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Albert Gockel, a pioneer in atmospheric electricity and cosmic radiation

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ABSTRACT

At the beginning of the 20th century, the community of investigators of atmospheric electricity included scholars from most (Western) European countries and even beyond. If Victor Hess is deservedly remembered as the discoverer of cosmic rays, his achievements was made possible by the work of close predecessors whose contributions went with time almost forgotten. One of the most noteworthy was Albert Gockel (1860–1927) from Freiburg (CH) University. I want to discuss Gockel's achievements in atmospheric electricity and in particular his substantial contribution to the study of ionizing radiation which led to the discovery of its cosmic origin.

The year 2012 celebrates the hundredth anniversary of the discovery of cosmic rays by the Austrian Victor Franz Hess. It gives the physics community the opportunity to look back at a century of scientific investigations in a field that offered physics some of its most exciting discoveries. For historians, it is also the occasion to have a closer look at some episodes and remind of the many pioneers, some of them fallen in almost complete oblivion, which made it all possible.

As it happened often in the history of discoveries, that of cosmic rays came as a surprise, uncovering a new realm of physical phenomena way beyond what was initially imagined. It was nonetheless the outcome of a sustained effort following a clear rationale. It originated in the field of atmospheric electricity pioneered mainly by Austrian and German investigators at the turn of the 19th century. It was known since at least the observations of Charles Augustin Coulomb (1736–1806) that charged electroscopes loose spontaneously their charge (1785) but the phenomenon went under close scrutiny only a century later. At Vienna University, Franz Exner (1849–1926) established from the middle of the eighties on a successful tradition of research in *Luftelektrizität* while in Germany the fundamental achievements and insights of the remarkable tandem formed by the Gymnasium teachers Julius Elster (1854–1920) and Hans Geitel (1855–1923) inspired the work of many local and foreign researchers.[1]

At the beginning of the 20th century, the community of investigators of atmospheric electricity included scholars from most (Western) European countries and even beyond. One of the most noteworthy among them was Albert Gockel (1860–1927) who spent the biggest part of his scientific career, until his death, at Freiburg (CH) University.[2] Here, I want to take a closer look at Gockel's career, his life-long interest in atmospheric electricity phenomena, and in particular at his substantial contribution to the study of ionizing radiation which led to the discovery of its cosmic origin.

In order to understand Gockel's achievements one has first to recall what were at the time the research trends and the main issues in the field of atmospheric electricity. After Elster and Geitel concluded that the spontaneous discharge of electrometers was due to the presence of ions in the atmosphere (1900) came the question of the their origin. The recent discovery of radioactivity (1896) and of its ionizing properties on gases led Elster and Geitel to investigate its presence in the air (1901–1902): the radioactive gaseous emanations corresponding to decay products of active minerals they detected made them conclude that it was indeed the primary cause of the conductibility of air. It was the time when one investigated the natural radioactivity of soils, rocks and air: its effects were examined underground, at ground level and in mountain heights, in land and in seas. While one learned more and more about the radioactive substances and their decay products, hypotheses on the location of the sources responsible for atmospheric ionization were getting more precise. When it turned out that the radioactive decay products of the gaseous emanations in the atmosphere could hardly account alone for its ionization, a direct outgoing radiation from the active substances in the Earth crust came to

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[1] For an overview of the history of the discovery of cosmic rays by his main protagonist see V.F. Hess, The Electrical Conductivity of the Atmosphere and Its Causes, New York, 1928; see also William F.G. Swann, History of cosmic rays, Am. J. Phys., vol. 29, 1961, 811–819; B. Rossi, Cosmic Rays, New York, 1964; Y. Sekido, H. Elliot (Eds.), Early History of Cosmic Ray Studies, Reidel, 1984; Q. Xu, L.M. Brown, The early History of Cosmic Ray Research, Am. J. Phys., vol. 55, 1987, 23–33 and L.M. Brown, L. Hoddeson (Eds.), The Birth of Particle Physics, Cambridge Univ. Press, 1986. For a recent account see P. Carlson, A. De Angelis, Nationalism and internationalism in science: The case of the discovery of cosmic rays, Eur. Phys. J. H, vol. 35, 2010, 309–329. Retracing in particular the early history before Hess' discovery, this article gives due credit to some of usually overlooked scholars who made Hess' discovery possible, with particular emphasis on the work of the Italian Domenico Pacini. I refer the reader to this article for many details only alluded to in the present work.

