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Horace Lamb... and how he found his way back to Manchester[☆]

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ABSTRACT

The paper examines aspects of the career of Professor Sir Horace Lamb, FRS, a highly regarded classical fluid mechanistic, who, over a period of some thirty-five years at Manchester, made notable contributions in research, in education and in wise administration at both national and university levels. The article reveals the unusual sequence of events that led to his removing from Adelaide, South Australia, where he had served for nine years as the Elder Professor of Mathematics, to Manchester where he frequently interacted (sometimes rather coolly) with Manchester's other outstanding fluid mechanistic of the period, Osborne Reynolds.

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1. Introduction

In September 1885 Horace Lamb, FRS took up his appointment to the Chair of Pure Mathematics at Owens College, Manchester, where he was to remain until he entered his eighth decade, thirty-five years later. Over the course of this residency he brought great distinction to himself, to the college and to its successor, the Victoria University of Manchester. This distinction included not just his research but also his exceptional administrative talents and, perhaps especially, his teaching skills exemplified through his textbook *Hydrodynamics*, which remains in print today, more than 130 years after the appearance of the first edition. This extensive Manchester period of Lamb's life has been summarized in several biographies and obituaries [1–4]. But how did it come to pass that there was a 'Manchester period' in Lamb's career in the first place? To place this question into context, immediately before Lamb accepted the position at Manchester he had held the Elder Chair of Pure and Applied Mathematics at the University of Adelaide, South Australia. Although by then the Suez Canal had been opened, newspapers and personal mail still took six weeks to make the journey between England and Australia. Thus, the time lapse between a newspaper, letter or printed notice containing news of the vacancy being dispatched to Australia and an application in response being received is unlikely to have been much less than three months. However, then as now, advertisements for academic appointments sought responses within a month or so of the announcement appearing. Moreover, Owens College already had professors of both pure and applied mathematics in post, both many years from normal retirement age and with no ambition to seek academic appointments elsewhere. The size of the college and the notion that appointees would uniquely 'profess' a distinct subject would thus have made it virtually impossible for a

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further chair in mathematics to have been created at that time. The present paper provides answers to the above questions, drawing especially on reference documents contained in the archives at the University of Manchester and the University of Adelaide; this forms the principal, newly revealed information of this contribution. (It will be seen later that the emerging technology of the telegraph had a vital role in the above events.) Some of the interactions Lamb had with Professor Osborne Reynolds, in the adjacent Department of Civil & Mechanical Engineering, are also noted.

First, however, some brief account of Lamb's earlier life is needed as background, both before and including the decade he spent in Adelaide, topics that are addressed in the next section. It is from this period that the four persons who were collectively crucial, first to his removal to Australia and thereafter to his appointment to a chair in Manchester, make their first appearance and, in some cases, play their decisive roles.

2. Formation, emigration, integration... and frustration!

Horace Lamb was born in Stockport (a town a dozen kilometers south of Manchester city center) on 29 November 1849, the son of Elizabeth (née Rangeley) and John Lamb. His father was a foreman in a cotton mill who had 'gained some distinction by an invention for the improvement of spinning machines' [1]. He died while Horace was still a child, however, and after his mother's decision to remarry, young Lamb was brought up by a strict but loving maternal aunt, Mrs Holland. He was sent to Stockport Grammar School, where he had fruitful interactions with two of the teachers who were destined to have a significant influence in shaping his life's course. One of these was a young classics graduate, Frederic Slaney Poole, who over the course of the year that he spent teaching Greek and Latin at the school (before leaving for South Australia) became good friends with Horace, who was then in his final year and, indeed, head boy [2,5]. The other was the Rev. Charles Hamilton, headmaster of the school, who also taught Lamb classics and elementary mathematics. Lamb evidently responded to the tuition provided by Hamilton and Slaney Poole and was offered a classical scholarship at Queens' College, Cambridge, in 1867.

Lamb's inclination, however, was to pursue an engineering career, broadly following the path of his deceased father. He was thus advised (presumably by Hamilton) to decline the offer at Queens' and went instead to Owens College, Manchester for a year to develop his capabilities in mathematics further. The Chair of Pure Mathematics at that time was held by Professor Thomas Barker, the third of the vital contributors to Lamb's future, who had distinguished himself at Trinity College, Cambridge, and had graduated in 1862 as Senior Wrangler and 1st Smith's Prizeman.¹ Barker had been appointed in 1865 to the professorship at Owens College. He was acknowledged to be a lecturer of very high quality although, despite his exceptional flair in mathematics, he was said by Joseph J. Thomson [6] never to have published a technical paper—at least not in that field. In any event, Lamb clearly prospered under Barker's guidance, being elected to a minor scholarship at Trinity College, Cambridge, whence he graduated in 1872 as 2nd Wrangler in the Mathematical Tripos and 2nd Smith's prizeman. He was immediately elected both a Fellow and a tutor in the college. Lamb's own tutor at Trinity had been Henry Martyn Taylor, with whom he developed a lifelong friendship. Indeed, Taylor is the fourth of those identified as playing an essential role in Lamb's destiny and, as will be seen later, was unquestionably the most important contributor.

