

On the Roots of the Institute of Geophysics, Polish Academy of Sciences

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Abstract The Institute of Geophysics, Polish Academy of Sciences, established in 1952, continues the long tradition of geophysical research done by the Poles in the past. The ample history of geophysical sciences, predominantly associated with academic centers in Kraków (Cracow), Lwów (Lviv), Warszawa (Warsaw), and also Wilno (Vilnius) and Poznań, is briefly outlined. The world's first Chair of Geophysics was established at the Jagiellonian University in Kraków in 1895 by Prof. Maurycy P. Rudzki. Various geophysical observatories and stations are mentioned, some of them having roots in the 19th century.

Keywords Geophysics • Geophysical observatories • Seismological observations • Geomagnetic measurements

1 Geophysics Amidst the Earth Sciences

The most general definition of geophysics is that it is a major branch of the Earth Sciences that applies the principles and methods of physics to the study of the Earth. Geophysics is a highly interdisciplinary subject and geophysicists contribute to every area of the Earth Sciences.

The very term *geophysics* was initially referred predominantly to the solid Earth study, quite often interchanged with geology. Presently, modern geophysical organizations use a broader definition that includes the atmospheric physics, hydrology, fluid dynamics, solar-terrestrial relations, and analogous problems associated with the Moon and other planets. Strongly interrelated with geophysics are many other disciplines, to mention only: space physics, geodesy, physical

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geography, geomorphology, climatology, oceanology, polar research, ecology, glaciology, as well as astronomy and physics.

As concerns the Institute of Geophysics PAS, its main research topics have been evolving over the years. Here we will focus on some historical facts relevant to the research done there in the 1950s. We made use of the comprehensive treatise by Olpińska-Warzechowa (1995) and the book by Jerzy Kowalczyk (2001), as well as other publications: Olczak (1958), (1991), Mikulski (1991), Kowalczyk (2009), Dormus (2011), Hanik (1986), Maj (2003a, b), Michalski and Małkowska (1947).

2 Early Years of Polish Geophysics

Roots of geophysics in Poland, as systematically practiced science, may be sought in the 19th century, in the time when our state was absent from maps. It sprouted, under various names, in Cracow (Kraków in Polish) and its surroundings where meteorological, magnetic and other physical observations were conducted, partly in the framework of the Astronomical Observatory. This Observatory, together with its meteorological station, started to work at the dusk of former free Poland, in 1792. Both astronomical and meteorological observations were initially led by Prof. Jan Śniadecki (1756–1830). In 19th century, connection of Polish research with world's science was facilitated by the fact that south-eastern part of Poland was then ruled by the Austrian Empire.

In the years 1839–1885, a small magnetic observatory created by Austrian scientist Maximilian Weisse (1798–1863) was in operation in Cracow; it was the first on Polish lands. Like the Astronomical Observatory, also this small facility belonged to the Jagiellonian University. Scientists tended to be comprehensive in those times. Ludwik Antoni Birkenmajer (1855–1929), one of many Cracovian erudits, was not only a physicist, astronomer and historian of science, but also a geophysicist, deeply involved in gravimetric research. His habilitation treatise in 1881 was devoted to the Earth's shape and structure.

Taking things formally, geophysics as a separate science emerged in Poland on October 1, 1895, when at the Jagiellonian University in Cracow, at the Faculty of Philosophy, the Chair of Mathematical Geophysics and Meteorology started functioning; it was headed by Prof. Maurycy Pius Rudzki (1862–1916), eminent Polish geophysicist, mathematician, geographer, astronomer, author of textbooks. **This was the first Chair of Geophysics in the world** (3 years later, in 1898, great German physicist Emil J. Wiechert (1861–1928) was nominated Professor of Geophysics at the University of Göttingen, bringing to life the first Institute of Geophysics—see Schweitzer 2003).

