Carl David Tolmé Runge

Quick Info

Born
30 August 1856
Bremen, Germany

Died
3 January 1927
Göttingen, Germany

View four larger pictures

Summary
Carl Runge worked on a procedure for the numerical solution of algebraic equations and later studied the wavelengths of the spectral lines of elements.

Biography

Carl Runge's parents were Julius Runge and Fanny Tolmé. Julius Runge was from a family of merchants but he went to Havana, Cuba, around 1836. He returned frequently to Bremen but lived mostly in Havana for around 20 years. Fanny Tolmé was the daughter of the English merchant Charles David Tolmé who was living in Havana. Tolmé does not sound very English, and indeed it is not for the family was of Huguenot descent. Julius and Fanny were married in Havana on 16 May 1846. Carl was the third of his parents' four sons. There were also four daughters from the marriage. Although Carl was born in Bremen, he spent his early years in Havana. Carl, who was always very close to his mother, was brought up like a typically British child. In fact Julius and Fanny spoke English at home so the children grew up with English as their first language. Three of Carl's four older siblings eventually settled in England. After Julius retired, the family returned to live permanently in Bremen, but Julius had only a short retirement for he died on 18 January 1864. Fanny was left on her own to bring up the eight children. Forman writes [1]:-

> There was thus a strong British element in his upbringing, particularly an emphasis upon sport, self-reliance, and fair play that, in combination with the civic traditions of the Hanseatic town, influenced his political and social views.

Carl attended the Lyceum in Bremen and, in 1875, passed the examinations required for university entrance. After leaving school in 1875, Carl Runge spent six months with his mother visiting the cultural centres of Italy. On his return to Germany he enrolled at the University of Munich at Easter 1876 to study literature and philosophy. His three elder brothers had not been interested in pursuing academic careers and they had all opted to enter the commercial world. Runge's career as a student of literature was, however, short lived for after six weeks of the course he changed to mathematics and physics. Runge attended courses with fellow student Max Planck and they became close friends, remaining so for the rest of their lives.

In the autumn of 1877 Planck and Runge both went to Berlin but Runge turned to pure mathematics after attending Karl Weierstrass's lectures. He had not found the lectures on mathematical physics given by Kirchhoff and by Helmholtz particularly attractive. On the other hand, he loved the courses given by Ernst Kummer as well as those given by Weierstrass. Although Runge had committed himself to the study of pure mathematics he did not lose his initial interest in philosophy. He attended Friedrich Paulsen's course on David Hume in the winter semester of 1878-79. Paulsen had just been appointed as an extraordinary professor at Berlin and Runge rated him extremely highly. He wrote that Paulsen was one of the two [1]:-

> ... to whom I owe the best of my knowledge and ability.

His doctoral dissertation, submitted to the University of Berlin on 23 June 1880, dealt with differential geometry. The title of the thesis was *Über die Krümmung, Torsion und geodätische Krümmung der auf einer Fläche gezogenen Curven* ⓣ and it was examined by Ferdinand Rudio, W Sachse, and Adolf Piltz who was a doctoral student of Kummer and Weierstrass. Now, although Weierstrass was his advisor, he had not suggested the topic of Runge's thesis; rather this had come out of discussions he had with other students in the Mathematischer Verein in which he was actively engaged.

After qualifying to be a Gymnasium teacher during session 1880-81, he completed the necessary examinations and returned to Berlin where he began to collaborate with Kronecker. Runge then worked on a procedure for the numerical solution of algebraic equations in which the roots were expressed as infinite series of rational functions of the coefficients. There were three standard methods for the numerical solution of such equations, namely by Newton, Bernoulli and Gräffe, and the method found by Runge had all three of the standard methods as special cases. He included these results in his Habilitation thesis which he submitted to Berlin in February 1883. This entitled him to lecture at the University of Berlin, and there he continued to undertake research on algebra and function theory as part of the group of mathematicians which had built up around Kronecker.

Runge had published little at this stage in his career but after visiting Mittag-Leffler in Stockholm in September 1884 he was persuaded by Mittag-Leffler to write up the results he had produced. With this encouragement, he wrote a number of papers which were printed in Mittag-Leffler's journal *Acta mathematica* in 1885. Runge was not only making his mark as a mathematician, he was also entering into the social life of Berlin [1]:-

> Runge - tall, lean, with a large finely sculptured head - had developed exceptional skill as an ice skater in his youth; and in Berlin in the early 1880s when that activity was becoming extremely fashionable, he cut a striking figure.

One of the most impressive professors at Berlin was Émile du Bois-Reymond, older brother of the mathematician Paul du Bois-Reymond. Émile du Bois-Reymond was interested in physiology, medicine and philosophy and gave a famous speech at the Berlin Academy of Science in 1880 in which he listed seven riddles which, he declared, science could not explain. These included: the ultimate nature of matter and force; the origin of motion; the origin of life; and the question of freewill. Runge became friendly with Émile du Bois-Reymond's family, particularly with his children. He became engaged to Aimée du Bois-Reymond in 1885 but her father, who had been brought up a Pietist and had strict views, said that they would not be allowed to marry until Runge had obtained a professorship. Fortunately this did not prove to be an obstacle for long for in March 1886 Runge

obtained a chair at the Technische Hochschule at Hannover. He married Aimée in August 1887 and remained in Hannover for 18 years. Paschen (who collaborated with Runge for seven years, see below) writes about Runge and his family life in Hannover [4]:-

