A Short Biography of G. R. Kirchhoff for the IEEE Kirchhoff Award
By R. W. Newcomb
ECE Dept, University of Maryland

The IEEE Gustav Robert Kirchhoff Award is an IEEE Technical Field Award in honor of Kirchhoff that is sponsored by the IEEE Circuits & Systems Society. The due date for nominations is January 31 of each year and the nomination form is available at http://www.ieee.org/awards/sums/kirchhoffsum.xml

With the inauguration of the IEEE Gustav Robert Kirchhoff Award as an IEEE Technical Field Award sponsored by the IEEE Circuits & Systems Society it is worth knowing more about Kirchhoff himself.

Every electrical engineer learns early of the two Kirchhoff laws, but not very many realize that they were published in while he was still a student. Thus the voltage law appears as an undisplayed equation at the top of page 502 of his first publication [1] and the current law is proven (and displayed) as part I of a theorem on page 513 of the same 1854 work. A portrait of Kirchhoff, taken from the cover of his collected works [2], is given in Fig. 1.

Kirchhoff’s mother was Johanna Henriette Wittke and his father was the lawyer Friedrich Kirchhoff. His date of birth was March 24, 1824, in Königsberg, Prussia (now Kaliningrad, Russia) and he died in Berlin on October 17, 1887 [3]. He attended the Albertus University of Königsberg where he attended the Neumann-Jacobi mathematics-physics seminars from 1843 to 1846 for which his paper cited above was prepared while studying under Franz Neumann. In 1847 he married Clara Richelot (1834-1869) the daughter of one of his mathematics professors, Friedrich Richelot, and in 1872 he was married to Benovefa Karolina Sopie Luise Brömmel (he had two sons and two daughters). In 1847 he also received the Doctor of Philosophy from Königsberg University with the mathematician Ludwig Otto Hesse as his advisor (Hesse studied under Jacobi also at Königsberg, graduating in 1840, and is known to many of us through the Hessian).

Kirchhoff’s dissertation title is: De criteriis quibus cognoscatur an aequatio quinti gradus irreductibilis algebraice resolvi posset / De parallaxi stellae Argelandiae [translation: On the criteria by which one solves a fifth degree irreducible algebraic equation / for the parallax of the stars of Argelander]

Argelander was an astronomer who published, also in Latin but in Finland, in 1830 a catalog of the 560 brightest stars in the northern hemisphere [4] (amazingly followed in 1850 by the same type of study for 324,000 stars, a catalog apparently still used through the 1950’s). Königsberg was also a place where many well known mathematicians worked and studied and is known for the bridge of graph theory problems.

Although Kirchhoff is best known to electrical engineers for the two laws mentioned above, some of his other work is well known to the chemists since he gave the spectra of a number of elements leading to a chemical analysis via the spectrum. This led him to a spectral study of the sun from which he was led to the discovery of cesium and rubidium. A landmark paper was his written with Robert W. Bunsen [5]. The spectra is shown in Fig. 2 and the apparatus he used to obtain it, called the “spectroscope,” is shown in Fig. 3 (both being attachments at the end of his collected works [2]). In Fig. 3 a
pellet of the material is placed at the tip of the rod in the flame on the right. The excited light is sent by the telescope on the right into the prism (with all angles 60°) in the center. The prism is rotated by use of the middle rod an amount recorded by the bottom mirror and the light at the rotated angle is magnified by the telescope on the left for recording (the angle between the two telescopes is set at 58°). Apparently his use of the spectroscope led to serious eye problems for Kirchhoff.

In 1847 Kirchhoff became an unsalaried lecturer (Privatdozent) at the University of Berlin with Bunsen joining as Professor of Chemistry in 1850 and where Heinrich Hertz was one of his students (after whom is named the unit of frequency). Then, during 1850-1854, Kirchhoff taught as extraordinary professor at the University of Breslau (now Warsaw). In 1854, following Bunsen's appointment in Heidelberg, he became a Professor in Heidelberg where he pursued investigations on the emission and absorption of light leading to his ground breaking work with Bunsen. His work on black body radiation is considered fundamental to the development of quantum mechanics. In 1875 he went to Berlin as Professor for mathematical physics where he had a disability that required him to spend much of his time on crutches or in a wheel chair and led to his early retirement in 1886. His lectures are assembled in the four volume work of 1876-94, “Lectures in Mathamatical Physics” [6]. At least two German stamps have been issued in his honor, one by the DDR [7a]. He graduated five doctoral students including Max Noether who in turn graduated 19 doctorates.

The following anecdote can be found on the web [7b]: His banker was skeptical of Kirchhoff's scientific work and once asked "what good is gold in the sun if I can't bring it down to earth?" Later on receiving a medal and prize in gold Kirchhoff remarked on handing the gold to the banker "Here is the gold from the sun."

Although a search on the web will turn up a number of details [7c], some of which are mentioned above, due to his importance to the fields of circuit theory, spectral analysis, and quantum mechanics, let alone chemistry and astronomy, a much more detailed and accurate historical biography of Kirchhoff is certainly in order.

References:


{Friedrich Wilhelm August Argelander lived 1799-1875, obtaining his PhD under Friedrich Bessel in 1922 on systematic evaluation of bright stars in part of the northern hemisphere. He went to Abo, Finland, in 1823 and became Professor of Astronomy at the University of Helsinki in 1828. He made this catalogue in 1830 of 560 stars and later published the Bonn Survey of 1859 – 1862 of more than 324,000 stars in the northern hemisphere}

[5] G. Kirchhoff and R. Bunsen, “Chemische Analyse durch Spectralbeobachtungen” Pogg. Ann., Vol. 110,. 1860 [reproduced in [2] pp. 598 –625 including a detailed analysis and a color print of the spectra of barium, calcium, strontium, lithium, natrium (=sodium), kalium (=potassium) in the order (left to right) copied here in Fig. 3]

1. Mechanik (1874).revised to Vollesungen über Mehanik (1897)
2. Vorlesungen ueber mathematische Optik (1891)
3. Vorlesungen ueber Electricitaet und Magnetismus (1891)
4. Vorlesungen über dei Theiories der Warme (1894),
5.

[7a] http://chem.ch.huji.ac.il/~eugeniik/history/kirchhoff.htm is a good site for general information including a picture of the two stamps.
[7c] http://www-gap.dcs.st-and.ac.uk/~history/BirthplaceMaps/Konigsberg.html
Figure 1: Portrait of Gustav Robert Kirchhoff
Figure 2: Atomic spectra measured by Kirchhoff

Figure 3: The key component of Kirchhoff's Spectroscope
Figure 4, 1974 stamp from Berlin and the DDR