

HISTORY OF LIGHTNING PROTECTION IN POLAND

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Abstract: The history of lightning protection in Poland and its short overview in the world is given. The first lightning rod in Poland were installed in Rawicz by Christian Gottlob Stiegler and in Dęblin by Jowin Fryderyk Bystrzycki both in 1783. The third lightning rod was mounted next year on the king castle in Warsaw. The book *Sposób Ubezpieczający Życie i Majątek od Piorunów (The manner protecting the live and real estate from lightning)* published in 1784 by priest Josef Osiński is treated as a one from the first electrical works in Poland. The most meritorious polish researcher of lightning in XX century was Prof. Stanisław Szpor.

1. BEGINNING OF LIGHTNING PROTECTION IN THE WORLD

Knowledge about the electricity in the first half of the XVIII century, in the period proceeding the discovery of lightning rod, was very poor. Williams Gilbert introduced in his work *De Magnete* (1600) the term “electricity”, especially friction induced electricity and divided the bodies on conductors and non-conductors (insulation). About year 1663 Otto von Guericke mounted the first electrostatic machine which was improved by English physician Francis Hauksbee in 1709. The electrical condenser was discovered by von Kleinst from Kamin (Kamień Pomorski) in 1745 and independently by van Musschenbroek from Leyden the year later (Leyden jar).

Charles Dufay in France has formed the hypothesis about the two different kinds of electricity, the “glass one” and the “resin one”. This idea was very helpful in understanding the nature of electricity. The both kinds of electricity show similar behaviour: a body attracts the body from opposite kind of electricity and repels the body showing the same kind of electricity. The two competitive fluid theory were proposed. It could be either

one fluid (one fluid theory) which in excess or in insufficiency causes the positive or negative electricity or two fluids (double fluid theory) the positive one and the negative one. Many scientists took part in electricity research: Stephen Gray, Johann Heinrich Winkler (*Die Staerke der elektrischen Kraft des Wassers in glaessernen Gefaessen*, Leipzig 1746), Giambattista Baccaria (*Dell'elettricismo artificiale e naturale*, Turino 1753), Jacques de Romas, Thomas Francois D'Alibard, Jean Antoine Nollet, Georg Wilhelm Richman.

The first lightning rod was installed by Benjamin Franklin on his home in Philadelphia in 1752. In the same year the lightning rod was also mounted in France by Louis Guillaume Le Monnier [1] and by Giovanni Babbatiste Torre in Florence [1]. Probably independent from Franklin, Prokop Divis (Dievisch) built his lightning rod in the village Przymetice near Znojmo in Moravia [2, 3]. Next lightning rod were installed on the House of merchant William West in Philadelphia in 1760. The first English installation of the rod was in 1760 to protect the wooden Eddystone lighthouse near Plymouth. To the oldest lightning rods in Europe belong also the devices on the San Marco church in Venice, on the home of physician Johann Reimarus in Hamburg (1768) [1], on the San Jacobi church in Hamburg (1769) and on the Augustinian church in Sagan/Żagań (Silesia, 1769) [4]

Quickly spread of lightning rods at the end of XVIII century was caused by the known spectacular lightning damages, especially the explosion of gunpowder magazines in Venice (1767), in Brescia (1772) where 3000 people were killed, at fort Malaga in Sumatra (1782) and lot of church towers and wooden ships not provided with lightning rods. On the other hand many objects, earlier destroyed by lightning were successfully protected after installation of lightning rods. To these famous buildings belong the St. Marco cathedral in Venice and the cathedral in Sienna. *Endeavour* was

probably the first ship provided with the lightning protection device in the form of metal chain [1].

2. BEGINNING OF LIGHTNING PROTECTION IN POLAND

The beginning of lightning protection in the world took place in the time in which the Polish state under the reigns of last kings August III Wettin and Stanislaw August Poniatowski brought nearer and nearer to its collapse. The education reform eg. the foundation of Collegium Nobilium or Knights Academy, the rise of metallurgy and mining industry in Staropolska region, the development of ceramics and glass industry and transportation was associated by efflorescence of science and arts. Stanislaw Konarski, Stanislaw Staszic, Hugo Kołłątaj, Jan and Jędrzej Sniadecki, Joachim Lelewel and Ignacy Krasicki were outstanding representative scientists of Enlightenment.

