

The Emergence of Biochemistry in the United Kingdom

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1.1 Introduction

A new science inevitably starts with a number of innovative, imaginative and enthusiastic investigators who, trained along classical lines, break away from tradition to attack problems from a fresh viewpoint. In experimental subjects the success of the new approach frequently depends on the ingenious interpretation and development of techniques borrowed from more than one established discipline. Growth of a new science will be rather slow and sporadic until the pioneers realize that significant progress can only be achieved by collective action through some type of organized body. Such a group of like-minded scientists should be able to weld themselves together as an active force to persuade their colleagues in traditional subjects that they indeed have something worthwhile to offer; they should also be capable of dealing with the inevitable obstruction from vested interests of well-established classical disciplines, and of persuading the appropriate authorities to provide research laboratories and University departments. Eventually they should be sufficiently confident to develop their own Journal. The two disciplines which spawned Biochemistry, or if you will physiological chemistry, in the latter half of the nineteenth century and the early years of the present century were physiology and organic chemistry, and the environment in which the subject grew was generally but not exclusively within a medical school.

The major centres for biochemical research between 1840 and 1870 were the German medical schools. Before 1840 most of the chemists in German Universities were in medical faculties and in this way many of them were attracted to biological research problems. However, chemistry was feeling its feet and transferring to philosophical (science) faculties as a pure science. This, combined with the decision in 1840 of the committee concerned with reforming medical education in Germany that organic chemistry should be taught by chemists

in the philosophical faculties, led to the development of organic chemistry at the expense of physiological chemistry. Many personal (*ausserordentlich*) chairs were held in medical schools by eminent physiological chemists at this stage but when they retired their chairs either disappeared or were transferred to the philosophical faculties.

Only one established (*ordinarius*) chair existed; this chair, which started as a personal Professorship in 1845 at Tübingen for J. Schlossberger, was elevated to an established chair in 1859. Schlossberger was succeeded by Hoppe-Seyler but the chair was transferred in 1863 to the philosophical faculty as a second chair in the chemical institute; however, when periodically it became vacant it continued to be filled by first-rate biochemists. Indeed it was the one chair established during this period to survive into the twentieth century. The fascinating story of the early developments of Biochemistry in Germany is described in detail by Köhler [1]. Because of these developments many German biochemists in the latter half of the nineteenth century became extremely well known for their outstanding research although they frequently did not work in a conventional biochemical environment. The pity is that they did not establish research schools which survived them; as Köhler [1] succinctly puts it, German Biochemistry represented "high intellectual achievement on the margin of the discipline and undeveloped institutions at the core".

Even the appearance of a high quality journal (*Hoppe-Seyler's Zeitschrift für physiologische Chemie*) in 1877 did not lead to a consolidation of biochemical activities in appropriate departments and the full development of the German biochemical potential had to wait until the 1950s, following the founding of the Gesellschaft für Physiologische Chemie in 1947 (the Society was re-named Gesellschaft für Biologische Chemie in 1964).

In spite of the rush of American scientists to study in Germany in the mid eighteenth hundreds and the fact that American biochemical centres between 1875 and 1900 bore strong similarities to their German counterparts, the essential development of the discipline in the U.S.A. was very different from that in Germany; by 1909 some 60 out of 97 medical schools offered courses in physiological chemistry. As Köhler [1] points out, although the continuous development of Biochemistry had its problems it was well established in both medical and agricultural schools by 1939 and, as is now clear, it occupies today a pre-eminent position in American scientific circles. Again we can turn to Köhler [1] for full details of this evolution.

The early developments in the U.K., to be discussed in the following sections, rather fell between those in Germany and those in the U.S.A. Full appreciation of the significance of the subject came a little later than in Germany but by 1939 it was

accepted as a respectable scientific discipline, although still only practised on a small scale. However, there was a sound foundation on which to build the relatively massive edifice of Biochemistry which has arisen in the U.K. since the end of the Second World War.

