

expert audiences, but in successive series of luminous popular lectures.

Of the literary style in which all this was done, Professor Engelmann must be allowed to speak. "Besseres Deutsch ist nicht geschrieben worden. Helmholtz' Sprache ist von vollendeter edelster Natürlichkeit, von ruhigstem Flusse und gleichmässigem Wohlklang. Er liebt die kurze gerade Redeweise, verschmäh't prunkvolle Worte und den häufigen Gebrauch von Bildern und erhebt sich doch, wo es der Gegenstand mit sich bringt, zu poetischer Wärme des Ausdrucks."

Such is a brief record of the more salient results of the work of von Helmholtz. If judged both by their variety and importance, they have, perhaps, never been equalled. They secured for him in his lifetime the admiration and respect of the whole civilized world. Honours were showered upon him. In particular, he was ennobled by the German Emperor, was a Foreign Member of the Royal Society, and in 1873 was awarded the Copley Medal. He attained his seventieth year in 1891, and the occasion was celebrated in Germany almost as a national festival, while outside the limits of the German Empire "learned societies," to quote his own words, "spread over the whole world, from Tomsk to Melbourne," expressed by diplomas and addresses their sense of the importance of his scientific work.

He outlived the celebration by three years only. His death deprived the world of one of the most notable of the leaders of the science of the nineteenth century.

A. W. R.

The death of Sir JAMES COCKLE removes from our midst a man eminent as a lawyer and a judge, and no less eminent as a mathematician. Of the work which he did, and the distinctions which he won at the bar and on the bench, something may be said here; though he was known to us chiefly by his writings on subjects far removed from his professional life. He commenced his legal career fifty years ago as a special pleader, and on being called to the bar joined the Midland Circuit, where he gained the good opinion and esteem of all with whom he came in contact. He was especially admired for his justness of thought, clearness of view, refinement of mind, and elevation of character. These characteristics, combined with a sound knowledge of law and unwearied industry, eminently fitted him for the high position he was afterwards called to fill as first Chief Justice of Queensland. This advancement he owed to the influence of Sir William Erle, then Chief Justice of the Court of Common Pleas, who had formed a very favourable opinion of his capacity and character. Erle, on being applied to by the Colonial Office,

“named” Cockle for the post “on account of the estimation and regard in which he was held by the good men on his circuit.”

Cockle commenced his judicial labours amid difficulties not of his own creating, for they had arisen before his arrival in the Colony, and were in no way connected with any action of his, but by courtesy, tact, and decision, he speedily overcame them, and his subsequent course was comparatively smooth. For fifteen years he presided over the Supreme Court of Queensland, and throughout the whole period he enjoyed the respect and confidence alike of his colleagues on the Bench, the members of the Bar, and the community in general.

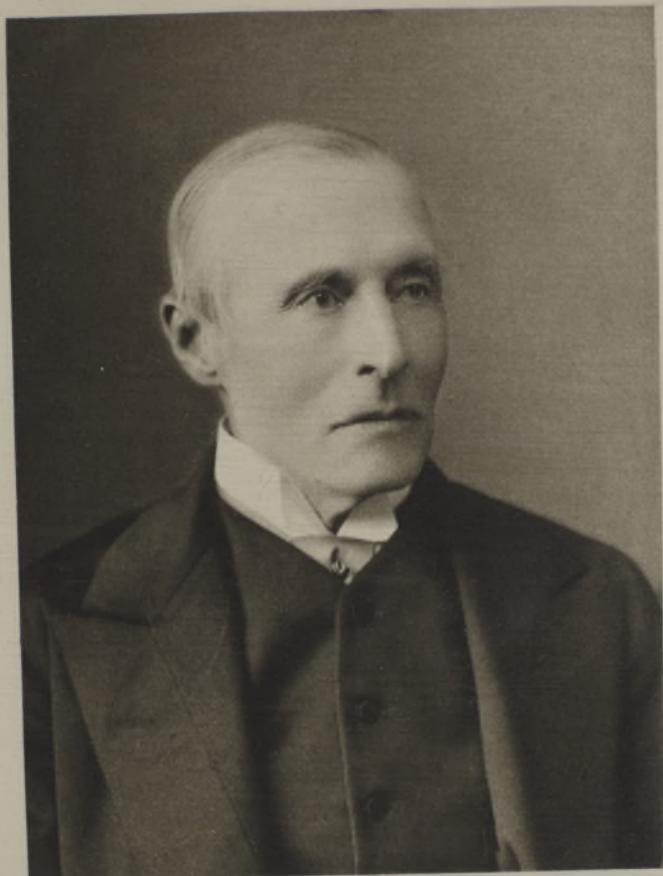
Chief Justice Erle, who watched his Australian career from the beginning to the end with interest and satisfaction, often testified to the excellence of his judicial administration. “With regard to the duties of his office,” he wrote to the Duke of Buckingham and Chandos when Cockle had been for some years at work in Queensland, “I am confident that he has done ‘what to justice appertains according to law’ with zeal and ability, setting a good example of the dignity and motives which become the office. But, besides the work included in his judicial contract, he has been indefatigable as a legislator, systematising the law there, and bringing it up to the best improvements here.” In this letter Erle enumerates some thirty statutes consolidated mainly by Sir James Cockle, and points to his endeavours to diffuse the culture which, as a Trinity (Cambridge) man, strong in mathematics, he “imported” with him, and had “imparted in lectures and publications.” “He set out in troubled waters—from the clash of legislative and judicial powers—which were soon calmed by his discretion. I have had much knowledge of judicial men, and I am sure the Queen has never had a servant who more thoroughly earned every farthing of the wages he hoped to receive.”