The literature development in the time of king Stanislaw reign was of big importance for the application of lightning rod in Poland. The different periodicals have been to appear e.g. *Pamiętnik Historyczny y Polityczny* (Historical and Political Memmoirs) published by court Pijar' printing-firm of P. Dufor and M. Groell, *Wiadomości Warszawskie* (Warsaw news) or *Dziennik Wileński* (Wilnius newspaper). To the first information about leyden jar belong the article in *Wiadomości Warszawskie* entitled *Doświadczenia około leydejskiej flaszki* (Experiments with leyden jar) from 5.07.1766. In 1777 the physics school-book *Fizyka doświadczeniami potwierdzona* (*Physics confermed by experiments*) by priest Józef Herman Osiński in which on page 384 the lightning rod (called *konduktor*) was shown. On page 408 we can find the description of ball lightning: "*pokazują się niekiedy kule wielkie na powietrzu palące się. Takie kule niekiedy z wielkim hałasem pękają, na miejscach na których trzaskają fetor siarki zostawiają*". („*sometimes big burning balls appear. These balls sometimes split and sulphur smell leave.*")

The year 1784 was very fruitfull for lightning protection. *Magazyn Warszawski* from 1784, in volume I, part 2, pages 346-349 showed the article entitled *Rysunek i opis dokładnego konduktora wyjęty z wiadomości uczonych de Gotha i dzieła o elektryce sławnego Cavallo, z angielskiego przetłumaczony*. In the same year the small book *Sposób Ubezpieczający Życie y Miałtek od Piorunów* by J. H. Osiński appeared in Warsaw (fig. 1). This peculiar work has 50 pages and contains 18 drawings (see the Appendix). In the first chapter description of lightning rod was given. In the second chapter the examples of lightning rod efficiency from the abroad were presented. Among other things the author reprints the Franklins' letter to D'Alibard and cites the Reimarus' work "Vom Blitze" printed in Hamburg in 1778. The next chapters explain the installation of lightning rod and material selection. Osiński describes also the lightning rod maintenance, gives the cost

calculation, the rescue methods for people and buildings stroken by lightning.



Fig. 1. Title page of the Osińskis' book *Sposób Ubezpieczający Życie i Miałtek od Piorunów* printed in Warsaw in 1784

The Osińskis' work and other information like e.g. edicts of prussian king Frideric and Austrian emperor Josef I published in *Pamiętnik Historyczny y Polityczny* brought the expected results. Płock bishop Michał Poniatowski forbited on 30.08.1784 parish-priests and monasteries to ring during the storms and ordered to fellow the Osińskis' instructions [7]. The ringing during the storms was very widespread superstitious practices this time in Europe and was found as silencing the storm. In reality a lot of bell-ringers were killed or gave electric shock during their unnecessarily and dangerous work.



Fig. 2. Town hall in Rawicz, present state.

The first lightning rod in Poland was installed on the town hall in Rawicz in 1783 by mayor Christian Gottlob Stiegler. The message about this fact was given in January 1784 number of *Pamiętnik Historyczny y Polityczny* in the article dedicated to Franklin (fig. 2, 3).

**.) Mamy nowy dowód użyteczności Konduktorów w kraiu naszym. Miasto Rawicz, sławne fabrykami sukieniami w Wielko - Polsce, podlegało bardzo przypadkom piorunowym. W roku przeszłym 1783 za staraniem Pana Krystyana Styeglera Burmistrza tamtejszego, dano Konduktora na Ratuszu, zaraz w tymże roku dwa razy piorun uderzył w wieżę, i po Konduktorze, bez żadnej szkody spłynął.*

Fig. 3. Annotation in *Pamiętnik Historyczny y Polityczny* about lightning rod installation in Rawicz in 1783

Our knowledge about Christian Stiegler is very little. The authors' search in town records of Rawicz in State Archives in Poznań revealed that he was mayor of Rawicz from 1774 to 1786. Rawicz was founded in 1638 after the permission of king Władysław IV Wasa. In XVIII century in the Province Great Poland many new towns were founded. The immigration of many Protestants persecuted in Austria and Germany in the time of thirty years war caused the economical prosperity in the region. According to *Opis Miast Polskich z lat 1793-1794* (redaction of Jan Wąsicki, Adam Mickiewicz University in Poznań, 1962) at the end of XVIII century in Rawicz lived 5000 Germans, 1000 Poles and 1000 Jews. Consequently, Christian Gottlob Stiegler was probably of German nationality.