It might be supposed that Lamb would, like Taylor, have remained many years at Cambridge. He had become thoroughly absorbed in his new role and, according to several accounts, prepared an innovative and much-appreciated set of lectures in hydrodynamics for third-year students. Richard Tetley Glazebrook, for example, wrote of his time as a final-year student at Cambridge in 1874 that 'his lectures were a revelation' and that 'Lamb, in his own inimitable manner unveiled the mysteries [of vortex rings] and made the properties of a liquid in rotational motion clear to us' [1].

The other decisive impact of the Rev. Charles Hamilton on Lamb's future was that, through their association, Lamb met and became romantically entwined with Miss Elizabeth Foot, the young sister-in-law of his former headmaster. Trinity College still required its junior lecturing staff to be unmarried; thus, Lamb had to seek another position. He had evidently remained in touch with his former Greek teacher, Frederic Slaney Poole, who had by then become established as a cleric in Adelaide. On learning of the problem arising from his friend's impending marriage, Slaney Poole enthusiastically wrote to Lamb [7] that the newly founded University of Adelaide was establishing a Professorship in Pure and Applied Mathematics and proposed that he should apply—advice that Lamb duly followed. On 31 May 1875 he wrote to the Agent General to South Australia, Francis Dutton, enquiring about the position [8] and then, having been loaned a copy of the university's constitution, confirmed his application for the chair by providing ten strong supporting references [9] from his senior colleagues and former examiners; three of these were Fellows of the Royal Society, and the list also included Henry Taylor and Thomas Barker. The university relied on a selection committee that worked by correspondence: two distinguished mathematicians, Isaac Todhunter, FRS and Peter Guthrie Tait, iteratively pruned some 20 initial applications down to their unanimously preferred candidate, and the former Governor of South Australia, Sir James Fergusson, then returned to London, oversaw and gave his blessing to their choice [9]. Thereupon the agent cabled the Registrar that Lamb should be offered the appointment, a recommendation immediately acted on by the university. Some weeks later, a further communication to Adelaide's Registrar by Dutton announced: 'Mr Lamb will embark in January [1876] before which time he will be engaged

¹ 'Wrangler' was the term applied to students at Cambridge University graduating in mathematics with first-class honors. The 'Senior Wrangler' was the overall winner of this group and thereafter each wrangler was given a number according to his or her ranking (though until 1881 women were not allowed to take degrees). The Smith's Prize was also an award in mathematics optionally competed for by the best students in the year.

in the pleasing duty of taking unto himself a fair partner in life to embark with him' [9]. Indeed, after a voyage around the Cape of Good Hope, Horace and Elizabeth Lamb arrived in Adelaide in March 1876 in time for the opening of the new university.

On first arriving, the couple stayed with Slaney Poole, whose letter had initiated their move, but in June that year they moved to a house just beyond the green belt to the north of the town in Robe Terrace, Medindie [5], that was to remain their home throughout their period in Australia and where six of their seven children were born.

Lamb very quickly became aware of the stark realities of teaching in Adelaide. In a letter to the Registrar of 20 March 1876 he wrote 'there will be little choice in the matter of chalk as Williams [a local stationer] has no such thing in his shop' [4]. Nevertheless, he eagerly plunged into his new responsibilities. As Samuel J. Way, the founding Vice-Chancellor of the university, later wrote [10]:

His appointment with us was to the Professorship of pure and applied Mathematics; but he has also voluntarily and without any additional salary undertaken the subject of Experimental Physics. This is only one example of the ungrudging way in which his services have been placed at our disposal.

Besides the formal instruction to the student body, Lamb also arranged to deliver a series of evening lectures on popular scientific topics for the population at large. It was not simply in the lecture room that Lamb contributed to the new university's development. As one of just four professors on the staff he was deeply involved in the academic, administrative and developmental activities of the university, serving as Dean from early 1878.

He also found time to pursue research. The first papers from his antipodean period appeared in London-based journals in 1877, with a further one or two articles being published in most years thereafter. Moreover, his lectures on fluid mechanics delivered orally in Cambridge in 1874 were formally shaped and expanded (to include more recent contributions) into a 259-page textbook published by Cambridge University Press [11]. The quality and number of his publications were such that Lamb was recommended in November 1883 by seven Fellows, including Lord Rayleigh and Arthur Cayley for election to the Royal Society, a proposal that was accepted in the following June.

However, it was the lack of colleagues at Adelaide with whom to discuss ideas on mathematical issues that left Lamb most dissatisfied with his position. Indeed, as early as 1877, on learning that the University of Sydney would be replacing its retiring professor in mathematics, Lamb, perhaps feeling that Sydney would offer a less parochial environment than Adelaide, had written to Sir George Stokes [12] (who was to chair the selection committee in England), enquiring whether he might be considered for the position. However, he received a discouraging response to this enquiry and did not submit a formal application. June Barrow-Green [12] suggests, plausibly, that Stokes's negative response reflected his view that it would be easier to find someone new for Sydney rather than a replacement for Lamb in Adelaide. In any event, this sense of academic isolation seemed to be an endemic problem that Lamb felt throughout his residency in Adelaide.