Equally emphatic testimony was given by men on the spot who had been long and intimately associated with Cockle in his judicial administration. When he was about to return to England, and before it was known that he intended to resign his official connexion with the Colony, the journalists of Queensland testified in warm terms to the general appreciation of his public services and private worth, and expressed the hope that his absence would be but of brief duration. And although seventeen years have since elapsed, Queensland still remembers with grateful feeling her first Chief Justice. When the news of his death was cabled out to the colony, the daily papers gave immediate expression to the public sense of loss. The occasion served to revive old memories: the Judge, his dignified and courteous bearing, his unwearied labours, the fidelity with which he dispensed justice according to law, his varied services to Queensland, the pro-

fundity of his learning, and his mathematical distinctions—all were passed under review. “No community could desire to build up their series of Chief Justices upon a more upright and steadier foundation-stone than the late Sir James Cockle.” (*Brisbane Telegraph*, January 30, 1895.) The following estimates of his character and work as a Judge are from the pens of his successors, both of whom had exceptional opportunities of knowing him in that capacity. Sir Charles Lilley, who was his colleague on the Bench and succeeded him as Chief Justice, writes:—

“Sir James Cockle’s services to Queensland as Chief Justice were of a high order. He was an excellent lawyer, and the dignity and urbanity of his judicial presence upheld the tone and character of the Bench and Bar as one of the highest institutions of the country. He felt and manifested the feeling that his decisions should be absolutely just. At times those who observed his anxiety to give exact and righteous judgment, thought it savoured of weakness and hesitancy, but this was an-entirely erroneous idea of his character and conduct. It arose from his settled idea that if by any labour of his own he could do right according to law, it was his duty to apply himself with diligence to the necessary task. He was fearless, and eminently successful in his administration of the law, few appeals resulting from his decisions, and only two being successful during his fifteen years’ presidency of the Supreme Court of the Colony as Chief Justice. He was courteous to the Bar, loyal and helpful to his colleagues on the Bench, and an example to the world of a righteous judge. He rendered great service to the Colony by a consolidation of large portions of the statute law, especially of the criminal law, the mercantile law, constitutional law, and of the procedure of the courts. He took an interest in the charitable institutions of the country, and for some years was Chairman of the Brisbane Boys and Girls’ Grammar Schools. He was President for some time of the Queensland Philosophical Society. Indeed he was one of its founders, and took an active part in its proceedings by contributing some valuable papers, since included in a publication collected from his contributions to several periodicals. He rendered in many ways most important services to Queensland. Not least was the example of his life as a Christian judge and gentleman. My friend was a sincerely convinced Christian. He had satisfied himself of the truth and beauty of Christian Faith and Hope, founding his belief on the proof of the great central miracle of the Resurrection. The news of his death was received with profound regret throughout the Colony, and from the Bench of the Supreme Court his life and services were eloquently eulogised by his successors. I regard my own loss of my old friend as irreparable.”