1.2 Early Developments in the U.K.

As early as 1802 Humphry Davy was lecturing on 'Agricultural Chemistry' at the Royal Institution and in 1809 The Royal Society announced the formation of a Society for the Promotion of Animal Chemistry. This was to be regarded as an Associated Society; in particular, all papers read before it were to be offered for publication in the *Philosophical Transactions of The Royal Society*. A number of papers, mainly on animal secretions, were published but sadly the Society soon became little more than a dining club and eventually disappeared [2]. However, the influence of developments in Germany was gradually having an impact and by the end of the nineteenth century physiological chemistry (Biochemistry) was appearing on the scene in medical schools, where it was taught as part of the pre-clinical instruction.

The centre of this development was University College London (UCL), where Dr W. D. Halliburton (Fig. 1.1) ran a course from 1884 to 1890 when he moved to the Chair of Physiology at King's College London. There he built up what has been described as the first research school in Biochemistry in the U.K. Certainly he seemed to be the first British scientist to visualize Biochemistry as a wide-ranging science in its own right and not merely as a handmaiden to medicine. He was a leading light in the founding of the Biochemical Society (Chapter 2). According to Gowland Hopkins "he was the first in this country, by his works and his writings, to secure for Biochemistry general recognition and respect" [3]. All these achievements were acknowledged when he was elected the first Honorary Member of the Biochemical Society. Chemical Physiology at UCL had its ups and downs after Halliburton's departure but was stabilized in 1901 by the new Professor of Physiology, E. H. Starling, who established two posts, one of which, Assistant in Physiological Chemistry, was filled in 1909 by R. H. A. Plimmer (Fig. 1.2), a protagonist in the efforts to found the Biochemical Society.

At about the same time as Halliburton's activities at King's College London (1895), Cambridge formalized Sheridan Lea's post in the Physiology Department as a lectureship in Physiological Chemistry. Lea soon had to resign owing to ill health and a crucial appointment was made when Gowland Hopkins (Fig. 1.3) filled the vacancy left by Lea's departure [1] (see section 1.4). W. Ramsden and J. S. Haldane were teaching physiological chemistry at Oxford in 1897 but the first efforts



Fig. 1.1. W. D. Halliburton, F.R.S. (1860-1931). Professor of Physiology, Kings College London 1910-1925. A pioneer of British Biochemistry who was the first Honorary Member of the Biochemical Society (1923).

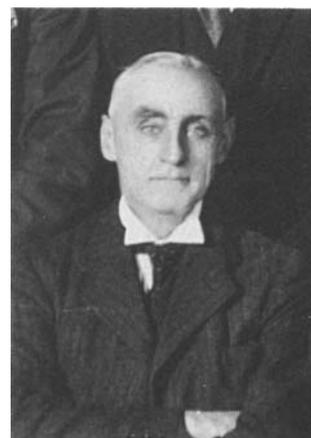


Fig. 1.2. R. H. A. Plimmer. Founder member of the Biochemical Society. Honorary Secretary, 1911-1919. Chairman of the Society's Committee, 1922-1923, 1939-1940. Honorary Member, 1943.

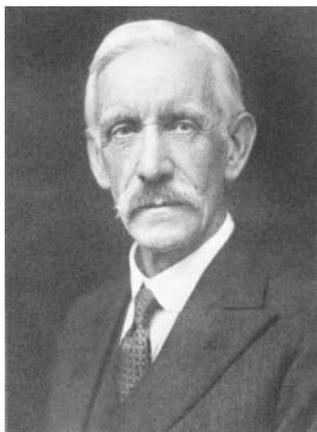


Fig. 1.3. Sir Frederick Gowland Hopkins, O.M., P.R.S. Sir William Dunn Professor of Biochemistry, University of Cambridge 1922–1936. First Chairman of the Biochemical Society Committee, 1913–1914. Nobel Laureate, 1929. Honorary Member, 1943.

to improve the facilities for physiological chemistry did not take place until 1906, and Ramsden was not appointed to a lectureship until 1914 when C. S. Sherrington arrived on the scene from Liverpool [1] to take up the Waynfleet Chair of Physiology. Meanwhile, at Liverpool Dr A. S. Grünbaum held a lectureship in Physiological Chemistry in Sherrington's Department of Physiology from 1898 until he accepted the Chair of Pathology at Leeds in 1904. However, an imaginative and far-reaching decision made at Liverpool at that time was to establish the first Chair of Biochemistry in the U.K. Events leading to this are described in the next section.

