THEORETICAL PHYSICS IN POLAND BEFORE 1939*

1. INTRODUCTION

Science, and in particular the exact sciences, is not a part of culture easily accessible to people outside a small group of experts in the given field. There is, however, at least one aspect of science - which seems not to be always duly appreciated - that can be found equally interesting and worthy of attention by both specialists and non-specialists, scientists and non-scientists. It is the history of science, of scientific institutions and of the people of science.

The main goal of this work is to describe the genesis and development of theoretical physics in Poland till 1939. In the sketch presented here I begin by recalling the history of physics as a whole in Poland up to the moment when theoretical physics became a distinct field. This happened in the late 19th century. From that moment on I will focus only on theoretical physics.

On its substance, I find it reasonable to split the history of physics in Poland before 1939 into the following periods:

- first: up to the establishment of the Commission for National Education;

- second: up to the end of the 19th century;

- third: up to World War II.

It is probably no coincidence that the abovementioned stages correspond roughly to the stages we find in the history of science, and of physics in particular, in the rest of the world. One may say that the first period is that of the origins of modern physics as an empirical and rational science, crowned by the works of Newton and their development in the 18th century. This is also the period when Huygens created his theory of waves (1678) and Romer measured the speed of light (1675). It was also then that the study of the properties of gases and liquids was initiated (Torricelli, Pascal, Poisson, Boyle, Charles, Gay-Lussac). At the turn of the 18th and in the 19th century an essentially new step was made in the advance of physics: the study of electromagnetism and the formulation of Maxwell's theory, the development of thermodynamics and of the foundations of statistical physics. The turn of the 19th century and the beginnings of the 20th century saw a revolution in our knowledge of the structure of matter through the discovery of new levels of constituents, the related creation of quantum mechanics and the new understanding of space and time given by the special and general theories of relativity. And finally, the present period, characterized by growing specialization, an explosive growth of team research and the ever-increasing speed with which new results are found.

Viewing the history of physics throughout its existence as a modern science from a certain perspective we see clearly of what unusual interest is the mechanism of the growth of science, the process of achieving a clear-cut synthesis through often winding paths, the mutual relation between different discoveries, the multi-threaded character of this growth, and finally, the process of systematic accumulation of human knowledge through the contributions of many scientists. Great ideas and great syntheses seldom appeared in a void; they were usually engendred by the collective efforts of often forgotten researchers.

Another reflection concerns the era when physics took shape as an empirical and rational science. This process is equally interesting as the later multioriented growth of physics. The struggle between rationalist and empiricist tendencies may be followed through the Middle Ages, the Renaissance, up to the Enlightenment, throughout the entire process of appearance of the modern sciences and their divorce from philosophy, initially synonim for all science[1]. One may note the tremendously multicolored views of individual thinkers, which often included together seemingly contradictory elements; they rarely appear as representatives of "pure philosophies" as defined in the textbooks. One may also see that the ideas attributed to a certain person or era often had already made their appearance earlier. That is why the individual stages may only be characterized through the tendencies and opinions which then prevailed, determining the mainstream of activity but not excluding others, which often were forerunners of future developments.

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[1] W. Tatarkiewicz, *Historia filozofii*, vol. l, PWN, Warsaw 1978.

Scholastics, identified with the Middle Ages (9^{th} -14^{th} century), had many different shades. It appeared as an attempt to rationalize a view of the world, but through the rational justification of dogma. It strives for synthetic intellectual constructions with no reference whatsoever to experience. In the late Middle Ages there however appeared, within the general framework of scholastics, currents which introduced certain elements of empiricism. This is related above all to the rediscovery of the works of Aristotle and his moderately empiricist theory of knowledge. One should mention here the famous Chartres school of the 12^{th} century and its empiricist tradition carried into the 13^{th} century by the University of Oxford (Roger Bacon). The philosophy of Aristotle, initially combated by the Church, later became reconciled with Christian philosophy. This was achieved by, first of all, Thomas of Aquinas, who was the first to draw line between faith and knowledge and who upheld an empirical-rationalistic episthemology. The 14^{th} century brought a further development: the appearance, within scholastics, of criticism. At the universities natural philosophy began to develop in place of philosophical speculation. The foremost among the criticists, William Ockham (1300-1350), gave up the synthesis sought by scholastics, replaced the dogmatic approach by a critical one and viewed science as an autonomous pursuit. The philosophical current initiated by Ockham found followers, and some among them made great achievements in natural science, physics and astronomy in particular. The best known were John Buridanus, Albert the Saxon, and Nicholas of Oresme. They all worked in the 14^{th} century and had ties with the University of Paris. They were forerunners of modern dynamics and its applications to astronomy, in a form not much different from the theory of Copernicus, Galileo, and Newton. They probably strongly influenced the the latter's work and their role in the history in physics is not sufficiently stressed.

The scientific principles of Ockham are essentially the same as the ideas held by the men of the Renaissance: Copernicus, Kepler, Galileo, etc. Still, this way of thinking is often attributed only to the Renaissance, which is not entirely correct. The reason for this is that in earlier times it remained rather isolated and did not exert an influence strong enough to change the dominant pattern of traditional scholastic thought. For the latter, Aristotle, reconciled with Christian philosophy, remained an unquestionable authority.

The Renaissance gave up the rationalism of scholastics. The empiricism of the Renaissance is most clearly reflected in the philosophical works of Francis Bacon and in the rapid growth of science, in particular astronomy and physics.

As the beginning of modern physics we will however consider the work of Isaac Newton, which belongs to the period of the Enlightenment. At that time, an appropriate combination of empirical and rational elements was achieved in physical research. We can see that both these factors, so obvious in modern scientific method, fought for their place through the history of human thought rather arduously before achieving due recognition.

2. FIRST PERIOD: UP TO THE ESTABLISHMENT OF THE COMMISSION FOR NATIONAL EDUCATION

Physics appeared in Poland as a separate branch of science only in the second half of the 18^{th} century. Until then it formed part of natural science, which in turn was a part of philosophy at that time. The Christianization of Poland gave it with time access to the main centers of Western culture; these contacts expanded considerably at the time of foundation of the first universities in the West (Paris, Montpellier, Padua, Bologne). Due to the lack of higher schools in Poland those universities were where a great part of Polish scholars (usually clerics) went to study.

In the 13^{th} century, at the time when Medieval philosophy flourished in the West, the Polish scholar Vitelo (about 1230-1280)[2] studied in Paris and later in Padua. His famous treatise on optics *Perspectlva*[3] is unique in Medieval literature and was used (at first in handwritten copies) as a textbook for teaching this branch of physics up to the times of Galileo. The advanced character of this work is certified by the fact that it was published in print in Basle in 1535 (that is, 255 years after the author's death) under the title *Vitelionis Thuringopoloni opticae libri decem*, and used, among others, by Leonardo da Vinci, Laplace, Kepler (who in 1604 published a supplement to the work), and among Polish scientists, by Brozek and Copernicus.

