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and of Daniel Stephens. These chambers dealt mainly with maritime cases, of which the Admiralty work was heard in the Admiralty Court, while the commercial work went to the Commercial Court. Langton also joined the South-Eastern circuit, and was for a time its junior, but the difficulty of combining a practice in the courts of common law and crime with one in the Admiralty and Commercial courts proved insuperable, and he gradually became a specialist in maritime law. This may be regrettable, for Langton's eloquence, humour, personal charm, and dramatic sense (he had been a highly successful president of the O.U.D.S.), combined with great mental and physical vigour, would without doubt have made him a very successful advocate before a jury.

When Langton had begun to do well in his profession, war broke out and before the end of 1914 he had obtained a commission in the Royal Garrison Artillery and was posted at Queenstown, of which he soon became garrison adjutant with the rank of captain. His extreme short sight preventing him from going overseas on active service, he was transferred in 1915 to the intelligence branch of the War Office, then to the Ministry of Munitions in 1916. There, in the capacity of director of the labour department and commissioner of labour disputes, he worked with (Sir) Alan Barlow and used his remarkable powers of persuasion and his witty friendliness with real effect. In 1918 he was made controller of the demobilization department of the Ministry of Labour, until his own demobilization in 1919. He was appointed O.B.E. in 1917.

Langton returned to the bar at a time when several leading juniors in the Admiralty and Commercial courts were taking silk, and at the same time the work in those courts was greatly increased on account of the war. Langton soon acquired a large junior practice, especially in the Admiralty Court under Sir Maurice Hill. From 1922 until his elevation to the bench in 1930 he acted as secretary and adviser to the British Maritime Law Committee. His interest in the Comité Maritime International led to his being appointed its joint general secretary and his presence at all their conferences; his fluent French and light-hearted humour made him a general favourite at these somewhat solemn meetings.

In order to relieve the heavy pressure of work in the Admiralty Court, Sir A. D. Bateson [q.v.] was appointed an additional judge in 1925. Langton was obviously the man to take his place in the front row, and very shortly afterwards he took silk. At once he became one of the leaders of the Admiralty Court and during the next five years he was employed in a very large proportion of the cases tried there, as well as in many other maritime cases. He also gradually acquired work in other courts, but the question whether he would have become a prominent leader of the common law bar was to remain unanswered, for in October 1930 Hill retired from the bench and Langton was appointed in his place, receiving the customary knighthood. Shortly afterwards he was elected a bencher of the Inner Temple.

During the twelve years in which Langton sat as a judge in the Probate, Divorce, and Admiralty division, he performed his judicial duties with ability and unflagging attention to the task. He thoroughly understood the Admiralty work, and his decisions, from which there was very seldom an appeal (and still less a successful one), were always well thought out and clearly expressed. In divorce cases he took great pains to master the law applicable to matrimonial disputes, and from time to time he found an outlet there for his humour and immense energy, which made it difficult for him to keep silent.

This exuberant energy also showed itself in physical exercise, especially lawn tennis and golf, in both of which Langton became a skilful player with a complete mastery of style. One of his qualities was an immense capacity for taking pains, and this showed itself both in his work and in his recreations. In 1939 he was elected chairman of the executive committee of the All England Lawn Tennis and Croquet Club and he held that position until his death, which took place suddenly at Burnham in Somerset 9 August 1942.

In 1919 he married Alice Mary Katherine, daughter of Daniel Francis Arthur Leahy, justice of the peace and deputy-lieutenant, of Shanakiel, county Cork. He was survived by his wife and a daughter. His portrait, by J. M. Crealock, is in the possession of the family.

[*The Times*, 15 August 1942; private information; personal knowledge.]

A. T. Bucknill.

LARMOR, Sir JOSEPH (1857–1942), physicist, was born at Magheragall, county Antrim, 11 July 1857, the eldest son of taken up by (Sir) Edward Victor Appleton and led to great advances.

Seen in its place in the history of physics, Larmor's work marks the end of the attempt to express everything in terms of the Newtonian mechanics of matter and the beginning of the electromagnetic theory of matter. But it led on immediately to the more revolutionary theory of relativity. For one of the main problems which Larmor attacked was the failure to find definite evidence of motion of the earth through the aether. Of this he was able to give a partial and approximate explanation, again on lines exactly parallel with the work of Lorentz. This explanation led up directly to the more radical outlook of Einstein which, while completing the discussion, shook the rigid framework of Newtonian conceptions of absolute time and space. Not only so, but it can scarcely be doubted that this loosening of classical concepts which for so long had been unquestionably held paved the way for the further new concepts of the quantum theory to be accepted. Thus Larmor stood between the old and the new physics, always conscious of his debt to the past, always labouring to free science from the shackles of the past, building the foundations of the new physics, yet always critical of rash enthusiasm for new paths. A deeply honest thinker, with wide interest in the world at large, never craving for publicity and winning respect from all for his judgement and his probity, he was one of the great band of men who have well deserved the title of professor of natural philosophy.