Sir Samuel Griffith, the present Chief Justice, and a former Attorney-General of Queensland, writes:—“The position of Sir James



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Cockle as the first Chief Justice of Queensland, was one of some difficulty. He was appointed over the head of Mr. Justice Lutwyche, an able and experienced lawyer, who had previously been the sole Judge of the Court, and who continued to receive for several years a considerably larger salary than the new Chief Justice. No signs of any friction between them, if any existed, were, however, allowed to become manifest to the public. The condition of the Bar, at first extremely small in numbers, and of the colony, which had been constituted at the end of 1859, and was very rapidly increasing in population and wealth, combined to render the office of the President of the Supreme Court one of special importance, it falling to his lot to a great extent to form, by precept and example, what were to be the future traditions of the Court, and to earn for the Bench that respect which, although generally associated by Englishmen with the administration of justice, was in the first instance acquired, and can only be maintained, by the personal qualities of the Judges. In this task Sir James Cockle was eminently successful. He earned and enjoyed the most profound personal respect. Implicit confidence was felt in his intense desire to administer justice with absolute impartiality.

“His courtesy and kindness to the profession, especially to the junior members, who were without the advantage of training in English Courts, were admirable, as was, on the occasion of his death, pointed out by two of them who now occupy seats on the Supreme Court Bench.

“His habit of accurate thinking was impressed upon his judgment, which erred, if at all, in being perhaps too laconic, just sufficient words being used to convey to a reasoning mind the logical conclusion from the premises. When sitting with juries, on the other hand, it was sometimes complained of him that it was impossible even to conjecture, from any indication of the inclination of his own mind, on which side he thought the balance of probability lay, so careful was he to avoid the appearance of partiality.

“Essentially of a shy and retiring disposition, and perhaps diffident of his own ability, he took little part in public affairs, except for a time as Chairman of Trustees of the Brisbane Grammar School. But this very aloofness was, probably, in the special circumstances of the colony an advantage, in that it prevented any imputation, always difficult to avoid in a small community, of undue friendship between judges and suitors. Of his ability as a sound and able lawyer no doubt has ever been felt, and the still more important work already referred to, of giving an initial direction to the administration of justice in Queensland, and establishing a lofty standard of duty in the Courts, could not have been in better hands.”

It was, however, as a mathematician, and not as a judge, that Sir

James Cockle was best known to us. He wrote on the Indian Astronomical Literature, on the Indian Cycles and Lunar Calendar, on the date of the Vedas and Jyotish Sastra, and on the Ages of Garga and Parasara. He also published four elaborate memoirs on the Motion of Fluids, and some notes on Light under the Action of Magnetism, &c., but in general he confined himself to problems in pure mathematics. His analytical researches were concerned for the most part with two subjects, viz., Common Algebra and the Theory of Differential Equations. In algebra he worked mainly among the higher equations, and for many years his labours in this department were inspired and directed by the hope of being able to "solve the quintic," or, in other words, to express a root of the general equation of the fifth degree by a finite combination of radicals and rational functions. The problem had long engaged the attention of mathematicians, and was attacked by the most celebrated analysts of the last century with great skill and vigour, but without success. In the early part of the present century, Abel, the young and gifted Norwegian mathematician, attempted to show that a finite algebraic solution of the problem was impossible. Cockle considered the argument with care, and reproduced it as modified by Sir W. R. Hamilton, in the 'Quarterly Journal of Mathematics' (vol. 5). To prove a negative, however, is proverbially difficult, and despite Abel's "demonstration," and the non-success of preceding investigators, Cockle for many years clung to the conviction that what had been done for the lower equations might be done also for the equation of the fifth degree. He laboured long and hard at the problem; and although he failed, as others before him had failed, to effect a general solution, and came finally to the conclusion that such a solution was "absolutely unattainable," yet his labour was not lost. He found not the thing he sought for, but other things which amply repaid the toil of effort, and he opened up new methods of working, and new lines of research which are of acknowledged value in themselves. A result which he obtained in the fifties attracted much attention at the time, on account of its remarkable simplicity. By an indirect but ingenious process he succeeded in determining the explicit form of a certain sextic equation on the solution of which that of the general quintic may be shown to depend. The accuracy of this sextic or "auxiliary" equation (whose coefficients are all monomials save one, which is a binomial) was shortly afterwards confirmed by an independent calculation. The writer of this notice was led to consider the problem in connection with some researches of his own on the finite solution of algebraic equations, in the course of which he calculated Cockle's sextic by a direct process. His researches were published in the 'Memoirs of the Manchester Literary and Philosophical Society,' to which Cockle had contributed his remarkable result, and the subject