The turning point for Polish intellectual life came in the 14^{th} century. In 1364 the Cracow Academy was founded, assembling a large number of foreign-educated Polish scholars. The strong Ockhamist[4] influence on Polish intellectual life of those times caused philosophy and natural science to be added in 1400 to the subjects taught at the Academy. At the turn of the 15^{th} century, in the period of greatness of the Academy, the world-famous "Cracow school" of mathematics, which produced Nicholas Copernicus, appeared there. Unfortunately,

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[2] T. Piech, *Zarys historii fizyki w Polsce*, PAU, Cracow 1948.
[3] M. Smoluchowski, *Dziela o historii fizyki w Polsce*, In: *Poradnik dla samoukow*, vol. 2, Warsaw 1917.
[4] This progressive tendency within scholastic philosophy reached Poland with almost a century's delay.

the first half of the 16th century already saw a visible reduction in the activity and importance of this Academy, which started its further decline.

While in the West the currents of the Renaissance and Enlightenment led to modern science taking its shape, in Poland the exact sciences remained a domain of Scholasticism. Unfortunately, even its progressive tendency, Ockhamism, was replaced by backward currents. Poland therefore neither took part in nor followed the great movement initiated by Kepler, Galileo, Newton and Torricelli. The new currents which occasionally did reach the country did not influence official Polish science, represented already at the end of the 17th century by three universities: the Jagiellonian (Cracow), Vilnius (since 1576) and Lvov (since 1661). They did however stimulate a few scholars to conduct their own scientific research.

The first Polish experimental physicist was Father Stanislaw Pudlowski[5], who after studies at the Cracow Academy traveled to Italy where he came into contact with Galileo and his disciples. After his return to Poland he set up in his Cracow parsonage a modern physics laboratory. His research touched on many different subjects, some of which were a continuation of Galileo's studies. Father Pudlowski strongly influenced with his work the development of experimental research in Poland. Though he did not publish his results, they were often quoted by scientists of the time, among them Jan Heweliusz, Jan Paterson, Tito Livio Burattini. Also worthy of attention is the work of the court mathematician and librarian of King Jan III Sobieski, Adam Amandy Kochanski, whose works on statics enjoyed recognition abroad. Among those who showed interest in them was Leibniz, which is evidenced by a longlasting scientific correspondence between the two scholars.

Attempts to carry out scientific research were also made at a few Jesuit colleges, with the setting up of the first physics laboratories where public exhibitions were held. The Jesuit College in Poznan held popular lectures in experimental physics, presented by Father Jozef Rogalinski.

In the second half of the 18th century the first physics textbooks appeared. In 1764 Father Samuel Chroscikowski published the manual *Fizyka doswiadczeniami potwierdzona* (*Physics Confirmed by Experiments*) and in 1765 the four-volume work by Father Jozef Rogalinski, *Doswiadczenia skutkow rzeczy pod zmysly podpadajacych* (*Experiments on the Effects of Things Perceived by the Senses*) appeared in print.

But the actual foundations for a modern higher education were laid only in 1773 by the newly-founded Commission for National Education, which reformed the teaching system and greatly increased the range of mathematical and natural science subjects taught.

3. SECOND PERIOD: TO THE END OF THE 19TH CENTURY

The functioning of the Commission for National Education was cut short by the political events of 1795. Nevertheless, during its brief existence it had managed to reform the Vilnius and Cracow Universities[6], organizing both these schools along western European lines and therefore with a much greater stress on the natural sciences. Thanks to this reform the first physics chairs at Polish universities were established. In 1775, at Vilnius University, within the Faculty of Mathematics and Physics, a Chair of Physics, headed at first by Jozef Mickiewicz and later by Stefan Stubielewicz, and a Chair of Mechanics, headed by Tadeusz Kundzicz, were established. In 1778 Chairs of Physics and Mechanics were established at the Jagiellonian University as part of its College of Physics[7]. The first was headed from 1783 by Father Andrzej Trzcinski, the second from 1780 by Feliks Radwanski. Polish physics could not, however, at that time boast scientists of world stature. The excessively utilitarian view on the role of science held by some of the members of the Commission for National Education reduced the universities to the role of vocational schools, producing secondary school teachers as the principal aim. Owing to this, no basic research was conducted at the two abovementioned universities. Nevertheless, establishing in Poland a unified schooling system and care for the proper selection of teachers, who were often sent abroad with special grants for study, is the Commission's undisputable achievement. Unfortunately, an outstanding exception was the abovementioned first head of the Chair of Physics at the Jagiellonian University, Father Trzcinski, who was outrightly accused of ignorance[8]. He however remained Head of the Chair until 1807, blocking effectively its advancement.

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5 T. Piech, *Fizyka*, in: *Zarys dziejow nauk przyrodniczych w Polsce*, ed. by K. Maslankiewicz, Wiedza Powszechna, Warsaw 1983.

6 Lvov University had fallen under Austrian rule before the Commission for National Education was founded.

7 T. Piech, *Zarys historii katedr fizyki Uniwersytetu Jagiellonskiego*, in: *Studia z dziejow Katedr Wydzialu Matematyki, Fizyki i Chemii Uniwersytetu Jagiellonsklego*, ed. by S. Golab, wydawnictwa Jubileuszowe UJ. Cracow 1964.

8 c.f. *Studia z dziejow Katedr Wydzialu Matematyki, Fizyki i Chemii Uniwersytetu Jagiellonskiego*, ed. S. Golab, Cracow 1964.

Following the downfall of the Polish Commonwealth (1795) Polish scientific institutions, and therefore Polish physics, went through diverse fates shaped by the diverse science policies of the powers which took over Polish territories (Russia. Prussia and Austria), the situation in world science, and above all, the far-reaching effects of armed uprisings.

History was most kind to the Jagiellonian University, which functioned without interruption until the outbreak of World War II, but even in this case Cracow's stormy history caused ups and downs in physics research. In 1805 a reform carried out by the Austrian government abolished the Chair of Mechanics, and Trzcinski's consecutive successors; the three Germans A. Gloisner, J. Zemantsek and J. Ch. Hoffman, followed by Roman Markiewicz and Stefan Kuczynski, dedicated themselves chiefly to administrating and modernizing. The last one of them carried out research in optics and although he did publish some interesting papers, he found no wider recognition. The turning point for Polish physics came only in 1882, when the Chair vacated by Kuczynski was assumed by Zygmunt Wroblewski, who had obtained his education abroad, in Paris and Strasbourg among others. His research on the condensation of the components of air, carried out together with the chemist Karol Olszewski, achieved worldwide recognition. The Chair of Physics gained a modern research laboratory which turned out several classical works on the physics of gases, a field which attracted great interest among the scientific community at that time. Besides his research on the condensation of gases Wroblewski also carried out other studies on the properties of gases, the relation between the solid and the liquid state of matter and its electrical properties at low temperatures, opening a new era in low-temperature physics. Unfortunately Wroblewski did not have the opportunity to educate scientists to continue his work, as he died prematurely in 1888, at the age of 43. Never again was research on the condensation of gases carried out at the Jagiellonian University on such a scale.

Wroblewski was succeeded by August Witkowski, previously Head of the Chair of Physics at the Lvov Polytechnical School. He continued research in the field opened by Wroblewski, working on determining the conditions under which gases condense, on the thermodynamical properties of air and the Joule-Kelvin effect in gases. Witkowski's work gained a high standing among the international science community and his experimental results were often exploited by theorists. Witkowski also had considerable achievements as a teacher. He was an excellent lecturer and author of a famous textbook titled *Zasady fizyki* (*The Principles of Physics*), which became a basic manual for entire generations of Polish physicists. He remained Head of the Chair until 1913.

