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## Investigations of the lithuanian quaternary deposits of duke Antanas Giedraitis in 1878-1895 and his approach to the theories of continental glaciation and polyglacialism

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**Abstract.** Vilnius College was founded in 1570 and Vilnius University in 1579. The Faculty of Philosophy teaches Aristotle's physics, often called natural philosophy or natural science. Geological knowledge was also provided. In the 18th century, scientific works on natural philosophy appeared at Vilnius University, which also dealt with geology. The Department of Natural History was founded in 1781, with the aim of linking science with practice and economic needs. Expeditions were organised to study the resources of the region, and collections of minerals, rocks and fossils were made. The most successful and distinguished professors were Ž. E. Žiliberas (*Joan Emmanuel Gilibert*, 1741-1814), J. G. Forsteris (*Johan Georg Forster*, 1754-1795) and St. B. Jundzilas (*Stanislaw Bonifacy Jundziłł*, 1761-1847).

The Department of Mineralogy was established in 1803. R. Simonavičius was its first head and organiser. He taught mineralogy until 1813, assembled a huge collection of mineralogy, created a classification of mineralogy, and is considered the pioneer of geological science in Lithuania. He was succeeded by Feliksas Dževinskis, who taught mineralogy from 1814 to 1817, Ignotas Horodetskis 1817-1824, Juozapas Jundzilas 1824-1825, Ignotas Jakovickis 1825-1832. After the closing of Vilnius University in 1832, a part of geognosists still worked in Vilnius Medical Surgery Academy, until its closing in 1842.

Geology as a science stopped to develop in Lithuania. For 80 years Lithuanias' geology saw only episodic interest from other universities', scientific societies', Geological committees' (since 1882) geologists. Tsarist government had no interest in prospecting local minerals. That is why geologists who originated in Lithuania tried to organise geological expeditions in an attempt to fill the gaps in the geological survey of Lithuania. Most notable example of such attempts are the geological researches in 1878, 1883, 1884 and 1885 by Antanas Giedraitis (Antoni Karol Giedroyc, 1848–1909).

Results were published in 1886 and 1887 (Giedroyc 1886a; 1886b; 1887). A summary of all research together with geological 10-verst scale map was published in 1895 (Гедройц, 1895).

Since 1882, A. Giedraitis was an associate of the Geological committee. This allowed him to carry out these geological expeditions, which (as he writes) began from his homeland, Korvio (Karvio) manor in Maišiagala region near Vilnius. He performed three main expeditions. Two were in the meridian direction. One in latitude direction. More than a third of all the expeditions are in current territory of Lithuania.

A. Giedraitis' drawings and descriptions of the observed outcrops' layers as well as the interpretation of the information suggests that he was very well acquainted with the newly established continental glaciation theory and was proponent of the theory.

He discovered there had been more than one glaciation. Some outcrops had visible sediment from two glaciations at different periods, in others even three. By supporting the polyglacialism theory he stated that he lacks data to precisely name the number of past icings. In A. Giedraitis opinion the polyglacialism theory is also supported by aging surface relief from north to south.

**Keywords:** Vilnius University – Continental Glaciation – Polyglacialism – Duke A.K. Giedraitis – Quaternary Deposits.

After the last division of the Republic of Both Nations in 1795 until the First World War, Lithuania was occupied by the Russian Empire, and in 1915 - German. Only in 1918 February 16 Lithuania was restored as a democratic state.

When the population came under the influence of the Russian government, they expressed dissatisfaction with conspiracies and uprisings. Vilnius University students and teachers actively participated in the particularly important uprisings of 1830-1831 and 1863-1864, which were brutally suppressed by the tsarist authorities. After each defeat, the conditions of the political and cultural life of Lithuania worsened, and the persecutions of the Russian authorities became more and more severe. The centre of Lithuanian science - Vilnius University - was closed in 1832, and geology, like other sciences, stopped developing.

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Tsarist government had no interest in prospecting local minerals.

That is why geologists who originated in Lithuania tried to organize geological expeditions in an attempt to fill the gaps in the geological survey of Lithuania.

The most striking example of such attempts is the geological research of Duke A.K. Giedraitis. (Antoni Karol Giedroyc, 1848–1909) (Fig. 1 and 2).

**Antanas Karolis Giedraitis** was born 1848 on the 20<sup>th</sup> February and baptized on the 21<sup>st</sup>.

**Antanas Karolis Giedraitis** died on November 8<sup>th</sup>, 1909. He was buried in the Karvis<sup>1</sup> cemetery (Figs. 3, 4 and 5).

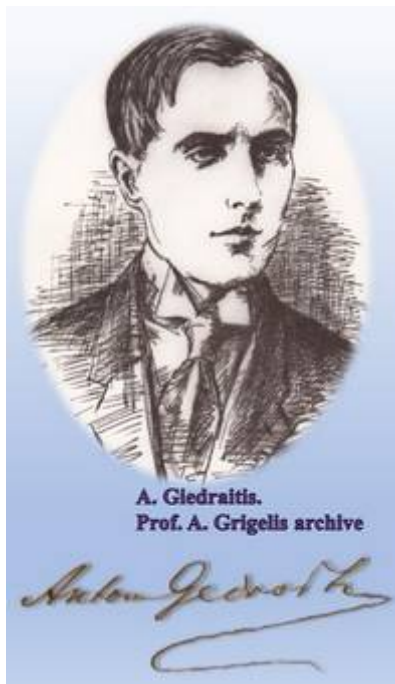


Fig. 1. Antanas Karolis Giedraitis (Antoni Karol Giedroyc, 1848–1909). Drawing, 1962. From the archive of A. Grigelis