To his labours in the electromagnetic theory of matter Larmor added a deep concern for thermodynamic principles and was in no small measure responsible for bringing their importance to the fore. He was much interested in the work of Josiah Willard Gibbs to whom he paid tribute in a very instructive obituary notice in the *Proceedings* of the Royal Society (1905). In his memoir in the same journal (1908) on the life of Lord Kelvin [q.v.] he gave a survey of the development of thermodynamics which merits preservation for its own sake. Later he made a very substantial contribution to scientific literature by revising Clerk Maxwell's edition of the papers of Henry Cavendish (1921), and editing the collected works of James Thomson (1912), the fourth and fifth volumes (1904–5) of the works of Sir G. G. Stokes, and the fourth, fifth, and sixth volumes (1910–11) of those of Lord Kelvin [qq.v.].

Apart from his scientific work, Larmor always showed a wide interest and shrewd judgement in the counsels of his college, his university, and the nation. He was for many years a member of the council of St. John's. Here he was often critical, but he never failed to see when an important point was in danger of being overlooked. Although radical in his natural philosophy he was conservative in temperament, questioning modern trends even in such matters as the installation of baths in the college (1920). 'We have done without them for 400 years, why begin now?', he once said in a college meeting. Yet once the innovation was made he was a regular user. Morning by morning in a mackintosh and cap, in which he was not seen at other times, he found his way across the bridge to the New Court baths.

Larmor was always looking for the general principles behind phenomena. This interested him much more than spinning webs of thought out of the mind. He had not much sympathy for the pure mathematician, the geometer, or the analyst. Minute attention to logic or playing with geometrical constructions just for the joy of it were not his way. He was not always willing to give patient attention to details and so at times failed to be convincing. The same generality of view characterized his lectures. To the average student they appeared slow and inconclusive. But to those who were prepared to follow with attention they were full of stimulus, sometimes by their very incompleteness provoking the mind to wrestling and questioning. His outlook was very far removed from that of the famous nineteenth-century coaches for the mathematical tripos, masters of manipulation and of method, solvers of special and artificial problems. For such things he had no use. As his creative powers declined he turned more and more to matters of wide national and cultural interest. Those who knew him in his later years remember him as one of Cambridge's greater men, somewhat remote, impatient of unreality, independent in judgement, doubtful of what the new age was bringing with it.

Elected a member of the London Mathematical Society in 1884, Larmor served on the council of the Society from 1887 to 1912 and was a vice-president in 1890 and 1891. He became treasurer in 1892 and held that office for twenty years. In 1914 he was elected president and in the same year he received the De Morgan medal of the Society.

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II. SECONDARY LITERATURE. The most important source is the anonymous "Notice biographique sur M. le prof. G. De La Rive," in *Bibliothèque universelle des sciences, belles-lettres et arts*. Sciences et arts, 55 (1834), 303–338, possibly written by A. Gautier, whose often identically worded obituary notice on Gaspard appeared in *Mémoires de la Société de physique et d'histoire naturelle de Genève*, 10 (1834), xii–xiv. In addition to the biography by de Fère cited above, mention should also be made of A. Maury, "Charles-Gaspard de Larive," in *Biographie universelle (Michaud) ancienne et moderne*, new ed. (Paris, n.d.), XXIII, 264–265. A wealth of information of Gaspard's activities at the Academy is in C. Borgeaud, *Histoire de l'Université de Genève*, II, "L'Académie de Calvin dans l'Université de Napoléon, 1798–1814," and III, "L'Académie et l'Université au XIX^e siècle, 1814–1900" (Geneva, 1909–1934), *passim*.

KENNETH L. CANEVA

LARMOR, JOSEPH (*b.* Magheragall, County Antrim, Ireland, 11 July 1857; *d.* Holywood, County Down, Ireland, 19 May 1942), *theoretical physics*.

Larmor was the eldest son in a large family. His father gave up farming to become a grocer in Belfast in 1863 or 1864. A shy, delicate, precocious boy, Larmor attended the Royal Belfast Academical Institution; received the B.A. and the M.A. from Queen's University, Belfast; and entered St. John's College, Cambridge, in 1877. In 1880 he was senior wrangler in the mathematical tripos (J. J. Thomson was second), was awarded a Smith's Prize, and was elected fellow of St. John's. For the next five years Larmor was professor of natural philosophy at Queen's College, Galway, then returned as a lecturer to St. John's in 1885. He succeeded Stokes as Lucasian professor in 1903 and retired from the position in 1932. His health deteriorating, he returned to Ireland to spend his final years. He never married.