Seven years later, writing to his friend Henry Taylor [10], he complained:

The sense of isolation is at times most painful. Except every two years or so when I come across Nanson² I have hardly a soul to speak to who has any understanding of or sympathy with my pursuits. I confess too to feeling that I am fit for something better than the work I have here.

By then, however, he was already deeply engaged in a different strategy for easing the problem. In December 1883 he had written to the Registrar as follows [4]:

Sir,

I wish respectfully to ask the Council whether they would be disposed to grant me a year's leave of absence at the end of the next academical year [i.e. late 1884]. I shall then have been nine years in the service of the University, during which time I have undertaken duties which do not fall strictly within the scope of my professorship. I think I may fairly urge in support of my request that the change would give me opportunities, of rendering myself more capable of discharging these as well as my other duties with efficiency and advantage to the University.

John G. Jenkin [4] has commented that although Lamb's request seemed straightforward, it contained 'the seeds of a long and sometimes distressing debate'. First, the university had no formal provision for leave of absence. Second, Lamb was reluctant to arrange for his teaching to be taken over by someone else during his period away (despite two requests from the Council for him to do so). Finally, the Council would not acknowledge the relevance of Lamb's voluntary teaching of experimental physics to his application although they did discuss the question with him as a separate matter. Over the course of these exchanges certain members of Council formed the impression that the principal reason for the requested leave of absence was to provide Lamb with the opportunity of finding a position in England, a suggestion that Lamb firmly denied in a letter to the Registrar of 28 March 1884 [13].

² Edward Nanson was a year younger than Lamb graduating from Trinity College, Cambridge in 1873. Two years later he became the professor of mathematics at the University of Melbourne [14].

However, perhaps that insinuation—that his main goal was to seek employment back in England—even if far from Lamb's thoughts initially, nevertheless lodged in his mind as an alternative option should the request for leave of absence finally come to naught. Correspondence traveled back and forth between Lamb and the Council, but by January 1885 no decision had yet been reached. Thus, in his letter to Henry Taylor of 31 January 1885, a fragment of which is quoted above, Lamb had also written [10]:

My dear Taylor

I am going to ask you a very embarrassing question and so will acknowledge at once that I do not hope for any very satisfactory answer. However, I shall be grateful for anything you can say on the subject.

I would like to know, if possible, what chances I should have of getting employment in England. My position here is not uncomfortable. I get £1000 a year (which is, however, far from equivalent to the same sum at home), [and] I have not too much work, although my time is a good deal cut up. . . . I have been on the whole very happy and comfortable here, but after all, I think, 10 years is a long enough time in Australia, if one has any chance of getting out of it.

There is a possibility that I may come to England for a visit towards the end of the year, but this is at present uncertain. If I came I could of course ascertain for myself what my prospects could be. But, in the meantime any ideas you could give me would be of great service to me in arranging the terms of my leave of absence. If I knew there was no chance of my getting anything I could afford to take I should probably engage³ to return and so secure more favourable terms; on the other supposition, I should leave myself free.

No record of Taylor's written response to the above letter seems to exist, and negotiations continued with the Adelaide authorities. In February Lamb wrote a long letter to the Registrar regarding his physics teaching, at the end of which he begged leave 'to suggest that the Council should formally establish a separate Lectureship on Experimental Physics. As I have no wish to create any unnecessary difficulties, I am willing... to accept this for the present, as an honorary appointment, from year to year' [4]. As will be seen below, however, these negotiations were soon to be overtaken by decisive actions by Henry Taylor that sprang from that fateful letter of 31 January from Lamb.

Taylor, it hardly needs adding, was someone whom Lamb both admired and felt close to. He was, moreover, already indebted to him, for Taylor was one of two Cambridge friends who had corrected the galley proofs and otherwise steered the production of Lamb's book [11] through Cambridge University Press, a contribution to which Lamb referred both in the book's preface and, obliquely, more than 40 years later, in his obituary of Taylor [15]. As a non-verbal acknowledgment closer to the event, Lamb's third son, born in 1883, was named Henry Taylor Lamb. The latter's personal contribution to his father's historical record appears below.

3. The chair of pure mathematics at Owens college

Thomas Barker had, as noted above, been appointed Professor of Pure Mathematics at Owens College in 1865 at the age of 27 years. He had an excellent record as a teacher but evidently did not spend his time—as Lamb very clearly did—exploring research issues in fluid mechanics. However, it was not that he had no research interests; rather, it was that they were directed elsewhere. From his youth, mathematics had been one of his two passions in life. The other was botany, and it was within this latter field that his creative energies were directed. By the 1880s he had become particularly attracted by bryology (the study of mosses) [16].

