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SWISS EXPERIENCES OF IGNACY MOŚCICKI

SZWAJCARSKIE DOŚWIADCZENIA IGNACEGO MOŚCICKIEGO

Abstract

In Fribourg, Ignacy Mościcki found favorable conditions for the development of his engineering talents. He was one of the founders of the Swiss nitrogen and electrical industry. He announced the results of his works in Polish, German and French scientific journals. This was followed by rapid adaptation of Mościcki's discoveries and inventions regarding the dielectric properties, the construction of technical high voltage capacitors, the construction of fuses protecting the electrical transmission lines against lightning, production of nitric acid from the air, the construction of devices used for absorption of gaseous substances, etc. His experience Mościcki transferred to Lvov.

Keywords: *nitrogen industry in Switzerland*, *glass capacitors*, *Mościcki's school of engineers*, *chemical research institute*

Streszczenie

We Fryburgu znalazł Ignacy Mościcki sprzyjające warunki dla rozwoju swoich inżynierskich uzdolnień. W Szwajcarii znacznie wzbogacił swoją wiedzę, zdobył doświadczenie i sławę. Był jednym z twórców szwajcarskiego przemysłu azotowego i elektrotechnicznego. Wyniki swoich prac ogłaszał w polskich, niemieckich i francuskich czasopismach naukowych. Tą drogą następowała szybka recepcja odkryć i wynalazków Mościckiego, dotyczących właściwości dielektryków, konstrukcji kondensatorów technicznych wysokiego napięcia, bezpieczników chroniących elektryczne linie przesyłowe przed skutkami wyładowań atmosferycznych, wytwarzania kwasu azotowego z powietrza, urządzeń do absorpcji substancji gazowych itd. Swoje doświadczenie technologiczne oraz własne przemyślenia na temat kształcenia dobrych inżynierów przeniósł Mościcki do Lwowa.

Słowa kluczowe: *przemysł azotowy w Szwajcarii*, *szklane kondensatory*, *szkoła inżynierów Mościckiego*, *chemiczny instytut badawczy*

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1. Electricity and the saltpeter

It happened already during Ignacy Mościcki's [1] first encounters with electrical engineering that he discovered a special interest for it, namely back in the years 1897–1901 when he worked as an assistant at the University of Freiburg. At that time, the depletion of the worldwide deposits of saltpeter, a mineral containing a high amount of sodium and potassium nitrates, was a major concern for scientists, industrialists and politicians. The problem was therefore perceived as severe because saltpeter was the basic material for the production of explosives as well as dyes, artificial silk, fertilizers and many other goods offered by chemical plants. So it was not surprising that efforts were initiated aiming at inventing an industrial method of the synthesis of nitric acid. Another incentive for those who were considering a confrontation with the problem was a quite well-founded belief according to which only water and air, cheap and easily accessible materials, were necessary to obtain nitric acid. The prevailing of such an opinion was due to the fact that the chemical reaction in which nitric oxides were spontaneously produced in the atmospheric air in which electric discharge has just taken place had been known for a long time.

Mościcki found experimenting with electricity and nitrogen very attractive. He devoted much time to them during his Easter holidays 1901. He had already read the latest scientific publications relating to this field. He knew that the synthesis of oxygen and nitrogen was an endothermic reaction and that temperatures reaching 3000°C were needed in order to start it. He also knew that leaving the newly produced oxide in this temperature would lead to its prompt breakdown. Considering all these factors, he came to the conclusion that positive results could be obtained if the synthesis would be conducted in an electric arc powered by alternating current of high voltage and high frequency. He intended to achieve improved thermal conditions by blowing the substrates (the air in this case) through a heated arc.

