Chapter 7. Augustus Love

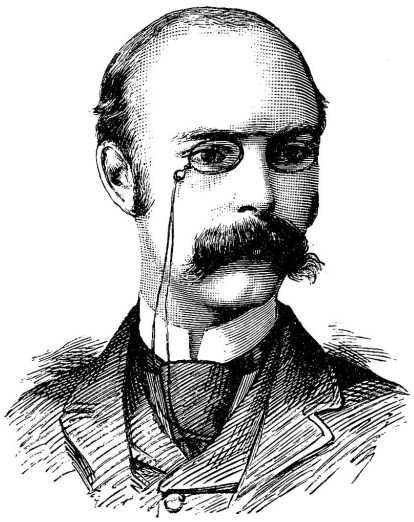
June Barrow-Green

When Augustus Love, a Cambridge wrangler, was elected to the Sedleian chair in 1898, all his predecessors bar one—Thomas Millington who held the chair from 1675 to 1704 (see Chapter 3)—had been educated in Oxford. To date, no details of Love's election have come to light, so it is unknown who, if anyone else, was in the running or even whether there was an election, or indeed if it was contentious to look beyond Oxford at the time. Be that as it may, Love set a trend for non-Oxford educated Sedleian Professors which continued until 2019 when Jon Keating, a graduate of New College, was appointed.

Love was born in 1863 in Somerset, the son of a surgeon and the second boy in a family of three boys and two girls, and spent his boyhood in Wolverhampton. His elder brother, Ernest, who obtained second-class honours in the Natural Sciences Tripos at Cambridge, became a lecturer in Natural Philosophy at the University of Melbourne. The elder of the sisters followed Ernest out to Melbourne where the two of them shared a house. Love's own domestic life followed a similar pattern, with the younger of the sisters keeping house for him in Oxford.

Love and his brothers were educated at Wolverhampton Grammar School where the headmaster, Thomas Beach, was known for sending 'a succession of good scholars to both Universities'.[1] Both Beach and the mathematical master, Henry Williams, were graduates of the Cambridge Mathematical Tripos. The former, a Junior Optime in 1856, had previously been mathematical master at Lancaster Grammar School, while the latter had been 28th Wrangler in 1864.[2] With such teachers, and with his brother Ernest already in situ, one might have expected Love to have a firm idea of his future at Cambridge when he successfully sat the examination for Minor Scholarships, but, when he went up to St John's College in 1882, he was undecided whether to read classics or mathematics. Having chosen mathematics, his progress was rapid, and it was said that 'no one with any personal acquaintance could fail to recognize his extraordinary cleverness'.[3]

In common with others aspiring to a high place in the Mathematical Tripos, Love employed a coach to prepare him for the rigours of the examination.[4] His choice, R. R. Webb, was the senior wrangler of 1872, and the most successful coach of his day.[5] Webb was also a college lecturer with a reputation as an excellent teacher, notably in elasticity and dynamics, both subjects in which Love would shine.[6] As expected, Love excelled in the 1885 examination, coming second in the order of merit, having been pipped to the top spot by Arthur Berry.[7] The following year, he was one of six students to be placed in Division 1 of Part III of the Tripos, and a year later he outdid Berry to win the First Smith's Prize.[8]



MR. E. H. LOVE
(St. John's College)
Second Wrangler

W

Figure 7.1: Augustus Love, Second Wrangler
The Graphic, 4th July 1885, p. 4

Having been elected a Fellow of his College in 1886, Love became a college lecturer in 1888. In 1898 he was appointed to one of the five newly founded University Lectureships in Mathematics, giving courses on elasticity, wave motion and optics. Meanwhile, he was also engaged in coaching, his most famous student being G. H. Hardy who, in his *Mathematician's Apology*, wrote appreciatively of his tutor:[9]

> My eyes were first opened by Professor Love, who taught me for a few terms and gave me my first serious conception of analysis. But the great debt that I owe him—he was, after all, primarily an applied mathematician—was his advice to read Jordan's famous *Cours d'analyse*.

Several of Love's other students gained high places in the Tripos, the most notable of whom was Charles Godfrey who was placed fourth in 1895, and who made a successful career as a textbook author and reformer of mathematics education.[10]

Oxford and teaching

Bartholomew Price resigned from the Sedleian Chair in the summer of 1898, having been in post for 45 years (see Chapter 6). Love was appointed not long afterwards, and arrived in Oxford in 1899. It seems Love's decision to move to Oxford had not been an easy one, but with little immediate prospect of being able to further his career at Cambridge, he took the plunge.[11]

On taking up the professorship, Love was made a member of the Senior Common Room at The Queen's College where, on his first visit, a memorable exchange took place, or at least so the story goes:[12] A stranger to the assembled company, Love introduced himself: 'I'm Love.' 'Ah' said one of the fellows '*Ερως* or *Αγαπη*?'[13] History does not relate what he replied. This was not the only occasion on which Love's name gave rise to amusement. In December 1898, a Melbourne newspaper, possibly due to the presence of Love's brother at the local university, published the following item:[14]

> Mr AEH Love of Cambridge has written a very learned book on a very learned subject, it being a mathematical treatise on elasticity. A few days ago an undergrad dropped in on one of our leading booksellers and airily enquired whether they had a copy of "Love's Elasticity". The

> shopman eyed him doubtfully for a few moments, and probably imagining him to be a pupil of the Ormond professor of music, asked doubtfully, "Er—do you happen to remember the author's name?"

In common with his predecessor Price, Love lectured in Oxford continuously for over forty years,[15] beginning and ending with courses on gravitational attraction and potential theory. In the intervening years he covered a wide range of topics in applied mathematics, from the well-established analytical dynamics, electricity and magnetism, waves and sound, to the more modern (and more advanced) relativity theory and tensor analysis.[16] Love was recognised as a great lecturer with a talent for seeing things from the student point of view.[17] The distinguished statistician David Kendall, who graduated from Oxford in 1939, considered Love to be 'the best mathematician lecturer in Oxford'.[18] As one obituarist put it, Love had 'a happy way of clearing up a difficult point with an illuminating phrase'.[19]

Love was the author of two textbooks, the first of which, *Theoretical Mechanics. An Introductory Treatise on the Principles of Dynamics*, appeared while he was at Cambridge.[20] Gilbert Walker, who reviewed it for the *Mathematical Gazette*, considered it to be 'Among the most interesting textbooks that have appeared in recent years […] conspicuous for the thoroughness of its treatment of fundamental principles as well as for the excellence of its style'.[21] As well as examples, it contained numerous problems—Walker counted over 660—which would have made the book attractive for those involved with the Mathematical Tripos, student and teacher alike. A second much revised edition appeared in 1906. In mathematical content it was not dissimilar from the first, but it was easier to navigate, being much better laid out, with fewer digressions and fewer problems, and as such was probably much more appealing to Love's Oxford students than its predecessor. A third edition followed in 1921 but it was little changed, apart from a further reduction in the number of problems, although, at 30 shillings, it was deemed rather expensive.[22]

For his second textbook, which appeared in 1909, Love turned his hand to the calculus, a subject he had been teaching to Oxford chemistry and engineering students for several years. In *Elements of the Differential and Integral Calculus*, his objective was to make the subject as widely accessible as possible, for as he said, 'The principles of the Differential and Integral Calculus ought to be counted as part of the intellectual heritage of every educated man and woman in the twentieth century no less than Copernicus or Darwin'.[23] It was certainly a laudable aim, if somewhat unrealistic. Nevertheless, the book hit the mark with one reviewer who thought 'Nothing could be simpler than the exposition, and the arrangement is all that can be desired. In a word, it is admirably done'.[24]

