Soil science in Estonia until 1918


When crop husbandry became more and more expanding and permanent field of activity for our ancient ancestors during the Bronze Age, or maybe already in the Late Neolithic period, people who had earlier lived on the forest and now on the field became interested in the soil that had formed during the preceding millennia. Naturally we do not have immediate information of the beliefs and values of that time, to say nothing of science or the scientific approach. However, the ancient fields at Kõmsi and Rebala, dating from the first millennia B.C., as well as other areas elsewhere, presumed to have been arable according to burial sites and other immovable artefacts, reveal quite a purposeful choice in terms of ecological conditions, especially the soil. It can be assumed that at least the soil water status, composition and the consequent properties must have been perceived and taken as a basis when growing foodstuffs and animal feed. It is quite certain that soil specifics were taken into account in regular crop husbandry during the Iron Age, especially if the location of the settlement of that time and the production proved by ancient finds are considered (Jaanits et al., 1982).

The contents of the Danish property assessment rolls and information obtained from [the historian] H. Ligi about maps dating from the period of Swedish rule give evidence of the description of the productive and morphological varieties and the regional distribution of soils. However, there is no soil science in its substantial meaning yet. The second part of Stratagema oeconomica, first published in 1645, with repeated publications of 1649, 1688 and 1757, can be regarded as the earliest publication in which the classification of soils with brief descriptions are dealt with as a specific subject of description (Gubert, 1688). The defined units are primarily based on soil colour and texture, whereby besides the brown (Braun Land) and two varieties of grey soil (Grau Acker and Grau Land), three different types of black earth are distinguished - Schwarze Erde, Schwarz Acker and Schwarz Land. Translated by Lomonossoff (1747), the former of these contributed the term chernozem to the Russian soil science terminology and therefrom to world terminology. The term did not originally refer to the steppe or forest steppe at all, but the Livonian oak forests. Although S. Gubert and its translation include black earth as a separate unit, the abovementioned and later papers by M. Lomonossov deal with it as the black surface layer of soil (Lomonossoff, 1747, 1763). When and how the black earth of the Livonian (possibly also Estonian) oak forests became a generally accepted term for the soil type found in the steppe and forest steppe zones needs to be explained yet because it is still not clear (Krupenikov, 1986). The second type of black earth (Schwarz Acker) is characterised by S. Gubert by its klint and limestone bedrock; the third type (Schwarz Land) features scree and high soil fertility but is hard to cultivate. This shows that the author must have been familiar with Estonia (North Estonia), because there are no klint and limestone or scree soils in Livonia.