was followed up by the same writer in two papers on the "Theory of Quintics," in the 'Quarterly Journal of Mathematics,' and also in an exposition of Cockle's "method of symmetric products" in the 'Phil. Trans.' for 1860. The study of these papers led the late Professor Cayley to investigate the subject, and his results were embodied in a memoir entitled "On a New Auxiliary Equation in the Theory of Equations of the Fifth Order," which appeared in the 'Phil. Trans.' for 1861. Cockle had calculated the auxiliary equation for one of the trinomial forms to which the quintic may be reduced without any loss of generality, hence the simplicity of his result. Cayley, employing an invariantive process, calculated the same equation for the complete quintic, that is, the quintic not deprived of any of its terms, and not modified in any of its coefficients. The result is, of course, less simple than that for the trinomial form, but it has the advantage of being absolutely complete. Thus Cockle's labours on the quintic invested the theory with a new interest, and the methods he devised, and the results he obtained, largely directed the course of subsequent speculation on the subject.

His mode of dealing with the theory of differential equations was equally marked by originality and independence of mind. Not confining himself to the beaten track, he pushed his way into unexplored regions, and succeeded in bringing to light important relations and analogies between algebraic and differential equations. Two examples may be given. He found that from any rational and entire algebraic equation of the degree n , whereof the coefficients are functions of a single parameter, we can derive a linear differential equation of the order $n-1$, which is satisfied by any one of the roots of the algebraic equation. Out of this germ has grown the theory of Differential Resolvents. To Cockle also belongs the honour of being the first to discover and develop the properties of those functions called Criticoids or Differential Invariants, so called because they remain unaltered when the differential equation is transformed by a change of one of the variables, and are therefore analogous in this respect to the critical functions or seminvariants of common algebra. Criticoids seem destined to play an important part in the theory of linear differential equations.

But it would be impossible, within the limits at our disposal, to discuss in detail Cockle's various discoveries in algebra and the calculus. Enough to say here that his work was eminently initiatory. He started theories, but left others to elaborate and perfect them. Of his eighty or ninety papers given to the mathematical world, many are no doubt slight and fragmentary, but there are few, even among the shortest and least complete, which do not contain original and valuable suggestions. He struck out ideas which have taken root in other minds and borne fruit.

The leading events in his life are soon told. He was born on January 14, 1819, being the second son of the late Mr. James Cockle, of Great Oakley, Essex. From 1825 to 1829 he was educated at Stormond House, Kensington; thence he was sent to Charterhouse, where he showed considerable power in making Latin verses. At the end of his second year he was removed and placed under the tuition of the Rev. Christian Lenny, D.D., of St. John's College, Cambridge, who was the first to discover his mathematical talent. In November, 1835, when he had nearly completed his seventeenth year, he went abroad, and was absent from England about twelve months, visiting the West Indies and the United States of America; in Cuba he acquired some knowledge of the Spanish language. On returning home he entered Trinity College, Cambridge, October, 1837, and graduated as thirty-third Wrangler in 1841. His position in the Tripos gave no indication of his future eminence as a mathematician, nor is the circumstance to be wondered at when we consider the character of his preparatory training, and the long break in his studies before he went up to the University. He proceeded to the degree of B.A. in 1842, and of M.A. in 1845.

Mr. Cockle was entered as a student at the Middle Temple in 1838. He practised as a special pleader from 1845 to 1849, was called to the Bar at the Middle Temple in 1846, and joined the Midland Circuit at the Nottingham Spring Assizes in 1848. On August 22, 1855, he married Adelaide Catherine, eldest surviving daughter of the late Mr. Henry Wilkin, formerly of Walton, Suffolk. In 1862 he drafted the "Jurisdiction in Homicides Act" (Imperial); and the following year (1863) he was appointed by the English Government first Chief Justice of Queensland. Allusions have already been made to the fact that the position at the outset was very trying, but the circumstances deserve more particular notice, as throwing light on the character of the man. Mr. Justice Lutwyche, who during the previous year or two had come into collision on several occasions with the Governor, and also with the Government of the Colony, and whose claims to the supreme place on the bench here in consequence passed over by the home authorities in favour of the English barrister, naturally felt himself aggrieved at the appointment of a younger man who had had no judicial experience. The story, as told in the Brisbane papers on the death of the old Judge in 1880, reflects equal credit on both men: "The late Judge made no secret of his mortification at the appointment of Mr. Cockle. A few years of association, however, entirely obliterated any feelings of hostility to the Chief Justice that this event may have originally engendered, and the two Judges became sincere and attached friends. Sir James always paid a very marked deference to the opinion of his learned brother, and the amiable disposition of the Chief Justice so

wrought upon the sterner nature of his colleague that, when Sir James left for Europe two years ago, the parting was a severe trial to Mr. Lutwyche, who was extremely affected at bidding good-bye to a friend whom he rightly divined he was never to see again."

