



McBain and the centenary of the micelle



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ABSTRACT

In 1913, J.W. McBain introduced the word “micelle” into surface and colloid chemistry in the context of the association of surfactant molecules in aqueous solution. This article gives a biographic account of McBain, and reviews the early work on micellar aggregation, leading up to the pioneering ideas of G.S. Hartley who introduced the first model of the spherical micelle that we would recognise today.

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1. Introduction

2013 marks the 100th anniversary of the first use of the word “micelle” to describe an aggregate of soap molecules in solution. James William McBain (1882–1953) introduced the term in a discussion contribution he made at a meeting on March 12 1913 in London of the Faraday Society (founded in 1903 and which in 1972 became the Faraday Division of the Royal Society of Chemistry). The meeting, entitled “Colloids and their Viscosity”, was held at Burlington House in Piccadilly (the home of the former U.K. Chemical Society and these days of the Royal Society of Chemistry). It was chaired by Emil Hatschek (born in Hungary but in 1913 a lecturer in colloid chemistry at the Sir John Cass Technical Institute in East London) and was attended by several eminent colloid scientists from Europe, including Herbert Freundlich (Brunswick), Wolfgang Ostwald (Leipzig), Victor Henri (Paris) and Wolfgang Pauli (Vienna). The proceedings were subsequently published in the Transactions of the Faraday Society [1]. There is an interesting account in the “History of the Faraday Society” [2] of the meeting. Apparently there was a collection held amongst the UK attendees to help pay for the travelling expenses of the overseas' guests, and for their “splendid dinner” at the Trocadero Restaurant in London after the meeting!

It is interesting that a three-day Faraday Society discussion meeting on “colloidal electrolytes” was held at University College, London in September 1934, under the chairmanship of Professor Frederick Donnan (University College) [3]. The following persons, who had been present at the 1913 Faraday Discussion meeting, were present also at the 1934 meeting: Herbert Freundlich (who had left Germany in 1933 for political reasons and in 1934 was a guest in Donnan's laboratory, before moving on to the University of Minnesota in 1938), Wolfgang Ostwald and Emil Hatschek. In addition, Wolfgang Pauli (Vienna) and James McBain (by then moved to Stanford) both submitted papers to the meeting, but were unable to be present in person.

McBain had joined the staff at Bristol University in 1906 as a young lecturer. There he had begun studying the physical properties (principally, the electrical conductivity and colligative properties) of aqueous soap solutions. He presented no thoughts, at that 1913 Faraday meeting, regarding the possible structure of soap micelles or of the idea of a critical micelle concentration. Those ideas were to follow subsequently.

This article has two further sections: the first contains some biographical notes on McBain himself and the second deals with the scientific story of the early research on micelles.

2. James William McBain

James William McBain (Fig. 1) was born on March 22, 1882 at Chatham, New Brunswick, Canada, the son of a Presbyterian minister.

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Fig. 1. J.W. McBain.

He studied chemistry at the University of Toronto, obtaining a BS in 1903, and then an MA with first class honours in chemistry and mineralogy in 1904, which included his first efforts in research (with a Dr. Miller). He then went to Germany to extend his research experience. The winter semester of 1904–5 was spent working with Professor Luther at the University of Leipzig. At that time the university had on its staff two early giants of surface and colloid science, who were to attend the 1913 Faraday meeting in London: Wolfgang Ostwald and Herbert Freundlich (who subsequently moved to Brunswick).

The following three semesters McBain spent with Georg Bredig at Heidelberg University, working towards his Ph. D. degree (subsequently awarded by Heidelberg University in 1909, i.e. *after* he had moved to Bristol). Here, significantly, he would have met Friedrich Krafft who in 1895 [4], was the first person to report the anomalous colligative properties of dilute soap solutions in water, although Krafft did not offer any satisfactory explanation at that time. In Germany McBain developed a strong passion for art and music, becoming an accomplished flute player.

In 1906 McBain was recruited as a lecturer by Morris Travers, the professor of chemistry at the then University College of Bristol in the UK. This became the University of Bristol in 1909, when it received its royal charter (Travers played a significant role in the early discussions on this matter, although he left for the University of Bangalore in 1907). McBain and Professor Francis Francis, who succeeded Travers as professor of chemistry in Bristol, both played major roles, along with the architects (Oatley and Laurence), in the design of a new chemistry building for the university, which was opened in 1910 (Fig. 2).