Research

Love's research publications span almost his entire career, with the first of his 57 papers appearing in 1887 and the last in 1939.[25] They were mostly theoretical, but some had obvious applications such as his paper on the collapse of boiler flues.[26] From early on he was drawn towards the subjects of hydrodynamics and elasticity, choosing hydrodynamics for his first publication which appeared in 1887,[27] and elasticity for his Smith's prize essay, a version of which was later published.[28] The former, which was on English research in vortex motion, had been commissioned by Felix Klein for *Mathematische Annalen*, and showed a broad knowledge of work in Germany as well as in England.[29] Klein also hinted to Love that he would like a comparable article on elasticity. But that was not to be. Not only had Love already been invited by Webb to collaborate on a treatise on the subject, but, as Love told Klein, much of the most important recent research had been done by continental, rather than English, mathematicians.[30] Later, Klein did succeed in commissioning two articles from Love, but these were on hydrodynamics and were for his famous *Encyklopädie*. They appeared in 1901.[31]

Some five years after the approach from Klein, the first volume of the treatise on elasticity appeared with Love as the sole author, Webb having handed him the project. Now considered Love's major

work, *A Treatise on the Mathematical Theory of Elasticity* was originally published in two volumes in 1892 and 1893. A second edition, substantially altered from the first—Love described it in the preface as 'a new book'—was published as a single volume in 1906, with a third edition in 1920, and a fourth in 1927 (reprinted in 2013). Each new edition contained results obtained since the previous one, all carefully referenced so that it provided an accurate picture of the current state of research, a quality for which the book was widely praised.[32] Containing much original work by Love, it was designed to appeal to physicists, engineers, and mathematicians alike.[33] Although appropriate for students,[34] unusually for Cambridge-produced texts of the time, it didn't contain examples but instead results were stated without proof and students encouraged to work them out for themselves—Love didn't want students to waste time 'problem-grinding' as he called it.[35] The book was an immediate success—George Greenhill, characteristically employing a military turn of phrase,[36] described it as 'an elegant and modern artillery of analysis',[37] while another reviewer commended its 'rigour free from pedantry'[38]—and it soon became established as a classic in the field of mathematical physics, alongside Horace Lamb's book on hydrodynamics.[39] As an American reviewer remarked of the fourth edition: [40]

> Those of us who are interested in mechanics have cause to be very thankful that Love's *Elasticity* and Lamb's *Hydrodynamics* are kept in print and kept up to date. There is not an equivalent of either in any other language.

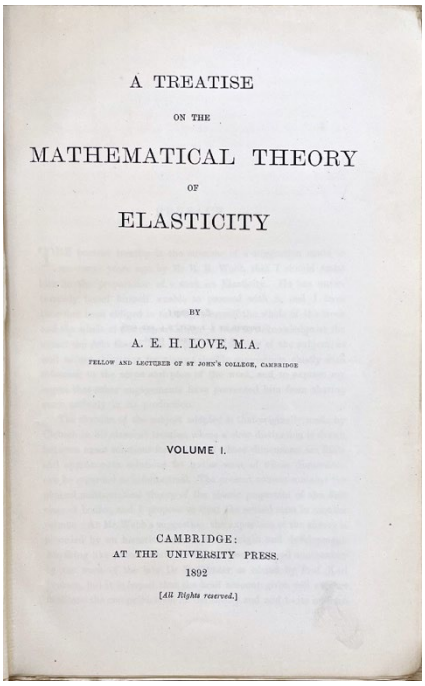
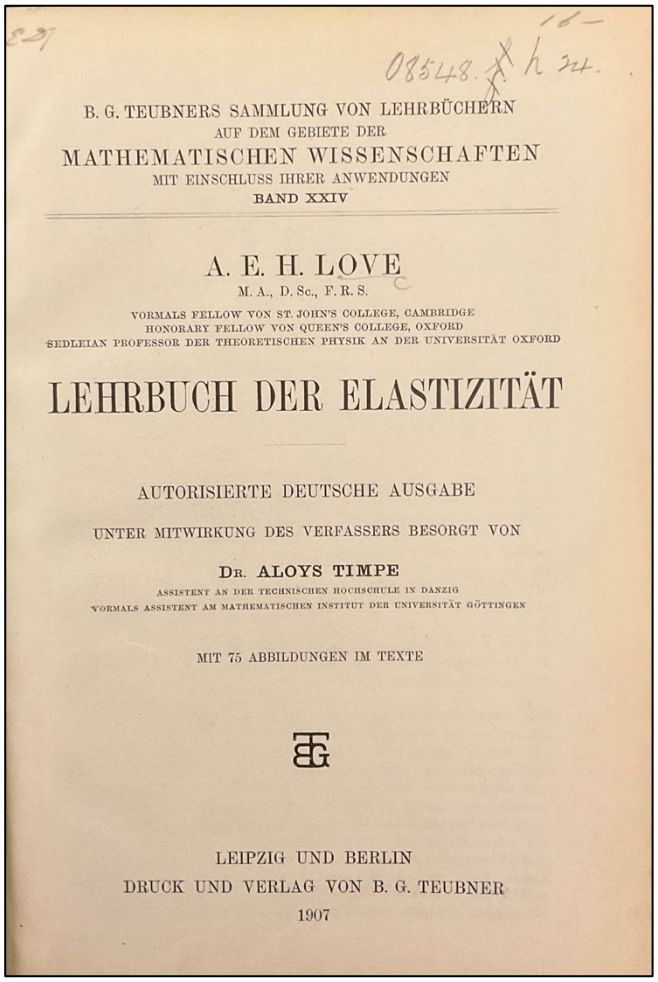

A TREATISE
ON THE
MATHEMATICAL THEORY
OF
ELASTICITY
BY
A. E. H. LOVE, M.A.
FELLOW AND LECTURER OF ST JOHN'S COLLEGE, CAMBRIDGE
VOLUME I.
CAMBRIDGE:
AT THE UNIVERSITY PRESS.
1892
[All Rights reserved.]

Figure 7.2 Augustus Love, *Elasticity*, volume 1, 1892 (Balliol College, Oxford).

Certainly in Germany there was no need of equivalents, since, on the instigation of Klein, German translations of both books had long since appeared.[41] Discussions between Klein and Love about the translation of *Elasticity* had begun in 1900, with Ernst Zermelo named as the translator.[42] But when the translation was eventually published in 1907, it was a translation of the second edition, and the translator was one of Klein's assistants and a former doctoral student, Aloys Timpe.[43] Love helped Timpe with the translation, and in many places the 'richer' (*reicheren*) English terminology was kept in preference to the 'clumsy' (*schwerfällig*) German terms.[44] To allow for students to use the English and German versions simultaneously, the German text was kept as close as possible to the English.[45]



B. G. TEUBNERS SAMMLUNG VON LEHRBÜCHERN
AUF DEM GEBIETE DER
MATHEMATISCHEN WISSENSCHAFTEN
MIT EINSCHLUSS IHRER ANWENDUNGEN
BAND XXIV

A. E. H. LOVE
M. A., D. Sc., F. R. S.
VORMALS FELLOW VON ST. JOHN'S COLLEGE, CAMBRIDGE
HONORARY FELLOW VON QUEEN'S COLLEGE, OXFORD
SEDLEIAN PROFESSOR DER THEORETISCHEN PHYSIK AN DER UNIVERSITÄT OXFORD

LEHRBUCH DER ELASTIZITÄT

AUTORISIERTE DEUTSCHE AUSGABE
UNTER MITWIRKUNG DES VERFASSERS BESORGT VON
DR. ALOYS TIMPE
ASSISTENT AN DER TECHNISCHEN HOCHSCHULE IN DANZIG
VORMALS ASSISTENT AM MATHEMATISCHEN INSTITUT DER UNIVERSITÄT GÖTTINGEN

MIT 75 ABBILDUNGEN IM TEXTE

LEIPZIG UND BERLIN
DRUCK UND VERLAG VON B. G. TEUBNER
1907

Figure 7.3: Augustus Love, *Lehrbuch der Elastizität*, 1907 (British Library).