In Scotland Physiological Chemistry began to be taught to medical students at Edinburgh soon after the arrival of E. A. Schäfer in 1899 as Professor of Physiology, when he appointed T. Milroy as lecturer in 'advanced physiology and physiological chemistry'. Biochemistry arrived a little later in Glasgow when in 1905 a bequest from Dr J. Grieve, a medical graduate of the University, was used to found a lectureship in Physiological Chemistry. The appointee, Dr E. P. Cathcart, was destined to play a most important part in the development of Biochemistry at Glasgow [4] by becoming the first incumbent of the Gardiner Chair of Physiological Chemistry within the Institute of Physiology in 1919. The Chair is named after two Glasgow ship-owning brothers who bequeathed to the University sufficient money to endow three Chairs, one of which was in Physiological Chemistry. The budding off of a separate Department of Biochemistry from the Institute of Physiology did not, however, occur until 1948 when J. N. Davidson, who played an important role in the development of the Biochemical Society, was appointed to the Gardiner Chair. Furthermore, implementation of Davidson's decision to change the name of the Chair from Physiological Chemistry to Biochemistry was delayed until 1958 because a change in a University Ordinance was required and that had further to be approved by the Privy Council. In Edinburgh, contrary to expectations, the development of Biochemistry was not made easy by the institution of a Chair of Chemistry Related to Medicine in 1929. Local University political activity resulted in the responsibility for teaching elementary chemistry to medical students being assigned to this Chair, whilst Biochemistry teaching remained in the hands of the Physiology Department. Thus no focal point existed to draw biochemical activities together and although many renowned biochemists were associated with the Chair of Chemistry Related to Medicine, Biochemistry did not free itself from Physiology until after the Second World War.

In the University of Wales, preclinical teaching in the Welsh National School of Medicine began in 1894 and the elements of Biochemistry were included in the Physiology Course, for the College's Calendar for 1894–1895 records that "the

student will himself experiment with the properties of albumen and its allies, the carbohydrates and fats of the food, blood, milk, the digestive juices, glycogen and wine*¹". However, it was not until 1910 that a member of the Department of Physiology, R. L. Mackenzie Wallis, was given the title of lecturer in Physiological Chemistry. A separate Department of Biochemistry did not emerge from the physiological nest until as late as 1956, when John Pryde, a member of staff since 1925, was appointed to the newly created Chair of Biochemistry [5].

Agriculture has always been a major interest in two other Constituent Colleges of the University of Wales, Aberystwyth and Bangor, and Agricultural Chemistry, somewhat akin to physiological chemistry as taught in a medical school, was very early part of the curriculum for degrees in Agriculture. The first lecturer in Agricultural Chemistry at Aberystwyth was J. Jones Griffiths (later Professor of Agriculture), who was appointed in 1906. The story of the eventual emergence of Biochemistry at Aberystwyth as a distinct discipline within the milieu of Agriculture has been delicately recounted by R. J. Colyer [6]. A somewhat similar historical development at Bangor has been described with characteristic enthusiasm and bluntness by Professor W. Charles Evans [7]. An autonomous Department of Biochemistry was not established at University College, Swansea until 1972.

In Queen's University Northern Ireland the first Professor of Physiology was appointed in 1902, and a lecturer in Physiology, J. A. Milroy, appointed at the same time, was redesignated lecturer in Biochemistry in 1909. In 1924 an autonomous Department of Biochemistry was established and Milroy, by now a Reader, was appointed to the newly endowed J. C. White Chair of Biochemistry. J. C. White was a Belfast City Councillor [8].