Priest Jowin Fryderyk Bystrzycki have built six lightning rods on Michał Jerzy Mniszech's palace in Dęblin, also in 1784 [5]. Priest Bystrzycki (1737-1821) was Jesuit, the priest consecration and doctor title became in Wilno [6]. After dissolution of Jesuit Order in 1773 J.F. Bystrzycki became the court astronomer of king Stanisław August Poniatowski. He carried out the first systematic measurements of atmospheric pressure and temperature in Warsaw from 1779 to 1799. Bystrzycki was a continuator of priest Osiński's work, he published the improved second volume of his book *Fizyka Doświadczeniami Potwierdzona* in 1800.

Inestimable *Pamiętnik Historyczny y Polityczny* in July 1784 give a short message that on July 6 this year on the cost of His King Majesty the lightning rod on the castle tower in Warsaw was finished (which can be treated as the third in Poland). *“Jest on spuszczoney z dwóch stron wieży, i składa się z dwóch odnóg; z których jedna, od strony starego miasta jest to drót na puł cala gruby, i prętami żelaznemi na łokieć od muru oddalony; zaś druga naprzeciw garderoby, jest blacha żelazna biała na 3 cale szeroka, do samego muru*

przytwierdzona. Końce tak drótu jak i blachy wpuszczono w doły umyślnie wykopane”.

There is conductor on two sides of the tower. It is divided in two limbs, one is wire on the town side which is a half inch thick and fasten to the wall with steal rods, the other is opposite dressing-room and made of steal sheet of 3 inches wide, fasten to the wall. The ends of wire and sheet are buried in the ground.

In XIX century also appeared many publication about lightning rod. These advice was differently called, how show the following titles [7]:

Mallet, *Nauka o piorunociągach*, (lightning ducts) wskazująca jak powinny być stawiane na magazynach prochowych. Translation from French, Warszawa 1818;

Smirnow F., *Nadzwyczajne skutki gradochronów*. (hail protector) Article in *Tygodnik Rolniczo-Technologiczny* which was printed in Warsaw in 1845, pages. 416-417 and 454-455;

Rychnowski F., *O urządzaniu odgromników*. (de-lightner) Article with a description of lightning installation on parliament building in Lvov, in *Czasopismo Techniczne* in Lvov in 1887;

Weber L., *Instrukcja o zakładaniu gromochromów* (thunder protector) przy budowlach, in *Przegląd Techniczny* in 1887, page 39

Prof. S. Szpor have found in Stanisław Staszic' work from 1815 *O ziemiorództwie Karpatów i innych gór i równin Polski* a storm description in Tatra Mountains. This text proves that Staszic have observed upward lightning 125 year earlier than Mc Eachron who discovered this lightning kind from Empire State Building. *“... słycać nieprzyjemny huk, nieustanne błyskanie i piorunów bicie. Tych zdawało się więcej ostrzem wypadać w górę, niżeli z góry uderzać w skały”.*

3. XX CENTURY

At the beginning of XX century Ignacy Mościcki, the outstanding chemist, professor at Technical University in Lausanne and since the President of Poland, built the glass high voltage capacitors. Already in 1905 I. Mościcki have indicated the limited possibilities of horn gaps and have shown new, better surge arrester [9]. These new devices were produced in the factory in Fribourg since 1907 and were called Giles ventilis from the its director name and Mościckis' co-worker.

In 1930s the firm K. Szpotański SA started the production of non-linear SiC resistors called featyt and manufactured gapped surge arresters. The surge arresters “Katodex” with cathodic voltage fall were produced in another firm Kleiman and Sons in Warsaw too [10]. These tradition was continued in Prof. Szpor's group where the cheap protection tubes with screw gas channel were built [11]. The metal oxide varistors and metal oxide surge arresters are manufactured since 1994 in the plant ZWAR in Przasnysz.

Prof. Stanislaw Szpor (1908-1981)

He started the lightning research before the world war II and continued it during his stay in Switzerland in Polish University Camp in Wintherthur. As soldier of Polish 2 infantry division Dr. Szpor took part in French campaign 1940 and was interned in Switzerland. The most important works from this time deals with impact of lightning on trees [12], the first in Europe photographs of multiple lightning were taken [13]. Prof. Szpor became head of high voltage department on Gdańsk University of Technology in 1947. He published few papers about the application of line choking coils for overvoltage protection of substations in 1950s [14]. Then he started the lightning current measurements by means magnetic links on transmission and distribution lines and industrial chimneys at many points in Poland. To the most important achievements of his research team was the revision of lightning current values. The values measured in Poland by Szpor were about two times greater than some values measured in other world parts [15]. To the pioneer work belong his article *Influence of surge reflection on lightning current records*. In this work he proved a large increase of current measured at the bottom of the structure and suggested "recording the current at the top is much more correct" [16]. On lightning pictures taken by his co-workers the record 3 stroke points of lightning were discovered [8]. The professor's passion was his relaxation theory of stepped lightning discharge proposed in Switzerland in 1942 [17] and skin effect during lightning current flow through a conductor [18]. The literary output of Professor contains 190 articles, 16 books, 25 patents, he was conferring 13 doctor titles.