Love's reputation as Britain's leading exponent on elasticity was cemented further in 1909 when the Royal Society awarded him one of its most distinguished prizes, a Royal Medal, for his work in the field. Elasticity was the subject that above all defined him as mathematician. Even after death he was still referred to as 'the elastic theory man'.[46] In 1911, he combined his broad knowledge of the subject and his skill as a communicator in an extensive article for the 11th edition of the *Encyclopaedia Britannica*.[47]

Love's work in elasticity covered a wide range from the equilibrium of beams and plates of different shapes to the theory of vibrations in many difficult cases, as well as applications to problems connected with the shape of the Earth. Questions concerning the latter became increasingly central to his research and in 1907 they were the focus of his Presidential Address to Section A of the British Association for the Advancement of Science (BAAS) in Leicester.[48] Two years later, when the BAAS met in Winnipeg, Canada, his opening of the 'Discussion on *Earth Tides*' brought to a wider public his recent work which contained his introduction of what are now known as Love numbers, dimensionless parameters which characterise the elastic response of the Earth to the tides, and which are today key numbers in tidal theory.[49]

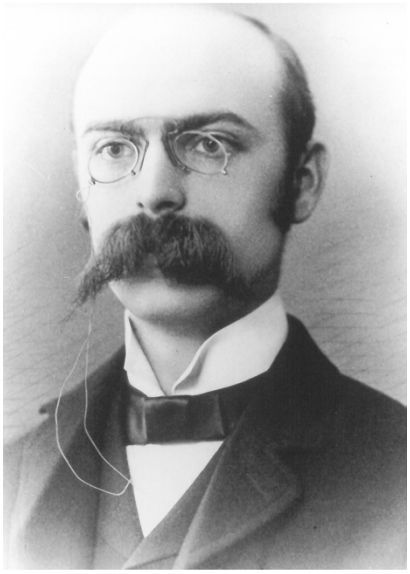


Figure 7.4 Augustus Love (courtesy of the London Mathematical Society)

When the 1910 Adams Prize of the University of Cambridge called for 'Some investigation connected with the physical constitution or motion of the earth',[50] so well did the topic fit in with Love's research, one could almost imagine it had been chosen with him in mind. His winning essay, *Some Problems of Geodynamics*, appeared in book form the following year.[51] Basing his investigation on the hypothesis of isostasy,[52] he employed elaborate harmonic analysis to tackle the various problems, leading the reviewer in the *Bulletin of the American Mathematical Society* to aptly describe it as 'a mass of intricate analysis interspersed with very readable comment'.[53] Perhaps surprisingly, the book was also reviewed in *The Athenaeum*, a literary journal, with the anonymous reviewer, who concentrated his review on the 'readable comment', fittingly concluding that it would be 'a revelation to any reader who may be inclined to think that there is no more room for mathematical research of the first order', i.e., pointing out to the uninitiated observer that what might seem to be abstruse mathematics for its own sake can lead to important practical results.[54] As well as the fine-tuning of his earlier research, the book also contained what is considered Love's most important discovery and now named for him: 'Love waves' which are fundamental in seismology.[55] Prior to Love's discovery, the theory of waves in an elastic medium without a boundary had been worked out by Siméon Denis Poisson (1830) and George Gabriel Stokes (1849). They had shown that given a disturbance, the wave motion will separate itself out into two types: faster compressional longitudinal waves and slower distortional transverse waves. When a boundary is present, the situation becomes more complicated because each type of wave can then give rise to repeated reflections of both types of waves, and this makes it difficult to analyse what happens in the neighbourhood of a boundary. In 1885 Lord Rayleigh mathematically predicted the existence of a type of surface wave in which each particle moves in an ellipse against the direction of propagation (in contrast to surface waves in water in which each particle makes a circular motion in the direction of propagation), and conjectured that they might play an important part in earthquakes (Figure 7.5).[56] However, when surface seismic waves were first detected in the studies of earthquake records in the early 1900s, it was found that they had features which were not consistent with the characteristic features of Rayleigh waves. Love postulated that these inconsistencies were due to another type of surface wave which propagates as a result of the difference in density between the earth's crust and its underlying mantle. These waves vibrate horizontally and transversely to the direction of motion (the amplitude decreasing with depth), and account for the horizontal shifting of the Earth during an earthquake (Figure 7.5). Love waves travel faster than Rayleigh waves and cause the greatest structural damage outside the epicentre of an earthquake (Figure 7.6), and are fundamental in the understanding of plate tectonics.

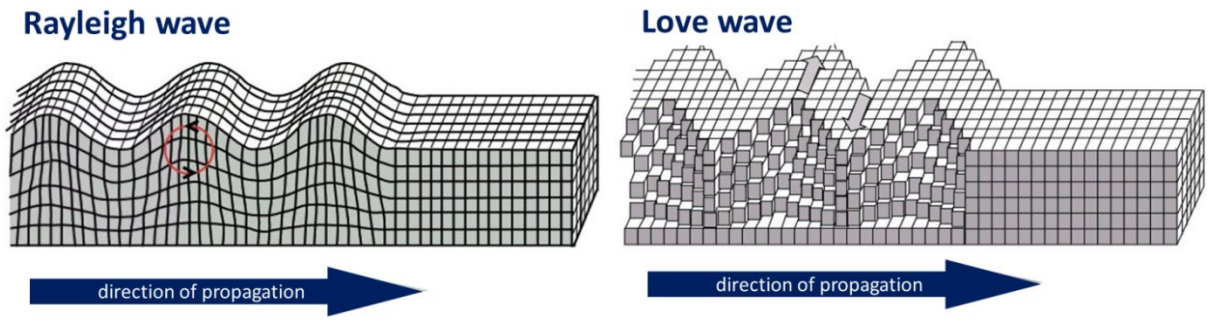


Figure 7.5 Rayleigh wave and Love wave (https://opentextbc.ca/geology/chapter/11-3-measuring-earthquakes/ (Wikimedia commons)

Figure 7.6 Twisted railway lines in the aftermath of an earthquake (Figure 5 in https://www.intechopen.com/chapters/60627)

In one of his last papers on elasticity, Love successfully attacked the problem of finding a solution to the biharmonic equation subject to boundary conditions over the perimeter of a rectangle, thereby solving the two-dimensional form of a problem described by the French mathematician Gabriel Lamé as 'le plus difficile peut-être de la théorie de l'élasticité'.[57] As Love described in a lecture to the London Mathematical Society, it was a result that could be used in practical applications such as in determining the thickness of glass for a shop window able to withstand a certain pressure of wind.[58]

During the First World War, Love remained in Oxford but diverted time towards research in ballistics, developing a small arcs method for calculating high-angle trajectories, work which was needed for the creation of range tables for anti-aircraft gunnery.[59] It seems very likely that he was drawn into this work by the Cambridge geometer George Richmond, who was Love's exact contemporary at Cambridge and was one place below him in the Mathematical Tripos, and who during the War was one of the leaders of the Anti-Aircraft Experimental Section of the Ministry of Munitions.[60] After the war, Love continued his work on ballistics, collaborating with his Oxford colleague Frederick Pidduck on Lagrange's internal ballistic problem, a problem concerning the interaction between the propellant gases and the projectile inside a gun barrel which had been first published by Poisson from the manuscripts of Lagrange.[61]

During the War, Love also had the opportunity to interact with scientists at the Royal Aircraft Factory at Farnborough who were concerned with the development of the fledgling science of aeronautics. On one occasion, the physicist Frederick Lindemann, later Lord Cherwell, a courageous pilot and renowned as a calculator, was proposing to test a fender-like device for pushing aside barrage balloon cables by flying an aircraft into just such a cable, having worked out that the maximum force the cable would exert on the device, which was fixed to the front of the aircraft, was 120lbs. The physicist Reginald Jones, to whom Lindemann had told the story, recounted what happened next:[62]

> Just as he [Lindemann] was about to make the test a telegram arrived to say that he was on no account to do it because his calculation had been shown to the distinguished applied mathematician, Professor A.E.H. Love, and Love considered that he had ignored some second-order terms that could be very important. He must therefore delay the test until Love had completed a rigorous calculation. After some weeks, Love came up with his answer—121 pounds.