In Trinity College Dublin a special lectureship in Biochemistry in the Department of Physiology was established in 1921. This was converted into a personal Chair for W. R. Fearon in 1934 but an independent Department of Biochemistry was not inaugurated until 1960. In the National University of Ireland Biochemistry first appeared on the scene in 1934, when a Department of Biochemistry and Pharmacology was established with E. J. Conway as professorial head [9].

From 1920 until the beginning of the Second World War the biochemical presence in British Universities increased so that by 1939 it was taught in 18 institutions, where six independent Chairs and four Dual chairs (Biochemistry with Physiology) had been established. The major expansion, however, occurred after the Second World War and in 1986 Professors of Biochemistry, in one guise or another, are found in all 44 Universities and also in many Polytechnics.

*Alas, a misprint for urine.

1.3 The First Chair of Biochemistry in the U.K.

To return to the early days, the most significant development at the turn of the century was, as indicated earlier, the decision of the University of Liverpool to establish a Chair of Biochemistry, the first in the U.K., as part of a programme to develop medical research. The leader in this move was Sir Rupert Boyce, the George Holt Professor of Pathology, who persuaded William Johnston, a wealthy Liverpool shipowner and Boyce's father-in-law, to support his proposals. Johnston first promised £5,000 towards implementing the University's decision to develop medical research but later reconsidered his offer and increased it to £25,000 [at least £750,000 at 1986 prices] in a letter written to the Principal of the University on 1 February 1902:

"I wish this sum to be devoted to the advancement of Medical Science, and I propose, with the approval of the Council, that it shall be divided as follows:

£10,000 to found a Chair of Biological Chemistry,

£9,000 to be used for building purposes,

£6,000 to be devoted to permanently endowing my two Fellowships of Colonial and International Medical Research, and for founding a third Fellowship in Gynaecological Research.

I am desirous that the sum of £9,000 shall be made to cover all expenses of erecting and fitting the proposed building, which I suggest shall be simply constructed and designed to give a maximum amount of space to research and teaching, and to adjoin the Thompson-Yates Laboratories. I wish the building to have accommodation for research in Physiology and Pathology, for the Tropical School of Medicine, for the new Professor of Biochemistry and for Clinical Pathology."

The increased offer was stimulated by the tragically ironic death of his daughter (Boyce's wife) in childbirth. The Fellowship in Gynaecological Research mentioned in the letter still carries her name.

This munificent gift was accepted by the University Council within two days of receiving the letter and they implemented the new proposals with such speed that at a special meeting on 29 July 1902 it was possible to approve the appointment of Benjamin Moore as Professor of Bio-Chemistry (the hyphen soon disappeared) on the conditions outlined in a minute recorded in copper plate handwriting (Fig. 1.4). The appointment was specifically dissociated from the teaching of medical students, although it was located in the Faculty of Medicine. This exclusion clause was probably due to Sherrington who, although he approved of physiological chemistry, had previously laid claim to it by appointing a lecturer in the subject in the Department of Physiology in 1898, and he would not have wished to see it drawn into the new Department.

