. They can usually be distinguished by the moth-eaten appearance of their clothes and the peculiar colour of their hands.

Bedford labs in the 1970s

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of optical isomerism in octahedral coordination compounds. *Cis*-bis(ethylenediamine)dinitrocobalt(III) bromide complexes spontaneously resolve upon crystallisation. Thus Humphrey was the first chemist to synthesise a chiral (optically-active) inorganic complex.[15] Yet curiously, Werner did not investigate Humphrey's complexes for optical activity. It was not until about 10 years later that optical activity was shown to occur in cobalt(III) complexes – a discovery that contributed to Werner being awarded the Nobel prize for chemistry in 1913.

Her PhD finished, Humphrey continued her studies with Professor Ostwald in Germany on the recommendation of Werner. There was a problem, as Humphrey herself commented:[12] 'But they wouldn't have me in Germany. They said I could go to lectures but not practicals because the men wouldn't do any work.' Thwarted in her plans, Humphrey returned to England and obtained work in the chemical industry, spending most of her working life as a research chemist with Arthur Sanderson & Sons, who specialised in the manufacture of fabrics and wallpapers. She died in 1977 at the age of 102.

The chiral crystals synthesised by Humphrey were donated to the Royal Society of Chemistry (RSC) in 1991 on the occasion of its 150th anniversary by the Swiss Committee on Chemistry. The crystals currently reside at the Society's headquarters in Burlington House, London together with a CD spectrum of a solution of one of Humphrey's crystals showing, without doubt, that it was an optical isomer.

Helen Archbold (Mrs Porter)

Helen Kemp Archbold, born in 1899, was educated at Clifton High School for Girls, Bristol, and entered Bedford College in 1917.[16] Graduating in 1921, she obtained one of the places reserved for women in Jocelyn Thorpe's organic chemistry research group at Imperial College.

In the early 1900s, during the large-scale importation of apples, whole cargoes in the refrigerated holds of ships were found to have turned brown and unfit to eat. A joint Cambridge–Imperial research team was set up in 1918 to investigate the problem. In 1922 Archbold was invited to join the team working on the plant biochemistry part of the study. As the chemist she investigated the nitrogen content of apples, used iodimetry to measure the levels of reducing sugars, and tried to relate carbon dioxide output to the loss of sugar and acid. Over time, her research shifted from the chemical analysis of apples to studying the metabolic processes of the maturing apple.

Helen Kemp Porter FRS

In 1931, Archbold was transferred to the plant physiology team at Imperial College to work on the origin of starch in barley. This study continued into the 1940s and laid the foundation for her subsequent research on polysaccharide synthesis. By the 1950s, her group was focusing on the newly-developed radioactive tracer methods as a way of studying metabolism in living plant tissues. As a result of this work she was elected a fellow of the Royal Society in 1956 and, in 1959, she became the first woman professor at Imperial College.

Archbold combined her academic brilliance with a taste for adventure and travel. Unfortunately, her personal life was dogged by tragedies. Her first husband, William George Porter, MD, died after only a few years of marriage, while her second, Professor Arthur Huggett, FRS, died after only six years of marriage. Archbold, herself, died at the age of 88.

Rosalind Henley (Mrs Pitt-Rivers)

Rosalind (Ros) Venetia Henley, born in 1908, developed her love of chemistry at the age of 12 when she was given a chemistry set by an uncle:[17]

> *This present proved to be such a success that she, along with her cousin Ed, ..., was given the stables ... to be used as a laboratory. The inhabitants of the estate were not only alarmed by the smells that emanated from there but remember at least one explosion that came quite close to a disaster.*

Henley went to Notting Hill High School in west London, another of the few pioneering girls' schools to offer science courses in those days. At Bedford she completed a BSc in 1930 and an MSc in 1931. That year she married George Lane-Fox Pitt-Rivers and the following year, her son was born. The marriage was not a happy one. In 1937, Henley left the family home and an acrimonious divorce ensued. George Pitt-Rivers' loss was chemistry's gain. Henley went on to do a PhD at University College Medical School on methyl glucosaminides and their hydrolysis by snail enzymes under the guidance of Sir Charles Harington.

Harington proved to be just the sort of mentor that Henley needed. Following completion of her PhD in 1939, Henley accompanied Harington on his move to the National Institute for Medical Research in Hampstead. She specialised in iodoproteins, particularly the thyroid hormone, L-thyroxine, for which she developed a model for its biosynthesis. However, her research was disrupted by World War II, during which she was seconded to various war-work projects.

It was the 1950s-developed analytical method of paper chromatography that provided her with the tool for her great discovery. Using the technique, she reported in 1952 that human blood contained another iodoprotein which she identified as triiodo-L-thyronine (T3). This compound has since been recognised as the major thyroid hormone. Blood levels of T3 have been used ever since as a routine diagnostic test for thyroid disorders. The discovery of this unusual hormone and its usefulness in clinical tests resulted in Henley's election as fellow of the Royal Society two years later. She continued working on iodine-containing biomolecules until her retirement in 1972. An outgoing person, Henley enjoyed the social aspects of science as much as the discovery aspect. However, her health started to deteriorate in 1985 and she died in 1990.

And finally ...

In the US, the role of small undergraduate colleges as nurturers of scientific talent has been long appreciated. Women, in particular, have benefited from the environments of such renown institutions as Bryn Mawr College and Mount Holyoke College. We believe it is unfortunate that there has been less recognition of this phenomenon in the UK. The atmosphere of enthusiasm and dedication for chemistry at Bedford College that produced such talented graduates as Tchaykovsky, Trew, Humphrey, Archbold, and Henley shows that the name of Bedford College should be added to that illustrious list. In 1985 Bedford College and Royal Holloway College were merged and now come under the name of Royal Holloway College. Sadly, chemistry degrees are no longer offered.

Edith Humphrey's chiral cobalt crystals

Royal Society of Chemistry

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