Although in the end Lindemann's estimate for the force differed little from Love's, the incident highlights the esteem in which Love was held across the scientific spectrum.

Love also made contributions to classical electrodynamics, as well as authoring several sensitively written obituaries of colleagues. He was well-known for his versatility as a mathematician, albeit one who 'rejoiced in algebra rather than geometry',[63] and his explanatory power and proficiency in pure mathematics can be seen in his articles in the *Encyclopaedia Britannica*.[64] In his final paper, published in the year before he died, he tackled a case of Boussinesq's problem.[65] The name of the problem derives from the work of the French mathematician and physicist, Joseph Boussinesq, who in 1885, was the first to consider the problem of the indentation of the plane surface of a semi-infinite elastic solid by pressure applied normally to the plane boundary. The particular cases successfully addressed by Boussinesq are of practical importance in the construction of roads and pavements, and in connection with Boussinesq's solutions, Love himself made reference to a recent report of the Road Research Board. In the case treated by Love, the elastic solid is temporarily deformed by the pressure against it of a perfectly rigid right circular cone with its axis normal to the indented plane and its vertex penetrating the region originally occupied by the solid. It is of importance in various areas of applied mechanics, including in soil mechanics where the cone is the conical head of a cylindrical pillar, and the solid is the soil on which the pillar rests. Love's success in solving the problem rested on the fact that he had the skill to guess a combination of potentials which satisfies the boundary conditions.[66] The success of his investigation, which involved clever analysis, shows that even towards the end of his life, his analytical powers remained undimmed.

The careful attention to detail which characterises Love's work, combined with the modesty Love displayed in connection with his own work, is captured by the applied mathematician Richard Southwell in his review of a paper on elasticity Love submitted to the Royal Society in March 1929. Southwell recommended that the paper be published in full, adding the following remarks:[67]

> I have [no material modifications] to suggest, except that references should be given to the author's 'Theory of Elasticity': he seems to have hesitated to do this anywhere.
>
> The paper seems to me to be a valuable discussion on an important class of problems. I have had no time to verify the details of the analysis, but it is not in the habit of Prof. Love to make mistakes.

Love in the community

Love had been in Oxford for three years when, in September 1902, he was invited to Kristiania (now Oslo) to be the university's representative at the four-day meeting to mark the centenary of the birth of the mathematician Niels Henrik Abel. It was a glittering affair, designed as a national Norwegian showcase, and attended by the King of Sweden and Norway. Fridtjof Nansen, the Arctic explorer, was president of the reception committee, and among the attendees were the writer Henrik Ibsen and the composer Edvard Grieg. Some 80 foreign mathematicians attended the celebrations. Among the other British delegates were A. R. Forsyth, Sadleirian Professor of Mathematics at Cambridge (who received an Honorary Doctorate, and who on behalf of the English delegation gave a speech celebrating Abel), George Greenhill, Professor of Mathematics at the Royal Military Academy at Woolwich, and E. W. Hobson, a lecturer at Cambridge. Love clearly relished the occasion, writing to his friend Joseph Larmor at Cambridge:[68]

> The Christiania [the name for Kristiania until 1897] people did us very well & I should have had a thoroughly enjoyable holiday if I had not had the misfortune to crush my left thumb in a cabin door on the steamer coming home.
>
> I learnt from the *Times* that Forsyth flushed with his Christiania triumph, which was genuine, rushed to Belfast to set the world right in the matter of teaching mathematics.[69]

Love enjoyed travel, and whether it was on this occasion, or more probably on a later one, he often recounted the story of driving across Norway together with Hobson, the two entertaining each other by singing.[70]

In August 1912 the International Congress of Mathematicians (ICM) came to Cambridge on the invitation of the Cambridge Philosophical Society. It was the fifth ICM to be held and the largest to that date, with 574 full members and a total of 708 attending. Love, together with Hobson, who in 1910 had succeeded Forsyth as Sadleirian Professor, were the joint Secretaries for the Congress. They were responsible for the local organisation which was no small task— the President of the Congress, G. H. Darwin, estimated it at no less than 16 hours a day each.[71] Love and Hobson were also responsible for editing the two volumes of the Congress *Proceedings*. But Love's role did not stop there. He was one of the organisers of Section III of the Congress (Mechanics, Physical Mathematics, Astronomy), he gave a talk on tidal theory, he organised a day trip to Oxford,[72] and he actively participated in the discussion of Carl Runge's report on the teaching of mathematics to physicists.[73] Regarding the latter, he made his own views very clear: in an ideal world, every mathematician would be a physicist and vice versa. Science students should not be limited to the useful parts of mathematics, for that, he said, would destroy the logical unity of the subject and relegate it to a subservient position not in line with its importance.[74]

Love was a member of several scientific organisations and played an active role in scientific life in Britain, beginning with his election to the Council of the London Mathematical Society (LMS) in 1890, three years after he had been elected to the Society's membership. He served continuously on the LMS Council until 1920, and again from 1922 to 1925, and for fifteen of those years, from 1895 to 1910, he was an Honorary Secretary, and he twice served as Vice-President. One of his roles as Honorary Secretary was to find reviewers for articles submitted to the *LMS Proceedings*, an undertaking which could prove quite challenging, and Love would often consult with his friend Larmor (who was the Society's Treasurer for much of the time Love was in office), such as he did on an occasion in 1909:[75]

> Many thanks for Hassé's paper & your report. I knew it was too bad to trouble you but these things are difficult to get through or get rid of. Niven wants to be sure of the details before making up his mind, Macdonald keeps a paper for six weeks in spite of reminders, Lamb won't look at this stuff, and we have no confidence in Bateman or Cunningham.

Love was President of the LMS for the customary two years from 1912, his term ending during the early months of the war. For his Presidential address, he discussed the question of value and

importance in mathematical research, or, as he put it, 'Wherein lies the difference between valuable research and laborious trifling?'[76] In answer, he proposed four qualities which characterise valuable research: novelty or creativity, relevancy, definiteness, and generality (not to be confused with vagueness). In the particular case of mathematical physics, he added a fifth: adherence to fact.

