Professor Jerzy Suszko (1889–1972)

Summary

Professor Jerzy Suszko, in the academic years 1952/53 till 1955/56, was the seventeenth person acting as Rector of the University of Poznań since it was founded after World War I (including the two people who acted as Rectors of the *Underground University of the Western Territories* in the years 1941–1943 and 1943–1945, assuming the University to be a continuation of the Poznań University existence). He was the most distinguished Polish pioneer in both natural products chemistry and the spatial stucture of organic compounds, the scientist meritorious for chemistry education, that was for chemistry, pharmacy and medicine students. Prof. J. Suszko was a founder of the first Polish school of cinchona bark alkaloids and stereochemistry research, it being the origin of many scientific achievements, which attained worldwide recognition and where a lot of young, talented scientists were educated.

He was born in Piosek, a village in Silesia near Teschen, on February 7, 1889 as the 12th child of a poor family of peasant origin. His first educational stage was financially supported by a Polish association called Macierz Szkolna dla Księstwa Cieszyńskiego (The School-Mother Country for the Duchy of Teschen). Due to the high marks obtained at high school, he got a fellowship, the Franz-Joseeph Gold Stipendium, and was able to begin studying at the Polytechnic of Prague from which he had graduated *summa cum laude* in 1912 and where he accomplished his Ph.D. thesis under the auspices of Paul Rabe at the age of 24. During World War I, he was serving in the Austrian army (as a lieutenant at the end) on the Croatian and Italian fronts. After Poland had regained its independence, the Polish citizenship of Jerzy Suszko and his family (he was married in 1918) was officially certificated in 1922. Since 1919 he carried out research work at the Jagielloński Universit*y* in Cracow, collaborating with Karol Dziewoński at the beginning. Next, after passing an habilitation examination (1925) and spending three years at the Polytechnic of Lvov (1927/28–1929/30, doing research and teaching as the Head of the General Chemistry Department in the Agricultural-Forestry Faculty), he was sent by a Minister's decision to Poznań in 1930, where he spent the second half of his life, working as a professor (as a Full Professor from 1937, nominated by President Ignacy Mościcki) and the Head of the Organic Chemistry De-

partment in the University of Poznań (which, in 1955, changed its name to the Adam Mickiewicz University). In October 1939, reacting to foreign invader repression, he left Poznań and was living in Cracow where, first, he was employed as a manual worker at a water pump station in Bielany, being also engaged in the bacteriological examination of water purity, and next, as a scientific manager in the chemical laboratory of a food inspection establishment. Additionally, since 1941/42 he was teaching at the Technical School in Cracow and also took part in secret teaching organized by the Underground Jagielloński University and the Underground University of the Western Territories.

At the end of February 1945, just after the cessation of hostilities in Poznań, Prof. J. Suszko came back and, as a Ministry of Education delegate and, later, as a representative of the Academic Senate, he undertook intense and effective policies to rebuild and restore the University buildings destroyed as a result of military operations. At the same time, during the next couple of years he was carrying on the Dean duties, interrupted by the war, (and, next, Deputy Dean) of the Mathematical and Natural Sciences Faculty. Additionally, at the beginning of the Fifties, he was to become the Head of the Laboratory of Alkaloids at the Institute of Organic Chemistry in the Polish Academy of Sciences (1954 – 1968, which, initially, till 1964, was called: Laboratory Nr 5th of the Department of Organic Synthesis, PASc). He also held some highly responsible positions at the University, the most important being as Rector of the University of Poznań (in the most difficult time of the Stalin period, 1952/53 – 1955/56), which was preceded as a pro-Rector in 1951/52 and Dean of the Mathematical and Natural Science Faculty for four academic years (1938/39–1946/47) interrupted by World War II.

In the year 1939, Professor J. Suszko became a Corresponding Member, and, in 1945, a Full Member of the Polish Academy of Skills, yet, in 1952, he became a Corresponding Member and, in 1958, a Full Member of the Polish Academy of Science. He was also a member of several foreign Academies of Science.