In distinction, the history of the University of Vilnius and of its Chair of Physics was not very bright. Aside from Stefan Stubielewicz, foreign-educated, an excellent teacher who taught physics according to the most recent knowledge available, this school cannot boast of outstanding Polish teachers, not to speak of scientists. Stubielewicz's succesors, Kajetan Krassowski and Feliks Drzewiecki, were rather mediocre scientists. Drzewiecki nevertheless wrote a series of textbooks, among which one titled *Kurs roczny fizyki eksperymentalnej* (*A Year-long Course in Experimental Physics*, 1823) was for quite a time the most important Polish textbook of physics and played a certain role in the history of Polish science.

The Chair of Mechanics, at first headed by T. Kundzicz, was taken over after his departure by an outstanding expert in the field, the German K. H. Langsdorf. His successors were the mathematicians Zachariasz Niemcewicz and Michal Palka. In 1822 a Chair of Practical Mechanics was established, headed by Walerian Gorski. In 1832, after the fall of the November (1830) Uprising, the University of Vilnius was shut down.

Scientific research was also in neglect at the Lvov University[9], which was reformed by Emperor Joseph II's Court Commission for Enlightment and remained an Austrian university until 1897. The Chair of Physics, established in 1783, was headed most of the time by German or Austrian professors and was several times abolished and re-established. Few Polish physicists ever worked there. The best known among those who did was Wojciech Urbanski, who created several works in theoretical physics, compilatory and popular in character. For three years he was also Head of the Chair. From 1873 the Chair of Physics was headed by Tomasz Stanecki, known in first order for his pedagogical activities. In 1893 he was succeeded by Ignacy Zakrzewski, graduate of and lecturer at Lvov University, who carried out research in the field of calorimetry. When the university was taken over by Poles in 1897, a Physics Department was established, where rather modest research was carried out, chiefly in calorimetry and electrochemistry.

There was another institution of higher learning in Lvov besides the University: the Polytechnical School[10], which grew out of the Lvov Real School, founded in 1811. Renamed in 1877 the Technical Academy, it was transformed in 1877 into the Polytechnical School (Technische Hochschule). The first Head of the Physics

[9] L. Finkel, S. Starzynski, *Historya Uniwersytetu Lwowskiego*, Lvov 1894.
[10] W. Zajaczkowski, *C.K. Szkola Politechniczna w Lwowie*, Lvov 1894.

Department established within the Polytechnical School was Feliks Strzelecki, not much known for research, professor of physics at the Technical Academy since 1856. After his death in 1882, charge of the department was taken by August Witkowski, who had graduated and obtained his habilitation from that school. He later moved to Cracow where he took over Wroblewski's post. Witkowski was succeeded in Lvov in 1889 by Kazimierz Olearski, graduate of and lecturer at the Jagiellonian University, author of eight scientific works on diverse subjects.

Both these Lvov institutions began to carry out serious scientific research only in the beginning of the 20th century.

In Warsaw[11] the fate of physics has been closely linked with the University founded here in 1816, whose involved history did not allow for rapid advancement. In 1819, within the then recently opened Philosophical Faculty, a Chair of Experimental and Applied Physics was established, headed by Karol Skrodzki[12], graduate of Vilnius University. He soon showed himself to be an outstanding teacher, dedicating special attention to modern teaching methods he came to know in the course of his previous scientific travels abroad. He also set to work vigorously on equipping a physics laboratory, where he carried out research, mainly on electricity and magnetism. Still, little original research which could be meaningful within the context of world science was carried out during that period. For this reason the work of scientists was sharply criticized by young intellectuals, in particular by Maurycy Mochnacki[13]. There was, however, no time for this criticism to stimulate the University's staff, as following the fall of the November Uprising, on November 19, 1831, Warsaw University was closed. It was re-established thirty years later under the name of "Warsaw Main School"[14] in 1862, shortly before the outbreak of the January (1863) Uprising, the fall of which weighed heavily on the school's history. Throughout its entire existence (seven years) it was constantly in danger of being dissolved, which finally happened in 1869. This brief period did not allow for the development of a climate favorable to research, and in addition the School was constantly short of means and qualified staff. Although its Chairs were headed by young men without the necessary experience, teaching at the School soon achieved a high level. The functioning of the Chair of Physics, which was part of the Faculty of Mathematics and Natural Science, was plagued by constant changes in staff. The first Head of the Chair was Adam Prazmowski, forced to emigrate in 1863 for his part in the uprising. For three years he remained unreplaced due to a lack of suitable candidates for the post. In 1866 Prazmowski was succeeded by Stanislaw Przystanski, excellent teacher and organizer. Besides him, physics was also taught by Tytus Babczynski, Nikodem Peczarski and Wladyslaw Zajaczkowski, who were rather mathematically inclined, and by Wladyslaw Kwietniewski.

Although no active physics research was conducted at the Main School, the school contributed to the advancement of science through its graduates. Several among them later became well known as physicists, for instance Edward Skiba, who became professor of theoretical physics at the Jagiellonian University; Oskar Fabian, professor at Lvov University; and the mathematician, professor Wladyslaw Gosiewski, author of several dozen papers in mathematical physics.

After the Main School was closed, it was replaced by the Imperial University of Warsaw, staffed mostly by Russians. This period of the university's history (1869-1915), when it was considered by Poles a foreign school, has not been closely studied and little is known about the Chair of Physics which then existed within a Faculty of Physics and Mathematics. It was headed by the Russian Pyotr Zilov. We know little of his research, and no outstanding Polish physicist of later times, indeed, none we know of, was graduate of this faculty. The university was boycotted during this period by the Polish public on political grounds.

In 1875 private donations made possible the founding in Warsaw of a Museum of Industry and Agriculture[15], where in 1887 a Physics Workshop was established, headed by Jozef Boguski. A large group of graduates of the Warsaw Main School carried out research there. This Workshop was where Maria Sklodowska (later Curie)

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[11] *Dzieje Uniwersytetu Warszawskiego*, ed. by S. Kieniewicz, PWN, Warsaw 1981.

[12] Rector of Warsaw University in 1831.

[13] "In the homeland of Copernicus and Vitelion you view what surrounds you through foreign reason. Foreign experiments are repeated in our laboratories. A mechanism has dominated the minds...Polish science is in a routine... But they say that scientists who don't use their own heads will take no place in it..." (M. Mochnacki, *O literaturze polskiej XIX wieku*, Warsaw 1911. p.77-79).

[14] S. Dobrzycki, *Wydzial Matematyczno-Flzyczny Szkoly Glownej Warszawskiej*, Wroclaw 1971; Z. Mizgier, *Fizyka w Szkole Glownej Warszawskiej (1862-1869)*, Postepy Fizyki 17(1966)657.

[15] B. Sredniawa, *Szkic historii fizyki polskiej w okresie miedzywojennym (1918-39)*, ln: *Studia poswiecone Marii Sklodowskiej-Curie i Marianowl Smoluchowskiemu*, Monografie z dziejow nauki i techniki, Wydawnictwo PAN, 1968.

learned laboratory techniques. In 1895 the Workshop was however closed for lack of funding, and a large group of Warsaw youths left abroad to study, not finding educational opportunities at home.