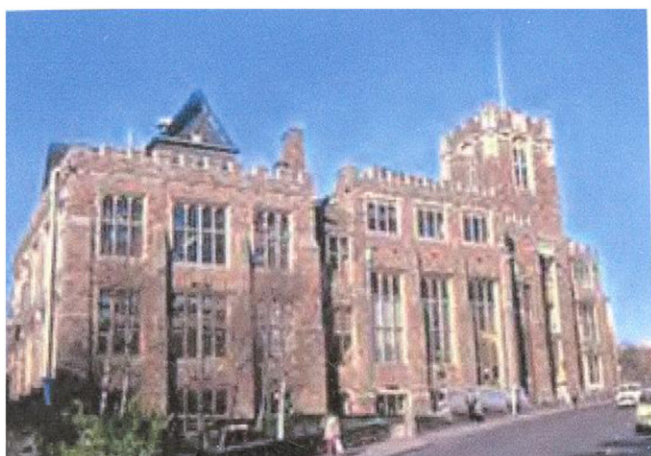


Fig. 2. The 1910 chemistry building, Bristol University.

When McBain first came to Bristol he worked on a variety of topics, including silver–tin alloys, the dissociation of acetic acid in solution and critical phenomena, but he soon turned his attention to the study of soap solutions. Most of his early work in this area was funded either by the Research Fund Committee of the U.K. Chemical Society or the Colston Society, which had close links to the University of Bristol. He undoubtedly drew on his first-hand knowledge of the earlier work of Krafft whilst in Heidelberg, and on the experience of organic chemists at Bristol, such as Professor Francis Francis, who had shown how to purify fatty acids. In 1919 McBain was appointed to the newly-created Leverhulme Chair of Physical Chemistry. This was created for McBain, largely to fend-off an approach by his old *alma mater*, the University of Toronto, to recruit him. The money for this chair was raised by the university from the Lever Brothers Company, largely through the efforts of Professor Francis and Mr. A. Walls, a Director of Lever brothers, who persuaded Lord Leverhulme to endow this new chair at Bristol. McBain's work on soap systems was well known to the company. Indeed McBain had analysed and had written about the principle soap manufacturing process used by companies like Levers, the so-called “soap boiling” process [5]. He also participated in the meetings of the Council of the UK Launderers' Research Association.

During his time in Bristol, McBain took a full part in the wider life of the university. He took active roles in the formation of the University Alumni Association, the Officers' Training Corps (O.T.C.), the Guild of Undergraduates, and the Association of University Teachers, for which organisation he served as president, firstly of the local Bristol branch and later of the National Association itself. He was an active sportsman, participating in football, tennis and swimming. In Bristol he became a Freemason and an ardent Rotarian. Prior to the onset of the First World War, McBain had married Anna Roeder from Karlsruhe. They had one daughter, Janet Quinn McBain, but the war divided their patriotic loyalties and the marriage ended in divorce. At the commencement of the war, McBain was already an officer in the O.T.C. at the university. Subsequently, during the war, he worked for the Department of Explosives Supply in the Ministry of Munitions.

During the 20 years he spent in Bristol, McBain supervised around 20 graduate students, including three ladies, two of whom went on to have significant academic careers of their own. One of these was Mary Evelyn Laing (more about her later). Another was Millicent Taylor with whom he published some of the early work on soap solutions. She was a teacher at Cheltenham Ladies College, and used to come to Bristol periodically to carry out her research with McBain, often cycling to Bristol at weekends (some 40 miles each way!) for this purpose. In 1921 she moved full-time to Bristol, as a staff member. Apparently she was still a regular visitor to the chemistry department, until she died in 1960, in her 90th year!

In 1926 McBain (aged 44) was finally tempted back to North America. During a period that year as a visiting professor at Berkeley he accepted an invitation to become a full professor of chemistry in the University of Stanford. Also, in the summer of 1926, he was the foreign “Guest of Honour” at the Fourth National Colloid Symposium of the American Chemical Society. He left for Stanford in December 1926, sailing from Liverpool to New York, accompanied by three females. These were his daughter Janet (then 11), and two ladies who had been on the staff at Bristol and for whom McBain obtained appointments at Stanford: Mary Evelyn Laing (then aged 35, his principal research assistant and former student — see earlier) and Mabel Norris (the chemistry librarian). On Jan 1st 1929 McBain married Mary Laing. They had one son, John Keith McBain, born 1933. The McBains became US citizens. In World War Two, McBain carried out research work for a number of American institutions, including the Office of Scientific Research and Development, the National Advisory Council of Aeronautics and the Rubber Research Board.

Sir Eric Rideal tells the following story [6] of how McBain interacted with his large research group at Stanford: “He would arrive at his laboratory at 8 am and take note of the already growing queue at his door

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