After some years, the newly established Chair was combined with the Chair of Astronomy and named the Chair of Astronomy and Geophysics. The main scientific and organizational achievements of Prof. Rudzki included the establishing

of a modern (as for those times) Seismological Observatory, and reactivation of measurements of the Earth magnetic field components; he was also supervising meteorological stations in Zakopane.

At the same time (1895) in Lwów (Lvov, now: Lviv in the Ukraine), the Chair of Higher Geodesy and Spherical Astronomy at the Polytechnical School (from 1920—the Lvov Polytechnic) was offered to Prof. Václav Láska (1862–1943), prominent Czech geodesist, astronomer, geophysicist and mathematician, with versatile scientific interests. He worked there until 1911 dealing, beside geodesy and astronomy, also with mathematical geography, hydrology, meteorology and the space physics. In the framework of geophysics, he was mainly interested in seismology (earthquakes). In 1899, Prof. Láska organized at the Polytechnical School the first seismological station on Polish lands, equipped with two horizontal Bosch-Omori seismographs (see, e.g., Berezowski 1972).

The Lvov Polytechnic was also the institution with which Prof. Wawrzyniec (Laurentius) Teisseyre (1860–1939), eminent Polish scientist of French ancestry, has been associated over most of his scientific life (see, e.g., Teisseyre 1998). His name is widely present on geological maps of Europe for his discovery of the central part of an important tectonic line cutting Europe from NW in Denmark to SE, towards the Black Sea. He introduced the term “cryptotectonique,” meaning “buried tectonics.” In recent times, his achievements have been recollected, e.g., in EOS Transactions (Teisseyre and Teisseyre 2002; the first author is his grandson). Wawrzyniec Teisseyre first described his discovery in 1893, and in 1903 he published a relevant map. His results have been corroborated in 1908 by Swedish magnetologist A. J. H. Törnquist (1868–1944), who studied the areas NW of the Teisseyre line. The whole system, originally named the Teisseyre-Törnquist (or Törnquist-Teisseyre) line/zone and presently known as the Trans European Suture Zone (TESZ) is still extensively studied with many geophysical techniques, mainly the deep seismic sounding methods, in which the Institute of Geophysics PAS has been deeply involved for years (see other chapters of this issue; also Korja 2007).

In Cracow, at the Jagiellonian University, the second Polish seismological observatory was established in 1901, in the cellar of Astronomical Observatory (in the same cellar, gravimetric measurements were sporadically made, interfering with seismic observations). In 1903, Prof. Rudzki managed to equip this station with two horizontal seismographs of Bosch-Omori type. The recording was made on smoked paper (e.g. Mazur 1993).

From the early 20th century, in the Polish lands annexed to Russia—called the Congress Kingdom—physicist and geophysicist Stanisław Kalinowski (1873–1946), under the auspices of the Museum of Industry and Agriculture, started preparations for implementing systematic measurements of the Earth magnetic field components and establishing a magnetic observatory at Świder near Warsaw. In this way, Prof. Kalinowski has incorporated Poland into international campaign on producing magnetic maps of our planet, initiated by the Carnegie Institution in Washington. The design of the Świder Observatory was similar to that of the Magnetic Observatory in Potsdam. The construction works started in

1910 and were completed in rather unusual, war-time circumstances in 1915. The Observatory began regular observations in 1921. The basic magnetic map of Polish Republic has been compiled through the years 1923–1930. In 1928 the Magnetic Observatory was renamed as the Geophysical Observatory, since its scope has widened by including the atmospheric electricity observations (see, e.g., Ołpińska-Warzechowa 1985). Nowadays, atmospheric electricity has become the main domain of research done there, since magnetic measurements had to be terminated because of interfering noise produced by electric railroad (more details in Józwiak et al. 2014; this issue). Now the Observatory (housing also a museum of old magnetic instruments, see Fig. 1) bears the name of Prof. Stanisław Kalinowski.

