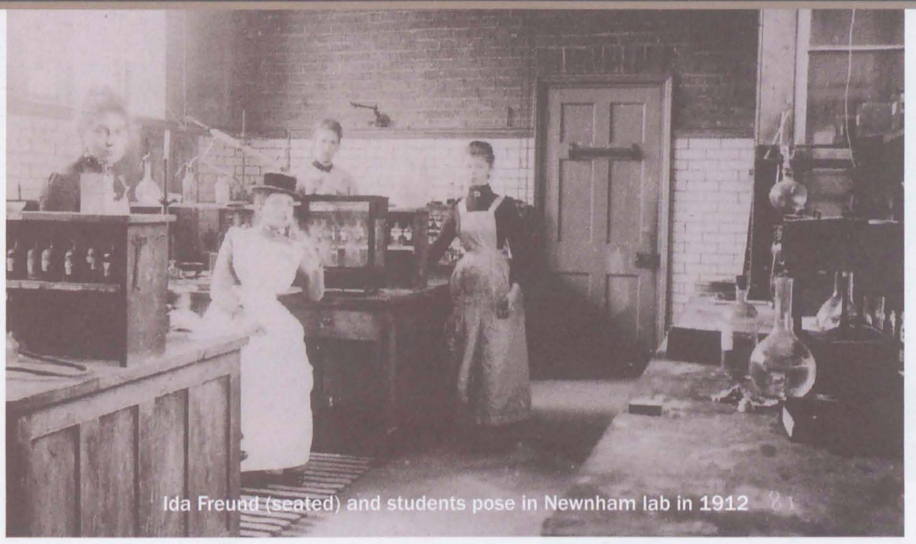
Ida Freund – pioneer of women's education in chemistry

Margaret Hill and Alan Dronsfield



Newnham College Archives

Ida Freund (seated) and students pose in Newnham lab in 1912

Ida Freund (1863–1914) was the first woman to become a university chemistry lecturer at a time when the subject at this level was almost exclusively the domain of men. But did she influence the chemistry taught in schools and colleges in the early years of the 20th century and if so, do any traces of her legacy persist today?

IDA FREUND WAS BORN IN AUSTRIA BUT HER mother died when she was just a child and she was brought up by her grandparents in Vienna. She went to the local state school and then to the state Training College for Teachers. In 1881, her grandmother died and she was sent to England to live with her uncle and guardian, the violinist Ludwig Strauss. One year later, Strauss enrolled her at Girton College, Cambridge, which in 1869 had been the first college for women at the University of Cambridge.

An academic pathway

Despite initially being vehemently against going to Girton – she had no real say in the matter anyway – in time Freund came not only to enjoy university life at Cambridge but she became devoted to it. In 1886, she gained 'first class honours' in the Natural Sciences Tripos course, though at the time 'women students were permitted to take university exams but were not members of the university, and hence were not eligible for degree status ... it was not until 1948 that women could formally receive degrees from Cambridge University'.[1] Instead, women were awarded a certificate of proficiency.

After graduating Freund went to Cambridge Training College for Women as a chemistry lecturer, and one year later joined Newnham College, Cambridge, as a demonstrator. Newnham, founded in 1871, was the second women's residential college at Cambridge. Three years later, in 1890, she was promoted to lecturer in chemistry at Newnham where she remained until her retirement in 1913. When she arrived at the college in 1887, 'women students were not admitted to the University Chemical Laboratory until they had passed Part I of the Tripos, and thus Miss Freund was entirely responsible for the [initial] laboratory training of the majority of her students, many of whom came up to College with little or no knowledge of chemistry'.[2]

Freund's teaching duties appear to have left her little time for research, she neither studied for a master's degree nor a doctorate. Her only published paper was *The effect of temperature on the volume change accompanying neutralization in the case of a number of salts at different concentrations.*[3] This is a meticulous, substantial 58-page paper, written in English and translated into German for publication and complete with many tables of results.

Freund did, however, write two chemistry textbooks. It is these we look to first for evidence of her approach to teaching, and any influence she may have had in the chemistry taught in schools and colleges in the early 20th century.

Freund's chemistry texts

Freund's first textbook, *The study of chemical composition: an account of its method and historical development with illustrative quotations,*[4] was published in 1904. This was a partial history of chemistry, concentrating on the development of ideas such as the periodic law, valency, the atomicity of matter and the Cannizzaro system of atomic masses. The book was written as a text for teachers who wanted to achieve a deeper insight into the topics in their syllabuses. For its time it was remarkably up to date, with sections on the electron, radioactivity and the noble gases. Indeed, a reprinted edition in 1968 suggests a continuing influence, and today it might profitably be read by individuals interested in the history of chemistry. According to historian M. M. Pattison Muir,[5] this book was 'among the really great works of chemical literature' and perhaps in its time, it was. But chemistry moves on and the genesis of chemical ideas appeals only to the select few, mainly historians of chemistry, and her book today is largely overlooked.

