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TEODOR LIPPMAA — AN OUTSTANDING ESTONIAN ECOLOGIST

Abstract. Teodor Lippmaa (1892—1943) was an outstanding Estonian ecologist and botanist. He used and developed the chromatographic adsorption method of M. S. Tswett studying the pigments ecology of subarctic plants and communities already in the 1920s. In the 1930s he studied thoroughly the flora and vegetation of Estonia, started exact vegetation mapping of this country, dealt with many theoretical problems of ecology and vegetation science (life-forms system, vegetation classification, structure of plant communities, etc.), composed a vegetation classification of Estonia on the basis of synusiae, etc. Many ideas of T. Lippmaa are followed and developed by Estonian botanists and in modern ecology and vegetation science.

Key words: Lippmaa, vegetation science, vegetation ecology.

Teodor (Theodor) Lippmaa (until 1924 Lipman) was born on November 17 (5), 1892 in Riga where his parents were seeking work. He graduated from a four-year town school (1908), passed the exams of home tutor (1909), worked as a teacher of natural history at a private school in Riga, and passed the final exams of high school in 1914. After the outburst of World War I, in 1915, he began to work as a chemist at a military plant, in 1917 he entered the Department of Physics and Mathematics of Petrograd University, but studied there only for one year. After that he moved to Altai where he worked as a school teacher. He also began his work as a botanist there. T. Lippmaa came to Estonia in 1922, entered Tartu University, graduated from it as a botanist in 1924, was awarded a master's degree in 1925, and was appointed to the post of senior assistant. He defended his doctor's thesis on September 4, 1926 and habilitation thesis to obtain the post of assistant professor on March 30, 1927. In the spring of 1929 he was relieved of the responsibilities of teaching for one year and sent abroad (France, Algeria). He was called back in the early spring of 1930 to fill the vacant position of botany professor and director of the Botanical Institute and Gardens in Tartu. Now the most productive period in T. Lippmaa's life began. He started to map Estonian vegetation, wrote numerous theoretical and methodological articles about vegetation structure, ecology, classification and dynamics, took part in several international botanical conferences, etc. At that time he became known in the whole world as one of the creators of the method of synusiae in vegetation science. He was also socially active — worked as chairman of the Nature Conservation Council (1935—1938) and that of the Naturalists' Society (1939—1941), drew up the Estonian Nature Conservation Law (came into effect in 1935), etc. In 1938 the Estonian Academy of Sciences was founded and twelve founders-academicians of the Academy were approved. On May 15, 1939 the thirteenth academician — Prof. Teodor Lippmaa joined them; he was the only elected academician in independent Estonia.

T. Lippmaa collected scientific facts on various research trips and in the course of stationary field work in Estonia (on Abruka Island, in Setumaa, Pärnumaa, Rangu heath, etc.) as well as abroad (North Altai, Finnish and Norwegian Lapland, France, Algeria, Holland, Germany, Sweden, Finland, Canada, USA). In the 1920s he investigated successfully the ecophysiology of plant pigments. During the German occupation, when it

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was not possible to continue field work and stationary observations, he returned again to the problem, intending to write a thorough comparative research on pigment biochemistry and ecophysiology. This superintensive work and also his life were cut short on January 27, 1943 by war — a bomb dropped by a Soviet bomber aimed at bridges on the Emajõgi River fell right upon the Lippmaas' apartment in the Botanical Gardens. The professor, his wife Hilja and their daughter Siiri were killed. Professor H. Kaho wrote in the *Postimees* newspaper on February 3, 1943: "All of us who knew Professor Lippmaa closely or through his papers were shaken by the news that he had been killed by accident in the evening of Jan. 27. Cruel fate broke of the life of an eminent scientist in his best years, shortly after his 50th birthday, when he was full of creative power and will /. . ./. The future will give a worthy estimation to his work and the memories about his work will always be alive. All the natural scientists of Estonia will remember him with great gratitude for all the valuable activities that helped to bring the nature of our homeland nearer to them." (About the biography of T. Lippmaa see Laasimer (1963); Trass (1982); and Vaga (1961)).