In the final period of Prof. J. Suszko performing the dean duties, he created, in November of 1946, a so called Chemical Committee, which was acting inside the Mathematical and Natural Sciences Faculty and considered all the affairs concerning the whole chemical branch, independently of its different Departments specialities. Under J. Suszko's chairmanship, these unit meetings for debate purposes took place frequently till 1951 when the Association of the Chemistry Departments was officially created and, in some sense, the Chemical Committee may be considered as being the origin of the Faculty of Chemistry later formed in the Eighties of the previous century. The creation of the Committee reflects the Professor's strong belief in the superiority of collective action and taking any decision on the basis of an opinion, resulting from a collective discussion, of competent people. The Chemical Committee creation was not the sole result of the Prof. J. Suszko's approach to holding the highly responsible positions at the University. The best known success in this field and most often mentioned as an unusual achievement (taking into account the political regulations at that time) in a research organization, was the creation by Prof. J. Suszko, as soon as he took up the Rector's duties, of a new, not being provided by the law, university administration structure unit, The Rector's College, which appeared to be very useful to perform the

Rector's duties in accordance with the old academic traditions of a democratic character.

Professor J. Suszko was a founder in 1951 and the Head of an Association of the Chemistry Departments of the Poznań University (1952–1959), an official unit which provided facilities to improve the teaching process and to undertake some combined efforts in the research activity sphere, the accuracy of such an idea can be supported by the later achievements of the X-ray crystallography and NMR-spectroscopy use for chemical and biochemical purposes acquired in the Poznań scientific environment as well as to organize a mutual library and laboratory of unique apparatus. The creation of the unit, availing the Chemical Committee experiences, may be seen as the beginning of the close cooperation of chemists at the University. Prof. J. Suszko's efforts in this matter were later undertaken by Prof. M. Wiewiórowski and led to establishing the Institute of Chemistry, being next transformed into the Faculty of Chemistry at the Adam Mickiewicz University in Poznań.

Prof. M. Wiewiórowski was additionally the founder of the Polish Academy of Science's Institute of Bioorganic Chemistry in Poznań in the late Eighties of the previous century, while the origin of the Institute reached back to the year 1954, when Prof. J. Suszko founded at the Poznań University a PASc research unit called Laboratory N° 5 of the PASc Organic Synthesis Department, located in Warsaw (the name was changed in 1964 to the Laboratory of Alkaloids of the PASc Natural Products Chemistry Department). This PASc research unit, operating under Prof. J. Suszko's supervision on Adam Mickiewicz University premises, was bequeathed in the late 60s to Prof. Maciej Wiewiórowski, who, on this basis, moving the staff out of the university to a new place and taking up the nucleic acids subject for research, created the Natural Products Stereochemistry Department of the PASc Institute of Organic Chemistry, which was finally transformed into an individual PASc research institution, the Institute of Bioorganic Chemistry. Most of the research and technical staff members of that Institute, at the time of its creation in the late 60s, had gotten their chemical education and scientific origin in Prof. J. Suszko's laboratories.

Prof. J. Suszko was an excellent experimenter in the chemical laboratory and an experienced lecturer in preparing his presentations on the basis of the most recent literature reports, concerning the most actual chemical and biochemical problems, all being of top interest in the scientific world at the time.

The main scientific achievements of Professor Jerzy Suszko were concerned with the chemistry of physiologically active natural products and with the spatial structure of organic molecules. From among the natural products, the alkaloids, and especially those of cinchona bark, were most intensively studied, because of their pharmacological properties to a great extent. The best known member of this class of compounds, quinine, known for centuries as a powerful drug in malaria treatment, can serve as an example. His synthetic and structural studies analysed all the most reactive and stereochemically important fragments of the molecules of quinine and the related alkaloids. This resulted in an elaboration of syntheses, allowing interconversions both between the analogues differing by the kind of substituent in the quinoline moiety as well as the corresponding stereoisomers as in the case of the inversion of the configuration around C(9) atom, leading to epialkaloids as the result of the corresponding toluenosulfonate hydrolysis, which, however, depending on the reaction conditions, can react towards the so-called heteroalkaloid (see reaction scheme No 2).

Further significant achievements in this field comprised, among others, the elaboration of a convenient method of a reverse quinotoxine conversion (the product of the acid treatment of quinine, but also occurring as the key intermediate in the total quinine synthesis) and related toxins to the natural cinchona alkaloids. This achievement was based on the Suszko and Ludwiczakówna discovery of a new vinyl group protection method by a bromine molecule addition, which followed, at the final stage of the synthesis, the double bond recovery by treating the dibromo derivative with iodine ions (r. sch. 1). Unfortunately, in respect of the quinine and cynchonine synthesis, these assignments, though elaborated before World War II, were only able to be published several years later after Woodward's wonderful achievements (preceded by P. Rabe's valuable discoveries in this field) in the total quinine synthesis.