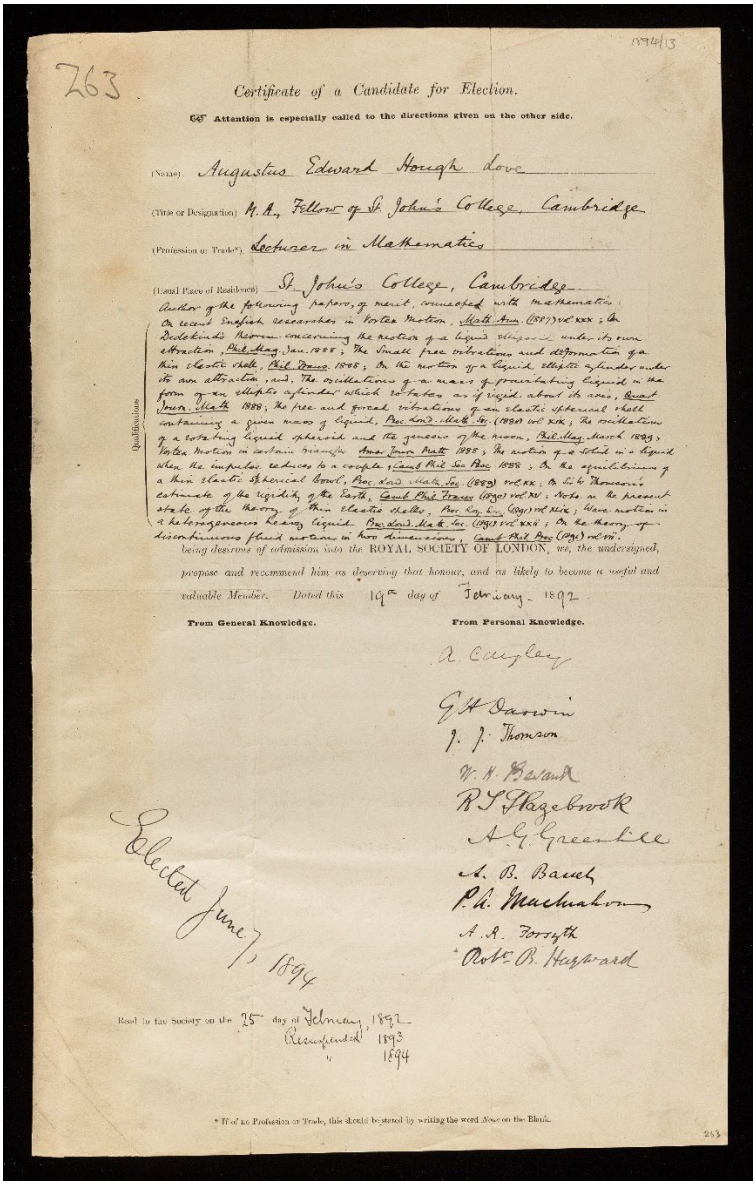
Gratifyingly for historians of mathematics, he made a plea for their subject:[77]

> I would plead for more attention to the history of mathematics. Towards elucidating this history Great Britain has not done very much; the study of it receives here but little encouragement. Yet it seems to me to be extremely desirable, if not actually indispensable, for entering into the heritage that has been bequeathed to us, and for seeking to enhance its value.

Love's interest in history of mathematics is also evident in his correspondence with Larmor. He was a subscriber to the collected works of Christiaan Huygens which had begun publication in 1888 with a volume of the correspondence and which, by 1901, had reached the ninth volume but it was still on correspondence. Publication of Huygens' actual works was yet to begin. This was a model which did not appeal to Love, as he made plain to Larmor when discussing a proposed edition of Newton's works:[78]

> I think it would be a great misfortune to begin an edition of Newton with the letters. People get sick of them, at any rate if they run to anything like the same length as Huygens's did. The Huygens' Committee are printing a very large number letters <u>to</u> Huygens as well as those which he wrote, and in any case where letters are published it seems necessary to have those both sides. Sampson seems to have the instinct of the historian and biographer and I think that he will make an excellent editor but I should have preferred a good translation of the more important works such as the *Principia* and the *Curvae tertii ordinis* to a collection of letters.

Love was elected to the Royal Society in 1894 at the young age of 31, with a distinguished cast of proposers including Arthur Cayley, George Howard Darwin, Andrew Russell Forsyth, George Greenhill, and James Joseph Thomson, all of whom knew him personally. Among the Society's most assiduous Fellows, he was elected to the Council in 1902, was a member of many committees, including the Royal Society Catalogue of Scientific Papers Committee and the Stokes Memorial Committee, exhibited at the Society soirées, and was often called upon to represent the Society, even at such events as the 1902 Coronation Naval Review.



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Certificate of a Candidate for Election.

☞ Attention is especially called to the directions given on the other side.

(Name) Augustus Edward Hough Love

(Title or Designation) M.A., Fellow of St. John's College, Cambridge

(Profession or Trade*) Lecturer in Mathematics

(Usual Place of Residence) St. John's College, Cambridge

Author of the following papers, of merit, connected with mathematics:
On recent English researches in Vortex Motion, Math. Ann. (1887) vol. xxx; On Dedekind's theorem concerning the motion of a liquid ellipsoid under its own attraction, Phil. Mag. Jan. 1888; The small free vibrations and deformation of a thin elastic shell, Phil. Trans. 1888; On the motion of a liquid elliptic cylinder under its own attraction, and the oscillations of a mass of gravitating liquid in the form of an elliptic cylinder which rotates as if rigid about its axis, Quart. Journ. Math. 1888; The free and forced vibrations of an elastic spherical shell containing a given mass of liquid, Proc. Lond. Math. Soc. (1890) vol. xxi; The oscillations of a rotating liquid spheroid and the genesis of the moon, Phil. Mag. March 1899; Vortex motion in certain triangles, Amer. Journ. Math. 1898; The motion of a sphere in a liquid when the impulse reduces to a couple; Camb. Phil. Soc. Proc. 1898; On the equilibrium of a thin elastic spherical bowl, Proc. Lond. Math. Soc. (1889) vol. xx; On Sir G. Darwin's estimate of the rigidity of the Earth, Camb. Phil. Trans. (1890) vol. xv; Note on the present state of the theory of thin elastic shells, Proc. Roy. Soc. (1891) vol. xlix; Wave motion in a heterogeneous heavy liquid, Proc. Lond. Math. Soc. (1891) vol. xxii; On the theory of discontinuous plane motion in two dimensions, Camb. Phil. Proc. (1892) vol. vii;

Qualifications

being desirous of admission into the ROYAL SOCIETY OF LONDON, we, the undersigned, propose and recommend him as deserving that honour, and as likely to become a useful and valuable Member. Dated this 19th day of February 1892

From General Knowledge.

From Personal Knowledge.

A. Cayley

G. H. Darwin

J. J. Thomson

W. M. Hicks

R. T. Glazebrook

A. G. Greenhill

A. B. Basset

P. A. MacMahon

A. R. Forsyth

Robt. B. Hayward

Elected June 7, 1894

Read in the Society on the 25th day of February 1892

Recommended 1893
1894

* If of no Profession or Trade, this should be stated by writing the word None on the Blank.

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Figure 7.7 Love's Royal Society Certificate of Election (courtesy of the Royal Society)

As chair of the Royal Society's Mathematics Committee, Love was heavily involved in the reviewing process of mathematical papers submitted to the Society, acting as a referee himself for over 30 years. It was a task he undertook conscientiously, often writing long reports, especially on papers he felt should be rejected. For example, in the case of a paper on torsion by Karl Pearson, submitted in the summer of 1900 to the *Philosophical Transactions*, to which he gave a decision of 'I think not', he included over two closely written pages of detailed remarks.[79] Having first observed there was nothing new in the methods employed in the paper, he made it clear that although he personally was not impressed by the results, he was prepared to concede to others more knowledgeable than himself that they may have value. But even so, he considered Pearson's 'prolixity', of which he gave several examples, made the paper unpublishable. In short, he said, should the paper be thought to have merit then it should be substantially condensed, which in effect meant it would have to be rewritten. Love's verdict won the day, and Pearson had to make do with a two-page abstract of his paper being published in the *Proceedings of the Royal Society* the following year.[80]

In the case of a paper by George Hartley Bryan and William Ellis Williams on the stability of flight, submitted in June 1903, just few months before the Wright Brothers made their historic flight, Love was positive but again critical of the paper's length—'too much "penny a line" padding'—noting that,

for example, readers of the *Philosophical Transactions* do not need to be told 'that an equation of the fourth degree "is a called a biquadratic equation"'.[81] This time he recommended publication, in the *Philosophical Transactions* or, if 'properly condensed' in the *Proceedings*, adding the prescient remark that the conclusions 'may prove to be important in the development of flying machines'.[82] The paper, despite being published after the Wright Brothers' flight, was virtually ignored when it appeared, but a few years later Bryan's ideas achieved wide recognition with the publication of his 1911 book *Stability in Aviation*, in confirmation of Love's judgement.[83]

In 1937 the Royal Society awarded Love its most prestigious prize in the field of mathematics, the Sylvester Medal, in recognition of his sustained contributions to elasticity and hydrodynamics.[84]

Another arena in which Love increasingly made his presence felt was the British Association for the Advancement of Science, having first given a paper at the annual meeting as early as 1888 when the meeting was held in Bath.[85] As well as being the President of Section A in 1907, he also served continuously on different BAAS committees between 1902 and 1931, many of the committees running for several years. These included committees on the Teaching of Mathematics, Engineering Research, Calculation of Mathematical Tables, Seismological Observations, Geophysical Discussions, and the Determination of Gravity at Sea Committee (which he also chaired). The remits of these Committees were all very different and the variety of their subject matter holds a mirror to the breadth of Love's mathematical and scientific knowledge, his willingness to serve demonstrating his dedication to the scientific community.