Moreover, whether by good luck or wise strategy, by the mid-1880s he had accumulated what Mark Lawley [16] has referred to as 'a modest fortune from his investments'. Thus, given that—as a bachelor living with two unmarried female cousins—his financial needs were modest, he decided, at the age of just 47, to resign his chair so that he could devote himself more fully to his botanical interests. The minutes of Owens College Senate from 25 April 1885 note that 'the Senate has learned with extreme regret that Professor Barker has resigned the Chair of Mathematics which he has during 20 years filled with so much credit and advantage to the College'. A fortnight later, on May 9, 1885, the Senate resolved:

that a Committee consisting of the Principal, and Professors Barker, Schuster, Stewart, Core, Reynolds, Ward, Adamson and Dawkins be appointed to examine, arrange and report on the applicants which may be received for the Professorship of Mathematics.

In the above list of professors, Arthur Schuster held the chair of applied mathematics and Osborne Reynolds the chair of engineering. Barker's resignation was to take effect from 29 September. The fact that he was appointed a member of the committee assessing potential replacements to fill his own chair perhaps underlines the warm sentiment felt towards him by the college's professoriate as well as the value that the committee placed on having his expert view.

The announcement of the chair vacancy (Fig. 1) brought 13 applications. The committee's report [17], presented to the Senate on 13 June, expressed satisfaction at the high calibre of the applicants. From the nine whose qualifications they

³ Lamb's calligraphy is sufficiently indistinct for the word 'engage' to be just a best guess by the author at what is written. The handwritten word clearly has two letters with descenders at the positions where the two letters 'g' appear and the shape of the other letters is not inconsistent with their making up the remainder of the suggested word.

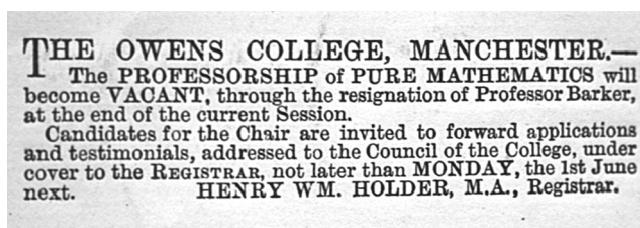


Fig. 1. Advertisement for Chair of Pure Mathematics at Owens College.

especially commended, Lamb's was one of two whose case the committee considered in fine detail. In fact, Lamb had not made his own application—indeed, given the remarks made at the beginning of this article on postal transit times, he could not have done so. Its originator was Henry Taylor who, after great efforts to contact potential referees to supply testimonials, had written [10] to the Council of Owens College on 28 May:

Gentlemen:

I am authorised by my friend Mr Horace Lamb, who is at present in Australia, to request you to accept him as a candidate for the Professorship of Pure Mathematics in the Owens College. I herewith enclose letters in support of Mr Lamb's candidature from the following gentlemen:

Professor G.H. Darwin, Mr J.W.L. Glaisher, Mr W.D. Niven, Lord Rayleigh and Professor J.J. Thomson.

I also enclose a private letter addressed to me by Mr Lamb which will explain in some measure the reason for the present application appearing in this form. It was in consequence of having received this letter that I was induced, on hearing of Professor Barker's resignation, to communicate with Mr Lamb by telegraph and to ask him whether he would be a candidate for the post. His reply is my authority for making this application.

I am, Gentlemen,

Yours faithfully,

H. M. Taylor,

Fellow and late Tutor of Trinity College

The 'private letter addressed to me by Mr Lamb' is, of course, the one reproduced above near the end of the previous section [10]. It is worth noting that if Taylor had not forwarded it with the letter of application on Lamb's behalf it would, in all probability, have been destroyed rather than being filed in the University of Manchester's archives, where papers of all successful chair applicants from that time are held. The five referees named in Taylor's letter were all Fellows of the Royal Society and, of those, William Davidson Niven and James Whitbread Glaisher, FRS were personally known to Lamb. Perhaps this single sample [10] from J.J. Thomson, later to become President of the Royal Society and Nobel laureate, may serve to convey the broad tone of all:

Trinity College, Cambridge May 22nd 1885

I understand that Professor Horace Lamb is a candidate for the chair of Pure Mathematics at Owens College, Manchester.

I have not the honour of knowing Prof. Lamb personally but I have read his Treatise on the Motion of Fluids and such of his papers that have appeared in the Transactions of the Royal Society and the Proceedings of the Mathematical Society. Judging from them I should say that Prof. Lamb is eminently qualified for the post for which he is a candidate. They not only justify his established reputation as an eminent mathematician but the clearness of their style impresses me with the belief that he must be an admirable teacher. I am confirmed of this view by the fact that his excellent Treatise on the Motion of Fluids is an expansion of lectures given in this college.

I can think of no one better fitted than Prof. Lamb to maintain the Mathematical School at the Owens College in its present high state of efficiency.

J.J. Thomson

The other best-ranked candidate, Robert Heath, was only 27 years of age and, while he had recently been appointed to a professorship at Mason's College (the forerunner of the University of Birmingham) he had published only two papers. It seemed glaringly obvious that Lamb's was by far the stronger case yet the committee's report went to great lengths to make the cases of the two applicants for the chair seem finely balanced. The author suggests in [18] that this distortion was to appease the sensibilities of a senior member of the committee that the remainder of the committee did not wish to offend: the departing Professor of Pure Mathematics, Thomas Barker. As already noted, Thomson [6] had remarked that there was no record of Barker's publishing anything in mathematics over the course of his career. Barker may thus have been less than impressed by the substantial body of research published by Lamb and his consequent admission to the Royal Society. Were they not the danger signals that if Lamb were appointed he would give inadequate attention to what Barker clearly saw as the most important role of the new professor: that of providing rigorous yet sympathetic instruction for the student body?