However, Woodward's multistep synthesis reached the quinotoxin level only, which was motivated by the fact that the final couple of steps, one of which consisted in the formation of the quinuclidine ring system, had already been elaborated by P. Rabe. Yet, because of some problems appearing with the repeatability of those additional reactions, the simple and efficient Suszko-Ludwiczak method, based on the vinyl group protection by the bromine molecule addition and removing the atoms after cyclization and carbonyl reduction, is an elegant termination of the total quinine like alkaloid synthesis. The vinyl group protection method, based on the intermediate bromine addition, elaborated by J. Suszko was also used in the synthesis of cupreine and additionally cupreidine, a diastereoisomer not found in nature (r. sch. 25, 26).

One of the scientific problems being of specific interest to Professor J. Suszko was the quinine (and related alkaloids) transformation, occurring under alkaline conditions and leading to a product with a broken N(1) – C(8) bond, which was first observed by Pasteur in the midle of the 19th century. The Pasteur observation at that time was interpreted as a new example of a „hydramine" rearrangement, yet, because of some similarities in this transformation to other cases differing in starting material stucture and reaction conditions, (e.g. the heteroalkaloids or Hoffman degradation products formation), the pattern of the rearrangement within the vicinal amino-alkohol fragment had to be solved. According to the Suszko assumption, the reason for the N(1)-C(8) bond breaking in Pasteur's transformation does not lie in the 1,2-hydroxy-amino system, but, instead, in a specific instability of that quinuclidine bond, being solely responsible for its breaking. The first efforts moving towards solving the problem had been carried out by J. Suszko's already at the beginning of his scientific career and described in his Ph.D. thesis.

Several years later he finally solved the problem and described the experimental results in a mutual publication with J. Pepke. The way to find proof, which showed that both the presence of the OH group at C(9) is not needed for carrying the reaction, and that the new bond is formed exclusively between the C(8) and C(9) atoms, is particularly interesting, taking into account that spectroscopic methods, especialy NMR, were not known at that time, and the structural determination of the product being under investigation was based, in fact, on the measurements of the optical rotation value, shown by the product obtained from both parallely carrying syntheses. The authors found proof for the J. Suszko's assumption in the transformations carried out under the Pasteur conditions with the 9-chloro-9-deoxyquinine and 9-chloro-9-deoxyquinidine, two stereoisomers differing between themselves in the opposite configurations of their chiral C(8) and C(9) atoms. Additionally, for the reaction carried out under the Hoffmann degradation conditions, those chloroderivatives were methylated at N(1) atom, and, for comparison purposes of the final four products, both compounds obtained under Pasteur conditions were additionaly methylated. The transformation of those two pairs of stereoisomers carried out in two different ways always led to an identical product. This can only be explained by assuming the annulation of the C(8) and C(9) chirality center, achieved by the N(1) – C(8) bond break (r. sch. 3 and 4).

Another interesting problem of the cinchona bark alkaloids searched for by J. Suszko concerned the chemistry of the vinyl side chain, which, being very reactive, can be a subject of valuable transformations, but can also be responsible for difficulties in carrying out an intended chemical transformation in another part of the molecule. A superb solution for that last problem gave the already mentioned bromine addition to the double bond, followed by the debromination using iodine ions (r. sch. 1, 26 and 27). The addition of hydrogen bromide (or hydrogen chloride) to the double bond yielded a pair of diastereoisomeric halogen derivatives with a new chiral center at C(10). The elimination reaction of hydrogen halide led to two ethylene geometric isomers with the double bond being shifted to the C(3) atom of the quinuclidine ring system. However, beside the C(3)=C(10) geometric isomers, in the case of quinidine, cinchonine and their derivatives, a third isomer was found, for which a cyclic ether type structure C(9) – O – C(10) was determined. The seven membered ring ether formation is connected with a convenient steric conformation of molecules, resulting from the r. configuration around the C(8) carbon atom (r. sch. 6 and 7). In the case of hydrogen iodide elimination from 10-iodo-10,11-dihydroderivative of quinine (quinidine), beside the product with the vinyl double bond shift to the C(3) position, niquin (niquidin) was found, in the formation of which the quinuclidine ring was ruptured with the production of a secondary amino group and one carbon atom was lost from the molecule. Moreover, the hydrogenation and oxygenation processes of the vinyl side chain were also examined (r. sch. 5).