2. The logistics of the undertaking

The results of these initial experiments of Ignacy Mościcki seemed to herald success. Therefore it happened already in autumn 1901 that a company *Société de l'Acide Nitrique à Fribourg* (Polish: *Towarzystwo Kwasu Azotowego we Fryburgu*, English: Nitric Acid Society in Freiburg) was founded. The company was ready to invest in electrochemical experiments of Mościcki who had given up his assistant position at the University and started working for the Society as a permanent employee [2]. His task was to conduct the necessary research and to prepare patent applications that were to be the property of the shareholders. He started receiving a quite high remuneration which made him totally free from financial worries and allowed to devote all his time to the research work. The cantonal government made three university rooms available to him free of charge, with all the necessary laboratory equipment and an unlimited supply of electricity.

Mościcki felt very responsible for the risk that was inherent in his experiments. He was also very much afraid of failure. That is how he was recalling that time twenty years later: "(…) I was keeping my nose to the grindstone. I made my experiments for days on end while at nights I prepared the theoretical bases for further research. When I encountered an even

single difficulty or a setback, a worry pestered me whether I was not trying to bite off more than one could chew" [3].

The major problem emerged when capacitors withstanding voltage of several dozen thousand volt had to be used. It turned out then that such capacitors had not been invented yet. That was the reason for which experiments aiming at producing nitric oxides came to a halt. They had to be stopped altogether for a certain time. Research into dielectrics, necessary to be conducted in that situation, had to be launched instead, in order to determine their electrical breakdown and surface discharge strengths.

3. Necessity is the mother of invention

In order to find solutions to these problems, Mościcki started independent and thorough studies into dielectrics. He took up research into the breakdown strength of glass. He analyzed the same aspect of ebonite, porcelain, natural rubber and other known dielectrics. Judging on the base of the results of his experiments and calculations, he concluded that – compared with all the other materials analyzed by him – glass possessed the best dielectric properties. This conclusion was a decisive factor for the choice of glass as the object of his further experiments.

The research into the properties of dielectrics was the first scientific activity of Ignacy Mościcki. His first reports on them were published in 1904 by the Academy of Science and Art in Cracow (Polish: *Akademia Umiejętności*) [4]. They also appeared in international scientific newspapers [5].

At first, Mościcki constructed plate capacitors, of the type that was in use at the time. He used capacitor plates made of different metals and changed the thickness of the coating. Glass was resistant to high voltage but it became hot too quickly and then it cracked. During these experiments, Mościcki observed that the electrical breakdown of the dielectric layer did not take place in the middle of the plates but on their rims. He came to the conclusion that in such a situation, the thickness of the dielectric layer should be differentiated – it should be thicker at the rims while in the central part of the plate it should be less thick. Capacitors having thicker rims retained the same capacity and resistance but they were much more resistant to an electrical breakdown. Considering all this, he thought that the best shape for such device would be that of a glass tube whose walls would be thicker at the rims. This shape had an additional advantage, namely the whole apparatus did not warm up very much when electric current passed through it. Besides, it was easier to cool it.

This idea was wholly original and deserved to be granted a patent. Its author started elaborating the details and soon after that he launched the laboratory tests. The results were excellent so he prepared a proper application and submitted it to a patent office in Bern. In 1903, he was granted a Swiss patent and a year later – a French one.

As his research into methods of obtaining the nitric acid were – at the time – not so successful as to generate profit, Mościcki felt indebted to the *Société de l'Acide Nitrique à Fribourg* and therefore he decided to donate his capacitor patents to the Society. They turned out to be worth over a million francs, which meant that they exceeded all the assets of the society several times.

In order to make use of Mościcki`s patents, a capacitor factory was built in Freiburg. It happened in 1903 and the factory is in operation to this day. Initially, it was called *Fabrique suisse de condensateurs Jean de Modzelewski et Cie*. It was the first factory of high voltage capacitors in Europe [6].

