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Reception and Research in Electricity and Magnetism in the 19th Century in Poland

Abstract

Teaching of electricity and magnetism in Poland began in the last decades of the 17th century. At the same time also collections of physical instruments, including electrical ones, were founded and completed with new instruments during the 19th century. The collectionof physical instruments of Cracow University were especially rich. In the 1840s observation of terrestrial magnetic fields began in Cracow. From the seventies theoretical and experimental papers on electricity and magnetism by Skiba, Olearski, Wróblewski and Witkowski were performed in Cracow and Lvov and in the laboratories in Western Europe. Wróblewski's discovery of strong increase of copper's conductivity in temperatures about -200°C was the most important one. In the 19th century only one original Polish university textbook, including an exposition of electricity and magnetism, was published in1823.

1. Introduction

Interest in the exact sciences and in their progress in Western Europe began to grow in Poland in the middle of the 18th century and soon resulted in the reform of the programmes of education, at first in the schools led by the convents of Piarists and Jesuits. In these schools collections of physical instruments for demonstrations of the lectures were organized. The first of such collections were founded by Jesuits in Warsaw in the 1760s.

Growing interest in the progress of science led later to the reform of the universities, where by the time the anachronic medieval science had dominated. Poland possessed three universities then, in Cracow, Vilna and Lvov. Their reform was accelerated by the foundation of the Commission of National Education in 1773. The reform of Cracow University was performed during the years 1777-80, that of Vilna University began in 1780.

After the partition of Poland the universities of Cracow and Lvov were acting during the whole 19th century in the Austrian zone, Vilna University was active in the Russian zone until 1831, when it was liquidated by tzarist authorities.

2. Physics Collections of Cracow University and its Electrical Instruments

All three universities had their collections of physics instruments. Since we have best information about the collection of Cracow University, we shall describe its history, as representing of university physics collections.[1]

In the frame of reforms of Cracow University two chairs, that of physics and that of mechanics were founded in 1782. In 1874 the University Physics Collection was founded. Among its (physics) instruments also electrical instruments were listed in the catalogue: electrical machine with a glass sphere and vessel ("conductor") with 15 additional instruments for different physical experiments, and electrophorus of ½ inch diameter. Until 1797 nine Leyden jars, Franklin disc, a machine with electrophorus from Prague, "palace for lightnings", "tower for lightnings" and other small instruments from Grivigny were bought. The catalogue from 1805 mentioned also: a Henley discharger, a Franklin disc, an electrical machine with a glass cylinder and two brass collectors, an electrical machine with one glass disc and brass collector, 30 copper discs and zink discs "for galvanism" (this means that Volta's discoveries were well known), an electrophorus and a kite. The professors managing the chair of physics in the time of the Napoleonic wars tried mainly to avoid the devastation of instruments and to make reparations.

It was professor Roman Markiewicz, head of the chair of physics in the years 1813-1933, who enlarged the collection. In 1833 the following instruments were still registered: Volta apparatus of 24 cells placed in our boxes composed of copper vessels and a zinc plate, three electro-dynamic apparatus for Ampère's experiments, Pixi's magneto-electric apparatus, Hare's deflagrator, electrophorus with a tin cover and a glass Volta pistol. In 1838 the magneto-electric Ettinghausen instrument was purchased.

Markiewicz published the first Polish article on electricity in 1823: *Treatise about the connection between magnetism, electricity and galvanism*.

Also Warsaw University possessed, during its short period of activity (1816-1831), a good collection of physical instruments, which after its liquidation by Russians in 1831 were transferred to Petersburg. The rich collection of physical instruments of Vilna University were, after its liquidation in 1831, transmitted to Kiev University. Markiewicz's successor Stefan Ludwik Kuczynski, head of the chair of physics during the years 1838-1882, modernized the Cracow physics collection. Its instruments could be applied not only for demonstration, but also for laboratory practice of advanced students and for scientific experiments conducted by professor Kuczynski and his collaborators.

The catalogue of the physics collection in 1863 also contained the following instruments: an electrical machine with 36'' plate from Winter (Vienna), a Grove's pile with 18 cells, a Ruhmkorff induction apparatus, two electromagnetic telegraphs, two multiplicators, a Bunsen pile with 20 cells, a Smec. pile with 12 cells, an Ekling

[1] KLECKI (1898).

apparatus for galvanic induction, Page's electrometer, four Geissler tubes, an arc lamp and Fechner's electroskope.

Among the magnetic instruments of the collection there were also: two magnetic instruments for inclination measurements, and two portable magnetometers.

The collection obtained a gift in 1840: a Neef galvanica induction instrument and in 1864 an "electromagnetic clock", a Winter's electroscope and electromagnet capable if lifting the weight of 20 pounds. In the article from 1881 Kuczynski did not mention further purchases.