Establishment of Chairs of Theoretical Physics

As a result of the rapid growth of physics during the 19th century there appeared, in its second half, a clear distinction between experimental and theoretical physicists, separate chairs of theoretical physics were established at many universities, and the field itself was introduced as a separate subject into the curriculum of study. Following this general tendency, in the 1870's the first chairs of theoretical physics were established also at the Jagiellonian and Lvov universities.

To make further reading easier we present here the following table:

	Year founded	Year a Chair of Physics was founded	Year a Chair of Theoretical Physics was founded	Heads of Theoretical Physics Chair before 1939
Jagiellonian University	1364	1778	1872	1872-1879: Edward Skiba 1879-1899: Chair inexistent 1899-1935: Wladyslaw Natanson after 1935: Jan Weyssenhoff
Vilnius University	1578	1775	1922	1922-1935: Jan Weyssenhoff 1935-1939: Szczepan Szczeniowski
Lvov University	1661	1783	1873	1873-1899: Oskar Fabian 1899-1913: Marian Smoluchowski 1913-1917: Konstanty Zaklrzewski 1917-1926: Stanislaw Loria 1926-1930: vacant 1930-1937: Szczepan Szczeniowski after 1937: Wojciech Rubinowicz
Lvov Polytechnical School	1877	1877	1921	1921-1937: Wojciech Rubinowicz 1937: Chair abolished
Warsaw University	1816	1818	1921	after 1921: Czeslaw Bialobrzeski

In Cracow the first Head of this Chair was Edward Skiba (1843-1911), graduate of the Warsaw Main School, who after a stay in Heidelberg became at first assistant at Kuczynski's chair, and later, professor of theoretical physics, on which he lectured from 1870. His research concerned the theory of elasticity, optics, and electricity. When in 1879 Edward Skiba was forced to cease working by illness, the Chair was abolished and lectures in theory started to be given by professors of experimental physics. Only in 1891 were they again taken over by a theorist, Wladyslaw Natanson, who in 1899 became Head of the re-established Chair of Theoretical Physics. At that moment he was already the author of original papers on the thermodynamics of irreversible processes, which in time gained him recognition as a forerunner of this field of physics as it underwent a rapid growth.

At Lvov University the newly established Chair was headed by Oskar Fabian (1846-1913), graduate of Warsaw and Vienna universities, author of a treatise on analytical mechanics and of several scientific papers. No serious research was undertaken at this Chair until 1899, when Oskar Fabian was succeeded by Marian Smoluchowski.

4. THIRD PERIOD: UNTIL WORLD WAR II

Lvov

Marian Smoluchowski (1872-1917)[16] headed the Chair of Theoretical Physics until 1913. Those were the years of his greatest scientific achievements. He came to Lvov from the University of Vienna, from which he had graduated and where he had worked for a time. He had also studied at the Sorbonne in Paris (with Lippmann), in Glasgow (with Kelvin) and in Berlin (with Warburg). It was in Berlin where he developed a taste for theoretical physics. In Lvov he continued research he had initiated in Berlin, on the kinetic theory of

[16] J. Szpecht, *Wsrod fizykow polskich*, Lvov 1939; *Wklad Polakow do nauki - nauki scisle* (a collection of articles), Biblioteka Problemow, PWN, Warsaw 1967.

matter. The results he obtained soon placed him among the world's best known physicists. Already in 1900 Smoluchowski was named associate professor (at the age of 28), and in 1903 - full professor of theoretical physics. He gained international fame with his work on the theory of fluctuations, the theory of Brownian motion, and the statistical interpretation of the Second Principle of Thermodynamics. His best known work is on the theory of Brownian motion, which he formulated simultaneously with Einstein (and independently). The effect itself had been discovered by the Scottish botanist Robert Brown and described in three papers in 1828-29. Smoluchowski and Einstein explained it in 1904-1906 on the basis of the Maxwell-Boltzmann kinetic theory of gases. In 1904 at a conference in tribute to Boltzmann which took place in Leipzig, Smoluchowski spoke on certain ideas concerning Brownian motion[17]. There he probably heard of Einstein's parallel research and came to fully understand the significance of the problem. On his return to Poland he published in Polish one paper and another paper in German[18].

Another part of Smoluchowski's considerable scientific production are his papers on hydro- and aerodynamics, electro-osmosis and the physics of colloids. In recognition of his achievements he was named Member of the Polish Academy of Knowledge (in 1913) and granted the Haitinger Award by the Vienna Academy of Science. Smoluchowski was also invited to lecture in Münster and Göttingen, alongside Lorentz, Sommerfeld and Debye.

In 1913, after the death of August Witkowski, Smoluchowski was offered the Chair of Experimental Physics at the Jagiellonian University. He held it for four years, dedicating himself chiefly to experimental work. He died in 1917 of dysentery, while he was Rector of the Jagiellonian University. He left over 90 scientific papers later published by the Polish Academy of Knowledge in a three-volume collection. He was also author of the second volume of a *Manual for Autodidacts*, where in a chapter on physics he treated diverse problems encountered by students of physics on all levels of learning. This manual also contains the first study on the history of physics in Poland.

Soon after his death several articles dedicated to his memory were published, by, among others, Einstein and Sommerfeld[19]. In 1943 one of today's greatest astrophysicists, the Indian S. Chandrasekhar, wrote the following on the significance of Smoluchowski's research[20]: "It is somewhat disappointing that the more recent discussions of the laws of thermodynamics contain no relevant references to the investigations of Boltzmann and Smoluchowski. The absence of references, particularly to Smoluchowski, is to be deplored since no one has contributed so much as Smoluchowski to a real clarification of the fundamental issues involved (…) The theory of density fluctuations as developed by Smoluchowski represents one of the most outstanding achievements in molecular physics."

After Smoluchowski's departure to Cracow his post in Lvov was taken over by Konstanty Zakrzewski (1876-1948), previously at the Jagiellonian University, an experimental physicist. In Cracow he had worked on the verification of Lorentz's theory of electrons. He happened to head the Chair of Theoretical Physics at Lvov in a rather unfortunate period: the four years of World War One. For this reason he did not manage to carry out any serious research while there. After Smoluchowski's death in 1917 Zakrzewski returned to Cracow and was succeded in Lvov by Stanislaw Loria (1883-1956), also graduate of the Jagiellonian University, who had also studied at several foreign institutions (Göttingen, Berlin and Manchester among others). Although Loria was named professor of theoretical physics, he was more attracted by experimental work. After a long stay (l923-l926) at the California Institute of Technology in Pasadena, USA, he took over the Chair of Experimental Physics. The Chair of Theoretical Physics at Lvov University remained vacant until 1930.

Commissioned lectures on theoretical physics were given from 1929 by Leopold Infeld, graduate of Jagiellonian University, Wladyslaw Natanson's student. For several years after receiving his doctor's degree he taught at a small-town secondary school, devoting himself on his own to research on topical problems in

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[17] *Űber Unregelmässigkeiten der Verteilung von Gasmolekulen und deren Einfluss auf Entropie und Zustandsgleichung* in “Boltzmann-Festschrift", Leipzig (1904).