Chromatography and Ecophysiology

Academician Endel Lippmaa, who is the son of Academician Teodor Lippmaa, recalls from his conversations with his father that the latter had wanted to become a chemist and that he was to a certain extent "a botanist by chance". He started to deal with botany in Altai where it was not possible to conduct chemical studies. Even in T. Lippmaa's library books on chemistry and physics dominated at first. After arriving in Tartu in 1922 he began to deal in parallel with botany studying the vegetation of South-East Estonia, the western islands (1924—1927), and Pärnumaa (1929 and 1931) as a scholar of the local committee of the Society of Estonian Literature; he also took up plant biochemistry and ecophysiology. He published several papers in these fields in German and French in the 1920s (Lippmaa 1924, 1925, 1926b, 1926c, 1926d, 1926e, 1926f, 1926g, 1926h, 1926i, 1928, 1929). In spite of the numerous publications his research in these fields did not become well known in the scientific community. He was mostly acknowledged as a geobotanist and ecologist. Recently, in 1985, an article written by Dr. Leslie S. Ettre was published in the *Chromatographia* journal — "Theodor Lippmaa — the Forgotten Chromatographer" (Ettre, 1985), which shows that during the "standstill period" in chromatography (from World War I to 1931 when articles by Kuhn, Winterstein and Lederer began to appear) it was still developed in Estonia by T. Lippmaa who used and developed the chromatographic adsorption method of M. S. Tswett (professor of Tartu University in 1917—1918). T. Lippmaa was the preserver, user and developer of the methods which had brought about a breakthrough in biochemistry and its cognate sciences. He was the first to understand the importance, application possibilities and prospects of Tswett's method in biochemistry and physiology. Without going into the details of T. Lippmaa's chromatographical investigations (see Talts, 1961) I would still like to present a quotation from L. S. Ettre's article in which he estimates fractions of xanthophyll and rhodoxanthin separated by T. Lippmaa and his conclusion that they are not isomers, but structurally different substances. L. S. Ettre writes: "This is really a very clear statement, well ahead of its time; just a look at the structure of these carotenoids shows how right Lippmaa was. This is even more laudable if we consider that at that time very little was known about the structure of the substances ... Lippmaa's investigations, demonstrating the superiority of Tswett's method, were carried out just a

Table

Phytochromatical spectra of plant communities in tundra and forest tundra

Plant communities	Plant species without red pigment, %	Plant species poor in anthocyanides, %	Plant species rich in anthocyanides, %
Birch open woodland	56	22	22
Heath birch forest	33.4	20	46.6
Arctic high grassland	42.8	28.6	28.6
Arctic dwarf shrub heath	19.2	15.4	65.4
"Snow meadows"	54.5	12.2	33.3

few years before the decisive work of the Heidelberg group which is generally considered as the rebirth of chromatography. It is a pity that, being a botanist, Lippmaa did not further pursue these investigations. Even so, he deserves more than a passing reference in the history of chromatography" (Ettre, 1985, p. 402).

From the aspect of ecophysiology and phytocoenology a certain part of T. Lippmaa's work which has not gained the necessary respect before should be pointed out here. This is his method of phytochromatic spectra suggested in his paper "Pflanzenökologische Untersuchungen aus Norwegisch- und Finnisch-Lappland unter besonderer Berücksichtigung der Lichtfrage" (Plant ecological investigations in Norwegian and Finnish Lapland, with special emphasis on the issues of light; Lippmaa, 1929). T. Lippmaa discovered that in different plant communities different amounts of different plant pigments come into being (Table). He explains this phenomenon by stating that different phytochromatical spectra of plant communities depend on site conditions (light intensity, water regime, temperature, etc.). He doubts J. Wiesner's hypothesis that arctic plants have an optimum amount of light energy. T. Lippmaa states that in the Arctics the amount of light is much bigger than the plants need and tolerate and that red pigments of flowering plants protect them against excessive light intensity. This viewpoint, which is right in principle, has been supplemented later by the discovery of other functions of pigments (especially in metabolism processes), but this does not lessen the importance of T. Lippmaa's phytochromatic analysis in the research of synecophysiological regularities.

Floristics and Plant Geography

T. Lippmaa started botanical research work already when living in Altai and later he published two papers on the flora of the neighbourhood of Chemal (Lippmaa, 1926a; 1927). In one of them even a new species was described (*Cardamine altaica* Lippm.). In the 1920s he also published several papers on the flora of different parts of Estonia. In the 1930s he started in cooperation with K. Eichwald large-scale preliminary work to compile "Estonian Flora", publishing exsiccatas "Estonian Plants" (4 issues, including 200 species) about species of Estonian flora. These publications provided the most important material when the compiling of "The Flora of the Estonian SSR" was started in the 1950s. In this field the most significant paper written by T. Lippmaa is a survey of the history and geography of the flora of Estonia (Lippmaa, 1935c), a wonderful book still used when studying the development and elements of Estonian flora and habitats of its species, or the territorial distribution of the plant cover in Estonia (Eichwald, 1961; Laasimer, 1965).

Vegetation Mapping

In 1930 the 5th International Botany Congress was held in Cambridge which passed a decision to compile a large-scale map of European vegetation. However, only two countries — Switzerland and Estonia — started to carry this decision into life. These countries had strong leaders and also means for such an expensive undertaking. In Switzerland — a country not affected directly by the war — the work was finished in 1949 (map 1 : 200 000), in Estonia in 1955 (manuscript map 1 : 42 000, consisting of several hundreds of map-sheets). Other countries had organizational and financial difficulties and I. Horvat had to convince geobotanists of European countries to start that work (setting an example of Switzerland and Estonia) at the International Vegetation Mapping Symposium in 1959.