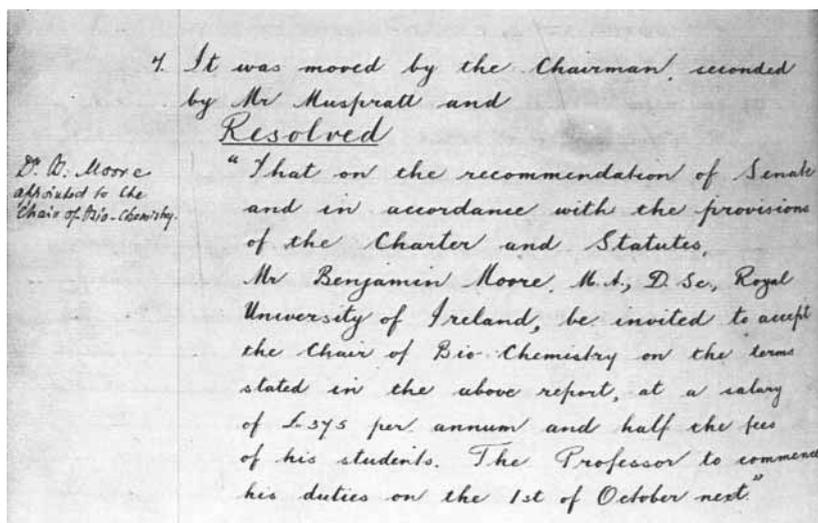


Fig. 1.4. The Minutes of the special meeting of the Council of the University of Liverpool recording the appointment of the first Professor of Biochemistry in the U.K. (Kindly provided by the Archivist of the University of Liverpool.)

The Chair was essentially a research Chair, with which was combined some advanced teaching, and although it was clearly intended that the holder should orientate his research in a medical direction Moore was given the freedom to develop Biochemistry relatively unrestricted as a true discipline within the Life Sciences. More importantly, he was freed from the shackles of physiology.

The salary arrangements offered to Moore, £375 p.a. [c. £12,000 today] plus half the fees of his students, would be readily acceptable to heads of large departments if 'students' were defined as the University Grants Committee's FTEs (full time equivalents).

Moore (Fig. 1.5) was a quite extraordinary person; he graduated in Engineering at Queen's College (now University) Belfast but then moved to Leipzig to work in Ostwald's laboratory, from where he moved to UCL to join the Physiology Department under Sharpey-Schafer. This was followed by a period at Yale after which he was appointed lecturer in Physiology at Charing Cross Hospital Medical School. During this period he qualified in medicine [10]. In 1902, as just recorded, he was appointed to the Johnston Chair of Biochemistry. With his great breadth of experience, his wide vision and his remarkable energy he collected around him able and enthusiastic assistants and colleagues and together they published on, *inter alia*, diabetes, photosynthesis, renal calculi and heavy metal toxicity. Amphibia and marine algae also came under Moore's scrutiny but perhaps his most important work was on membranes: thus Gowland Hopkins, in an obituary of Moore [10], said "it is clear for instance, that he possessed at this time (1910) a fairly definite conception of the

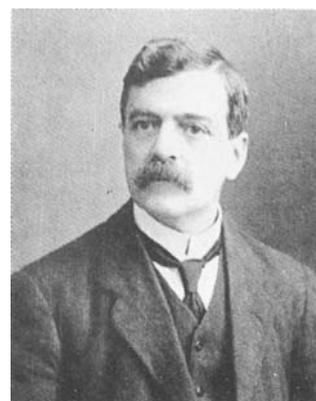


Fig. 1.5. Benjamin Moore, F.R.S. Johnston Professor of Biochemistry, University of Liverpool 1902-1914. Founder of the *Biochemical Journal*. Whitley Professor of Biochemistry, Oxford 1920-1922.

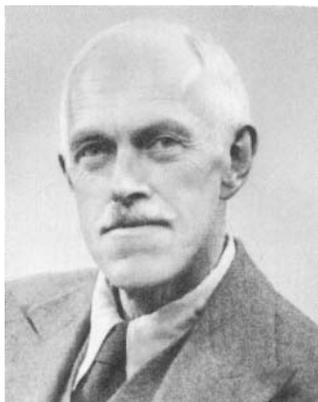


Fig. 1.6. Edward Whitley, M.A., Benjamin Moore's wealthy research assistant who helped him launch the *Biochemical Journal* in 1906. He also provided the funds to found the Whitley Chair of Biochemistry at Oxford. (Photograph kindly provided by Dr T. Moore, Benjamin Moore's son, who obtained it from Mr E. Whitley, grandson.)



Fig. 1.7. Walter Ramsden. Founder member of the Biochemical Society. Johnston Professor of Biochemistry, University of Liverpool 1914-1931.

membrane equilibrium which four years later, was quantitatively studied and clearly defined by Donnan”.