[2] For a brief scientific biography of Gockel see H. Schneuwly, Albert Gockel et la découverte de rayons cosmiques in «Défis et dialogue/Herausforderung und Besinnung», vol. 13, Editions Universitaires Fribourg, 1991; a further list of publications on Gockel and his work can be found at <http://www.unifr.ch/sfsn/pdf/gockel>. This useful web site includes links to pdf files of several Gockel's key articles, reports and books.

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be considered as the next explanation. Contemporary experiments conducted by Canadian teams on ionization of air in sealed vessels showed on the other hand that, in spite of shielding, the enclosed air was still ionized by a very penetrating radiation different from the radiation originating from the vessels walls or nearby artificial or natural formations (1903). For some time it was commonly accepted that the ionizing radiation from substances in the Earth's crust could explain it all. At the very end of the first decade it was realized however that this radiation, given its decreasing strength with distance, could not account for the ionization, at least in the higher layers of the atmosphere. After a series of investigations in situations where the effects of the direct radiation from the ground could be ruled out, it became more and more evident that a new source of radiation of non-ground origin was involved. Most remarkably, instead of decreasing rapidly with altitude, the penetrating radiation was found, after an initial albeit slower than expected fall, to rise again. In 2012, Victor Hess brought finally indisputable evidence that the radiation had to come from outside the atmosphere, hence was genuinely of extraterrestrial origin. His series of celebrated balloon observations in 1911–1912 which enabled him to reach this conclusion were preceded by extensive attempts by some other investigators who came very close to similar conclusions. Among the latter Albert Gockel deserves particular attention: with a series of balloon flights almost two years before Hess', he preceded the Austrian on some key observations. However, due to reasons that will be discussed shortly, it was not given to Gockel to bring forth evidence as strong as Hess'. Lack of material means and support, even (and especially) from his home institution, ruled him out of the game just when the investigations reached their climax and that first priority claims were issued. To better understand the circumstances, let us have a closer look at Gockel's training, academic career and the context of his position at Freiburg.

Born in Stockach (Baden-Württemberg, Germany), Gockel received his secondary training at Konstanz gymnasium and then studied at the Universities of Freiburg im Breisgau, Würzburg and Karlsruhe. He obtained his Ph.D. degree in Heidelberg under the direction of Ferdinand Braun (1885), with a dissertation on the Peltier's effect. Right after, Gockel went to teach for a few years at the Ladenburg gymnasium in his native Baden state. Teaching was not his sole activity since he managed during these years to investigate extensively phenomena related to lightning and storm.[3] In a series of meticulous measurements he monitored the potential of atmospheric electricity and reported his results in great detail comparing them with the observations of the Karlsruhe's meteorological station and with other investigations, and especially those of Elster and Geitel.[4] One of the outcomes of Gockel's research was a successful book he published in 1895 entitled *Das Gewitter* which went reedited several times.[5]

Then, for reasons that remain unclear, Gockel decided gave a new turn to his career: at the age of 36, he transferred to Switzerland where he joined the newly founded Institute of Physics of Freiburg University. When he moved there in 1896, he became assistant to Joseph de Kowalski, the almighty head of the Institute, at the time only 29.[6] Over the next four years, Gockel worked on his habilitation work entitled "*On the relationship between polarization and current density in solid and molten salts*".[7] This topic, at odds with Gockel's former research interests was probably dictated by Kowalski, who had an absolute say in everything which concerned his institution and, in the initial years at least, in much of the Faculty life.[8] The acceptance of Gockel's habilitation gave rise to the first of a series of ongoing conflicts between both men. In spite of a positive assessment of the other referee,[9] Kowalski rejected Gockel's work judging it vague and inaccurate, and required extensive corrections. It took one more year to Gockel to see his habilitation finally accepted. Soon after, the Faculty proposed him as extraordinary professor for physics and meteorology.[21] He was supposed to teach meteorology and "other selected topics in physics", however under strict supervision and approval of Kowalski. The latter was definitely not willing to give up his grasp over Fribourg's physics: the decision of Gockel's nomination was shortly supplemented with some Faculty clauses severely restraining Gockel's status and role in the Institute of Physics: he had no academic power whatsoever and access to instruments for his research was submitted to prior approval of Kowalski, the tenant of the only chair of physics.