Quite soon thereafter, in 1681, simultaneously with the land audit in South Estonia extensive land valuation started, whereby land was classified according to the thickness of the humus layer, texture and bedrock and the yield level of each class was expressed according to grain and hay yield in money (Hueck, 1845 - quot. Vint, 1959). There is no complete data about the beginning and basis of land valuation conducted at the same time in North Estonia (Kask, 1975). On the island of
Saaremaa land was valuated a century later. The instructions in 1766 also considered the thickness of the plough layer, soil texture and bedrock, and overall production and profit was calculated on the basis of rye (Vint, 1959). Opening the Chair of Agriculture in the Department of Philosophy of the University of Tartu in 1803 did not mean a new stage only in the agricultural science of Estonia, but also for soil science. When J. W. Krause, the first head of the Chair of Agriculture, Technology and Construction that was founded at the same time, started his lectures on agriculture in 1806, the programme also included soil science. Unfortunately, it is not known what and how J. W. Krause lectured on soil, but the fact is noteworthy that already more than 180 years ago it was considered necessary to provide systematic information on soil when teaching agricultural specialists. Moreover, until that time this had not been taught in any Russian universities. In the 1829/1830 academic year J. W. Krause's successor J. F. L. Schmalz, who had earned a doctoral degree from the University of Jena, included soil science with plant nutrition as a main subject in the curriculum. As the university became the main and, at that time, the only place in Estonia where soil science was taught and soils studies conducted, the following deals with the work related with soil science done by lecturers of agriculture at the university. From the 1830/1831 academic year J. F. L. Schmalz began teaching a special course in soil evaluation and classification according to the textbook compiled by himself (Schmalz, 1824). In 1836 already the subject of agricultural chemistry is included as a special course. It can be assumed that the nine-class manor and farm land evaluation scale, adopted by the 1856 Agrarian Reform Act, also reflected the impact of J. F. L. Schmalz and his teaching (Kask, 1975). Furthermore, one of his first students Jakob Johnson, who came from a peasant family in Viljandi county, worked as a land evaluator and published several papers. J. F. L. Schmalz taught in Tartu, but also in the Vaste-Kuuste Agricultural Institute that he founded (1834...1839), but he was sent by the Ministry of Internal Affairs to South and South-East Russia and the Crimea to solve different soil problems, especially ones related to growing grapes, olives, tea bush and cotton. In his reports he mentions that thanks to the contribution of his colleagues he had an opportunity to raise the research work in Tartu to an honourable level and in cooperation with his students to make a considerable contribution to the promotion of Russian agriculture. At his initiative efficient studies were conducted in the field of soils and fertilizing, and even in the issues of gas and nutrient exchange (Schmalz, 1845). Topics of the awarded papers of the Department of Philosophy included in 1838 included e.g. the following: a) what is the benefit of knowledge about soil, its fertility and the richness of nutrient elements; b) what measures have been used to determine the production capacity of soil; c) how to evaluate these measures; d) how to determine the production capacity of soil according to a scientific and feasible model. At the same time the subjects for teaching lecturers, presented by J. F. L. Schmalz, included soil science, study of plant nutrition and fertilizing. After J. F. L. Schmalz retired, he was succeeded by Georg Paul Aleksander Petzholdt (1810...1889), the personal student of Justus v. Liebig. Petzholdt had particular merits in promoting soil science and agricultural chemistry in the University of Tartu, including teaching masters of agriculture in these fields. Agricultural chemistry became an independent subject, taught according to an original textbook (Petzholdt, 1846). A practical training in the chemical analysis of soils and plants was included in the curriculum. The course was much more extensive (12 hours per week) than the practical training for students of agronomy in Estonian University of Agriculture today. G. P. A. Petzholdt established laboratories, equipped as
appropriate in the period, and besides other agricultural material collected a significant study collection of soils and fertilizers there. During his numerous journeys to Russia and Germany, Belgium, England, France, Netherlands, Algeria, Spain and many other countries he combined research with collecting study aids, improving his research and teaching skills and promoting the image of the University of Tartu. He pioneered in studying black soils in the steppe areas of Russia already in the 1850s (Petzholdt, 1851, 1856, 1864), decades before V. Dokuchaev and other founders of genetic soil science. The data and standpoints of G. P. A. Petzholdt in the issues of the black earth in steppe have not been specially studied and in the interests of science history it should be done more in-depth and more variedly than by I. Krupenikov (1981). Also worth more serious study are his reports on research trips to foreign countries, to Caucasus and Turkestan (Petzholdt, 1856, 1862, 1864), especially in terms of the associations of soils, land cultivation and crop production. He should be considered the most outstanding person who continued the traditions of foreign relations and publicly promoting science, started by J. F. L. Schmalz. Petzholdt played a significant role in promoting and developing the reputation of the University of Tartu and the agricultural science, especially soil science and agrochemistry.

G. P. A. Petzholdt was succeeded in the chair of agriculture and technology by Carl Georg Franz Hehn (1821...1875), who was born and raised in Estonia and educated and awarded a degree at the University of Tartu. Hehn was the editor of several agricultural journals and the organiser of the 1st Baltic Agricultural Conference and regional exhibitions. However, at the same time the mineralogist and chemist Johann Theodor Lemberg delved into the problems of soil science. According to his student, the later well-known soil scientist A. A. Jarilov, Lemberg dealt with soil science as a part of chemical geology (Krupenikov, 1981).

When Hehn retired as a scientist, the situation at the university had changed so that it was not possible any more for one professor only to teach all agricultural disciplines. Agricultural chemistry was taught then by associate professor W. von Knieriem, and soil science, after C. G. F. Hehn's death, by G. B. Brunner (1835...1892). The latter's merit was the initiative to analyse soils, plants and fertilizers for practical purposes. He evidently followed the example of the work done under the proposal of Vassili Dokuchaev and led by Carl Ernst Heinrich Schmidt in analysing the chernozem of Russia in the chemistry laboratory of the university. The University of Tartu and Schmidt's lab can be regarded the first centre of soil analysis in the world. A. A. Jarilov was the student of C. E. H. Schmidt, J. T. Lemberg and later A. D. L. Thomson at the University of Tartu, and to them he dedicated his monographic textbook in two volumes¹ (Jarilov, 1904, 1905).