Fig. 2. Photograph of the envelope in which Horace Lamb transmitted references from Adelaide. (© The author.)

Moreover, Heath was 27 years old at the time of his application, Barker's age when he had been appointed to the chair at Owens! That, too, would clearly have had nostalgic resonances for him as he prepared for his own retirement.

Finally the committee's report reached the conclusion that Lamb's case was, by a whisker, the stronger. The Senate thereupon approved its recommendations but with one further proviso:

The Senate, while cordially adopting the recommendation of its Committee in placing Mr Lamb first, would draw the attention of the Council to the fact that, owing to the circumstances of Professor Lamb's candidature, they have not had before them any record of his career, other than of his scientific activity, or testimonials relating to his experience as a teacher in the post he has held for the past 10 years at Adelaide.

With the addition noted above, the report was 'adopted as the report of the Senate to the Council by resolution of the Senate' and, at the meeting of Council on 19 June 1885, was approved without dissent. Henry Taylor was then duly notified of the likelihood that Lamb would be offered the chair subject to an interview by Council and to Lamb's furnishing references from appropriate persons in Adelaide. Taylor in turn (and, from what is noted below, clearly at the request of Council) telegraphed the Council's decision to Lamb. In response, on 1 July Lamb addressed an envelope (Fig. 2) containing four letters of support from members of the Adelaide Council to Dr Joseph Greenwood, the Principal, together with the following covering letter from himself [14]:

Dear Sir,

I have received a telegram from Mr H.M. Taylor from which I gather that the Council of the Owens College have postponed the election to the Professorship of Pure Mathematics for which I am a candidate in order to give me an opportunity, if possible, of meeting the Council in person, and also to furnish testimonials relating to my career in Australia. For this kind consideration on the part of the Council I beg leave to tender through you my warmest thanks. I send with this letter testimonials from several of the more important members of the Adelaide University Council.

As regards a personal interview, I have arranged to leave Adelaide by the P&O steamer 'Carthage' which sails on July 30 and is due in London on Sept. 15. I will inform you immediately of my arrival; and in case there is anything which you would wish to communicate to me beforehand, I would be much obliged if you would kindly address it to me c/o Sir Arthur Blyth, KCMG, Agent General for South Australia. The above date, July 30, is the earliest at which I could, consistently with my duty to the University here, make my departure.

I have the honour to remain

Your obedient servant,

Horace Lamb

The four Adelaide testimonials all praised Lamb's qualities but expressed regret at his probable impending departure. A fragment from the letter from the Chancellor, Samuel Way, has already been quoted. The following from the Vice-Chancellor [10] expresses the general sentiment of all but, uniquely, shows a knowledgeable and affectionate view of Owens College that may have made it particularly persuasive.

The University of Adelaide, July 2, 1885

To the Council of Owens College, Manchester

Gentlemen,

It was with great regret that I heard from Professor Lamb, at the last meeting of Council of this university that he was a candidate for the vacant chair of Mathematics in the Owens College. He has held the chair of Mathematics in this university from the time when it first commenced practical work more than nine years ago. The difficulties of his position in having to occupy so prominent a place in a university which was then deemed by many, like Owens College in 1852, as unnecessary and premature did not appall him. He entered with spirit into the circumstances of the colony and did his best not only to teach the students of his classes but to foster the spirit of learning in the Community.

By public lectures and evening classes he added to his own labors &, at the same time, awoke more interest in the university and its work.

Of Professor Lamb's unbounded enthusiasm in the cause of Science and of the wide range of his acquirements outside the limits of his own chair, all who know him intimately can speak with confidence and admiration. It has been my pleasure to work with him as a member of the Professorial staff, having for 2 years held one of the chairs of this university and to share with him in the labors of the examinations. I am thus able from experience to testify to his skill in the management of the internal working of the university, as well as to his wisdom in the deliberations of the Council.

I shall regret exceedingly the departure of Professor Lamb if he should obtain the appointment for which he seeks. At the same time I cannot be unmindful of the fact that I was myself a student of the Owens College in its early years & have always felt a deep interest and no small pride in its history & progress. For this reason I shall be glad if you see fit to appoint Professor Lamb to the vacant chair, for I believe his appointment would serve the best interests not only of Owens College but of Victoria University [of Manchester].