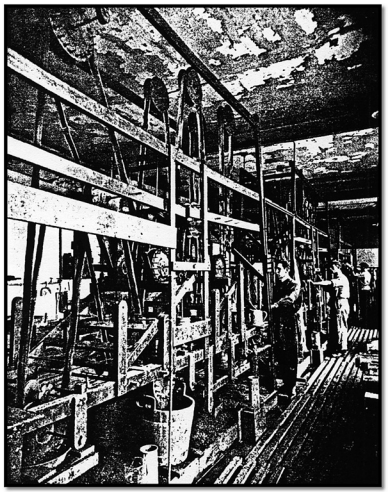

Fig. 1. Factory of capacitors in Freiburg (From the collections of the Museum of Maria Curie Skłodowska in Warsaw)

The capacitors for which Mościcki was granted patents were made of glass and had the shape of a narrow, very elongated bottle with a thickened neck and a rounded thick bottom. Its outer and inner walls were covered with a thin layer of silver that functioned as the capacitor`s plates. A firm galvanic copper coating, fixed on the plates, was there to protect the delicate covers from possible mechanical damage. The whole was later placed in an iron or brass metal sheet, filled with water mixed with glycerin. It was a kind of a cooler. Glycerin prevented the cooling liquid from freezing at low temperatures. Rubber rings, fixed in proper places, guaranteed the tightness of the construction. Wires were put through those rings in order to connect the capacitor plates with current terminals, placed outside.

It was possible to bind these appliances so as to form smaller or bigger batteries that would be resistant to the respectively higher voltage. The batteries of the Mościcki's capacitors were successfully applied in electric circuits with the voltage exceeding 100 kV. They were the best capacitors worldwide at the time.

4. The usefulness of the new capacitors

The demonstration of artificial electrical discharges, organized in a Freiburg laboratory, found a loud resonance in scientific publications devoted to electrical engineering. These electrical discharges were similar to atmospheric phenomena appearing during thunderstorms [7]. The demonstration took place in 1905 during the Congress of

Electrical Engineering. The author of this loud – also in the literal sense of the word – demonstration was Ignacy Mościcki. He wished to demonstrate his latest invention at the Congress, that is the fuses securing the transmission lines and other electric appliances in cases of a sudden increase of voltage. Such temporary increases of voltage, known as overvoltage, were especially dangerous for power lines and power plants as they often caused damage to transformers in the distribution boards.

The fuses invented by Ignacy Mościcki formed an electric system, made of glass capacitors and induction coils. The Capacitor Factory in Freiburg took up their production immediately. As Mościcki used to cede his electrotechnics ideas for the benefit of this factory, the fuses that he constructed were later widely known as the *Giles' valves* (Giles was the name of the factory's director). It was the big hydroelectric power station in Hauterive, the main electricity supplier of Freiburg, that installed the *Giles' valves* in its appliances as the first factory. It was already in 1903 that capacitor fuses were experimentally installed in two main transmission lines there, each of them several dozen kilometers long. The results were very positive. Other power plants – initially in Switzerland, later also in France and in other European countries – soon followed the example of Hauterive.

In 1906, the Mościcki's capacitors were presented for the first time at the world exhibition in Milan and were very much appreciated by specialists. They were honoured with honorary diplomas and a golden medal [8].

The capacitors of the Mościcki's system served reliably in the radio station installed at the Eiffel tower in all the years of the First World War and later. In the interwar period, after it had been found out that other dielectric material could be used instead of the brittle and heavy glass, they lost their significance. In 1920s they were displaced by paper capacitors of Fischer.

5. The design of the industrial synthesis of nitric acid

When the problem of capacitors was already successfully solved and when it was possible to use them for the construction of an electric circuit arc having parameters that seemed to be ideal for conducting the synthesis of nitric oxides, Ignacy Mościcki returned to this subject. After having conducted many experiments and calculations, aiming at making as economical use of energy as possible, he used a system of coils and capacitors of the latest generation, suitable to resist the high voltage. All the experimental results were positive and it did not take long until the method of the production of nitric acid was ready to be applied, after having been examined in a laboratory. Eventually, the time came for this method to be implemented on a larger scale. It was decided that a small experimental factory would be opened in the big factory hall in Vevey. It was Mościcki himself who supervised all the stages of the assembling work.