One of Moore's assistants was Edward Whitley (Fig. 1.6), a wealthy Oxford graduate in physiology and psychology. He supported Moore financially when he decided to found the *Biochemical Journal* in 1906. He was the son of Edward Whitley M.P., sometime Lord Mayor of Liverpool, and his wealth came from a family connection with the brewers Greenall Whitley. Whitley did Biochemistry another signal service when in 1920 he provided the University of Oxford with £10,000 [£200,000] to endow the Whitley Chair of Biochemistry [11]. It seemed entirely fitting that the first holder of this Chair should have been his old friend and colleague Benjamin Moore. Sadly Moore died in 1922 before he had time to stamp his personality on the Oxford scene. One can only regret the loss suffered by both British Biochemistry and Oxford by the early death of this imaginative and impressive man.

Moore's breadth of vision resulted in the introduction at Liverpool in 1910 of the first Honours School of Biochemistry in the U.K., and his achievements must have impressed on Sherrington that the future of Biochemistry lay outside a Physiology Department, because just before he (Sherrington) left Liverpool for Oxford in 1913 he persuaded Moore to take over the teaching of Biochemistry to medical students.

Unfortunately Moore, who had been elected a Fellow of The Royal Society in 1912, left Liverpool in 1914, soon after Sherrington, to enter the newly established National Institute for Medical Research at Hampstead. His successor, Walter Ramsden (Fig. 1.7), did not seem to possess Moore's all-embracing view of Biochemistry and had apparently neither the drive nor interest to develop Moore's imaginative ideas. In fact, his early promise in research did not materialize. Ramsden, who was, however, active in founding the Biochemical Society, was mainly interested in Medical Biochemistry and he cultivated the clinical aspects of the subject. Thus Biochemistry at Liverpool gradually reverted to its traditional role of handmaiden to Physiology and Medicine. Indeed a proposal from the Medical Faculty that the name of the Department be changed to Chemical Physiology was fortunately defeated. The situation did not change until the appointment of H. J. Channon in 1932, when Ramsden, a bachelor, retired to return to Oxford to continue his Sheppard Medical Fellowship of Pembroke College, which was 'tenable for life unless forfeit by marriage'. Channon was given the specific remit to develop Biochemistry as such and to revitalize the Honours School. This he did with some vigour.

Whilst the broad view of Biochemistry as a primary discipline was disappearing temporarily from the Liverpool scene it was being pursued with great fortitude by Gowland

Hopkins (Fig. 1.3) at Cambridge. However, he found the going heavy at times.

1.4 Early Days at Cambridge

The Professor of Physiology (M. Foster) at Cambridge in the 1880s began to develop Chemical Physiology and, as indicated earlier, Sheridan Lea who was responsible for this teaching was appointed to a special lectureship in 1895. When Lea retired owing to ill health, the position was not immediately continued but by 1898 it was revived with no stipend attached. £100 was allocated temporarily from departmental funds and on this basis, with a supplement for teaching at Emmanuel College, Hopkins at the age of 38 succumbed to Foster's entreaties and accepted the post. This type of administrative manoeuvring was to dog Hopkins until the 1920s when the trustees of the Dunn bequest made a massive contribution to his department. Hopkins had the same view of Biochemistry, a fundamental subject central to biology, as had Halliburton and Moore, and with great determination, wide vision and a magnificent command of the English language (there can be few biochemists who have in their undergraduate years managed to avoid writing an essay on one or other of Hopkins's famous aphorisms), he eventually achieved the acceptance of Biochemistry as a Part II (Honours) subject during the First World War and collected around him a group of outstanding research workers.