Freund's second textbook, *The experimental basis of chemistry: suggestions for a series of experiments illustrative of the fundamental principles of chemistry,*[6] was published posthumously in 1920, and gives more of a flavour of her approach to teaching. In its preface, editors A. Hutchinson and Mary Beatrice Thomas (one of her students and a lecturer at Girton College) suggest that in writing it: 'Miss Freund was attempting to bring to the notice of other teachers her views as to the manner in which students may be helped to realise that chemistry is a science based on experiment, and that logical interpretation of experiments leads directly to the generalisation known as the laws of chemistry'.[2]

Thomas says of her approach that: '(she) had a dread of thoughtless experiments and slipshod thinking, and that she felt strongly that much that passed for training in science had little relation to scientific method and was of small educational value'. Certainly, rigour was Freund's strong point. In her description of a method to find the mass (D) of one litre of HCl gas at 0°C and 760mmHg she applies the rather daunting equation:

$$D = \frac{\left(w' - w + d_{air} \times a \times 273 \times \frac{p}{(273 + t) \times 760}\right) \times 1000}{a \times \frac{273 \times p'}{(273 + t' \times 760)}}$$

She then worries over the fact that her (or her students') results gave $D = 1.688$ (leading to a relative molar mass for HCl of 37.8), significantly different from the 1909 accepted value of 1.639 (RMM for HCl of 36.7).[6]

Freund's approach to teaching chemistry was certainly experimentally based, though she had little patience with Henry Armstrong's heuristic approach that pupils should discover chemistry like front-line researchers. According to Freund: '[This] would have us believe that in the course of some couple of hours' work the average pupil can definitely correlate an observed effect with its cause, can *discover* the nature of a chemical relationship, or can prove a law'.[6]

Instead, Freund advocated the approach favoured by Wilhelm Ostwald in which: 'The main facts of chemistry are dealt with in the form of a dialogue between a teacher and a pupil. 'The method is heuristic in its truest ... sense, but there is ... no pretence about what the pupil really accomplishes for himself and what is done for him. Thus in the investigation of the effect of varying pressure on the volume of a definite quantity of air ... the results [are] recorded in tabular form:

Pupil: What is the use of that?

Teacher: I want to show you *how to discover a law of nature*. And when, after a number of ex-

planations ... and trials, the relation pv = constant has been formulated:

Teacher: Right. Now you have found the law which connects the pressure and volume of air with each other, or makes them dependent on each other.

Pupil: I should never have found that out without your help.

Teacher: I quite agree.

Pupil: I say, did *you* find it out by yourself?

Teacher: No. An English physicist named Boyle discovered it more than 250 years ago, and it now goes by the name of Boyle's Law.'[6]

Freund goes on to say: 'Surely, therefore, the more honest, intellectually more bracing and eventually more fruitful course is to sweep away all delusions as to what pupils can discover for themselves, and further to impress on them at as early a stage as possible the fundamental difference between the 'illustrative experiments' they perform and real research.'[6]

So this is it. Freund's experiments were designed to demonstrate chemical truths. There was nothing new in this, and until Armstrong's version of heurism, this was the traditional aim of most experimental work. And largely it persists today in our teaching. Freund's contribution was to contextualise almost exhaustively, the experiments her pupils did, and have them perform them with such rigour that the chemical truths were as unambiguous as possible.

The disadvantage of this approach, however, was that pupils progressed slowly, which led George Fowles, a distinguished chemical author of the 1930s–50s, to comment on her text: 'This work, though full of helpful suggestions, arguments, and keen criticism, constitutes in itself a most weighty objection (to her) method. For in a course intended for university students, and occupying 400 closely packed pages, the author arrives no further than the law of multiple proportions.'[7]

Newnham College Archives

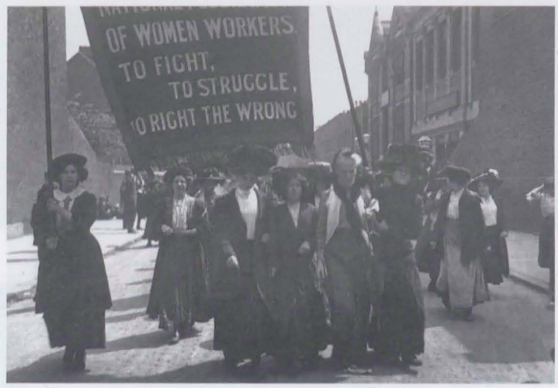
Former pupils

In our search for evidence into the extent of Freund's influence on chemical education, we now turn to testimonials of past students, some of whom later went on to become chemistry teachers or lecturers themselves. Their comments suggest that her work was influential in promoting the subsequent entry and acceptance of women into academic and research careers.