The research concerning the chemical properties of the heteroaromatic moiety of the cinchona alkaloid molecules led to an elaboration of the optimum conditions, under which the catalytic hydrogenation (in the presence of a Raney nickel catalyst) or a sodium and amyl alcohol reduction, is limited to the pyridine ring (contrary to the catalytic action of Pt, r. sch. 10) of the quinoline fragment of the alkaloid molecule and is avoided by the anomalous hydrogenolysis of the hydroxy function at C-9 (r. sch. 11). (The saturation of the pyridine fragment of the quinoline moiety causes a new chiral center at the C-4' formation, as a result of which an additional stereoisomer will appear.). It was found that the susceptibility of the C-9 hydroxy group towards the reductive action of sodium and alcohol depends upon the steric arrangement around C-8 and C-9 atoms (occurring in the case of cinchonine but not quinine) and the reaction temperature and,moreover, occurs only in the alkaloids containing the heteroaromatic quinoline ring system.

The above mentioned research concerning the hydrogenation of the aromatic fragment, was mostly carried out to find a synthetic way from a cinchonine to quinine type alkaloid, assuming that the substitution in the case of the saturated pyridine fragment of quinoline moiety will occur at the 6' position (occupied in quinine molecule by the methoxy group), while the electrophilic substitution of the natural alkaloid yielded a 5' (or 8') derivative, only. It has been established that in the nitration of N(1')–acetylo-9-acetyloxy-10,11,1',2',3',4'-hexahydrocinchonine, the substituton takes place exclusively at position 6' in the tetrahydroquinoline moiety (r. sch. 12). Important evidence for such a direction of the substitution was gained from studying what is called the O. Fischer-Hepp rearrangement when applied to N(1')-nitroso-hexahydrocinchonine. It is known that in the O. Fischer-Hepp rearrangement the nitrosyl group migrates from a secondary N-nitroso-arylamine to the *para* position of the ring. Proof of the substitution position resulted from finding that 6-nitroso-hexahydro-cinchonine being a product of the O. Fischer-Hepp rearrangement gave, after oxidation, nitro-hexahydrocinchonine identical to that obtained by the direct nitration of hexahydrocinchonine.

The chemical properties of the C-5' dervatives, obtained as a result of the electrophilic substitution of the natural alkaloids with the fully aromatic quinoline moiety, were also examined. First, an efficient method for introducing the nitro group (followed by its reduction to amino function) into the 5' position in quinine and quinidine through 10,11-dibromo intermediates was elaborated (r. sch. 8). The diazo compounds deriving from those amine-5'-alkaloids yielded two kinds of anhydrides, the „*intramolecular*” one which was formed by the hydrolysis of the methoxyl group, and the second one, „*intermolecular*”, being the result of an interaction between two diazoalkaloid molecules. (r. sch. 9). The „*intermolecular*” diazoanhydrides deriving separately from quinine and quinidine are distinct compounds, but, when decomposed, they transformed into an identical product, quinane; whereas the „*intramolecular*” diazo-anhydride forms, deriving from both these bases, are identical and can be decomposed to cuprean. Both of the final products are dehydrated alkaloids, the molecules of which contain a new double bond located between the C(8) and C(9) atoms. The nature of the transformation of diazo-derivatives is neither dependent on the saturation degree of the side chain nor on the configuration of the parent alkaloids in the range of the C(8) and C(9) chirality centres.

The two sets described above of identical transformations, which were carried out separately, using quinine and quinidine as starting materials, respectively, supplied a succeeding example of product structure determination by comparing their stereochemical properties. The identity of the products' properties showed that the stereochemical differences between the starting alkaloids were removed, which was only possible when a new double bond was formed instead of the chirality centers at C(8) and C(9).

The originality of the applied method for proving the identity of the different reaction products additionally lies in measuring the optical rotatory power, that is the property of an individual molecule, instead of the intermolecular interaction, as it is, for example, in the case of melting point determination. As a result of that, it was possible (using the optical rotatory power in combination with a synthesis) to determine the structure of a compound, being in a liquid or solid state, independently.