Larmor became a fellow of the Royal Society in 1892 and served as a secretary from 1901 to 1912. From 1887 to 1912 he served on the council of the London Mathematical Society; he was president of this society in 1914–1915, having been at times vice-president and treasurer. The Royal Society awarded him its Royal Medal in 1915 and its Copley Medal in 1921, and he received the De Morgan Medal of the London Mathematical Society in 1914. Larmor was also awarded many honorary degrees and became a member of various foreign scientific societies. He was knighted in 1909. He represented Cambridge University in Parliament from 1911 to 1922. In his maiden speech in 1912 he defended the unionist position in the debate on Irish home rule. His major concern then and later was for education and the universities. Those who knew him report that Larmor was an unassuming, diffident man who did not readily form close friendships and whose numerous acts of generosity were performed without publicity. In the words of D'Arcy Thompson, "Larmor made few friends, perhaps; but while he lived, and they lived, he lost none."

Larmor's lectures and writings were often obscure, in that he would sketch the broad outlines of his thought without filling in the mathematical details, but this thought was stimulating and creative. He was concerned to stress the physical and geometrical characteristics of a problem rather than the analytical niceties. Of interest in this connection is his "Address on the Geometrical Method," delivered in 1896. In dynamics Larmor was a champion of the principle of least action. An early paper (1884) showed the analogies between diverse physical problems that it can bring to light. The use of the method of least action enables the compression of the basic assumptions involved in constructing a theory into a single function, from which results may be deduced with some guarantee of consistency and completeness. Larmor employed this method in his fundamental works, particularly in electron theory.

Larmor's scientific work centered on electromagnetic theory, optics, analytical mechanics, and geodynamics. As one of the great completers of the edifice of classical mathematical physics he bears comparison with H. A. Lorentz. Like Lorentz, his major work concerned electron theory, that is, the interaction of atomically charged matter and the electromagnetic field. Unlike Lorentz, Larmor did not participate to a large extent as a guide to the newer generation of physicists developing quantum theory and relativity. In general, he maintained a conservative, critical attitude toward the new ideas, particularly examining the possible limitations of the relativity theories.

Larmor's electron theory was a new fusion of electromagnetic and optical concepts. His first paper on electromagnetism, written in 1883, dealt with

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LARMOR

electromagnetic induction in conducting sheets and solids. In this work he encountered the problem of the effect of the motion of matter through the ether, the central problem leading to relativity and the key concern of his famous book, *Aether and Matter*. Larmor reported on the action of magnetism on light to the British Association for the Advancement of Science in 1893. In this report he discussed the dynamical theory of wave optics which the Irish physicist James MacCullagh had perfected in the 1830's. MacCullagh's treatment had avoided the flaws of other more or less contemporary theories, but MacCullagh had been unable to supplement his mathematical work with a specific mechanical model of the luminiferous ether. His expression for the action function of the ether corresponded to a medium possessing rotational elasticity, however, so that any element of it would resist rotation but otherwise would behave like a liquid. Kelvin's gyrostatic model of the ether, which had been the subject of an article by Larmor, removed the major objection to MacCullagh's theory on grounds of physical unrealizability. Furthermore, in 1880 G. F. FitzGerald had translated MacCullagh's analysis of optical reflection into the language of electromagnetic theory.

Inspired particularly by this last work, Larmor presented his electron theory in three important papers entitled "A Dynamical Theory of the Electric and Luminiferous Medium" in 1894, 1896, and 1898. He combined MacCullagh's type of ether with the electromagnetic field theory by identifying the magnetic force with the rate of displacement of the ethereal medium, and the electric displacement with the absolute rotation of the medium (the curl of the displacement of the ether). At first the permanent Amperian electric currents of material atoms were treated as vortex rings in the ether, thereby introducing Kelvin's vortex theory of the atom, while electric charge was not included integrally in the theory. Two months after the first article in the series was written, however, Larmor added a section incorporating "electrons" into the theory as mobile centers of rotational strain in the ether. In the MacCullagh type of ether such centers of strain would be permanent, possess inertia, and act upon one another as charged particles do.

The second article in the series (written in 1895) developed the theory of electrons foreshadowed in the addendum to the first. The only interaction between the ether and ordinary matter was assumed to be via the discrete electrons (of both signs of charge), and Larmor discussed the relation between a microscopic theory treating the dynamics of the electron and a macroscopic theory in which the current and other variables are treated as statistical averages. The influence of the motion of the matter through the ether on light propagation and the null result of the Michelson-Morley experiment were treated in a fashion similar to that of Lorentz in the same year. A standard of time varying from point to point was introduced, and it was shown that the FitzGerald-Lorentz contraction would arise out of the theory of the equilibrium of charges in a moving ether. Part 3 (written in 1897) dealt further with the effects involving material media, including motion through the ether, optical dispersion, and particularly electrical stresses. Much of this work was incorporated in *Aether and Matter* (published in 1900), which won the Adams Prize at Cambridge in 1898. This book concentrated mainly on the problem of motion of matter through the ether; here we find, perhaps for the first time, the full Lorentz transformations for space and time and for the electromagnetic field *in vacuo*.