A former student writes:[8] 'In my day Miss Freund reigned supreme in the chemistry lab in the garden.' (The old laboratories were restored in the 1990s and are now used for concerts, plays and exhibitions.) 'She was a great character – Austrian by birth, she wrote excellent English but never managed to speak it. She would break off a sentence and say, "Have I got you wiz me in zat?"; and on one occasion when a student had had a little argument with her she said, "Now, Miss X, have I got you wiz me in the hydrochloric acid?". Every year just before the Tripos examination she would summon her chemistry students to do some special study. It was of course a hoax. In 1907 she urged them to go to the lab to study again the lives of certain chemists. They found large boxes of lovely chocolates ... with a different life-history and picture of some famous chemist in each. In my year we were requested to go and make a further study of the "Periodic Table of the Elements". We found a very large board with the Table set out. The divisions across and down were made with Edinburgh Rock, numbers were made of chocolate, and the elements were iced cakes each showing its name and atomic weight in icing. The nonvalent atoms were round, univalent had a protruding corner, bivalent two, trivalent triangular, and so on. We divided it up between us!.'

'Miss Freund's invitation to the Periodic Table read: "Your attention is drawn to the desirability – in fact the necessity – of perfecting your knowledge of the Periodic System of Classification of the Elements. Whether considered from the point of view of theoretical or of descriptive and classifactory chemistry, Mendeléev's system demands extensive and detailed knowledge, and such time as you can still give to revising (= cramming??) chemistry might, it is suggested, be advantageously spent on this subject. Since however it has always been recognised that a well-arranged and well-spaced out table which allows one to take in at a glance as many facts and relationships as possible, is a desideratum in this matter, you will find at the laboratory such a table provided for your use. This table, whilst in the main following the usual lines, tries to bring out, by means of a tentative symbolism, more facts than it is usual to try and convey. Whether however it is of a kind that would lend itself to extended use as an adjunct to the study of chemistry must be considered doubtful".

Another Newnham student reminisces about her tutor, Freund, who had lost a leg as a result of a cycling accident in her youth:[8] 'Miss Freund was a terror to the first-year student, with her sharp rebukes for thoughtless mistakes. One grew to love her as time went on, though we laughed at her emphatic and odd use of English. Yet how brave she was trundling her crippled and, I am sure, often painful body about in her invalid chair smiling, urging, scolding us along to "zat goal to which we are all travelling which is ze Tripos".



Hulton-Deutsch Collection/Corbis

Freund backed the suffragettes

A leading light

Only a brave minority of university-educated women went on to pursue careers, particularly in teaching. Several teachers were former students at Newnham[9] and they in turn encouraged their pupils to study at Newnham. One such pupil was Mary Beatrice Thomas, who co-edited the Ida Freund textbook, and another was Ida Smedley MacLean (1877–1944), who became a research scientist at the Lister Institute of Preventative Medicine.

Ida Freund was also an active feminist and supporter of women's suffrage. Together with Ida Smedley and Martha Annie Whiteley (1866–1956), a lecturer at the Royal College of Science, she was a leading light among the women who fought for admission to the Chemical Society in the early 1900s.[10]

Sadly, Ida Freund did not live to see her friend's victory in gaining admission to the Chemical Society in 1920. She died in 1914 following an operation and the Ida Freund Memorial Fund was set to raise the standard of women teachers in the physical sciences by giving them opportunities for further study. The fund still exists today.

Examination of Ida Freund's textbooks and personal testimonies from students, together with her campaign for the acceptance of women in chemistry on equal terms, suggests that she did have an influence on chemistry teaching in the early 20th century. The outward ripple effect of pioneer women teachers, including Ida Freund, has spread through successive generations of students and teachers, and inspired girls to study chemistry. Today women comprise about half of all undergraduate chemistry students.

Acknowledgements: we thank the principal and archivist of Newnham College for their help.

Margaret Hill is an honorary research assistant at the University of Derby, Kedleston Road, Derby DE22 1GB; and Alan Dronsfield is professor of the history of science at the same institution.

References

1. M. and G. Rayner-Canham, *Women in chemistry*. Philadelphia: Chemical Heritage Foundation, 2001.
2. A. Hutchinson and M. B. Thomas, editors' preface to I. Freund, *The experimental basis of chemistry*. Cambridge: CUP, 1920.
3. I. Freund, Zeitschrift fòr Physikalische Chemie, 1909, **66**, 555.
4. I. Freund, *The study of chemical composition: an account of its method and historical development with illustrative quotations*. Cambridge: CUP, 1904.
5. O. T. Benfry, biographical essay in I. Freund, *The study of chemical composition*. New York: Dover Publications, 1968.
6. I. Freund, *The experimental basis of chemistry*. A. Hutchinson and M. B. Thomas (eds). Cambridge: CUP, 1920.
7. G. Fowles, *Lecture experiments in chemistry*, 6th edn. London: G. Bell and Sons, 1963.
8. A. Phillips (ed), *A Newnham anthology*. Cambridge: CUP, 1979.
9. M. R. S. Creese, *Br. J. Hist. Sci.*, 1991, **24**, 275.
10. J. Mason, *Chem. Br.*, 1991, **27**, 233.