I am, Gentlemen

Yours obediently,

Wm. Roby Fletcher, M.A. Lond. & Adelaide

Vice Chancellor of the University of Adelaide

Even before receiving the above letter from Lamb, Greenwood's actions suggest that he may have received some telegraphic communication, whether direct from Lamb or via Taylor, setting out a proposed arrival schedule. In any event, by early July he had realized that the inevitably protracted timescale of Lamb's arrival in Manchester meant that the other candidates could not be kept waiting with no news of their application until September (after Lamb had presented himself to Council). The next meeting of Council on 3 July thus decided that all the other candidates, including Heath, should forthwith be sent a letter thanking them for offering their services but announcing that the appointment would go 'subject to certain conditions' to Horace Lamb. A fortnight later the Minutes of Council of 17 July noted that 'The Principal reported that he expected that Professor Lamb was now on his way to England', although Lamb's letter to Greenwood cited above (which was then still in transit) implies that to meet his obligations to Adelaide he would have to take a later sailing than had originally been intended.

Back in Adelaide, while the Council were aware that in all probability Lamb would be leaving permanently, he was formally granted leave of absence. The news spread around campus, and Stanley Tomlin [2] reports that before his departure, at a gathering of students and staff in the university library, he was presented with a silver rose bowl and, from the student body, an illuminated address handwritten on vellum that read:

Dear Sir—We who have enjoyed the rare privilege of sitting at the feet of so able an instructor as yourself gladly avail ourselves of the occasion of your departure for England to enjoy a well-earned holiday, to express in some slight form our high appreciation of your ripe scholarship and the universal esteem in which you are held. The zeal displayed in the discharge of your arduous duties, and the interesting and happy manner in which you have delivered your able lectures will not soon be forgotten by those who have attended them.

Your ready and generous assistance in times of difficulty and the kind interest you have always shown in our welfare, have become by-words to us who in the pursuance of our studies have come under your care. It is therefore with mingled feelings of pleasure and regret that we join in wishing Mrs Lamb and yourself a very pleasant journey, and we trust that at no distant date we shall have the pleasure of seeing and hearing you again.

Though Lamb was evidently very touched by the gifts, he was never to return to Australia. Some 30 years after his death, however, both artefacts were donated to the University of Adelaide by his descendants [2].

As he had promised, on arrival in England Lamb immediately made contact with the Owens College authorities and on 18 September a special meeting of Council was held at which just six members, including the Treasurer (in the chair) and the Principal, interviewed the aspirant new professor. At its conclusion the meeting resolved [19]:

That Mr Horace Lamb be appointed from and after the 29th September next and subject to the By-laws of the College for the time being at an annual fixed stipend of three hundred and fifty pounds together with a share of the fees of students attending his classes according to the usage of the College.

That this resolution & engagement are made subject to their being reduced into form as an agreement with the Professor under the By-laws of the College.

Thus did Horace Lamb exchange his professorship in Adelaide for one in Manchester, thanks to his own personal qualities, the major efforts of a loyal friend and the coming of the telegraph! Indeed, this may well be the first occasion on which the telegraph had been employed to facilitate a professorial appointment (a quarter century before its celebrated role as the instrument for capturing Dr Hawley Crippen for the murder of his wife).

Concerning the last of these contributors, the overland telegraphic connection from Adelaide to Port Darwin had been completed in August 1872 with much national rejoicing and praise. By October in the same year, the sea cable linking Port Darwin to Java, after initially failing, had been repaired, thus providing the connection to Europe via pre-existing cables

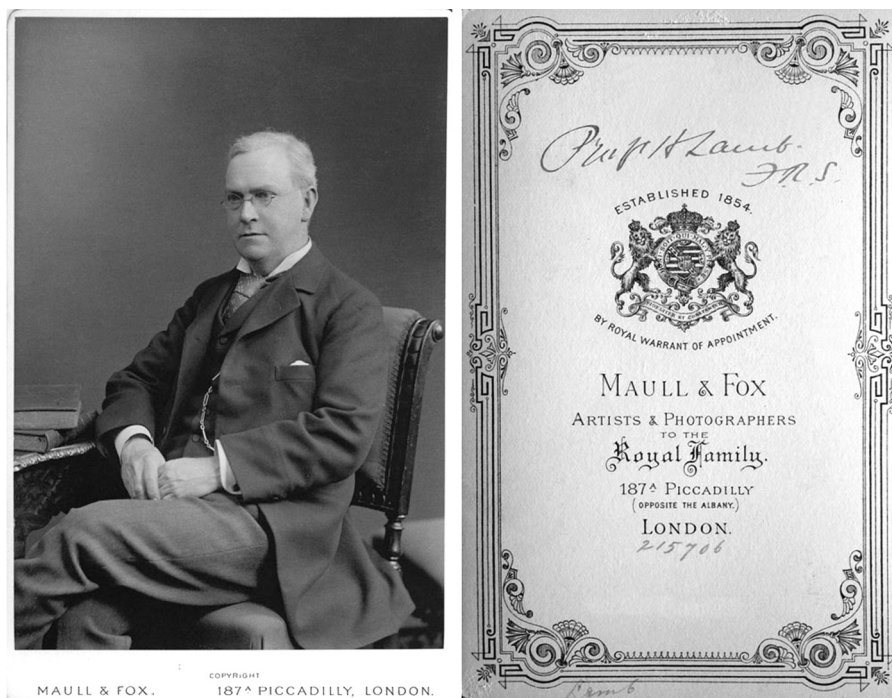


Fig. 3. Horace Lamb at the time of his admission to the Royal Society: (Left) Official photograph. (Right) Reverse of photograph with Lamb's signature. (Copyright © The Royal Society.)