The outbreak of the First World War on 28 July 1914 disorganized the scientific life in the area. In Cracow, this was soon followed by the death of Prof. Rudzki. His Chair was taken over by the well-known physicist Marian Smoluchowski (1872–1917), for a short time unfortunately. Later it was headed by Władysław Dziwulski (1878–1962), notable astronomer. Subsequently, in 1919, the Chair of Astronomy and Geophysics became just the Chair of Astronomy, led by Prof. Tadeusz Banachiewicz (1882–1954), eminent astronomer, geodesist and mathematician. Certain research in the domain of geophysics, e.g. in gravimetry, was conducted there, but the Cracow seismological station declined because of technical problems. It restored full functioning in 1927 (after 6 year break). When Prof. Rudzki passed away, seismological reports from Cracow ceased to be published till 1955.

After the First World War, in reborn Poland, two academic centres for geophysics have been established. These were: (i) the Institute of Geophysics and Meteorology at the Jan Kazimierz University in Lwów, headed by Prof. Henryk Arctowski (1871–1958), prominent Polish geophysicist, geochemist and polar explorer, and (ii) the Free Polish University (Wolna Wszechnica Polska) acting in 1918–1952 in Warsaw, where, in the framework of the Faculty of Mathematics and Natural Sciences, geophysics was extensively taught and studied under the guidance of Prof. Stanisław Kalinowski, initiator and director of the previously mentioned Magnetic Observatory at Świder (see, e.g., Maj 2013).

At the Jan Kazimierz University in Lwów, the scope of research included, among other things, the measurements of the geothermal gradient and the Earth magnetic field. In 1928, first geomagnetic measurements (of inclination) were performed near Lwów. The next comprehensive surveys were done in this region in the years 1929–1930. This was possible due to cooperation with the firm “Pionier” SA from Lwów, and governmental financial help. These measurements served both prospecting and purely scientific purposes. In June 1929, magnetic station in Daszawa near Stryj was erected, equipped with high-class instruments, including the Askania-Werke magnetograph. Daszawa station worked till 16 May 1931, when heavy storm and rain destroyed it. Next station, in Janów near Lwów, was operative in the years 1933–1939 (see, e.g., Ołpińska-Warzechowa 1988).

In Mikołów in Upper Silesia, the Society of The Experimental Mine “Barbara” built a magnetic station, which worked in the years 1925–1939. Magnetic declination was measured for the mine surveying purposes.



Fig. 1 Some of the modern instruments installed in the 1920s at the newly-built Świder Observatory. *Top* The Kew magnetometer of the Cambridge Scient. Instr. Co. *Bottom* The Sartorius magnetometer for magnetic declination measurements. *Photos* taken in the observatory museum by K. P. Teisseyre in 2006

Some branches of geophysics, like meteorology and climatology, were also among the disciplines taught and studied at the Stefan Batory University in Wilno (presently the Vilnius University), Poznań University (founded in 1919; presently the Adam Mickiewicz University in Poznań), or in the Main Agricultural School (presently the Warsaw University of Life Sciences SGGW). The role of the Mining Academy in Cracow, instituted in 1919 (now the AGH University of Mining and Technology), was also significant.

Not surprisingly, elements of geophysics were included in the mainstream research of the State Meteorological Institute (PIM) and the State Geological Institute (PIG), both established in 1919. Besides, gravity force surveys in Poland were conducted by the Central Office of Measures (Główny Urząd Miar) in Warsaw (see, e.g., Olczak 1932, or Kwiatkowski 1937), and the geomagnetic measurements belonged to the sphere of interest of the Military Institute of Geography (known for issuing excellent maps). Since 1921, in the Free Town of Gdańsk operated the Marine Department of PIM, transferred in 1927 to the newly built city of Gdynia. In addition to typical oceanographic/meteorological studies, it provided meteorological and hydrographic service for marine administration of the Polish Republic.