In that period Vassili Dokuchaev also organised two expeditions to Estonia – in 1876 to Narva and Sillamäe and in 1881 to the surrounds of Haapsalu (Reppo, Valdek, 1963). He used the data collected there, among other data, for writing Russian Chernozem, published in 1883, and several other papers. As far as it is known, these expeditions did not have any immediate impact on the development of the soil science in Estonia. In this respect, analytical collaboration with C. E. H. Schmidt (not with F. Schmidt, as mistakenly noted in the paper by E. Reppo and E. Valdek) had a much greater impact. The doctoral thesis by G. Thoms (1892) and several studies published by him in 1888...1900 present numerous data about the chemical composition and properties of the soils of Tartu county. These data were used and

¹ This book was presented to the author of this article by the daughter of A. A. Jarilov, Jekaterina Jarilova after the III USSR Soil Scientists Conference held in Tartu in 1966.
referred to by prof. A. Nõmmik in his later reviews (1923). Needless to say, inspiration for this kind of study could stem from larger-scale works conducted at the university. A graduate of Tartu university Arvid Dietrich Leopold Thomson (1862...1941) and Sergei Bogushevski, an immediate colleague of Vassili Dokuchaev in St.Petersburg, started their career at the university more or less at the same time. A. A. Jarilov remembers the former of these two as his agrochemistry teacher, but when S. Bogushevski came, he obviously had already completed his soil science course lectured by Johann Lemberg. S. Bogushevski came to Tartu with considerable research experience (Bogushevski, 1890, 1892) and supposedly also brought along the experience of collaboration with Vassili Dokuchaev and the influence of the Dokuchaev school. Among his studies conducted in Tartu is a remarkable paper on soil physics (Bogushevski, 1898), which may be worth closer analysis with relation to modern machine degradation of soil. Sergei Bogushevski still lectured the course in soil science (3 hours per week) in the spring semester of 1917, but supervised practical projects in the autumn semester. There is no information of his later course of life. According to hearsay he had evacuated to Voronezh, but so far we have had no success in finding out anything about him with the help of our colleagues in the university there.

Among the doctoral students who defended their thesis when A. D. L. Thomson and S. Bogushevski worked at the university, was Sergei Kravkov, the later head of the Chair of Theoretical Soil Science at the University of Leningrad. He was promoted at the University of Tartu (dr. oec.) in 1912 and a selection of his articles from 1898...1937 and bibliography were published in a separate collection (Kravkov, 1978). A. D. L. Thomson, who meanwhile also worked in Moscow at Petrovski Academy (currently named after Timiryazev) and in the Soil Committee of Moscow Agricultural Society, supervised more than 25 dissertations and acted as an opponent to a number of thesis papers. It appears that shortly before World War I there was an increase in the number of dissertations defended in the field of soil science and agrochemistry at the University of Tartu and this gave a new impetus to creating contacts with other universities, scientific societies and committees.

The results of the land valuation conducted in South Estonia pursuant to the law act of 4 June 1901 were summarised in a paper by E. Campenhausen in 1911 (Vint, 1959). However, not a map of soils but the map of the geological formations of Livonia was given in its appendix (Kongo, 1957). It is difficult to say to what extent these papers reflected the soil science-related influence and activities of the University of Tartu. In that period a relatively general overview of the geography of soils was included only in the works by K. D. Glinka, describing the rendzinas and degraded rendzinas in North Estonia and podzols in South Estonia. In the schematic map of Russia (scale: 1:25,200,000) the whole Estonia is shown as a podzol area (Kongo, 1957). Before the 1920s no work was done at the University of Tartu on soil geography and cartography.

In summary, it should be once more mentioned that the development of soil science in Estonia before 1917 was closely connected with the development of agricultural education at the University of Tartu and with the land valuation conducted at the beginning of the century. The professors who promoted the agricultural science and education of the whole Russia at the University of Tartu within more than 100 years included soil scientists and agricultural chemists, many of whom had already specialised and were educated in the field – G. P. A. Petzholdt, C. G. F. Hehn, W. v. Knieriem, A. D. L. Thomson, S. K. Bogushevski. Their activities created the prerequisites for establishing an independent chair and developing active research at the University of Tartu after the Republic of Estonia was declared in 1919.