According to Mościcki, the performance of the experimental factory in Vevey did not turn out to be satisfying. Therefore he found it necessary to undertake efforts aiming at improving the whole technological process. The device that was most energy-intensive and that, at the same time, generated the biggest losses was the stove so this element of the installation captured the most of the constructor`s attention. The result of these efforts was the invention

of a stove possessing a system of several electric arcs. A technological test of this stove took place in Freiburg in autumn 1905. The stove prototype with a system of several electric arcs was soon improved by Mościcki in such a way that it could operate continuously and almost wholly automatically. The next invention of Ignacy Mościcki was a vibrant arc. Mościcki constructed the stove prototype with a vibrant flame in 1906.

The construction of electric stoves, however perfect it was, did not solve other problems that were piling up in the process of the production of nitric acid by the use of the Mościcki method. Looking at it from the viewpoint of the improvement of the profitability of the production, one of the most important tasks was to construct absorptive machines for nitric oxides because the absorptive columns, known at the time, did not wholly respond to the requirements. Large amounts of the air-diluted gas mixture of nitric oxides were produced during the process of obtaining the nitric acid. This mixture dissolved in water only slowly and not wholly.

Mościcki solved this problem by constructing absorbing columns which he based on his own ideas. They were later granted patents and used in many countries. The columns found their use not only in the production of the nitric acid but also in other branches of the chemical industry.

At that time, in Norway, a factory operated according to the system of K.O. Birkeland. However, it produced only small amounts of a very diluted nitric acid and nitrates. Mościcki's intention was to design, build and open a big factory that would produce concentrated nitric acid from air and water. He undertook this task, commissioned by the Swiss cantonal authorities. As the factory`s localization, Chippis was chosen.

6. From the project to its realization

When Mościcki was designing and building the factory in Chippis, he was at the same time making its miniature copy at a university laboratory in Freiburg. He did it for his experimental needs because he wished that each element being currently implemented be checked one more time on a laboratory scale [9].

The nitric acid`s factory was built in the valley of Rhone, next to the town of Sierre. Not far from there, large (large also at the time) hydroelectric power plants were situated that satisfied the needs of the stove with a vibrant flame and of other appliances used in the production process. The construction of the factory lasted less than two years. Its equipment included absorptive columns, invented by Mościcki, and condensation appliances than had been granted patents shortly before. It was possible to obtain the 98% concentration of nitric acid by the use of these appliances. In 1910, the first tank containing concentrated nitric acid left the factory in Chippis. It was also the first ever cistern with a highly concentrated nitric acid that had been obtained from the atmosphere using the method of the electrochemical oxidation of nitrogen [10].

The factory's output supplied the chemical industry in Switzerland and the surplus was exported to other European countries. The profitability and receptivity of the market were the reasons for the decision to expand the factory. Mościcki received the next order. This time, the contract foresaw a tenfold increase of the nitric acid that was to be produced there.

It was to be equally pure and should have the same concentration as that produced before. This meant in practice that a new factory had to be built.

The new factory started in 1912 and all the improvements that had been introduced had the patents of Ignacy Mościcki. These were – on a European scale – large factories and they made Switzerland wholly independent from external supplies of nitric acid. This played an important role during the First World War when – due to the blockage of the Central Powers – the delivery of the potassium nitrate from Chile was very difficult. At that time, Switzerland could cover its whole demand for nitrogen compounds from its own production.

7. Profits and loss of the Freiburg period

Mościcki's activities in Switzerland were marked by successes but the work atmosphere did not always allowed freedom and the necessary effectiveness of research. This was due to crossing of scientific ambitions and financial interests of factories, a phenomenon typical for the field of technology. It happened many times that Mościcki, forced by circumstances, sold his ideas – they were not fully elaborated at the time – to different firms, receiving only small sums of money in return. The purchasers implemented a given idea and put appliances on the market after having given them various commercial names. This was the reason for the squandering of many valuable inventions of Mościcki. Today little is known beyond the fact that these inventions should be traced back to him.