Unfortunately, no archive of Love's papers exists, but a glimmer of the humorous side of his nature can be seen through some of his correspondence with Larmor which is preserved in the St John's College Library archives.[86] In 1899, not long after his arrival in Oxford, he wrote to Larmor to inform him that:[87]

> Stout is an awful warning; he is trying to do "what is usual", otherwise he is unchanged and as you may expect his efforts in the direction of normality are not very successful. So far I have no reason to suppose that the malady from which he is suffering will presently attack me also, but doubtless there are "dangers lurking unseen". […] Stout and Weldon are both coming over to celebrate their benefactors.

Quite what Love was getting at here with respect to the philosopher and psychologist George Stout, who had recently arrived in Oxford as a reader in mental philosophy, is somewhat enigmatic but there was clearly camaraderie between them. Both Stout and the evolutionary biologist Raphael Weldon, who had just been appointed to a chair in zoology at Oxford, had been Cambridge contemporaries of Love's and Larmor's, all four being fellows of St John's College.

Love enjoyed keeping up with the St John's gossip and a few years later, in 1907, he had heard some rather unexpected news about Charles Taylor, the Master of St John's:[88]

> I hope you are all pleased with the Master's engagement. Is "better later than never" true? Or must a man as Foxwell said make the mistake of his life sometime or other? Did the Master omit to "pack his portmanteau"?

Taylor had been Master of St John's since 1881, so was well-known to both Love and Larmor. He married for the first time in October 1907 at the age of 68, and died suddenly the following July. The reference to Foxwell is a reference to another fellow of St John's, the economist Herbert Foxwell who held the chair of economics at University College London while maintaining a college lectureship at St John's.

Aside from music and travel, another of Love's extra-curricular interests was the game of croquet and he was a familiar figure in the Parks in Oxford where 'as regularly as the swallows brought the summer' he could be seen wielding a mallet 'with doughty energy and enjoyment'.[89] No doubt he could be readily identified by his remarkable moustache which was described by the astronomer Thomas Cowling, a student of Love's in the 1920s, as 'charmingly reminiscent of a frozen waterfall'.[90]

Conclusion

Although Love was initially hesitant at taking up the Sedleian Chair, his migration to Oxford was an unequivocal success as witnessed by both his mathematical productivity and service to the scientific community. After the move, he kept close ties with Cambridge, especially with his friends Larmor and Hobson, and it must have given him great pleasure when St John's College made him an Honorary Fellow in 1927, the same year he was elected to a fellowship at The Queen's College in Oxford.[91]

Love died in Oxford in 1940 after an operation. He was aged seventy-seven and had been active in his role as Sedleian Professor until very shortly before his death, having occupied the chair for twelve years beyond the normal retirement date. As his Oxford colleague E. A. Milne wrote,[92] 'Certainly, if compulsory retirement from formal University business is in general wise, the case of Love shows that it would be still wise to provide for exceptional relaxation of the rule.'

The sketch of Love (Figure 7.8) was drawn by one of his students, Kenneth Thornhill, during a lecture *c*.1938, when Love was in his mid-seventies. Thornhill, in recounting the episode, bears witness to Love's success as a teacher:[93]

> At first [Love] was somewhat affronted that anyone should do that sort of thing at his lectures; but when I explained that I was there for the second year so as not to miss anything, his eyes twinkled and his face glowed as it always appeared to do at any words of appreciation; and he immediately acknowledged, if only a little grudgingly, that the likeness was good enough to sign.

Love was remembered by his colleagues not only as a man of mathematical talent and versatility, and as an outstanding teacher, but also as a friend. Testament to his modesty, generosity, and kindliness is woven through the many tributes that were paid to him after his death.[94] He was, in Milne's words, indeed 'truly simple and so truly great'.[95]

Figure 7.8 Augustus Love drawn by C. K. Thornhill, *c*.1938, and signed by Love

[1] E. A. Milne, 'Augustus Edward Hough Love, 1863–1940', *Journal of the London Mathematical Society* 16 (1941), 69–80 at p. 70.

[2] Beach's teaching was of the classical style with an emphasis on the quadrivium. He nurtured such a dislike of science that he resigned in 1889 when the first science master was appointed at the school. See S. Jones, 'School was forced to find a new home', *Black Country Bugle*, 28th November 2018, p.12. Students passing the Cambridge Mathematical Tripos were divided into three classes according to merit: Wranglers (first class), Senior Optimes (second class), Junior Optimes (third class).

[3] Milne, 'Augustus Edward Hough Love', p. 70.

[4] For a discussion of the development of the Mathematical Tripos and the role of coaching, see Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, Chicago: University of Chicago Press, 2003.

[5] Between 1882 and 1902 Webb coached 100 students to top 10 places. For a detailed description of Webb's coaching style, see Warwick, *Masters of Theory*, pp. 247–52.

[6] A. R. Forsyth, 'Old Tripos Days at Cambridge', *The Mathematical Gazette* 19 (1935), 162–79 at p. 175; Anon, 'Obituary. Robert Rumsey Webb', *Monthly Notices of the Royal Astronomical Society* 97 (1937), 283.

[7] Arthur Berry made his career at Cambridge, pursuing an interest in economics as well as in mathematics. The third wrangler in 1885 was George Richmond who, like Berry, was a scholar at King's College, and who also made his career in Cambridge.

[8] Since 1885 the Smith's Prizes have been judged on the basis of an essay rather than by examination. Although Love's winning essay of 1887 no longer appears to exist, its title, 'The small free vibrations of a thin elastic shell, and on the free and fixed vibrations of an elastic spherical shell containing a given mass of liquid', is closely related to titles of papers published by Love soon afterwards: A. E. H. Love, 'The free and forced vibrations of an elastic spherical shell containing a given mass of liquid', *Proceedings of the London Mathematical Society* 19 (1889), 170–207; *idem*, 'The small free vibrations and deformation of a thin elastic shell', *Philosophical Transactions of the Royal Society of London. Series A* 179 (1889), 491–546. The latter paper generated some controversy between Love and Lord Rayleigh which is discussed in detail in C. R. Calladine, 'The theory of thin shell structures 1888-1988', *Proceedings of the Institution of Mechanical Engineers* 202 A3 (1988), 141–9. For a history of the Smith's Prizes, see J. E. Barrow-Green, ''A Corrective to the Spirit of too Exclusively Pure Mathematics': Robert Smith and his Prizes at Cambridge University', *Annals of Science* 56 (1999), 271–316.

[9] G. H. Hardy, *A Mathematician's Apology*, Cambridge: Cambridge University Press, 1940, p. 147.

[10] Godfrey's year, 1895, was recognised as being a particularly brilliant one, with Thomas Bromwich topping the list and John Hilton Grace and Edmund Taylor Whittaker being bracketed equal second.

[11] J. Larmor, 'Augustus Edward Hough Love', *The Eagle* 52 (1941), 62-3 at p. 62.

[12] C[harles] H[enry] T[hompson], 'Professor A. E. H. Love', *The Queen's College Record* II, 8 (1941), 11–2 at p. 11.

[13] That is, eros (romantic love) or agape (God's divine love).

[14] See *The Australian*, 3rd December 1898, p. 1266.