[18] *Zarys kinetycznej teorii ruchow Browna* (*Sketch of the Kinetic Theory of Brown's Movement*), Bulletin Intern. de 1'Academie des Sciences et des Lettres de Cracovie, 1906; *Zur Kinetischen Theorie der Brown'schen Molekularbewegung und der Suspensionen* (Annalen der Physik 21(1906)756. The papers of Einstein on this problem were: *Űber die von der molekularkinetischen Theories der Wärme geforderte Bewegung von in ruhenden Flussigkeiten suspendierten Teilchen,* Annalen der Physik 17(1905)549 and *Zur Theorie der Brownschen Bewegung,* Annalen der Physik 19(1906)371.

[19] A. Sommerfeld wrote (Phys. Zeitschr. 15(1917)533): "Those who followed his brilliant achievements saw him as the logical heir to Boltzmann's view on describing nature. His name will forever remain linked with the first blooming of atomic theory".

[20] *Stochastic Problems in Physics and Astronomy*, Reviews of Modern Physics 15(1943), pp. 1-89.

theoretical physics. He was particularly interested in the theory of gravity and he continued this research later at Lvov, where he received his habilitation in 1923. A year later he left for Cambridge (England) with a grant from the Rockefeller Foundation, returning to Lvov after a year and a half. In 1936 he left for the USA, where he received a grant at the Princeton Institute for Advanced Study. He soon became there one of Einstein's closest collaborators[21].

From 1930 the Chair of Theoretical Physics at Lvov University was headed by Szczepan Szczeniowski (1898-1979), graduate of Warsaw University and Stefan Pienkowski's former student. In Warsaw he had worked on the subject of fluorescence. He was also author of one of the first experimental papers on the diffraction of electrons. He had also worked in Chicago with Compton, where he came to know Heisenberg and developed an interest in theoretical physics. In his Lvov period he worked on the applications of quantum mechanics to solid state physics. In 1937 he moved to Vilnius, and the Lvov Chair of Theoretical Physics was taken over by Wojciech Rubinowicz (1889-1974)[22].

Wojciech Rubinowicz, one of Poland's greatest physicists, graduated from the German university of Czerniowce[23], where he also received his doctor's degree. After this he went to Munich, where he became assistant to Sommerfeld. In this period he published two papers which already secured him a place in the history of physics[24]. The second paper contains the famous selection and polarization rules for atomic dipole electric radiation. Rubinowicz discovered them on the basis of Bohr's conditions, further developed by Sommerfeld.

After his stay in Munich, Rubinowicz first worked as docent at the University of Czerniowce, and later as full professor at the University of Ljubljana. In that period he twice visited Niels Bohr in Copenhagen. In 1922 Rubinowicz was named full professor of the Lvov Polytechnical School, where three laboratories of experimental physics had been created after World War I. In 1921 a Special Chair of General Mechanics and one of Theoretical Physics, this latter headed by Rubinowicz, were also established at the School. In his research Rubinowicz developed the ideas of his two previous great papers and expanded them into two comprehensive theories: the theory of multipole radiation and of wave diffraction. Ten years after his basic paper on electric dipole radiation Rubinowicz published a work in which he stated, now on the grounds of quantum mechanics, the corresponding selection rules for electric quadrupole radiation, explaining, among other features, the appearance of a green line in the spectrum of polar aurora[25].

Wojciech Rubinowicz was one of the outstanding physicists who created the quantum theory. He strongly influenced its development, particularly in the period between the discovery of Bohr's quantization rules in 1913 and the final formulation of quantum mechanics given in the years 1925-1926 by Heisenberg, Schrödinger, Dirac and Born.

As opposed to Smoluchowski and Natanson, Rubinowicz had many students and was teacher to several generations of Polish physicists. Among his most outstanding students in Lvov were J. Blaton and W. Milianczuk, who closely collaborated with him and contributed much to his research. Especially J. Blaton (1907-1948), author of several excellent papers on quadrupole radiation, who later became famous through his discovery (together with the experimentalist H. Niewodniczanski) of magnetic dipole spectral lines, while he was working at Vilnius University.

After the General Faculty of the Lvov Polytechnlcal School was abolished, Rubinowicz moved to the University where he took over the Chair of Theoretical Physics.

Lvov, which was an important center of theoretical physics in Poland between the world wars, became however famous chiefly owing to the "Lvov School of Mathematics"[26], which focused on functional analysis. Its magnificent growth was mainly due to Stefan Banach, and in part also to Hugo Steinhaus. Thanks to them and

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[21] In 1950 Leopold Infeld returned to Poland and created Warsaw school of theoretical physics and the Institute of Theoretical Physics at Warsaw University.

[22] W. Krolikowski, *Wojciech Rubinowicz - wielki fizyk okresu przelomu*, Postepy Fizyki 36(1985) 259.

[23] The University of Czerniowce (presently Ukrainian SSR, then within the limits of the Austro-Hungarian Empire, called Czernowitz in German) was founded in 1675.

[24] *Die Beugungswelle in der Kirchhoffschen Theorie der Beugungserscheinungen* (Annalen der Physik 53(1917)357) and *Bohrsche Frequenzbedingung und Erhaltung des Impulsmomentes* (Z. Phys. 19(1918)441,465).

[25] A. Rubinowicz, in: Sommerfeld-Festschrift, p.123 [Leipzig 1928]; Phys. Z. 29(1928)817; Naturwissenschaften 18(1930)227.

[26] K. Kuratowski, *Pol wieku matematyki polskiej 1920-1970, wspomnienia i refleksje*, Wiedza Powszechna, Warszawa 1973; R. S. Ingarden, *Wojciech Rubinowicz. Szkic biograficzny*, part 4 (unpublished).

their students (S. Mazur, W. Orlicz, J. Schauder, S. Kaczmarz, M. Kac[27], H. Auerbach) the Lvov center of mathematics became the most important center of functional analysis in the world. A special position in this group was held by Stanislaw Ulam, an all-round outstanding mathematician, who kept constantly in touch with physics, which was rather rare among the mathematicians of those times. He collaborated with Banach, Steinhaus and Rubinowicz, and after emigrating to the US, with Fermi and von Neumann[28]. A precious relic of the Lvov School of Mathematics is the famous *Scottish Book*, which survived the catastrophy of the war and was donated to the Stefan Banach Center of Mathematics in Warsaw on the day of its foundation (January 13, 1972). This book was used by Lvov mathematicians and their foreign guests, who often worked at a table in the "Scottish Cafe", to write down problems which emerged from hours of discussions (some of them still remain unsolved).

Vilnius

Vilnius University, which had been shut down in 1832, was later re-established in 1919, and in 1922 a Chair of Theoretical Physics was created there, headed by Jan Weyssenhoff (1889-1967), previously of Cracow. He had graduated from Jagiellonian University and afterwards worked under the guidance of Witkowski. Later he stayed at Zurich, received his habilitation after returning to Poland in 1919, and was named professor of theoretical physics at Vilnius, remaining Head of the Chair until 1935. At the time he worked on the theory of relativity. From 1933 to 1935 a former student of Rubinowicz, Jan Blaton, also worked at Vilnius. After returning from a yearlong stay in Munich (where he worked with Sommerfeld) Blaton became assistant at the Chair of Theoretical Physics. It was there that he attained his greatest achievement, the discovery of dipole magnetic radiation. J. Blaton obtained habilitation in 1934, but his radically leftist political views impeded his further academic career. In 1936 he became Director of the State Meteorological Institute in Warsaw, post that he held until 1939. Being technically a docent at Warsaw University, he lectured in Vilnius. His courses on quantum mechanics given there were among the first of their kind anywhere[29].