> *They had four daughters and two sons, one of whom was killed in the war* [*World War I*]. *Runge's home at Hannover ... will never be forgotten by those who had the privilege of entering it. The family cultivated many sciences and arts. Runge himself played the piano, and he and his children would often render musical classics such as the 'Matthäus Passion'. Runge was a man of affairs and of great personal charm. He was fond of all kinds of sports and practised bicycling, gymnastics, and swimming. At Hannover he used to ride his bicycle a distance of about eight kilometres from his house top the Technische Hochschule four times a day. In all his activities he placed scientific things foremost and was willing to sacrifice everything to their advancement.*

Within a year of taking up the professorship at Hannover, Runge had moved away from pure mathematics to study the wavelengths of the spectral lines of elements other than hydrogen. (J J Balmer had constructed a formula for the spectral lines of helium.) In fact Runge's interest in this topic came though Émile du Bois-Reymond in the year before Runge had married his daughter. Du Bois-Reymond had attended a lecture at the Berlin Academy by Heinrich Kayser on the topic, which had interested him, and after Kayser was appointed as Professor of Physics at the Technische Hochschule of Hannover in the autumn of 1885, all three men began to work on the problem together. Kayser and Runge published seven joint papers in the Proceedings of the Berlin Academy of Science over a period of seven years. These papers, covering over 350 pages, made important contributions. In one of these papers, published in 1888, they write that this problem of the wavelengths of the spectral lines of elements other than hydrogen was [1]:-

> *... affording a much deeper insight into the composition and nature of atoms than any other physical process.*

Runge did a great deal of experimental work and published a great quantity of results. He succeeded in arranging the spectral lines of helium in two spectral series and, until 1897, this was thought to be evidence that hydrogen was a mixture of two elements. After working with Kayser for seven years, Kayser left Hannover in 1894 to take up the chair of physics at the University of Bonn. This had become vacant through the tragic death of Heinrich Hertz at age 36 from blood poisoning. Runge continued his work on spectroscopy alone for six months but then persuaded Friedrich Paschen to join him. Paschen was an experimentalist and they worked together at Hannover for seven years. Runge visited England in 1895 and became friendly with Lord Rayleigh. Two years later he travelled to the United States where he became friends with A A Michelson. While in the United States he visited Yerkes Observatory and was offered a professorship by George E Hale but he declined. Paschen writes about their joint work in Hannover [4]:-

> *We investigated the spectrum of helium when this gas was first discovered by Ramsay. We then turned to the spectra of oxygen, sulphur, and selenium. In these spectra we found for the first time series systems of two different multiplicities.*

In 1901 Paschen left Hannover when he was appointed professor of physics at the University of Tübingen. At this stage Runge continued his work with Julius Precht who had previously held the Extraordinary Chair of Theoretical Physics at Heidelberg. Runge and Precht worked [4]:-

> *... on the spectrum of radium and on the Zeeman effects on its lines. They found the principal groups of lines in the arc and in the spark spectrum and classified them as belonging to that of an alkali-earth.*

It is interesting to consider why Runge remained so long at the Technische Hochschule at Hannover while others were appointed to more prestigious chairs. The reason almost certainly is that Runge did not fit in. On the one hand he was considered a traitor to mathematics by many having left the area to undertake research in physics. Physicists, however, considered Runge a mathematician and would have not considered him entirely suitable for a chair of physics at one of the leading institutions. It is worth remarking at this point that Runge always considered himself a mathematician. In 1904 Klein persuaded Göttingen to offer Runge a chair of Applied Mathematics, a post which Runge took up in the October of that year and held until he retired in 1925 [4]:-

> *At Göttingen he was appointed for teaching and research in applied mathematics. He worked out many numerical and graphical methods, gave numerical solutions of differential equations, etc. He was the pioneer in introducing this kind of mathematics into Germany.*

At Göttingen, Runge became highly involved in teaching and undertook less research. He published *Analytische Geometrie der Ebene* in 1908 and the book *Vorlesungen über numerisches Rechnen* ⓣ, co-authored with H König, in 1924. He lectured on *Graphical methods* at Columbia University in New York from October 1909 to January 1910, being Kaiser Wilhelm Professor of German History and Institutions for the year 1909-1910.

Here is the Introduction to *Graphical methods*.

Runge was a highly influential figure in the University of Göttingen [1]:-

> *Despite his liberal political views - open opposition to the annexations during World War I and membership in the Democratic Party afterwards - Runge retained the confidence of his colleagues and his influence in the university.*

Runge reached the retirement age of 68 in 1923 but he continued to run his Institute until his successor, Gustav Herglotz, arrived in 1925. We should note, however, that the name of the chair ceased to be 'Applied Mathematics' when Herglotz took over.

We have noted above that Runge was very sporting, a fit and active man even as he grew older, and on his 70th birthday he entertained his grandchildren by doing handstands. He was still mathematically active with several ambitious projects underway. However six months later he had a heart attack and died. His mother Fanny had died in 1910.

Other Mathematicians born in Germany
A Poster of Carl Runge

References (show)

Additional Resources (show)

Honours ([show](#))

Cross-references ([show](#))

[School of Mathematics and Statistics](#)
[University of St Andrews, Scotland](#)

University of
St Andrews

If you have comments, or spot errors, we are always pleased to [hear from you](#).