Fig. 2. Ignacy Mościcki, Freiburg 1907

However, the industrial technology to obtain nitric acid from air and water, using the energy of electric discharge, has been permanently connected with his name. The capacitors for alternating current circuits of high voltage and frequencies that were immediately used in the biggest radiotelegraphic stations in Europe also brought him fame. Appliances made of a system of coils and capacitors, used to secure power plants and electrical transmission chains from electrical breakdowns that were induced during thunderstorms due to electrostatic discharges in the atmosphere were also associated with his name. Besides,

the name "Mościcki" appeared from time to time in the catalogues of firms offering their own electrical products.

Ignacy Mościcki himself positively evaluated the time that started with his arrival in Freiburg. This attitude found resonance in his *Autobiography* in which he wrote: "The summary of my stay in Switzerland is very positive. In the first years of my work as a university assistant, I very much broadened my scientific range. Apart from the chemical knowledge that I had acquired earlier, I got an education in physics and electrical engineering and my knowledge in electrophysics deepened very much. Not only was it my favorite field of science but also this one in which I worked most during the 15 years of my work. All my knowledge comes only from books and possibilities to experiment. The more significant inventive activities that I mentioned before as well as other, having smaller significance, broadened my technological experience. All this resulted in an increase of my intellectual capabilities to solve tasks I had chosen for myself" [11].

8. The reception of the Swiss experiences

In 1912, Ignacy Mościcki received a job offer in Lvov. He was asked to organize from scratch and take over a new chair of electrochemistry and physical chemistry at the Royal Polytechnic School. Mościcki did not spend much time considering the offer. He knew that his salary in Lvov would be over four times smaller than what he used to receive in Switzerland but he also knew that this was a moment in which his dreams about a modern educating path for engineers for the Polish chemical industry were coming true, which he did not expect to happen. Keeping in mind the twenty years of his work abroad, he was aware of the significance of this task. He also felt ready to confront it.

As he intended to continue the research that he had conducted in Switzerland, he purchased – for his own money – the whole equipment of the Freiburg laboratory and dispatched it by rail to Lvov. The devices and appliances occupied a few wagons and weighted over ten tons.

The new professor met with real friendliness from the Royal School of Technology in Lvov. He was given spacious rooms, located on the ground floor of the Main Building, that were made free especially for him where he could organize his laboratory. That should be the first step in creating a research institute. He had been trying to achieve this aim by removing numerous administrative obstacles that piled up at the different levels of the vast university administration. When he came to Lvov, he already had a didactic project ready to be used. This project was based on his own experiences. Mościcki was convinced that even the best theoretical background and laboratory practice were not enough to educate a good engineer. He was of the opinion that such model of education, present at most European universities at the time, did not respond to the needs of the requirements of the methods of production that were advancing very quickly. On many occasions, Mościcki could see the awkwardness of young people who were so accustomed to conducting experiments in laboratories that they felt lost and confused in contact with the real industrial technology [12].

Coming back to his own experiences made him to admit that his individual abilities for innovative work developed under circumstances that he encountered at the University

of Freiburg. A good equipment of the university laboratory, readiness to take up current challenges and a real independence in their realization triggered his invention and led him to studying specialist publications and examining solutions that were coming to his mind.

Mościcki intended to introduce such points into the curriculum in his department. He saw many parallels between Freiburg and Lvov. There were no modern industrial plants in Lvov, either, where students could get acquainted with the latest achievements of the factory technology. Therefore he needed a research institute where the best students – those close to the finishing their education as well as young engineers – could participate in the design works, construct prototypes of experimental factories and then implement – on a large scale – projects that had positively undergone the necessary tests. This meant that they could take part in the construction and starting up new industrial plants.

For the time being, all he could do was to organize the laboratory. He wanted it to be as good as possible. The friendliness of people around him was very helpful. The electrical plant in Lvov, under the direction of Józef Tomicki, helped him a lot. The laboratory was supplied with high voltage current and a small distribution board was located at Mościcki's room. The board was covered with mirror panes and everything was done with a great amount of attention. All this – and many other devices that were handy at electrical experiments – was donated by the power station.