In 1935 Jan Weyssenhoff took over the Chair of Theoretical Physics in Cracow, being succeeded in Vilnius by Szczepan Szczeniowski, previously at Lvov, who remained Head of the Chair until 1939, carrying out research on cosmic rays.

Cracow

Starting from 1899, the Chair of Theoretical Physics at Cracow's Jagiellonian University was headed for 35 years by Wladyslaw Natanson (1864-1937)[30]. He had studied at the universities of Petersburg, Cambridge (with Kelvin), Dorpat and Graz. He began research in 1860. Natanson arrived in Cracow soon after Wroblewski's tragic death, there he obtained habilitation and was named professor. He initially worked on the kinetic theory of gases and thermodynamics. This research resulted in a series of papers published in 1896 and 1897 in which he generalized Hamilton's variational principle to irreversible processes. One of the chapters of Duhem's classic *Traite d'Energetique* is based on his ideas. In the later period Natanson became interested in the theory of electrons and in the optical properties of matter, obtaining a series of valuable results. His most important paper of that period, *On the elliptical polarization of light in an absorbent medium and the twisting of the polarization plane*, published in 1909 in "Journal de Physique", gives a rule concerning the polarization of light known today as "Natanson's rule".

In 1911 Natanson's interest turned to quantum theory[31]. In that year he published the article *On the Statistical Theory of Radiation* (in English - BIAC(A)134-148(l911), and in German - Phys. Zeits. 12, 259-266(1911)) in which he took into account - being the first to do so – the indistinguishability of photons in the analysis of their

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[27] Mark Kac, later world-famous professor of American universities.

[28] S. Ulam, together with E. Fermi, made important contributions to the theory of solitons, and together with J. von Neumann and M. Metropolis he invented the random sampling method, often used today, for which he coined the name "Monte Carlo Method". He is also known for his participation in nuclear research carried out at Los Alamos Scientific Laboratory, where he worked as mathematician, collaborating with Fermi and von Neumann.

[29] In 1944 Jan Blaton took part in organizing the Maria Sklodowska-Curie University in Lublin. He at first headed that university's Chair of General Physics, and from 1945, the Chair of Theoretical Physics. In 1946 he was named professor of theoretical mechanics at Jagiellonian University. He died in an accident in the Tatra Mountains in 1948. He received (post-mortally) a State Award, as the first Polish physicist. Among those who were his students are Professors J. Rzewuski and J. Prentki.

[30] J. Weyssenhoff, *S. p. Wladyslaw Natanson*, Acta Physica Folonica 6(1937)295.

[31] B. Sredniawa, *History of Theoretical Physics at Jagiellonian University in Cracow in XIXth Century and in the First Half of XXth Century*, in: Zeszyty naukowe Uniwersytetu Jagiellonskiego - Prace fizyczne 24(1985).

energy distribution[32], However, these papers, as they were not written sufficiently clearly, were not duly appreciated by physicists of that time[33]. Natanson later continued research on these subjects, and in 1912 he published (in Polish) the monograph *Principles of the Theory of Radiation* (Prace Mat.-Fiz., Warszawa 1912, p. 88). In 1929 Natanson started working on the foundations of geometrical optics. His ample scientific legacy consists of over a hundred papers concerning diverse areas of theoretical physics. Those papers, published in a number of Polish and foreign journals, were well-known, appreciated and often quoted (e.g. Bruhat, in his monograph *Traite de la Polarimetrie*, quotes Natanson's works repeatedly, with special attention to his "rule"). Natanson was the first representative of Polish theoretical physics abroad (later joined in this by Smoluchowski). Along with research, he also devoted himself enthusiastically to teaching. He was an excellent lecturer and author of a number of well-written textbooks, including a *Introduction to Theoretical Physics* (1890) and *The Science of Physics* (1924-1929), this latter co-authored by K. Zakrzewski. He did not however create a school of his own, and he tutored only one graduate – Leopold Infeld. He took an active part in organizing the science community in Poland, and in 1920 he became the first president of the Polish Physical Society. Natanson retired in 1935 and was succeeded by Jan Weyssenhoff, professor of Vilnius University, who took over the post following a several weeks' stay at the Princeton Institute for Advanced Study. In Cracow Weyssenhoff continued research he had initiated previously, on the theory of relativity. He invited the collaboration of two Warsaw physicists, (docent) Myron Matthison and (assistant) Antoni Raabe. Jan Weyssenhoff also dedicated considerable effort to teaching and organizing. He was author, among others, of the textbook *Principles of Electromagnetism and Classical Optics* and initiator of the first nationwide conversatory of theoretical physics[34], which took place in 1939, right before the outbreak of World War II.

Poznan

In 1923 a Section of Theoretical Physics was established at the recently founded University of Poznan, headed by Tadeusz Peczalski (1891-1946). It did not however play an important role in the development of Polish theoretical physics in the period discussed here.

Warsaw

Warsaw University was reopened, as a Polish institution, on November 15, 1915[35]. Until that moment Warsaw had only the Physics Workshop at the Museum of Industry and Agriculture (reopened in 1902), and the Society for Scientific Courses, founded in 1905, which consisted of four departments, among them one of natural science. Neither of these institutions could however fulfill the role of a university. A detailed plan of re-establishing a university, prepared by the Society for Scientific Courses, was put in action following the outbreak of World War I, when the complex political situation in Europe made it possible.

Initially the University consisted of only three departments, among them one of mathematics and natural science. In 1916 in the course of a re-organization it was joined with the Department of Philosophy (in 1927 this was again split, into a Department of Humanities and one of Mathematics and Natural Science).

In 1916 a Section of Experimental Physics was created within the Department of Philosophy. The Section was initially headed by Jozef Wierusz-Kowalski, educated at German universities, professor of the University of Freiburg (Switzerland). He however resigned in 1919 to devote himself to work in the Foreign Service and was succeeded by Stefan Pienkowski, arrived from the University of Liege, of which he was graduate and where he had previously worked[36]. To him the Section of Experimental Physics owes its rapid growth. The new Head first of all took care of having the Section's building at 69 Hoza St. finished (it had been built in 1914 but remained unfinished for seven years). The Section of Experimental Physics moved into its new building on January 9, 1921.

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[32] The quantum statistics of integer-spin indistinguishable particles was discovered 13 years later by Bose and developed by Einstein, and is known today as Bose-Einstein statistics.

[33] The historian Armin Hermann (*The Genesis of Quantum Theory*, Cambridge, Mass. 1971, p. 141) expressed the opinion that Natanson was, along with Planck, Einstein and Ehrenfest, one of the first physicists, who formulated the principles of quantum statistics, and that his contribution has not yet been properly valued by historians of science. See also: B. Sredniawa, *History of Theoretical Physics at Jagiellonian University in Cracow in XIXth Century and in the First Half of XXth Century*, PWN, Warsaw/Cracow 1985.