3. Research

Kuczynski's research in physics concerned optics, thermometry and terrestrial magnetism. He published the article *On magnetic force of the Earth about the phenomena of terrestrial magnetism* and the paper *The roots of terrestrial magnetic force* in Cracow,[2] which presented the results of the intensity of terrestrial magnetic field measurements in Cracow, conducted during 24 years, from 1848 to 1872.

In 1872 the chair of theoretical physics was created in Cracow. Its head, Edward Skiba, was interested mainly in elasticity, thermodynamics and optics. In the domain of electricity he published two papers. In the theoretical paper *Theory of radiating electricity*[3] he investigated the laws of mutual interactions of electric currents in Ampère's theory.

He assumed that this mutual interaction of two (moving) charges is transferred by means of longitudinal wave in ether and the interaction force is proportional to kinetic energy of the particles of ether. From these assumptions he deduced Ampère's laws. This paper was anachronic just in the time of its publication (1874) when we remark, that Maxwell had formulated the laws of electromagnetic field nine years earlier (in 1865).

Skiba's experimental work (with Karol Olszewski) *Influence of temperature on galvanic conductivity of water*[4] contained the results of the precise measurements of the specific conductivity of water in the range of 10C–1600C.

In the beginning of the eighties Kazimierz Olearski, an assistant and later lecturer in the chair of experimental physics, published three experimental papers in the domain of electricity.

The papers: *On electrical oscillations*[5] and *On the transport of alternating currents through electrolytes*[6] were performed in 1884 in G. Helmholtz' laboratory of the Institute of Physics in Berlin. In this work Olearski investigated the validity of Ohm's law for alternating currents (of the frequency of severat kHz obtained in discharging of a capacitor). In the first paper Olearski verified the validity of

[2] KUCZYNSKI.
[3] SKIBA (1874).
[4] SKIBA and OLSZEWSKI (1874).
[5] OLEARSKI (1882).
[6] OLEARSKI (1880).

Ohm'slaw for alternating currents in metallic conductors, in the second one for alternating currents in electrolytes.

During the academic year 1884-85 Olearski worked in J.J. Thomson's. laboratory in Cambridge and published the paper *Some experiments on the dielectric strength of mixtures of gases*[6] which contained the results of measurements of specific resistivity of nitrogen, oxygen, hydrogen and their mixtures.

Zygmunt Wróblewski, Kuczynski's. successor, worked in cryogenics. Together with Karol Olszewski he liquefied nitrogen and oxygen and investigated the properties of the matter in low temperatures. In 1885 he discovered that copper shows unusually high increase of conductivity in the temperatures about –2000C. He published this discovery in the paper *über den elektrischen Widerstand des Kupfers bei höchsten Kältegraden*.[7] Further investigations of the conductivity of metals at very low temperatures led H. Kamerlingh-Onnes to the discovery of superconductivity in 1911.

Lecturer at Lvov Technical University, August Witkowski, during the period 1890-93, published three experimental papers on electricity. The first one *About polarization currents*[8] was made in G. Helmholtz' laboratory in Berlin. The second one, *Effects of strain on electric conductivity* was made in Glasgow in Lord Kelvin's laboratory. Witkowski's third paper was entitled *Zur Theorie der galvanischen Kette*.

After Wróblewski's tragic death in 1888 August Witkowski became his successor at the chair of experimental physics in Cracow, where he continued Wróblewski's work in cryogenics.

4. University Textbook on Electricity and Magnetism

The only original Polish university textbook edited in the 19th century, which included the exposition of electricity and magnetism, was the *Yearly course of experimental physics*, published in 1823 by the professor of Vilna University, Felix Drzewinski. The fourth part of this textbook, entitled *On radiative bodies investigated from the XVIIth century*, was divided into two chapters: *On electricity* and *On magnetism*.

In the chapter devoted to electrical phenomena, the author presented the Coulomb law for electrical charges, described the instruments for collecting electrical charge, as an electrophorus, a capacitor, a Leyden jar and an electrical battery. Then different kinds of electrical discharge were presented. In the paragraph *On excitation of electricity* by means of contacting bodies, Galvani's and Volta's experiments were dicussed and Volta's and Richter's piles were described. Then Franklin's theory of electrical fluids was discussed.

The chapter on magnetism described magnetic and terrestrical magnetic phenomena. Then the description of Oersted experiment was presented and the concept of electric current was introduced. Then Ampère's experiments on the

[7] WRÓBLEWSKI (1885).
[8] WITKOWSKI (1880).

interaction of currents and magnetic properties of elecrtical circuits were described, and the hypothesis explaining terrestrical magnetism by electric currents in the Earth influenced by the Earth rotation was presented.

Other Polish university textbooks in the 19th century did not include the exposition of electricity or magnetism; it was only August Witkowski who published his mimeographed textbook *Electricity and magnetism* in 1905.

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