The Chief Justice was Senior Commissioner for the consolidation (effected in 1867) of the statute law of Queensland. He was knighted by patent in 1869. In 1874 the Legislative Assembly of Queensland showed their appreciation of his services by passing an Act giving him a substantial increase of salary.

Sir James Cockle's professional occupations at this period were numerous and exacting, yet he did not neglect his favourite science. He turned to mathematics as a relaxation, and devoted the intervals of official labour to researches in algebra and differential equations, embodying his results in papers which appeared from time to time in the 'Manchester Memoirs,' the 'Quarterly Journal of Mathematics,' the 'Philosophical Magazine,' and other periodicals in England, and in the 'Proceedings' of the Royal Societies of New South Wales and Victoria, in Australia. He also wrote and published a number of presidential addresses delivered before the Queensland Philosophical Society (now incorporated into the Royal Society of Queensland) in which he dealt with questions in philosophy, logic, and mathematics.

In 1879 he resigned his position as Chief Justice of Queensland, having a few months before returned to England with his wife and children. The remainder of his days was given to mathematical writing, the business of several learned bodies, and the society of his friends; but he was never really strong after his return home, his health suffering perhaps from the change of climate.

He was elected a Fellow of the Royal Astronomical Society in 1854, and served on its Council from 1888 to 1892. He was elected a Fellow of the Royal Society in 1865, a Corresponding Member of the Manchester Literary and Philosophical Society, and a Member of the London Mathematical Society in 1870; he filled the Presidential Chair of the latter Society from 1886 to 1888. He was President of the Queensland Philosophical Society from 1863 to 1879, and was elected an Honorary Member of the Royal Society of New South Wales in 1876. He was a Commissioner for the Queensland Section of the Colonial and Indian Exhibition held in London in 1886; and was nominated to represent the Australian Colonies at the Washington Prime Meridian Conference in 1884, but was unable to accept the position.

Of his personal and social qualities the writer may be permitted to speak from personal knowledge. He looks back with pleasure to an acquaintance begun nearly fifty years ago, which soon ripened into a friendship, never clouded even for a moment by the slightest

misunderstanding; drawn together by similar scientific tastes, the two men had otherwise little in common. In their political and ecclesiastical opinions they differed fundamentally, and had it not been for Cockle's imperturbable temper and graciously tolerant spirit, these differences would often have disturbed their cordial relations. Controversy, however, was distasteful to him, and he avoided the conflict of argument. When it was suggested on one occasion that he should offer himself for a seat in Parliament, he said playfully: "My address to the electors shall run thus,—Gentlemen, I am in favour of making things agreeable all round—all round!" The saying revealed his spirit. He desired to live peaceably with all men, and so far as we know he had not a single enemy. A man of somewhat phlegmatic temperament, he was not easily excited. His features in repose were calm and serious, and to strangers he usually gave the impression of being very reserved; but when conversing with his friends on congenial subjects his countenance would light up with a pleased expression, and his manner become animated, while his fulness of knowledge and ripe and varied experience imparted to his observations an interest of their own. He was extremely cautious in offering a definite opinion on any debateable question, a habit probably due to his legal training. When not engaged in mathematical investigations, his leisure was mostly devoted to problems in metaphysics and geology, studies which had for him a special attractiveness, and in both of which he was deeply versed. His modesty was remarkable; rarely speaking of his own work, he was ever ready to recognise and do full justice to the work of others. There was in him none of the petty jealousies which haunt meaner minds. The writer remembers with gratitude how, when he entered fields which Cockle might be said to have made his own, he was not treated as an intruder or a rival, but welcomed as a friend and fellow-worker, and how he received from his elder an amount of encouragement and help which he can never sufficiently acknowledge.

Cockle was an excellent correspondent, his caligraphy was clear and good, and when writing on congenial themes he would often wax truly eloquent. He had a positive enthusiasm for mathematics, and the discovery of a new theorem or a new method always gave him intense delight. The writer has preserved most of the letters he received from him, and placed them bound in several goodly volumes among the choicest of his literary treasures.

Something of a recluse, Sir James astonished many of his friends, both in England and Australia, by the zest with which, during the last ten or twelve years, he threw himself into the club life of the Metropolis. He became a member of the Garrick, the Savile, and the Savage, and an *habitué* of all three, being particularly attached to the last, of which he was Treasurer from 1884 to 1889. Queens-