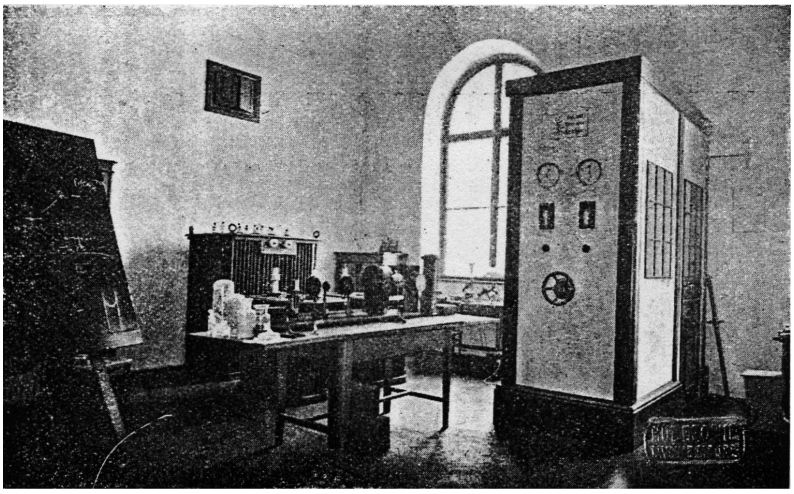

Fig. 3. High-voltage transformer in the cabinet for I. Moscicki in Lvov University of Technology (*Politechnika Lwowska*, Lvov 1932, p. 139)

After a few months during which the necessary equipment was installed, the laboratory was ready. A separate part of it belonged to Mościcki. He conducted his own research there and worked together with more advanced students. The rest of the laboratory was used for experiments that were conducted by students under the supervision of assistants.

Leon Wasilewski, Moscicki's student and later a co-worker, characterized his professor in this way: "(…) Professor Mościcki was a talented man and a wonderful teacher of inventive engineers, architects of the Polish national industry that was emerging at the time. He had

an enchanting – and also a little queer – influence on young people which was surprising because he was not a good speaker. In most cases, the professor devoted his lectures to the analysis of the way one had to go in order to reach a given technical solution. It was often a lecture about the development and research inventiveness in technology, usually based on his own experiences" [13].

At the beginning of his stay in Lvov, Mościcki continued his Swiss research. Commissioned by France, he made a project of the factory of nitric acid that was to be built in Mulhouse in Alsace. He also designed a factory of ferrocyanides located in Silesia, in Bory near Jaworzno. The implementation of both projects was interrupted by the outbreak of the First World War. The warfare activities, compulsory enlistment into the armed forces, the moving front line disturbed the normal functioning of the Royal Polytechnic School. In addition, most school space and dormitories were temporarily occupied by a war hospital. In such circumstances, Ignacy Mościcki put a lot of efforts into setting up a research institute that would be independent form the technical university.

He managed to convince two enterprisers – engineers Władysław Szaynok and Marian Wieleżyński who were also pioneers of the Polish natural gas and oil industry – about the necessity to do this. Gas and oil were natural resources of the region surrounding Lvov. On the initiative of Szaynok and Wieleżynski, following companies were set up in the mining region of Borysław: *Natural Gas, Gasoline, Natural Gas Plant in Kałusz* and other. New technological trends for to the gas and oil industry were very much in demand at the time because the war meant positive economic circumstances for them. A research institute, focused on this field, had therefore many chances to succeed.

9. The company *Metan* (English: Methane)

Similarly as earlier in Freiburg, a company was set up in Lvov in 1916 in order to finance research into the technology of the extraction and procession of gas and oil. Because of this advanced scope, it was named *Metan*. Most assets, necessary to launch the *Metan*, were brought in by Władysław Szanyok, an engineer for machines construction (a graduate of the University of Technology in Lviv). He was director of the Oil Bank which – to a significant extent – financed the construction of the gas piping from Borysław to Drohobycz. The initiators of the new company expected that the research would be soon self-financed. However, unlike the Swiss Nitric Acid Society, the company *Metan* was not profit-oriented. Its main aim was to educate engineers and to cooperate in expanding of the chemical industry. Therefore, only recommended persons could become its shareholders because they guaranteed that the founders' intentions would not be distorted in the future.