[15] Most of his lectures were given in the Electrical Laboratory which was in the Townsend Building of the Clarendon Laboratory, see Milne, 'Augustus Edward Hough Love', p. 72.

[16] Love taught the following courses at Oxford:

1898-99

Gravitational attraction and potential theory

1900-1938

Advanced applied mathematics - Analytical dynamics - Analytical statics - Attractions and electrostatics - Differential and integral calculus - Differential equations - Dynamics - Electricity and Magnetism - Fourier series - Geometrical optics - Harmonic analysis - Hydrodynamics - Hydrostatics - Introduction to mathematical physics - Mechanics of deformable bodies - Potential theory - Relativity (1927) - Spherical harmonics - Tensor calculus (1931) - Waves and sound - Problem classes

1939

Gravitational attraction and potential theory - Electricity and magnetism - Dynamics - Hydrodynamics.

Informal problem classes: electricity and magnetism; electrodynamics; hydrodynamics.

[17] See Milne, 'Augustus Edward Hough Love', p. 72.

[18] See Calladine, 'The theory of thin shell structures', p. 142.
[19] See Thompson, 'Professor A. E. H. Love', p. 12.
[20] A. E. H. Love, *Theoretical Mechanics. An Introductory Treatise on the Principles of Dynamics with Applications and Numerous Examples*, Cambridge: University Press, 1897.
[21] G. T. Walker, 'Theoretical Mechanics', *The Mathematical Gazette* 1(13) (1898), 173–4 at p. 173. Walker, the senior wrangler in 1889, was a lecturer at Trinity College Cambridge.
[22] S. Brodetsky, 'Statics, Dynamics, and Hydrodynamics', *Nature* 110 (1921), 243–4 at p. 244. The price of the book in 1921 is equivalent to approximately £55 in 2023.
[23] A. E. H. Love, *Elements of the Differential and Integral Calculus*, Cambridge: University Press, 1909, p. v.
[24] Anon, 'Elements of the Differential and Integral Calculus by A. E. H. Love', *The Mathematical Gazette* 5 (1910), 316–7 at p. 317.
[25] See Milne, 'Augustus Edward Hough Love', pp. 78–80.
[26] A. E. H. Love, 'On the collapse of boiler flues', *Proceedings of the London Mathematical Society* 24 (1893), 208–19.
[27] A. E. H. Love, 'On recent English researches in vortex motion', *Mathematische Annalen* 30 (1887), 326–44.
[28] A. E. H. Love, 'The free and forced vibrations of an elastic spherical shell containing a given mass of liquid', *Proceedings of the London Mathematical Society* 19 (1889), 170–207.
[29] Between February and September 1887, Love exchanged several letters with Klein about the content of the article (Cod. Ms. F. Klein 10: 871–880, Manuscript Division, Niedersächsische Staats- und Universitätsbibliothek Göttingen). His paper heralded the wider dissemination on the Continent of British work on hydrodynamics. See R. Tobies and D. E. Rowe, *Korrespondenz Felix Klein – Adolf Mayer*, Teubner Archiv zur Mathematik 14, Leipzig: Teubner, 1990, p. 161. Love retained an association with Klein throughout his career, being one of the sponsors of the 1912 portrait of Klein by the leading German impressionist Max Liebermann. See R. Tobies, *Felix Klein. Visions for Mathematics, Applications, and Education*, tr. V. A. Pakis, Basel: Birkhäuser, 2021, p. 616.
[30] Letter from Love to Klein, 6th July 1887. Cod. Ms. F. Klein 10: 876, Manuscript Division, Niedersächsische Staats- und Universitätsbibliothek Göttingen.
[31] A. E. H. Love, 'Hydrodynamik: Physikalische Grundlegung' (IV. 15), 'Hydrodynamik: Theoretische Ausführungen (IV. 16), in *Encyklopädie der mathematischen Wissenschaften*, Leipzig, 1901.
[32] See, for example, L. N. G. Filon, 'Mathematics of Elasticity', *Nature* 105 (1920), 511–2.
[33] For a detailed discussion of the contents of *Elasticity*, see Milne, 'Augustus Edward Hough Love', pp. 73–6.
[34] It was, for example, recommended reading for mathematics undergraduates at Edinburgh University.
[35] A. E. H. Love, *A Treatise on the Mathematical Theory of Elasticity*, 2 vols., Cambridge: University Press, 1892–1893, vol. 1, p. ix.
[36] Greenhill was professor of mathematics at the Royal Military Academy, Woolwich.
[37] A. G. Greenhill, 'Mathematical Elasticity', *Nature* 47 (1893), 529–30 at p. 529.
[38] G. B. Mathews, 'A Standard Treatise on Elasticity', *Nature* 74 (1906), 74–5 at p. 75.
[39] Lamb's *Hydrodynamics* of 1895 was first published as *A Treatise on the Motions of Fluids* in 1878.
[40] E. B. Wilson, 'A Treatise on the Mathematical Theory of Elasticity', *Bulletin of the American Mathematical Society* 34 (1928), 242–3.
[41] See Tobies, *Felix Klein*, p. 302.
[42] Letter from Love to Klein, 4th February 1901. Cod. Ms. F. Klein 10: 881, Manuscript Division, Niedersächsische Staats- und Universitätsbibliothek Göttingen.
[43] It was the proposal of a translation with the possibility of including corrections that prompted the production of the second edition. See Love's letter to Klein of 4th February 1901 (note 42).
[44] A. E. H. Love, *Lehrbuch der Elastizität*, tr. A. Timpe, Leipzig; Berlin: B. G. Teubner, 1907, p. V.
[45] It was said that *Elasticity* had been translated into 'several languages': see Milne, 'Augustus Edward Hough Love', p. 76. To date, the only translation other than German to come to light is Russian: *Математическая теория упругости*, Москва, 1935.
[46] Letter from Francis Simon to Sybrens Ruurds de Groot, 15th February 1953. Papers of Sir Francis (Franz) Eugen Simon, Royal Society Archives, FS/7/2/179. I am grateful to Christopher Hollings for drawing this letter to my attention.
[47] A. E. H. Love, 'Elasticity', *Encyclopaedia Britannica*, 11th edition, Cambridge: University Press, 1911. Love also wrote articles on 'Functions of real variables', 'Infinitesimal calculus' and 'Calculus of variations' for the same edition.
[48] A. E. H. Love, 'Address to the Mathematical and Physical Section of the British Association for the Advancement of Science', *Report of the British Association for the Advancement of Science, Leicester 1907* (1908), 427–38; *Nature* 76 (1907), 327–32.