On the initiative of the Marine Department of PIM, a Magnetic Station was erected on the Hel Peninsula. It was built in 1931 and opened on 1 August 1932. Many magnetic field measurements were done in the Polish coastal region from Gdynia to Karwia and from Gdynia to Hel—see, e.g., Czyszek and Czyszek (1984), Jóźwiak et al. (this issue). The Hel station had to terminate its activity in its original shape after the outbreak of the Second World War on 1 September 1939. The Germans seized the last Polish outpost, which happened to be the little town of Hel with surroundings, on 2 October. In recent times, an interesting story of three quartz horizontal magnetometers (QHM) from Hel has been presented, with optimistic end, by Voppel and Schulz (2002).

In 1930, Polish geophysicists established their first organization, the Society of Geophysicists in Warsaw (Towarzystwo Geofizyków w Warszawie), with Prof. Antoni B. Dobrowolski (1872–1954) as chairman. Plans for its activities, wide and deliberate, included the development of the geophysical research in Poland and international cooperation. This society strongly enhanced the position of geophysics among the earth sciences in our country (see, e.g., Mikulski 1984; Maj 2011). One of the effects was the creation of Seismological Observatory at the Józef Piłsudski University in Warsaw. Organization of this observatory started in 1935. The Observatory, headed by Dr. Irena Bóbr-Modrakowa (1889–1959), was located in a basement in one of main buildings of the University campus. It was equipped in seismometers of Golicyn-Wilip type, with galvanometric (photographic) registration. The Seismological Observatory in Warsaw started to record distant earthquakes in 1937, but official opening took place on 1 January 1939 (see also Jankowska 1986).

The Society of Geophysicists supported also the organization of Polish Polar Expedition during the Second International Polar Year 1932/1933. In this case, a



Fig. 2 The former Józef Piłsudski Astronomical-Meteorological Observatory on the Pop Ivan Mount in Czarnohora Mts. *Photo* by K. P. Teisseyre taken in 2010

leading role was played by the State Meteorological Institute (PIM) in Warsaw, directed then by Jean Lugeon (1898–1976), Swiss engineer and meteorologist. During this expedition, observations in the fields of meteorology, physics of atmosphere and geomagnetism were done; there was also a temporary magnetic station (see e.g., Lugeon 1933). The successful First Polish Polar Expedition (with wintering!) gave an impulse for organizing consecutive expeditions (which came to effect after the Second World War) (Giżejowski 2011).

Professor Jean Lugeon was promoting the construction of the High Mountain Meteorological Observatory on the summit of Kasprowy Wierch in Polish Tatra Mountains. This modern research center, constructed incredibly fast (in about 12 months), started functioning on 1 January 1938; its first director was Dr Edward Stenz (1897–1956), physicist and geophysicist.

The other noteworthy facility was the high-class Józef Piłsudski Astronomical-Meteorological Observatory on the top of Pop Ivan mount in the Czarnohora range in eastern Carpathians (now the Ukraine). It was built in the years 1936–1938 due to donations from the Polish paramilitary organization named Air and Anti-gas Defense League. It was intended to be part of Astronomical Observatory at Józef Piłsudski University in Warsaw; its director was Włodzimierz Midowicz (1907–1993), meteorologist and geographer. The seizure of this observatory (together with the whole eastern part of Poland) by the Soviet Union in 1939 marked the beginning of its devastation, which lasted through the war and much later (see Fig. 2) (Kreiner and Rymarowicz 1992). Since 2011, the building has