Prof. Janusz Lech Jakubowski (1905-1997)

Prof. J.L. Jakubowski became Dean of Electrical Engineering Faculty at Warsaw University of Technology in 1945. He founded Electrotechnical Institute in 1946 and then Polish Committee for Lightning Protection. He became the first Rector of Algiers University of Technology and worked there for seven years. Professor was the member of Polish Academy of Science and doctor honoris causa of Warsaw University of technology and Łódź University of Technology. The main field of his research was high voltage engineering, he has also valuable achievements in lightning protection. Among other things he proved the injustice of theory which suggested the occurrence of propagation waves as a result of electromagnetic field induced by lightning current [19]. Together with docent Jerzy Zieliński he applied the active lightning rods in the research of lightning protection zones [20].

The literary output of Professor contains about 250 positions, in them 200 deals with technical science and 40 was published in foreign languages [21]. He wrote 5 books, e.g. *Piorun ujarzmiony (Subjugated lightning, 1957)* or *Podstawy teorii przepięć w układach energoelektrycznych (Overvoltages in electrical circuits, 1968)*.

4. REFERENCES

- [1] Prinz H. *lightning in history*. in Golde L.H., *Lightning*, Vol. 1 *Physics of lightning*. Academic Press 1977
- [2] Sevcov I., *Ochrona odgromowa*. Wydawnictwo Komunikacji i Łączności, Warszawa 1966, tłumaczenie z j. słowackiego
- [3] Victory B.M., *Benjamin Franklin and Germany*. Ph.D. thesis, University of Pennsylvania 1915
- [4] Hasse P., Wiesinger J., *Handbuch fuer Blitzschutz und Erdung*. Pflaum Verlag, Muenchen 1993
- [5] Orłowski B. et al. *Z dziejów techniki w Polsce*. Wydawnictwo PAN, Warszawa 1992, s. 478
- [6] praca zbiorowa, *Polski Słownik Biograficzny*. tom III, 1937, s. 177-178
- [7] Stowarzyszenie Elektryków Polskich, *Historia Elektryki Polskiej. Tom I, Nauka, Piśmiennictwo i Zrzeszenia*. Wydawnictwo Naukowo-Techniczne, Warszawa 1976, s. 202
- [8] Szpor S., *Polskie wyniki piorunowe*. Problemy 1968, nr 7, s. 425-431
- [9] Mościcki I. *Wentyle Giles'a*. Przegląd Elektrotechniczny 1925 nr 7
- [10] Kleiman M., *Ekspansywny ochronnik przepięciowy ze spadkiem katodowym*. Przegląd Elektrotechniczny 1935 nr 11
- [11] Szpor S., *Ochrona odgromowa t. 2*, PWT, Warszawa 1955
- [12] Szpor S., *Elektrische Widerstaender der Baeume und Blitzgefaerdung*. Zeitschrift fuer Forstwesen, 1945, nr 9
- [13] Wasilenko E., *Prof. Stanislaw Szpor, człowiek i jego dzieło*. Seminarium Postęp w Dziedzinie Ochrony Odgromowej, Gdańsk 1999, s. 11-37
- [14] Szpor S. *Inductance coils for the protection of substations against the effects of lightning*. CIGRE Session, Paris 1958
- [15] Szpor S., *Comparison of Polish versus American lightning records*. IEEE Trans. on Power Apparatus and Systems 1969, pp. 646
- [16] Szpor S., *Influence of surge reflactions on lightning current records*. Archiwum Elektrotechniki 1971, zeszyt 2, pp. 305-310
- [17] Szpor S., *Theorie de relaxationdu leader seccade de la foudre*. Bull. Schweiz. Electr. Vereins 1977
- [18] Szpor S., *Skin effect in current impulses due to lightning*. CIGRE Session, Paris 1946
- [19] Jakubowski J.L., *Calculation of the magnetic component of the voltage induced by lightning in power lines*. Bulletin of the Polish Academy of Sciences: Technical Sciences, vol. 35, no. 11-12, 1987, pp. 747-751
- [20] Aktualne zagadnienia techniki wysokich napięć – osiągnięcia ośrodka warszawskiego. 1965
- [21] Flisowski Z., Horodecki A., Śliwiński T., *Na 90-lecie profesora Janusza Lecha Jakubowskiego*. Nauka, 1996 nr 1, s. 165-171