[49] See A. E. H. Love, 'The Yielding of the Earth to Disturbing Forces', *Proceedings of the Royal Society of London. Series A* 82 (1909), 73–88, and A. E. H. Love, 'Discussion on 'Earth Tides'', *Report of the British Association for the Advancement of Science, Winnipeg 1909* (1910), 408–9.
[50] The Adams Prize is named after John Couch Adams. It was founded in 1848 to commemorate Adams' discovery of the planet Neptune two years earlier. A subject was set every two years and it was open to graduates of Cambridge. Today the prize is awarded annually to UK-based researchers under the age of 40.
[51] A. E. H. Love, *Some Problems of Geodynamics being an Essay to which the Adams Prize in the University of Cambridge was Adjudged in 1911*, Cambridge: University Press, 1911.
[52] Isostasy is the principle that the Earth's crust is floating on its mantle, rather like an iceberg floating on water.
[53] E. B. Wilson, 'Some Problems of Geodynamics, being an Essay to which the Adams' Prize in the University of Cambridge was adjudged in 1911', *Bulletin of the American Mathematical Society* 20 (1914), 432–4 at p. 433.
[54] Anon, 'Science. Our Library Table. Some Problems of Geodynamics by A. E. H. Love', *The Athenaeum* 4397 (1912), 133.
[55] For Love's introduction of 'Love waves', see Love, *Some Problems of Geodynamics*, pp. 176–181; and for a discussion, see Milne, 'Augustus Edward Hough Love', pp. 76–77.
[56] Lord Rayleigh, 'On waves propagated along the plane surface of an elastic solid', *Proceedings of the London Mathematical Society* 1 (1885), 4–11.
[57] Sir William Bragg, 'Address of the President', *Proceedings of the Royal Society of London. Series B.* 124 (1937), 395–6 at p. 396.
[58] A. E. H. Love, 'Biharmonic analysis, especially in a rectangle, and its applications to the theory of elasticity', *Journal of the London Mathematical Society* 3 (1928), 144–56; *Proceedings of the London Mathematical Society* (2) 29 (1929), 189–242. The biharmonic equation is a fourth-order partial differential equation related to the Laplace equation.
[59] H. W. Richmond (ed.), *Textbook of Anti-Aircraft Gunnery*, vol. 1 (1924), H.M.S.O., pp. 233–4.
[60] See J. E. Barrow-Green, 'Cambridge mathematicians' responses to the First World War', in *The War of Guns and Mathematics* (ed. D. Aubin and C. Goldstein), Providence, RI: American Mathematical Society (2014), 59–124 at pp. 89–97.
[61] A. E. H. Love and F. B. Pidduck, 'Lagrange's ballistic problem', *Philosophical Transactions of the Royal Society of London. Series A* 222 (1922), 167–226. Pidduck, an Oxford graduate in physics, was a research fellow at The Queen's College. He had spent the war at Woolwich Arsenal working on ballistics.
[62] R. V. Jones, 'Lindemann beyond the laboratory', *Notes and Records of the Royal Society of London* 41 (1987), 191–210 at p. 193–4.
[63] See Milne, 'Augustus Edward Hough Love', p. 72.
[64] See note 47.
[65] A. E. H. Love, 'Boussinesq's problem for a rigid cone', *Quarterly Journal of Mathematics* 10 (1939), 161–75.
[66] See A. N. Sneddon, 'Boussinesq's problem for a rigid cone', *Mathematical Proceedings of the Cambridge Philosophical Society* 44 (1948), 492–507 at pp. 492–3.
[67] R. V. Southwell, Referee's Report on the paper by A. E. H. Love 'The Stress Produced in a Semi-Infinite Solid by Pressure on Part of the Boundary', [June 1929]. Royal Society Archives, RR/39/76. A. E. H. Love, 'The Stress produced in a Semi-Infinite Solid by Pressure on Part of the Boundary', *Philosophical Transactions of the Royal Society of London. Series A* 228 (1929), 377–420.
[68] Letter from Love to Larmor, 24th September 1902. GB 275 (Misc)/LO2/18, St John's College Library, Cambridge. Larmor had been senior wrangler in 1880, and the two had become friends after Larmor returned to St John's in 1885, the year in which Love was second wrangler. At the date of the letter, Larmor was a fellow and mathematical lecturer at St John's College and Secretary of the Royal Society. He would be elected to the Lucasian Chair in Cambridge the following year.
[69] The meeting in Belfast was the annual meeting of the British Association for the Advancement of Science. Forsyth was Chair of the Teaching of Elementary Mathematics Committee of which Love and Larmor were both members.
[70] See Milne, 'Augustus Edward Hough Love', p. 72.
[71] *Proceedings of the Fifth International Congress of Mathematicians*, 2 vols., Cambridge: Cambridge University Press, 1913, vol. 1, p. 43. Unfortunately, no archives exist for the Congress, so it is impossible to ascertain the extent of the tasks of the Secretaries. The two volume *Proceedings* can be found online at https://www.mathunion.org/icm/proceedings.
[72] See A. E. H. Love, 'The application of the method of W. Ritz to the theory of the tides', *Proceedings of the Fifth International Congress of Mathematicians*, vol. 2, 202–8.
[73] C. Runge, 'The mathematical training of the physicist in the university', *Proceedings of the Fifth International Congress of Mathematicians*, vol. 2, 598–607 at p. 605.
[74] Anon, 'The Fifth International Congress of Mathematicians', *Nature* 90 (1912), 4–6 at p. 6.

[75] Letter from Love to Larmor, 30th May 1909. GB 275 (Misc)/LO2/44, St John's College Library, Cambridge. The paper under review was by Henry Ronald Hassé, then an assistant lecturer in Liverpool, and it had the title 'The equations of electrodynamics and the null influence of the earth's motion on optical and electrical phenomena'. See *Proceedings of the London Mathematical Society* 7 (1909), ix. The reviewers mentioned were Charles Niven, Hector Macdonald, Horace Lamb, Harry Bateman, and Ebenezer Cunningham.
[76] A. E. H. Love, 'Mathematical research', *Proceedings of the London Mathematical Society* (2) 14 (1915), 178–88.
[77] See Love, 'Mathematical research', pp. 187–8.
[78] Letter from Love to Larmor, 11th November 1903. GB 275 (Misc)/LO2/22, St John's College Library, Cambridge. The Cambridge Philosophical Society had proposed the project, but it never got off the ground. See R. A. Sampson, 'On editing Newton', *Monthly Notices of the Royal Astronomical Society* 84 (1924), 378–83.
[79] A. E. H. Love, Referee's Report on the paper by Karl Pearson 'On the Kinetic Accumulation of Stress, illustrated by the Theory of Impulsive Torsion', 12th July 1900. Royal Society Archives, RR/15/97.
[80] K. Pearson, 'On the kinetic accumulation of stress, illustrated by the theory of impulsive torsion', *Proceedings of the Royal Society of London* 67 (1901), 222–4.
[81] A. E. H. Love, Referee's Report on the paper by G.H. Bryan and W.E. Williams 'The longitudinal stability of aerial gliders', 10th July 1903. Royal Society Archives, RR/16/27.
[82] G. H. Bryan and W. E. Williams, 'The longitudinal stability of aerial gliders', *Proceedings of the Royal Society of London* 73 (1904), 100–16.
[83] For a discussion of the Bryan-Williams paper, see T. J. M. Boyd, 'One hundred years of G. H. Bryan's *Stability in Aviation*', *Journal of Aeronautical History* Paper No. 4 (2011), 97–115 at pp. 104–6.
[84] See Bragg, 'Address of the President', pp. 395–6. The Sylvester medal is named for James Joseph Sylvester and was first awarded in 1901 to Henri Poincaré.
[85] A. E. H. Love, 'On the oscillations of a rotating liquid spheroid and the genesis of the Moon', *Report of the British Association for the Advancement of Science, Bath 1888* (1889), 562–3.
[86] The correspondence consists of 67 letters from Love to Larmor, dating from 1899 to 1930. Much of it relates to Royal Society or London Mathematical Society business, as well as their own mathematical work.
[87] Letter from Love to Larmor, 28th April 1899. GB 275 (Misc)/LO2/1, St John's College Library, Cambridge.
[88] Letter from Love to Larmor, 4th October 1907. GB 275 (Misc)/LO2/35, St John's College Library, Cambridge.
[89] See Milne 'Augustus Edward Hough Love', p. 72.
[90] See Calladine, 'The theory of thin shell structures', p. 142.
[91] The election to the fellowship at The Queen's College only became possible in 1927 due to a change in the statutes.
[92] E. A. Milne, 'Augustus Edward Hough Love', *The Eagle* (St John's College, Cambridge) 52 (1941), 60–4 at p. 60.
[93] The information about the sketch comes from Calladine, 'The theory of thin shell structures', p. 142. For information about Thornhill, see J. Dunning-Davies, 'Charles Kenneth Thornhill (1917–2007)', *Progress in Physics* 4 (2007), 115–6.
[94] See, for example, Milne, 'Augustus Edward Hough Love' (*The Eagle*).
[95] See Milne, 'Augustus Edward Hough Love' (*Journal of the London Mathematical Society*), p.78.