The initial capital, modest at the beginning, expanded quickly. The first investment of the *Metan* was the setting up of an analytical laboratory in which commissioned work was done, in most cases it was research into fuels, raw materials or half-finished products in order to determine their quality. Next to the laboratory, a mechanical plant was set up that produced devices that were currently necessary for technological works. Research requiring more advanced devices was conducted – wherever it was possible – in the laboratory that Mościcki had organized at the University of Technology. However, this research was often

severely disturbed by various war events. In this case, the University of Lvov offered help by putting at the disposal of the company its own laboratory at the Department of Chemistry as well as rooms located in the basement.

Already after the first research topics had been ready and rewarded with patents, it was clear that the company *Metan* had promising future perspectives and that the demand for new technologies, possible to be implemented in a short period of time, was very large. In 1917, a scientific magazine *Metan. A monthly on natural gas industry, published thanks to the efforts of Metan, L. L. Company in Lvov* was launched which served the popularization of the current activities of the company.

10. The transformation of the *Metan* into a research institute

The scope of the research conducted by the *Metan* expanded quickly and the laboratories, small at the beginning, after less than three years after the founding of the company could be transformed into a private research institute known as the Institute for Scientific and Technological Research, having its own office at 3, Leon Sapieha Street. The magazine *Metan* also changed its title, adopting a more appropriate, broader name in 1920, namely: *Chemical Industry.* The numbering of the successive issues was not changed. The *Chemical Industry* is still published.

Despite the disruption caused by the war, many students and assistants from the University of Technology were advancing their engineering talents in the laboratories of the Institute for Scientific and Technological Research. The number of permanent employees was between ten and twenty. The achievements of the institute were impressive. As many as 30 innovative technological solutions were elaborated within five years, which meant over a hundred patents, granted in different countries. All the earnings coming from the sale of patent rights and licenses were assigned to the development of the Institute and to the financing of research.

When the war ended and Poland regained its independence, the Lvov Institute for Scientific and Technological Research was – on the initiative of Mościcki – given as a present to Warsaw. Its new owner was a community association *Chemical Research Institute*. At the shareholders` meeting on March 24, 1922, it was unanimously decided that all the possessions of the *Metan* company would be given to this association. The possessions were considerable in its intellectual and material dimensions.

The major intellectual achievements of *Metan* were named and characterized by Ignacy Mościcki during a lecture [3] delivered at the festive meeting of the Polish Chemical Society in Warsaw on June 1, 1922. Among them there were the following achievements: a new technology of coal, brown coal and peat carbonization; fractional oil distillation; the construction of a gasoline factory in the mining region of Borysław, using the method elaborated in the *Metan*; the method and equipment for separating of brine from the oil emulsion; a very cost-effective technological line for pyrotechnics reactions of oil distillates that had a military meaning; a new way to obtain activated carbon; the technology of electro--winning of alkali hydroxides and chlorine as well as carbon tetrachloride and hydrochloric acid; the method to obtain pure aluminum oxide from clay which allowed to become independent from aluminum deliveries from abroad.

In the material dimension, the company *Metan* possessed devices and appliances that could be used in different branches of the chemical industry. Besides, the profits from the selling licenses increased each year.

The founding meeting of the Chemical Research Institute [14] took place on May 20, 1922. Mościcki was of the opinion that it was necessary to open at least a few such institutes in which new technologies would be developed. These technologies would be appropriate for the country`s needs and for its raw material deposits. Young engineers could extend their qualifications there. They would also be of great importance for further development of national industry. He was deeply convinced that such institutes, directed by outstanding specialists, should be set up as part of universities of technology and also as separate research institutes.

The Chemical Research Institute was intended to function independently from the state budget, as a self-financing association. It was expected that the financial means necessary for its functioning would be coming from the sale of its own ideas concerning technology. This was to be read in the fourth paragraph of its Statutes: "The association is not profit--oriented and its sole aim is to support innovative initiatives of the Polish chemical industry. All its revenues will be assigned for the realization of the Institute`s various aims as well as for its enlargement" [3].

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