[34] After World War II and Leopold Infeld's arrival in Warsaw, these conversatories were transformed into summer conferences of theoretical physics (called "Infeldiads"), and later into summer schools of theoretical physics organized by Cracow physics institutions.

[35] T, Manteuffel, *Uniwersytet Warszawski w latach 1915/16-1934/35 - Kronika*, Warsaw 1936.

[36] Rector of Warsaw University in the years l925/26, 1933/34, 1934/35 and 1935/36.

On October 1 of the same year a Section of Theoretical Physics was created within the Department of Philosophy, but for lack of space it remained a one-person Chair until 1929/30. From its creation the Section was headed by professor Czeslaw Bialobrzeski (1878-1953)[37].

Czeslaw Bialobrzeski graduated from the University of Kiev in 1901 and for the following ten years dedicated himself to experimental work. In 1907 he received what was then called "veniam legendi" as a private-decent at the University of Kiev. He spent the years 1908-1910 in Paris, studying in Langevin's laboratory at the College de France, where he carried out experimental research on the ionization of liquid and solid dielectrics. This work formed the basis of a thesis upon presentation of which he obtained (in 1913) the title of "magister". and was offered the Chair of Physics and Geophysics at Kiev University. After almost ten years of experimental work Bialobrzeski switched to theory. His most important paper, concerning stellar radiation, was published in May 1913. In that paper, titled *Sur 1'equilibre thermodynamique d'une sphere gaseuse libre* (*On the Thermodynarnical Equilibrium of a Free Gaseous Sphere*), Bialobrzeski took into account, being the first to do so, the influence of radiation pressure in the theory of stellar structure. The article, was published in French in the Bulletin of the Cracow Academy of Knowledge (Bull. Intern. Acad. Sc. Cracovie, A264(l9l3)), in a rather small number of copies. Although in Poland it was received with interest by scientists of the stature of Wladyslaw Natanson and Marian Smoluchowski, it did not attract attention abroad. The same results were obtained independently and by different means three years later by the famous English astronomer and astrophysicist A. S. Eddington, After receiving a reprint of Bialobrzeski's paper Eddington acknowledged his priority ("I congratulate you on having been apparently the first to point out the large share of radiation pressure in the internal equilibrium of a star") but in his later papers he did not give reference to Bialobrzeski's work. Eddington's prestige within the science community caused these results to be attributed exclusively to him, and Bialobrzeski's work fell into almost total oblivion. Few specialists stressed the Polish physicist's priority. Two of those who did were M. Minnaert, docent of astronomy at Utrecht, in his 1926 lectures, and the Swiss astrophysicist G. Tiercy, who in his work *On Radiative Equilibrium in Stars*, published in 1935 in Paris, dedicated the entire fifth chapter to a discussion of Bialobrzeski's 1913 paper, calling it "a fact of very first importance" ("de toute premiere importance").

In 1914 Bialobrzeski was offered the Chair of Experimental Physics at the Jagiellonian University, but the outbreak of World War I prevented him from taking over that post. In 1919 Bialobrzeski returned to Poland and, following a year spent in Cracow, took over the Chair of Theoretical Physics in Warsaw. Here he became the leader of a small group of persons interested in theory.

The most outstanding among them was Myron Mathisson (1897-1940)[38], who's doctor's thesis was tutored by Bialobrzeski. His name is connected with, among others, the appearance of a new subfield of general relativity: the relativistic theory of the motion of particles with structure. Myron Mathisson graduated from the Department of Philosophy in 1924. He obtained his doctor's degree in 1930, his habilitation in 1932, and beginning from the academic year 1932/33 gave commissioned lectures at Warsaw University as a docent, on mathematical physics.

His research on the relationship between the equations of motion for particles and the gravitational field equations forms a lasting contribution to the general theory of relativity. Already with his first three papers[39] he initiated research on this problem which is still under way[40].

In 1936 Mathisson went for a yearlong stay to Kazan (USSR) where he gave a series of lectures as head of the section of theoretical physics. He was also named full member of the Institute of Mathematics and Mechanics at Kazan University. He returned to Warsaw in 1937 but remained here only for a few months. In the same year the most important of Mathisson's papers appeared[41], it was the high point of his studies on the motion of particles of matter. This paper attracted great interest and resulted in Mathisson being invited by Bohr to

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[37] W. Scislowski, *Czeslaw Bialobrzeski*, Postepy Fizyki 5(1954) 413.

[38] B. Sredniawa, *Myron Mathisson* (1879-1940), Postepy Fizyki 33(1982) 373.

[39] *Die Beharrungsgesetze in der allgemeinen Relativitätstheorie* (*Conservation Laws in General Relativity Theory*), Z. Phys. 67(1931) 270-277; *Die Mechanik des Materieteilchens in der allgemeinen Relativitätstheorie* (*The Mechanics of a Material Particle in General Relativity Theory*), Z. Phys. 67(1931) 826-644; *Bewegungsproblem in der Physik und Elektronenkonstanten* (*The Problem of Motion in Physics and the Electron Constants*), Z. Phys. 69(1931) 389-408.

[40] Mathisson's papers were quoted e.g. in several of the lectures given at the May 1979 Erice summer school, dedicated to spin, torsion and supergravity.

[41] *Neue Mechanik materieller Systeme*" (A *New Mechanics of Material Systems*, Acta Phys. Polonica 6(1937) 163-209)

lecture in Copenhagen. It is one of the few often-quoted Polish publications in the area of theoretical physics of the period between the world wars and has found numerous continuators.

The results of Mathisson's research attracted the interest of Jan Weyssenhoff and in 1937, thanks to his support, Mathisson received a private grant in Cracow. He collaborated with Cracow physicists for two years. In 1939, desiring closer contact with foreign scientists, Mathisson traveled first to Paris and later to Cambridge (England), where he died of tuberculosis in 1940. He left in total ten original published papers in which he always appeared as of Warsaw University, although he was never its employee (he made a living by commissioned lectures and calculations for engineering firms). Mathisson's name was well known to the international community of theoretical physicists. His last paper (Proc. Cambr. Philosoph. Soc. 38(194Z) 40-60), published after his death, was prepared for publication by P. A. M. Dirac, who was also author of a brief in memoriam (Nature 146(1940) 613).

Another member of the small group of Warsaw theorists was Stanislaw Mrozowski (presently professor emeritus of the University of Buffalo, USA), graduate of the Warsaw University Department of Philosophy, taught and tutored by Stefan Pienkowski, docent at the Experimental Physics Section of Warsaw University, He later moved to the Theoretical Physics Section, where he became assistant. His experimental and theoretical research, initiated in the beginning of the 1930's, concerned atomic spectra, a subject which he remained faithful to up to the outbreak of World War II. While working on this subject Mrozowski visited Niels Bohr in Copenhagen three times. Starting 1933 he gave commissioned lectures in theoretical physics at Warsaw University.