T. Lippmaa acted decisively. In the spring of 1934 a notification about the method to be used and the vegetation units to be distinguished (there were 40 of them) was distributed in Estonia. Financial aid was given by the Ministry of Education. In 1934 about 40 sheets were mapped (by K. Eichwald, J. Eplik, H. Aasamaa, S. Kaaber, E. Pastak (Varep), A. Rühl, E. Saarsoo, H. Salasoo, V. Sirgo, E. Kumari, A. Tamsalu, G. Vilbaste), one sheet covering about 100—150 km^2 (Lippmaa, 1936). Everything went according to the schedule and T. Lippmaa hoped to finish the mapping in 7—10 years. In 1940 nearly half of the territory of Estonia was already mapped. After the war this work was continued by A. Vaga and finished by L. Laasimer. Altogether 68 botanists and representatives of other branches as well as amateur botanists took part in this work. A great task had been fulfilled — the largest and most exact vegetation map in Europe on state level had been completed. Unfortunately, due to the Soviet cartography policy, this material is not easily accessible for researchers while the generalized 1 : 600 000 map is deformed revealing little of the enormous amount of the vegetational cartographical material. We can only be glad that this material of growing scientific importance (vegetation dynamics!) is being carefully preserved.

Theoretical Problems of Vegetation Science

Theoretical problems of vegetation science are dealt with in 30 publications by T. Lippmaa. The development of his theoretical convictions (taking into account the rapidly changing terminology of the 30s when most of his papers were published) was a complicated process (see Trass, 1955; 1961; 1975; Trass, Malmer, 1973; Трасс, 1964; 1976; Vaga, 1940; Laasimer, 1965). T. Lippmaa reacted flexibly to some new theoretical solutions and syntaxonomical re-evaluations, but held firmly to some of his viewpoints proved correct by personal research. The following approaches deserve special attention:

Plant community. T. Lippmaa proved in several papers (Lippmaa, 1931b; 1933a, b; 1935b; 1938; 1940) plant community to be first and foremost an ecological phenomenon; therefore it is clear that the ecological factors affecting directly the structure and species composition of a plant community must belong to the characteristics of plant communities. T. Lippmaa disagreed with the wide-spread opinion that plant communities must be defined and classified only according to their own characteristics, i. e. without ecological factors, and wrote (Lippmaa, 1931b, p. 27) that differentiation of plant communities by their floristic composition would be thoroughly justified if plant communities were distributed evenly on very different sites, as genotypical characteristics of plant species persist even under very different conditions. As this is not true about plant

communities, a method proceeding only from the vegetation itself and searching dependences between vegetation and site only afterwards will not yield good results. Applying this principal viewpoint, T. Lippmaa became a consistent developer of the ecological approach in vegetation science.

Classification. The classification principles worked out by T. Lippmaa are ecological due to the ecological treatment of plant community. In the classification of Estonian vegetation published in 1933 (Lippmaa, 1933a) which differentiates about 150 syntaxa, the groups of syntaxa are distinguished by the main ecological factors (light, water regime, soil fertility, etc.) and sections by life forms. The ecological principle in the classification of plant communities has also been followed by other Estonian geobotanists, especially Liivia Laasimer (1965) in her survey of the plant cover of Estonia.

Character species. T. Lippmaa regarded character species as the most informational for vegetation classification. Other North-European and Soviet phytocoenologists also consider dominant and constant species to be of high diagnostic value. T. Lippmaa showed in his study of the *Galeobdolon — Asperula — Asarum* union of deciduous forest herb layer (Lippmaa, 1938) that the classificational content of this widely spread vegetation unit could be objectively understood only if character species were applied when distinguishing syntaxa, i. e. plants which with their occurrence, abundance, cover and vitality characterize the ecological conditions and floristic composition of this vegetation unit. However, it must be noted that the meaning of character species suggested by T. Lippmaa differed from that suggested by J. Braun-Blanquet (former Zürich-Montpellier school). The latter stresses the quality of such species of characterizing a certain floristic grouping, while T. Lippmaa stresses their indicator characteristics, i. e. characteristics showing environmental conditions of plant communities.