The structure and conversion studies of other alkaloids concerned those occurring in the genera *Papaver* (codeine and rheadine, r. sch. 14), *Lupinus* and *Cortinarius* (r. sch. 16). The very interesting achievement was reached in cooperation with M. Wiewiórowski concerning the so–called α-isomerism in codeine chemistry (r. sch. 15). A small sample of codeine received just after World War II was the only alkaloid reagent in J. Suszko's laboratory at that time. In that situation, efforts were made to elaborate a synthesis of morphine, using codeine as a starting material. Carrying out the experiments in this direction, the problem with α- isomers appeared, which had already been known for many years, but the unknown structure of these derivatives complicated the synthesis endeavours. In that situation, research to solve the problem was implemented and resulted in finding that all α-isomers were acetyl derivatives of the corresponding synthetized compound and, though unstable, are easily formed, even in a reaction with an acetic acid component of the reaction medium.

Later, M. Wiewiórowski was very much engaged in independent research on the alkaloid composition of lupine, their isolation procedure, as well as the structure and chemical properties. Professor J. Suszko participated in part of this work, including searching through the lupanine – lupinic acid equilibrium (r. sch. 13).

At the beginning of the thirties in the previous century, Jerzy Suszko put forward a new method of determining the molecular symmetry, especially in the case of fused-ring polycyclic aromatic hydrocarbons. This method was, next, verified, mainly on naphthalene molecules, and based on the binding of two identical chiral substituents to the ring system in different positions, followed by an analysis of the resulting stereochemical mixture (r. sch. 18). J. Suszko's analysis of molecular symmetry determination was highly appreciated by foreign scientists and their opinions being presented in world literature. Other stereochemical studies, concerning stereocontrolled syntheses, conformation stability and configuration determination, were carried out on various cyclic aliphatic hydrocarbons, including bornane derivatives (r. sch. 17 and 19 to 24).

Professor Jerzy Suszko got a *Doctor Honoris Causa* degree from the *University* of Adam Mickiewicz in 1969. He educated a great number of University students both in chemistry and pharmacy. From about forty people who got their Ph.D. degrees under his scientific supervision, many later reached the highest levels in their scientific careers.

He was a founding member of the Polish Chemical Society and was very much engaged in its activities during his whole life, including the frequent presentations of scientific achievements by him and his Ph.D. students at the Society meetings. He also held some responsible offices therein, including the President of the Society, and was a member of its Council. His merits were appreciated by the Society and, as a result of which, he became an honorary member of the Polish Chemical S*ociety* in 1964 and was awarded the Jędrzej Śniadecki medal in 1968. He was also a member of several foreign scientific societies, including the American Chemical Society, American Association for the Advancement of Science, the German Chemical Society, the Chemical Society of London and chemical societies in some other countries. This enabled him to obtain numerous volumes of foreign journals and books to compose a large chemical library, all being in his ownership, which he transfered by testament to the Adam Mickiewicz University.

Beside the numerous professional duties carried out by prof. Jerzy Suszko, especially during the first decade after World War II, he was also a very active member of the Evangelical Augsburg Church in the Poznań parish. During his intensive activity for the congregation, he became a president of the Polish Evangelical Society (PTE) and, being delegated by the academic Senate, was a superintendent (curator) of the Polish Evangelical University Students' Association (SPAME). The Professor's daughter, Alina, was engaged in this youth organisation as vice-president for a few years.

Professor Jerzy Suszko was married twice. With the first wife, Emilia, maiden name Gulda (1895–1972), he had four children, three of them, Roman (1919–1979), Alina (1923–1996), and Jadwiga (1925–1994), having a scientfic career, while the second son, Bogdan (1921–1924) died when he was three. The Professor spent the last years of his life, together with Wiktoria Ewa Bagińska-Antkowiak (1907–1988), employed for many years at the University as the head clerk of the Dean's office, whom he married at the begining of 1972. Professor Jerzy Suszko died on October 5, 1972 and was buried in the pathway for meritorious people at the Junikowo cemetery in Poznań.

To honour the merits of Prof. J. Suszko for the University in Poznań, one of the streets in Poznań is called by his name. On the centenary year of his birth, a commemorating plate with his image (done by Stefan Stawiński) was unveiled in the Adam Mickiewicz University hall of Collegium Chemicum.

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