A woman at the dawn of biochemistry

Maud Leonora Menten

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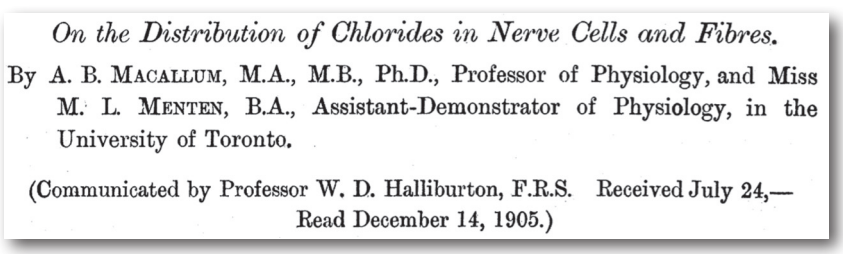
Ask an average biochemist who was the first to realize that variant proteins could be detected by electrophoresis and sedimentation, and had used this understanding to recognize different forms of haemoglobin, the reply would probably refer to Linus Pauling and his work on sickle cell disease. Yet, although this work was certainly important, that would be the wrong answer, because Maud Leonora Menten, who sometimes seems to be remembered for one paper only, had this idea several years before him, and used it to recognize the differences between foetal and adult haemoglobin[1]. She was unfortunate, however, in that her paper appeared in war time, and was eclipsed a few years later by a far more high-profile study[2].

In 2013 we celebrate two important centenaries not only of the admission of women to the Biochemical Society (why did it take so long?), but also of the publication of a paper by Maud Menten, who was one of the first women to leave her mark in biochemistry, with a paper that is cited more often in the 21st Century than it was in the 20th. This, of course, is the famous paper that she published with Leonor Michaelis in *Biochemische Zeitschrift*.

Menten was already an established researcher before she went to Berlin at the age of 33 years. She had published her first paper with Archibald Macallum, the Professor of Physiology at the University of Toronto, Canada, in 1906, on the distribution of chloride ions in nerve cells. Macallum was not only a very distinguished scientist, but he later became a very powerful one, as he set up the National Research Council of Canada. It is hard to believe, therefore, what one can read in various articles that she made her career in the USA because women were not able to do research in Canada: what was she doing in 1906, if not research? Probably, we shall never know, but it seems more plausible that either she had no possibility of setting up her own research programme in Canada, or she left on Macallum's advice, and that he believed she would have more scope in the USA to develop her full potential. Whatever the reason, she went to the Rockefeller Institute for Medical Research to work with Simon Flexner, its first Director, and later the person who appointed Leonor Michaelis to his position there. With Flexner and James W. Jobling, she wrote a book (the first monograph emanating from the Rockefeller Institute) on the effects of radium bromide on tumours of animals, published in 1910 – barely 10 years after Marie Curie's discovery of radium.



On the Distribution of Chlorides in Nerve Cells and Fibres.

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Figure 1. The title of title of her first paper with Macallum; Macallum, A.B. and Menten, M.L. (1906) Proc. Roy. Soc. Lon. B **77**, 65–193

From the Rockefeller Institute she moved in 1912 to Cleveland, to work with George Crile, one of the greatest surgeons of his time, where she worked on the hydrogen ion concentration in blood in relation to the control of acid–base balance during anaesthesia and surgery. (There is even a mention of this work in a 1918 paper by Benjamin Moore, the first Chair of Biochemistry in the UK, who refers to Menten, alongside Crile, among many American surgeons… [sic]). It was almost certainly this interest that took her to Berlin, and we can imagine that Crile advised her to learn about pH and buffers from the world's leading expert at that time, Michaelis. (Michaelis, with his colleague H. Davidsohn, had already published a paper on the effects of hydrogen ions on invertase activity in 1911[3], just 2 years after Sorenson's seminal contribution on pH.) She probably went to Berlin at her own expense, as Michaelis, who had no paid academic position himself, was unlikely to have been able to support her financially. Moreover, she made no mention of her work in Berlin in her entry in American Men of Science, but listed two apparently consecutive fellowships in Cleveland, for which the most likely explanation is that she had no formal position in Michaelis's laboratory at the Hospital am Urban. As she already had her MD from the University of Toronto (despite being named as 'Miss Maud L. Menten' on the paper with Michaelis) it is possible that she had some income from the hospital.

However, that is just speculation. One might doubt whether she would have known enough German at that time to work with patients, but she had great linguistic skills, and it is by no means unlikely that she could already


Die Kinetik der Invertinwirkung.

Von

L. Michaelis und Miß Maud L. Menten.

(Eingegangen am 4. Februar 1913.)

Figure 2. The title of the Michaelis and Menten paper in Biochem. Z. **49**, 333–369

speak German by 1913. By the end of her life Menten was fluent in six languages, not only English, French, Italian, German and Russian, but also Halkomelem, one that most readers of *The Biochemist* may not have heard of (she learned this as a child growing up in Harrison Mills, British Columbia, Canada, as it was the language of some of her friends at school).

Menten obtained her PhD from the University of Chicago (USA) in 1916, which was awarded for studies of the effects of adrenalin on haemoglobin. Subsequently, she made her career at the University of Pittsburgh (USA) until her retirement in 1954. She was appointed as demonstrator in pathology at the University of Pittsburgh Medical School in 1918 and became a pathologist at the Pittsburgh Children's Hospital in 1926. Her work was in medical research, especially histochemistry and paediatric pathology, and that, no doubt, explains why it has tended to fade from the view of biochemists, although much of it built on her expertise in biochemistry, and deserves to be better known that it is. Apart from the work on haemoglobin mentioned above, she introduced a histochemical method involving azo dye coupling for detecting alkaline phosphatase in the kidney that a leading textbook of the 1950s[4] described as a 'touch of genius', and she discovered the explanation of the hyperglycaemic effects of bacterial toxins. It is somewhat surprising, therefore, that she was not promoted to a full professorship until 1950, the year she retired. Someone thought better of this… and 1982 saw the establishment at the Pittsburgh School of Medicine of the Annual Maud L. Menten Lecture and in 1988, the Maud L. Menten Professorship of Experimental Pathology.

But returning to the Menten's original claim to fame, it is remarkable that nearly 100 years after publication of Michaelis and Menten's original data, a new analysis of

Maud Menten as a young woman (photograph kindly provided by her great-nephew Mr John R. Barberie).

the original data, using modern computational methods, 'revealed an unanticipated rigor and precision'[5]. Quite likely, this is a tribute to her and Leonor Michaelis's fine skills as experimenters.

The 'Leonora' in her name has sometimes caused some speculation: did she, for example, add it in honour of Leonor Michaelis, as Keith Laidler suggested, or was it there all the time? There was an 'L.' in her first publication with Macallum in 1906, long before there was any question of working with Michaelis, and her great-nephew, John R. Barberie, informs us that there were other Leonoras before her in her family. That would seem to settle the question, but recently Mr Barberie has obtained a copy of her birth certificate, in which there is no L. and no Leonora.

More detail on Menten's life and career may be found elsewhere[6–8] ■.

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