Aside from his general version of the electron theory, constructed from a rotationally elastic ether, Larmor is noted for two specific contributions to electrodynamics. He introduced the Larmor precession, which orbiting charges undergo when subjected to a magnetic field, in 1897 in connection with a discussion of the Zeeman effect. In the same article he treated the radiation of an accelerating charge, obtaining the well-known nonrelativistic formula expressing the power radiated as proportional to the square of the product of charge and acceleration.

Larmor was interested in the dynamics of the earth's motion from 1896, when he published a work on the earth's free precession. In 1906 and 1915, with E. H. Hills, he analyzed possible causes of the irregular motion of the earth's axis; among his other articles one concerns irregularities in the earth's rotation and the definition of astronomical time (1915). Among the 104 articles included in Larmor's *Papers* is "Why Wireless Electric Rays Can Bend Round the Earth" (1924), which was of importance for radio communications. He edited several collections of scientific papers besides his own; and he contributed valuable biographical notices of scientists, particularly one of Kelvin (1908). Strongly interested in the history of his subject, he included in his longer papers and as appendixes to his *Papers* very interesting critical summaries of the work that preceded and led to his own research. His own work owed much to "that Scoto-Irish school of physics which dominated the world in the middle of the last century," particularly to W. R. Hamilton, J. MacCullagh, J. C. Maxwell, Kelvin, and G. FitzGerald; and there is little doubt that he considered himself the last follower of this tradition.

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A. E. Woodruff

LA ROCHE, ESTIENNE DE (*fl.* Lyons, France, *ca.* 1520), *arithmetic.*

La Roche, known as Villefranche, was born in Lyons. A pupil of Nicolas Chuquet, he taught arithmetic for twenty-five years in the commercial center of his native town and was called "master of ciphers."

La Roche's *Larismetique*, published at Lyons in 1520, was long considered the work of an excellent writer who, early in the sixteenth century, introduced into France the Italian knowledge of arithmetic and useful notations for powers and roots. His fame decreased remarkably in 1880, when Aristide Marre published Chuquet's "Triparty," written in 1484 but preserved only in manuscript. The first part of *Larismetique* was then seen to be mostly a copy of the earlier work, with the omission of those striking features that established Chuquet as an algebraist of the first rank. Chuquet, for example, employed a more advanced notation for powers and he introduced zero as an exponent. It is not clear why La Roche failed to publish the "Triparty." He may have suppressed it in order to claim the credit for himself, or perhaps he thought it too far beyond the comprehension of prospective readers. Nevertheless, through *Larismetique* some of Chuquet's innovations influenced such French arithmeticians as Jean Buteo and Guillaume Gosselin.

The second, and greater, part of La Roche's work has, apart from some geometrical calculations at the end, a commercial character. The author states that as a basis he used "the flower of several masters, experts in the art" of arithmetic, such as Luca Pacioli, supplemented by his own knowledge of business practice. The result was a good but traditional arithmetic that presented an outstanding view of contemporary methods of computation and their applications in trade.

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J. J. Verdonk

LARSEN, ESPER SIGNIUS, JR. (*b.* Astoria, Oregon, 14 March 1879; *d.* Washington, D.C., 8 March 1961), *geology.*

The son of a Danish immigrant who had settled in Oregon and had become the first Danish consul in Portland, Larsen attended the local schools. Upon graduation from high school, he did not enter college immediately but worked to ease the financial pressures on the family. Entering the University of California in 1902, Larsen came under the influence of A. C. Lawson and A. S. Eakle while an undergraduate. This led to his taking advanced courses in mathematics and chemistry and contributed to his ultimate decision to make geology and petrology his lifework. After receiving the B.S. degree in 1906, Larsen remained at the university to teach. He left in 1908 but returned to take his doctorate in 1918.

His early studies developed in Larsen the habit of extensive and detailed examination of specimens. He conducted advanced research first as an assistant petrologist in the geophysical laboratory of the Carnegie Institution in Washington, D.C. With H. E. Marwin he developed petrographic techniques, making investigations in optical crystallography and the immersion method of mineral analysis.

In 1909 Larsen was appointed assistant geologist for the U.S. Geological Survey, an association that was one of the most important in his entire professional life. He joined Whitman Cross, who had been studying the volcanic province of the San Juan Mountains of Colorado and New Mexico for fifteen