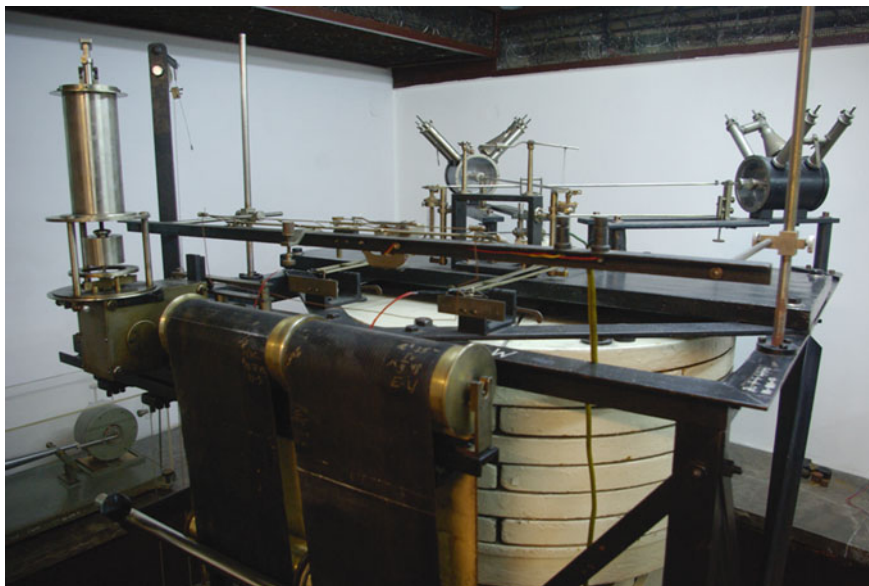


Fig. 3 The Wiechert horizontal seismograph, originally installed in Wrocław, then transported to the Racibórz Observatory. *Photo* taken in the museum part of the seismological station at the Silesian Planetarium in Chorzów by K. P. Teisseyre in 2013

been overhauled, with participation of Polish Republic. There are some plans to commercialize this building, strongly opposed by the defenders of wildlife nature in this small mountain range.

Seismic observations were also conducted in those parts of today's Poland, which before or during the Second World War belonged to Germany; they were under supervision of the observatory in Królewiec (German name Königsberg, now Kaliningrad, Russia), or in Wrocław (then Breslau); see Tams (1950) and Schweitzer (2003). The latter was founded by Prof. Gustav H. G. von dem Borne (1867–1918) in 1908, in then suburban district Krietern (now Krzyki) in Wrocław, and was named “Erdbebenwarte Breslau-Krietern”. It started functioning in 1909 and worked till 1916. In 1910, Königliche Technische Hochschule Breslau was instituted and took over the management of the observatory (since 1945 the Hochschule's buildings have been occupied by the Wrocław University of Technology). In the years 1928–1929 the operation of the observatory was temporarily stopped, but registration re-started in 1929. During military operations in 1945, the building of observatory was completely ruined, but the Wiechert's seismographs survived in the basement. These were excavated in 1945 by Professors Edward Stenz and Tadeusz Olczak (1907–1983), and in 1954 transported to the Racibórz Observatory (Olczak 1991). These valuable historical instruments are now displayed in the seismological station at the Chorzów Planetarium (Fig. 3).

3 From the Outbreak of the Second World War to 1952

The Second World War, started on 1 September 1939 with German aggression on Poland and Soviet invasion from the East on 17 September, caused a several-year break in the promising development of Earth Sciences in this part of the world. It is to be noted, though, that two observatories, in Świder and at the Warsaw University, were functioning under German occupation, as entities subject to the Geological Institute of Warsaw District of General Gubernatory, the so-called “Amt für Bodenforschung”.

The Geological Institute was allowed, at least in first years of German occupation, to conduct certain geophysical field surveys, for example measurements of magnetic declination (*nota bene*, useful for production of maps for military forces of the Polish Underground State—ZWZ and later AK, i.e., the Home Army). Germans soon activated the High Mountain Meteorological Observatory at Kasprowy Wierch and used it for their purposes, the same concerns Marine Department of PIM in Gdynia. Generally, both invaders, Germans and Soviets, tried to wipe out Polish identity of the science and education in enslaved lands; they sometimes destroyed even the publications.

The scientific centers in Lwów and Wilno were, after Soviet aggression on 17 September 1939, lost for Poland. Scientists have dispersed, many of them met repressions, were killed in mass murders or sent to German concentration camps or Soviet lagers (forced labor camps). Many people did not survive harsh conditions. Quite a lot reached Western Europe or USA, via different ways, joined the Polish Forces in the West and after the war did not return to homeland for political reasons. Human and material loss of Polish science and higher education, in the effect of the Second World War, are enormous and even hard to estimate. Those scientists from Lwów or Wilno who survived all these hard times and returned to Poland, settled in Wrocław, Toruń or elsewhere, joining or organizing the scientific centers there.