Method of synusiae. The term *synusia* denoting the main functional-structural element of a plant community was first used by Helmut Gams in 1918. Being convinced already in the 1920s, but especially after his visit to Lapland that the structural elements of plant communities were often quite loosely connected to each other and that one and the same synusia might occur together with other synusiae (e. g. the synusia of *Hepatica nobilis — Pulmonaria officinalis* occurs in Estonia both in deciduous forests and mixed spruce forests and in Central Europe in beech forests; herb layer synusiae of Lapland's open birch woodlands extend further to the north than birch forests themselves, etc.), T. Lippmaa worked out his one-layer associations method or method of synusiae which was widely acknowledged. This doctrine was the basis for T. Lippmaa's or Estonian school in vegetation science which has existed since the 1930s. One of the most outstanding ecologists and vegetation scientists R. H. Whittaker has written with admiration about the significant role of small nations in the development of vegetation science referring especially to the Estonian school created and led by T. Lippmaa (Whittaker, 1962).

Continuum. The concept of continuum did not exist in vegetation science during Lippmaa's activities (it was taken into use in the early 1950s), but it should still be stressed that T. Lippmaa understood that plant communities were not closed, firmly framed and discrete units (many of the leaders of vegetation science of his time considered them to be such, e. g. J. Braun-Blanquet, G. E. Du Rietz, V. N. Sukatchov, etc.), but units related to one other with transitions which could under certain

conditions form a series of spatial changes, or, according to the modern concept, a continuum of vegetation that has relatively obscure coenotic borders (Трасс, 1966). Descriptions of such series can be found in the works of T. Lippmaa when he refers to spruce-hardwood swampy forests and in his vegetation analysis of islands rising from the sea due to land rise (Lippmaa, 1931a; 1933a; 1935a). At the same time T. Lippmaa did not negate the existence of well-distinguished plant communities with distinct characteristics; on the contrary, if there existed inevitable conditions — ecotopes with more or less equal ecological conditions, enough time for coenogenesis and enough space — well-distinguishable communities would take shape in the plant cover. Many of the present-day phytocoenologists share this viewpoint.

Ecology

It is difficult to make a difference between T. Lippmaa's phytocoenological and ecological researches. Actually, all his papers dealing with vegetation are ecological (and they could be evaluated as such, especially when taking into account that vegetation science — phytocoenology, phytosociology — is now considered to be part of ecology). Some of his works were purely ecological, e. g., an original paper (which, for some reason, has not found much attention) about elementary life forms (Masing, 1961) and stationary ecological investigations of broad-leaved forests on Abruka (Lippmaa, 1933a; 1935b; 1939; 1940). T. Lippmaa entered his name into the list of the top ecologists of the world with his research of Abruka Island and was asked to make a presentation about his research methods and results on the Plant and Animal Communities Research Conference in North America in 1938 (as the only botanist from Europe). All the stationary investigations carried out and to be carried out in Estonia after T. Lippmaa (in Rangu, Palupõhja, Avaste, Voore, etc.) have been and will be influenced in some way by the ecological methods and principles worked out by T. Lippmaa.

Nature Conservation

T. Lippmaa studied problems of nature conservation already in the 1920s when he worked for the Local Studies Committee, but he had no closer cooperation with the pioneers of Estonian nature conservation (F. Bucholtz, J. Piiper, A. Mathiesen, G. Vilbaste, et al.) yet. Nature conservation problems became especially important for him in 1935 when it became necessary to pass a law on nature conservation (Eilart, 1961). T. Lippmaa drew up a draft of the Estonian nature conservation law in 1935; it was discussed on September 30, 1935 in the Estonian Naturalists' Society and adopted as a national law at the end of the same year. The highest body of nature conservation was the Nature Conservation Council at the State Parks Administration. On December 23, 1935 T. Lippmaa was elected Chairman of that Council. He guided the activities of the Council proceeding strictly from scientific principles and taking into account the experience of other countries. He organized a network of volunteers involving about 600 people in 1937, planned the principal trends of nature protection (compiled the corresponding programme), started to compile a list of animal and plant species and erratic boulders to be taken under protection, and made proposals about founding nature reserves, etc. At his initiative or under his guidance state nature reserves were founded in the course of three years. In addition to that 26 rare plant species, 107 great erratic boulders, 111 primeval trees, etc. were taken under protection.

At the beginning of 1938 the system of nature conservation management was reorganized and it became less democratic (the members and chairman of the Council had to be nominated, the director of Nature Care and Tourist Institute was nominated to the post, more bureaucratic documents came into being, etc.). T. Lippmaa resigned from the Nature Conservation Council under those conditions and his active participation in the Estonian nature conservation movement came to an end. However, these three years (1935—1938) were the most fruitful period in Estonian nature conservation, mostly so thanks to T. Lippmaa's profound knowledge.

If a scholar whose investigations have a firm place in the history of science, who has created something permanent in science, who has been the creator and applier of new ideas, whose papers are taken into account and quoted even after many years can be called an eminent scientist, then T. Lippmaa is undoubtedly an eminent Estonian botanist and ecologist.

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