APPENDIX

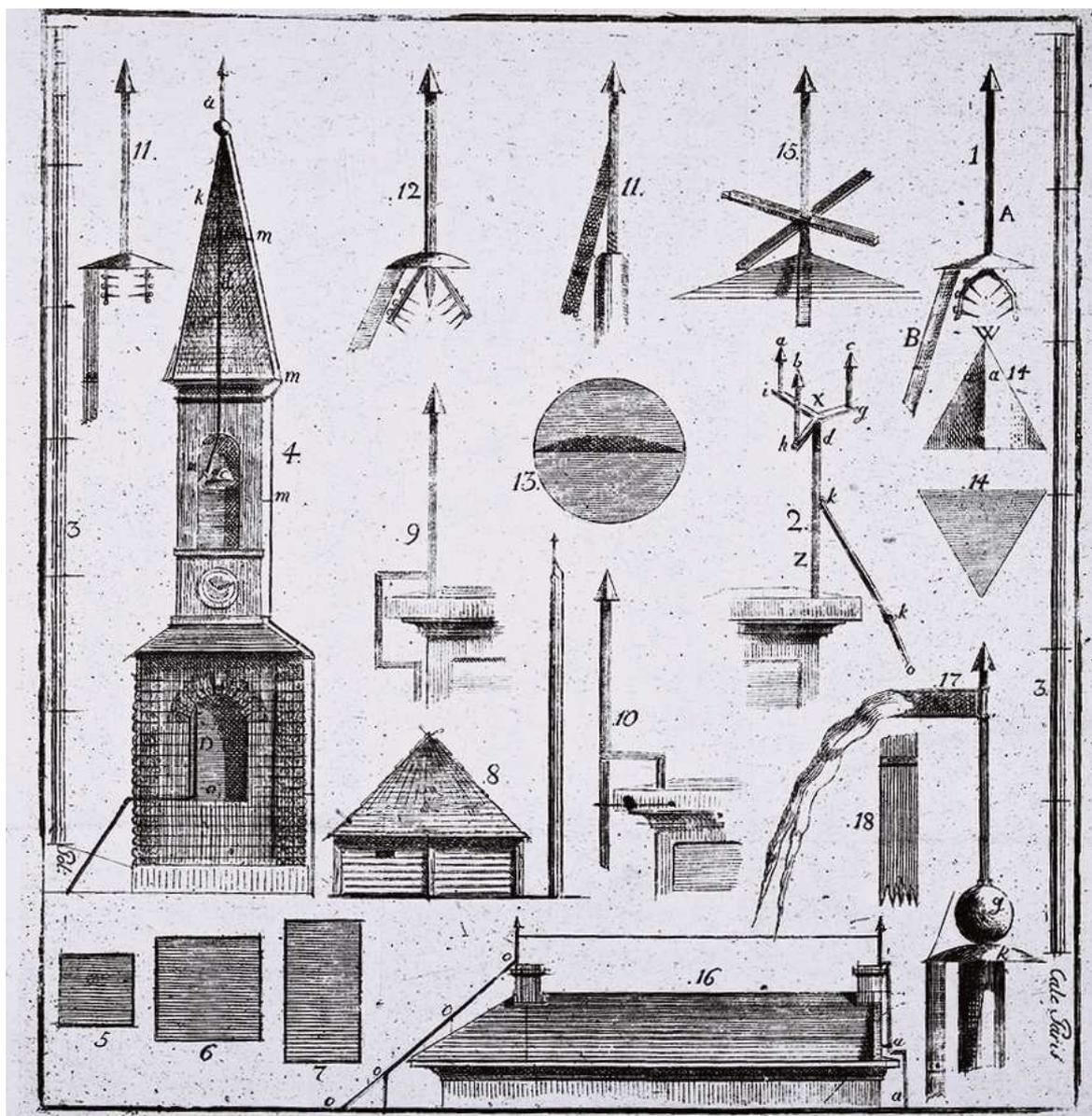


Fig. 4. Drawings from Osiński's book *Sposób Ubezpieczający Życie y Maiątek od Piorunów*