After the war, the works on reconstruction of education and structures of science started immediately. The plans for reconstruction and reforms were already prepared before, by educational agendas of the Polish Underground State (as, e.g., the Secret Organization of Teachers “TON”). In 1945, reactivated were (among other) the State Geological Institute (PIG) and the PIM, under the name of State Institute of Hydrology and Meteorology (PIHM). The first of these took over the management of the Magnetic Observatory at Świder and Seismological Observatory at the University of Warsaw. The State Geological Institute soon started gravimetric, magnetic and seismic surveys, mainly in the Kujawy district (search for the salt deposits). The High Mountain Meteorological Observatory at Kasprowy Wierch was activated after a few-month break.

Because of territorial changes after the war, borders of Polish state embraced the meteorological observatory on the top of Śnieżka mount (Schneekoppe in German), built in 1900, and the Silesian Geophysical Observatory in Racibórz

which was ruined in major part. The latter started working in 1929, in then German Ratibor, arranged and directed by Silesian-German seismologist Prof. Karl (Carl) Mainka (1873–1943), inventor of the long-period seismographs, known as the Mainka seismographs (also the magnetic measurements were made in this observatory in the years 1932–1933). After the war, this observatory started to work in 1947 (see Olczak 1948); in 1953 it was taken over by the Institute of Geophysics PAS. Due to overwhelming disturbances caused by heavy traffic, this observatory was removed from the network of seismic stations in 2010. Now the Geophysical Observatory in Racibórz is only a museum and educational facility, where the huge, old Mainka seismographs may still be admired.

In Polish capital, the Warsaw Seismological Observatory re-started normal functioning in 1946, run by still the same person, Dr. Irena Bóbr-Modrakowa (then replaced by Wiesława Jankowska). In September 1947, the Society of Geophysicists in Warsaw was reactivated under a new name: Polish Society of Geophysicists (Maj 2011). Its main goals included proposals for geophysical studies programs and edition of monographs on the Earth sciences. In the same time, another society relating to geophysics, the Polish Meteorological-Hydrological Society, came into being.

At the Mining Academy, Prof. Edward Walery Janczewski (1887–1959) organized, already in 1945, the Chair of Geophysics, the first after the war. It was mostly focused on prospecting geophysics (see, e.g., Kowalczuk 2011). In the Faculty of Mathematics, Physics and Chemistry at Warsaw University, the Department of Geophysics was organized in 1948, under the guidance of Prof. Teodor Kopcewicz (1910–1976). It was concerned with physics of the atmosphere, seismology, gravimetry and general geophysics. In the next year, it was split in two: the Chair of Geophysics I (since 1952: Physics of the Lithosphere), headed by Prof. Edward Stenz (1897–1956), who had just returned from the Kingdom of Afghanistan, and the Chair of Geophysics II (since 1952: Physics of the Atmosphere) headed by Prof. Teodor Kopcewicz (Kozłowski 1990).

On the turn of June and July 1951, Polish state authorities organized in Warsaw the First Congress of Polish Science, when the plans to bring into being the Polish Academy of Sciences (PAS) were announced, basing on scheme of the Academy of Science of the USSR. This decision was authorized by governmental edict of 30 October 1951. At the same time, the Polish Academy of Arts and Sciences (in Cracow), Polish Academy of Technical Sciences and the Warsaw Scientific Society were closed. Within the Polish Academy of Sciences, numerous departments/institutes dealing with various branches of science were instituted by the end of 1952. These included the Department of Geophysics, later transformed into the Institute of Geophysics PAS. The following observatories constituted its main experimental background: the Magnetic Observatory at Świder, Seismological Observatory at the University of Warsaw, Silesian Geophysical Observatory in Racibórz, and the Marine Station Sopot-Molo.

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