The premises Gockel could use were secluded from the rest of the physical Institute and he could not benefit from any help since he was not granted a personal assistant of technician. Actually, over the years when Kowalski directed the Institute of Physics, and even later on, Gockel was never granted, on a regular basis, the appropriate resources for his research. When in need of funds for particular research, Gockel had instead to apply directly to the Freiburg state education authorities. While such extra funds were often approved, his fixed funds remained the same since his initial nomination as an extraordinary professor in 1903[24]; the amount he could invest in his research was actually even less given that a part had to be allocated to his students' laboratory work.[10]

Until he left Freiburg in the 1920', Kowalski continued to counter any initiative aiming at strengthening Gockel's academic situation. When, in December 1909, the Faculty of Science proposed to promote Gockel to an ordinary professorship, Kowalski argued that the Institute of Physics was not intended to have two ordinary professors and that he wanted to remain the only assessor for the physics degree and the doctorate. Gockel got eventually promoted but again under restrictive clauses: he did not obtain a chair, and his nomination was specifically understood as an honorary one: it was only meant to "recognize the number and quality of the services that (Gockel) did and the considerable amount of his works, while not causing any prejudice to the rights and privileges of the holder of the ordinary professorship of physics".[11] The title of professor was conferred to him only *ad personam*. Thus, notwithstanding his promotion, Gockel's status at the Physics Institute did not see much improvement. His situation, his salary and the funds granted to his research did not change until years after Kowalski returned to his native Poland.[12]

All these impediments did not prevent Gockel to become a front-rank investigator in his field. According to his list of publications,[13] he followed and contributed to the latest developments in atmospheric electricity and related phenomena. In particular, Gockel

[3] See Schneuwly, loc. cit., p. 6.

[4] Ibid, p. 7.

[5] Das Gewitter, Köln, Bachem, 1895.

[6] One does not know who did the first steps. It could be that de Kowalski knew Gockel's Das Gewitter and made him an offer. On the other hand, maybe Gockel chose Freiburg because electrical phenomena were at that time at the focus of the local Institute of physics, but such was, at the time, the case for many other institutes. Another reason could be related to religious affinity: Gockel was catholic and the Freiburg University was at the time proudly displaying its status of the only catholic university in Switzerland.

[7] A. Gockel, Über die Beziehungen zwischen polarization und Stromdichte in festen und geschmolzenen Salzen, Zeitschrift für Physikalische Chemie, vol. 39, 1900, 529–559.

[8] For a detailed work devoted to Gockel, Kowalski and the initial years of the Freiburg Institute of Physics focusing in particular on the opposition of their scientific styles and tense relations, see R. Catinaud, Which physics for a new institute? Albert Gockel, Joseph Kowalski and the early years of the Fribourg Institute of Physics, Communications of the Swiss Physical Society, nr 36, 2012, 24–27.

[9] See Catinaud, 2012, p. 25.

[10] Ibid.

[11] Excerpt from the State protocol no. 284, February 18, 1910, State Archives of Freiburg, see Catinaud, ibid, p. 26.

[12] The precarious academic situation of Gockel in Freiburg is certainly linked to his research topics and style at odds with de Kowalski successors,

[13] See the list at the end of Gockel's obituary by A. Reichensperger, in Bulletin der Naturforschenden Gesellschaft Freiburg/Schweiz, vol. 28, 1927, 227.