[20]. This development meant that texts from England could reach destinations in Australia in a few days (rather than two months by sea) or, rolling forward in time to the mid-1880s, in a few hours! The telegraphic connection was immediately heavily used, but principally for commercial exchanges, governmental business and by journalists transmitting news events to home newspapers. Apart from the telegrams exchanged between Taylor and Lamb, however, no instance has been found of expatriate professors making use of the telegraph to seek (or be solicited for) possible employment in Britain. Indeed, in her review (appropriately entitled 'Wranglers in exile'), Barrow-Green [12] cites some two dozen British mathematics graduates who emigrated in the nineteenth century to take up posts at universities in the Southern Hemisphere. Of these, Lamb was the only one who returned, other than two who had been dismissed. As her title suggests, once the decision had been taken to emigrate, it was, at that time, tantamount to a commitment for life.

The reason that the telegraph had been so little used by senior academics in seeking distant positions must principally have been the cost. In this connection, Henry Taylor's name makes one further appearance in the records of Owens College Council, this time in the report of the Treasurer, Alfred Neild, of 7 August 1885 in the depths of the long vacation [21]:

The only account which I have to present is: Mr H.M. Taylor: £9 1s 4d for telegraphic communications with Professor Lamb in Australia which I recommend the Council to pass for payment.

The value of the reimbursement in today's (post-Brexit) currency amounts to about 1000 euros in terms of retail price index or, on the basis of average earnings, approximately 5000 euros!

4. ... and thereafter

Lamb, having agreed the terms of his appointment, set up house with his family in Burton Road, Didsbury, at that time a leafy suburb some six kilometers south of the new campus. Fig. 3 shows a photograph of him taken on his admission to the Royal Society in 1885, one year after his election. His signature on the reverse of the photograph, prefixed by the title 'Prof' and the postnominal 'FRS', seems to suggest his quiet satisfaction with his new estate. Once settled at the college, however, one of his first services was to the University of Adelaide as a member of the selection committee for his successor, a role to which W.H. Bragg was appointed (and who, after spending 20 years in Adelaide, went on to win the Nobel Prize in Physics and become President of the Royal Society). Records contained in the University of Adelaide's archives make it clear that that was by no means the only service provided for his former employer. On many occasions he acted as an agent for the university in making numerous purchases on its behalf as well as leading the assessment of candidates for the Chair of English at Adelaide in 1894.

The final step in Lamb's installation within the academic establishment of Owens College did not occur until three years after his arrival in Manchester. In 1888, after the death in post of Balfour Stewart FRS, the senior of the two professors

of physics, the college formed a committee, of which Lamb and Osborne Reynolds were members, to consider whether, as a measure of economy, some rearrangement of responsibilities could be made to avoid the appointment of an external replacement. Lamb clearly became the driving force on the committee and successfully proposed that Arthur Schuster (also a committee member) should relinquish his Chair in Applied Mathematics to take over the Chair of Physics (which Stewart had held), while Lamb's own remit should be enlarged to embrace Schuster's responsibilities. Thus, as the Beyer Professor of Pure and Applied Mathematics, Lamb's title, salary and authority finally properly reflected his expertise and interests and provided the scope to develop in Manchester the broad spectrum of mathematics teaching and research that was to place the university among the leading establishments across Europe in these fields.

Besides interactions on college business, such as that cited above, Lamb and Osborne Reynolds (the only two professorial fluid dynamicists in the college and both Fellows of the Royal Society) had numerous exchanges on issues relating to fluid mechanics. Two that occurred close together are noted here. In 1894 Reynolds had orally presented his 'Reynolds-averaging' proposals to a meeting at the Royal Society and followed this up by having copies of his work printed privately which he sent for possible publication in *Phil Trans Roy Soc*. Lord Rayleigh, the editor, had sent a copy to Sir George Stokes for review; but Stokes clearly had not understood the paper and after much delay sent an inconclusive assessment. Rayleigh thereupon decided to send the paper to Horace Lamb who, on November 21st 1894, sent his longhand assessment which began with the brisk summarizing statement:

I think the paper should be published in the Transactions as containing the views of its author on a subject which he has to a great extent created, although much of it is obscure and there are some fundamental points which are not clearly established.

There followed three pages of quite severe criticisms including complaints at the excessive length of and confusing nature of the introduction, at the inadequate definition of Reynolds' term 'mean-mean motion' and a misprint in the manuscript (Royal Society Archive Ref. 208). Thereafter, Rayleigh persuaded Lamb to interact with Stokes and eventually they sent a joint report largely following Lamb's original review. Although the review had been transcribed by a clerk before it was forwarded to Reynolds, it may well have been the case that Reynolds recognized the source of the criticisms. His response to the suggestion to shorten the introduction was to add a 4-page supplement to explain more clearly the meaning of his terms! The revised manuscript was accepted [22] and is now recognized as one of the major contributions to engineering fluid mechanics.⁴

At the same time Lamb was engaged in expanding and updating his 'treatise' [11] published during his Adelaide period. He wanted to include an account of Reynolds' discoveries reported in the earlier paper on transition from laminar to turbulent motion in pipe flow [23] but had difficulties in understanding one aspect of the results. So, Lamb set out his queries to Reynolds along with the draft of that part of his expanded book. This produced the following rather tetchy written response from the Professor of Engineering (quoted from Allen [24]):

You have not noticed the fact that just above the critical velocity the resistance dp/dz varies nearly as the cube of velocity until dp/dz is about double what it is at the critical velocity. Of course these dimensional facts, although they may not affect the practical side of the question greatly, are the definite clues to the physics and mechanics of the problem.