Intertwined with the development of the science of Biochemistry at Cambridge was Hopkins's further aim of establishing an institution free from the (generally) benevolent patronage of the Physiology Department. The love-hate relationship between the physiologists and the protagonists of the rapidly developing science of Biochemistry was, to some extent, the basis of the difficulties which Hopkins faced, but more important were the labyrinthine activities of the University and the Colleges; furthermore Hopkins's personality apparently did not allow general administrative activities to become easy to him; he was "shy, diffident to a fault, and at a loss in the rough and tumble of University politics" [1]. His problems have been frequently described [12] but it is worth outlining them here in order to see how much he had to endure.

In 1902 he apparently refused the Liverpool Chair [13] on the understanding that he would be offered a readership at Cambridge; however, no such offer exists in the Liverpool archives. In the event, Hopkins's Professor (J. Langley) did not recommend an endowed readership but an upgrading of his title to Reader with an increased contribution of the University to his salary (£50-£100) [£1800-£3600]. However, Langley supported Hopkins more strongly when he felt that he was not

in direct competition with the Physiology Department for funds. Kohler [1] gives two examples. On the one hand, there was the strong support Langley gave to the attempt in 1906 to obtain the Quick Chair of Biology for Hopkins. This foundered because according to W. M. Fletcher (eventually, the first secretary of the Medical Research Council) “the interference of lay opinion outside, unskilfully handled, led to its association with a science whose importance is secondary and not primary” [1]. On the other hand, when a Draper’s bequest of £2200 [£26,000] for a new laboratory for Physiology came along in 1909, Hopkins’s hope for ‘self-contained and independent laboratories’ was dashed when the money was directed elsewhere.

Meanwhile, in 1906 Emmanuel elected Hopkins Science Tutor, which also involved a Fellowship which he held until 1910. By then Fletcher had entered the fray both for Hopkins and the maintenance of the status of Cambridge Physiology/Biochemistry. He was stimulated into activity by the decision of the University Senate that it could not support a Chair in Biochemistry without outside help: “although Foster brought the centre of gravity of English Physiology to Cambridge, and left it there, it has been seriously displaced recently by the foundation of a chair of Biochemistry at Liverpool and the publication there of the *Biochemical Journal*” [13]. This is an extract of part of a document presented to Trinity College Council recommending the election of Hopkins to a Fellowship and Praelectorship, tenable with the University Readership. The recommendation was accepted by the College in the “confident hope that the University will not relax its efforts to secure at the earliest opportunities the foundation of a Professorship created without salary or endowment” [14]. This was eventually implemented in 1914 but there was still no possibility to develop the study of Biochemistry along the lines Hopkins wished for. Eventually his dreams were realized in 1919 by a magnificent bequest of £210,000 [$£4.5 \times 10^6$] by the Dunn trustees to set up a Dunn Biochemistry Institute. This Institute was opened in 1924 and Hopkins, now holding an endowed Chair (the Sir William Dunn Chair of Biochemistry), was poised to achieve his ambition — the rest is history.

The procrastination at Cambridge meant that Hopkins’s Chair was only the third to be established in the U.K. The second was established in 1912 by the University of London at the Lister Institute in order to recognize the outstanding research achievements of Sir Arthur Harden (Fig. 1.8). Harden was also outstanding in his service to the Biochemical Society; this will be described in the next chapter.

Although the mainstream of Biochemistry evolved from medical school-teaching in Universities, it must be remembered that qualitatively impressive contributions although on a small scale were made by the fermentation industries and agri-



Fig. 1.8. Sir Arthur Harden, F.R.S. Professor of Biochemistry, Lister Institute 1912–1930. Founder member of the Biochemical Society. Chairman of the Society’s Committee, 1914–1915. Editor of the *Biochemical Journal*, 1913–1937. Nobel Laureate, 1929. Honorary Member, 1938.

cultural science. This as we shall see was appreciated by the founders of the Biochemical Society. Biochemists were also appearing in departments of botany, zoology and pathology and in retrospect it is clear that even as early as 1900 the writing was on the wall that a new central discipline within biology was emerging.

With the background summarized in this chapter, we can now move to consider the formation of the Biochemical Society in 1911 and appreciate how the founders got the timing exactly right.

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