Let us now return to the history of the Theoretical Physics Section itself. As has been mentioned above, lack of space did not allow the Section to grow, and this did not change when it received in 1927/28 three rooms at 69 Hoza St. (Head's office, lecture room for 20 persons and a working room). Czeslaw Bialobrzeski remained the sole employee of the Section. In the first years of his stay in Warsaw he kept working on the subjects he had initiated research on while in Kiev, in the years 1923-26 he published several papers on the internal structure and radiation of stars. An abridged version of these papers was presented by Bialobrzeski in his book *La Thermodynamique des Etoiles* (*The Thermodynamics of Stars*), published 1931 in Paris.

According to personnel lists and faculty reports kept at the Warsaw University Archives[42], the Theoretical Physics Section was augmented in the academic year 1989/30 by the addition of an assistant, Wlodzimlerz Scislowski (1902-1982) (later professor at the Warsaw Technical University), and remained composed of these two persons until 1937/36, when Scislowski was replaced by Wladyslaw Opechowski (presently renowned expert in the theory of magnetism, professor emeritus at the University of British Columbia, Vancouver, Canada). In the academic year 1938/39 an assistant professor was also hired, doctor Stanislaw Mrozowski.

The accommodation situation changed radically in January 1932. The Section then moved to the newly built Pharmacy Department building at 3 Oczki St., where it obtained space for several working rooms on the third floor. At 69 Hoza St. two rooms remained for the Section's use: the Head's office and a lecture hall (presently they house offices of the Administrative Manager and Finance Section of the Physics Department).

The fact that the Section had now premises of its own enabled Bialobrzeski to carry out plans related to his continuing interest in experimental physics. For this purpose he set up in his Section and under his charge a Physics Laboratory, which however was not a part of Warsaw University, and its workers (five or six) were employed by the Ministry of Religious Denominations and Public Enlightenment. They worked chiefly in experimental physics and for several years were totally exempt from teaching duties. Over the seven years of the Laboratory's existence experimental research there focused mainly on optics, solid state and cosmic ray physics. The two first were fields Bialobrzeski had worked in the beginning of his scientific career. Theorists also took part in this research. Wlodzimierz Scislowski studied the conductivity of liquid and solid dielectrics, while Stanislaw Mrozowski (who had previously worked at the Section of Experimental Physics) and Czeslaw Bialobrzeski studied the spectrum of mercury. In the years 1935-36 Bialobrzeski also started working on cosmic ray physics (a special pavilion was built for this purpose in the yard of the building at 3 Oczki St.). He published three papers on this subject, two of them co-authored by his graduate student and long-time worker at the Physics Laboratory, Ignacy Adamczewski (presently professor emeritus of Gdansk University).

Although Czeslaw Bialobrzeski's person formed a link between the section of Theoretical Physics and its autonomous Physics Laboratory, it would be a mistake to assume that in those years theorists worked chiefly on

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42 *List of members of Warsaw University and lists of lectures for the years 1922/23-1938/39*, Warsaw University Archives; *Faculty reports from the years 1934/35-1937/38*, Warsaw University Archives.

experimental physics. Such a statement is refuted by their publications in theoretical physics[43] and by the list of subjects of seminars and monographic lectures which may be found in surviving faculty reports of those times. Quite the contrary, this small group of theorists had made significant achievements. The subjects of theoretical research were quite diverse and included astrophysics, the theory of relativity and the theory of atomic spectra. In the years 1921-1939 over 50 original research papers in theoretical physics were published by the members of the Warsaw group. Looking into Czeslaw Bialobrzeski's list of publications we may notice that starting 1931, as quantum mechanics was developed, his interest focused on the problem of the physical interpretation of this theory's basic concepts.

In 1935 Bialobrzeski was named member of the Commission for International Intellectual Cooperation affiliated with the League of Nations. His frequent travels for the Commission's meetings made it much easier for him to keep in touch with eminent foreign scientists.

In 1935 in Geneva, during a meeting of the Commission for International Intellectual Cooperation, Bialobrzeski came out with the initiative of holding an international scientific conference in Warsaw. The first conference of theoretical physics in Poland took place in May 1938, and was organized by the Institute for International Intellectual Cooperation in Paris and the Polish Commission for Intellectual Cooperation, The subjects for the conference were proposed by Czeslaw Bialobrzeski; it was devoted to fundamental theoretical problems of quantum mechanics and quantum field theory. About thirty eminent foreign theorists took part, among them Bohr, Darwin, Eddington, Langevin, von Neumann, Brillouin. Fowler, Gamow, Klein and Wigner. Czeslaw Bialobrzeski also chaired the conference. The proceedings were published under the title *New Theories in Physics*, in English and French, in 1939 in Paris.

We will conclude with some information on lectures and seminars held at the Section in the discussed period, which is an interesting complement to the picture of the activities of the Warsaw group of theorists.

The general structure of these activities was as follows:

1. a general course of theoretical physics (4 hours weekly)
2. a course of special lectures (1 or 2 hours weekly)
3. a seminar for students (2 hours weekly)
4. a conversatory (2 hours weekly)
5. commissioned lectures
6. practice classes.

The subject matter of lectures and seminars varied year by year. For instance, **in the academic year 1934/35**:

- the general course of theoretical physics highlighted the quantum theory of radiation and quantum statistics;

- 26 seminars for fourth-year physics students were held, devoted to the application of group theory in quantum mechanics;

- conversatories were dedicated to problems in the theory of metals and semiconductors. Current research by the participants was also presented;

- commissioned lectures: M. Mathisson on quantum scattering and on the quantum theory of molecular binding; and S. Mrozowski on the theory of atomic spectra.

In the academic year 1935/36:

- the general course of theoretical physics focused on electricity and magnetism. and on radiation and relativity theory;

- the special lectures were devoted to the quantum theory of metals;

- 25 seminar sessions for fourth-year physics students were held, dedicated to Dirac's theory of the electron;

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[43] *Prace uniwersyteckiego osrodka fizyki opublikowane w 50-leclu 1921-1970*, Wydawnictwa Uniwersytetu Warszawskiego, Warsaw 1971.

- the conversatories were devoted to problems in cosmic ray physics and solid state theory. Also presented were results of current research by the participants;

- commissioned lectures: M, Mathisson on the theory of relativity and on cosmology, plus a commissioned seminar on relativity; S. Mrozowski on the theory of light scattering; O. Nikodym[44] on the theory of the Dirac equation.

The structure of lectures and seminars was similar through the entire period of the 1920's and 1930's, until the outbreak of World War II. The extremely up to date selection of subject matter for the lectures and seminars merits attention.

CONCLUSIONS

Based on the information given here we see that the history of theoretical physics proper in Poland began in the last decade of the 19th century, and that already in the first fifty years of its growth Polish theoretical physics could boast results and names which form an indelible part of the history of science. Research centers appeared in Lvov, Cracow, Warsaw and Vilnius, which, though not strong in number of scientists, made a lasting contribution to the general development of theoretical physics. Marian Smoluchowski, Wojciech Rubinowicz, Myron Mathisson, Wladyslaw Natanson, Czeslaw Bialobrzeski and Jan Blaton in Poland, as well as graduates of Polish universities working abroad, like Leopold Infeld and Stanislaw Ulam, gave Polish theoretical physics an impressive stature, considering the difficult conditions in which it was born. Theoretical physics in present-day Poland owes very much to these men.

Zofia Ziółkowska (1986)
[English translation by *R. Budzyński*]

[44] Docent of mathematics at Warsaw University, he gave commissioned lectures from 1933.