Reynolds then went on to make a further (though, in his mind, perhaps the principal) complaint:

Nor is it polite or true to speak of the 'empirical formula adopted by engineers' since it is engineers who have done the scientific investigations which alone have given us accurate data.

Then, possibly recognizing that his remarks were at least ungracious, given that the purpose of Lamb's enquiry was simply to present what Reynolds had found as unambiguously as possible, he added a final remark:

I am obliged for the trouble [you] have taken to bring my work in [to your new edition]. I fear my criticism will bother you ... but you will take what notice of it you like.

Lamb, ever the calmer of aggrieved sensibilities, duly replaced the above offending phrase by 'practical formula adopted by writers on hydraulics'. When, later that year, the new edition was published, its length had more than doubled (from 278 to 604 pages) while its title had been shrunk to just a single word, *Hydrodynamics*, which when coupled with the surname of its author, still has resonance for fluid mechanicians well over a century after its publication.⁵ In total, the book ran to six

⁴ In 2015 Reynolds' paper was identified as one of the sixteen most influential papers to have been published in *Phil Trans Roy Soc A* over its lifetime to commemorate its 350 years of publication [26].

⁵ In fact, the third edition, published in 1916, contains numerous citations of Osborne Reynolds' contributions including a more concise and manifestly clearer account of the 'Reynolds decomposition' paper than in Reynolds' original [22].



Fig. 4. Portrait of Horace Lamb by his son Henry Taylor Lamb RA, 1913. (Copyright © The University of Manchester; photograph by Prof. N. Higham, FRS.)

editions; the sixth, which weighed in at nearly 740 pages, appeared in 1932 when Lamb was well into his eighties. In his obituary to Lamb, Geoffrey Ingram Taylor [25] wrote of the book:

During its long career, which is still in full vigor, it has been the foundation on which nearly all subsequent workers in hydrodynamics have built. The long-continued supremacy of this book in a field where much development has taken place is very remarkable and is evidence of the complete mastery which its author retained over this subject throughout his life.

This is not the place to provide a detailed account of Lamb's other accomplishments during his Manchester years, both within the university and at national level. Besides the enduring legacy of his monumental textbook *Hydrodynamics*, he wrote at least a further half-dozen volumes covering various fields of mechanics, most of which are still available in re-printed editions. Even in research his name is still frequently cited in papers on the *Lamb vector*, $\mathbf{v} \times (\nabla \times \mathbf{v})$, e.g. [27], and the *Lamb–Oseen vortex*, $v_\theta = \Gamma[1 - \exp(-r^2/4\nu t)]/2\pi r$ in cylindrical coordinates, [28]. Separate but linked obituaries by Glazebrook and Augustus Love [1] have summarized these and other research contributions many of which lay outside the domain of fluid mechanics. At what may have been seen as a prelude to a normal-age retirement, in 1913 Ernest Rutherford, FRS had presented the university with a portrait of Lamb painted by Lamb's son Henry Taylor Lamb, RA (Fig. 4), which now hangs in the Alan Turing Building of Manchester University. However, the outbreak of World War I in 1914 caused Lamb to postpone any thought of retirement until the end of hostilities. When, in 1920, Lamb's actual impending resignation was announced it was met with considerably more than the usual expressions of thanks and regrets. Senate, for example, resolved [30]:

That [it] wishes to place on record its high appreciation of the long and devoted service of Professor Lamb as a Teacher in the Owens College and the University, its recognition of the distinction he has conferred on the Chair of Mathematics and on the whole University by his brilliant research and its gratitude for the wisdom and unfailing courtesy with which he has taken a leading part in its activities and maintained the dignity of its debates.

Moreover, it took the unusual steps of organizing a farewell dinner in Lamb's honor and conferring on him an honorary doctor of science degree. Thereafter, as the honorary Rayleigh Lecturer in Cambridge, he relentlessly pursued his scholarly and public-service activities for more than a dozen years at the conclusion of which, at the age of 82, a knighthood was conferred on him (i.e. he became Sir Horace Lamb).

Besides the publication of two further editions of *Hydrodynamics* during this Cambridge period, he was also appointed chairman of the Fluid Motion Panel of the Aeronautical Research Council and acted as coordinator and editor of *Modern Developments in Fluid Mechanics*. On Lamb's death in 1934, Sydney Goldstein, FRS took over the editorship of this book which was published as a two-volume set in 1938 [29] and dedicated to the memory of Horace Lamb.

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