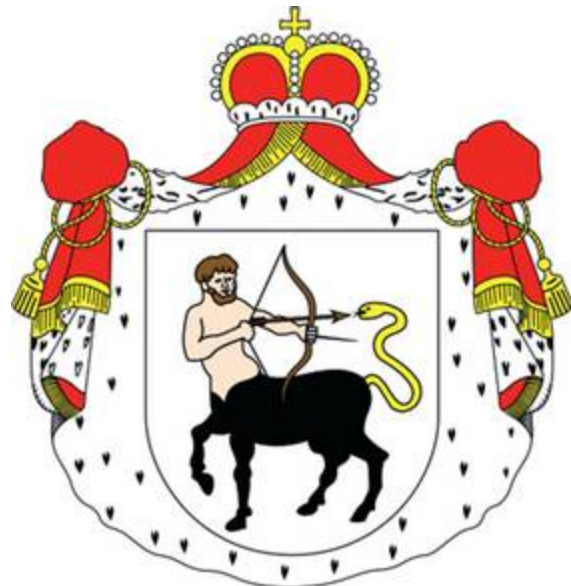


Fig. 2 Coat of arms of the Giedraičiai family (XIII<sup>th</sup> century)

<sup>11</sup>Vilnius district village in Maišiagala ward, on the south bank of Karvi's lake. In historical sources, Karvis manor first mentioned in 1691. For some time it belonged to the Giedraičiai family. There are the remains of the manor house.

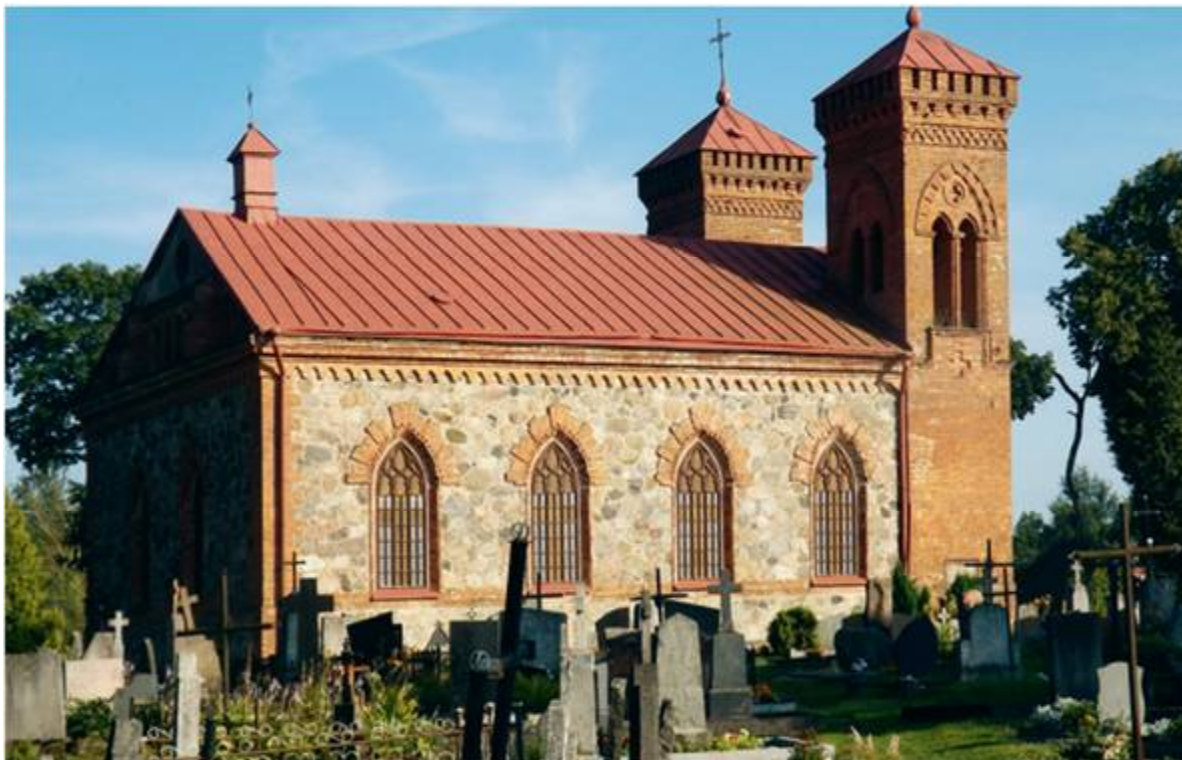


Fig. 3. Karvis Church, built in 1865, with a cemetery



Fig. 4. The graves of A.K. Giedraitis and his father Edmundas have been newly arranged (photograph by E. Genutis)



Fig. 5. The Priest consecrates the renovated tombstone. 19/05/2023 (photograph by V. Baltrūnas)

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Having established relations with the Petersburg Mineralogical Society, in 1878 A. Giedraitis carried out geological work in Gardins Governorate, neighbouring Lithuania and Poland territories.

A. Giedraitis prepared the reports of these studies, which were published 1886-1887 (see bibliography). In 1882 after the establishment of the Russian Geological Committee, A. Giedraitis becomes its member and actively engages in its activities.

He conducted geological routes in Kaunas and Suvalkai provinces (Fig. 6), used their geological material for making the fifth sheet of the 10-valve scale geological map (Гедройц, 1884). Later, he conducted new geological surveys of Poliesia, the reports included a geological map compiled by him was also published (Гедройц, 1895).

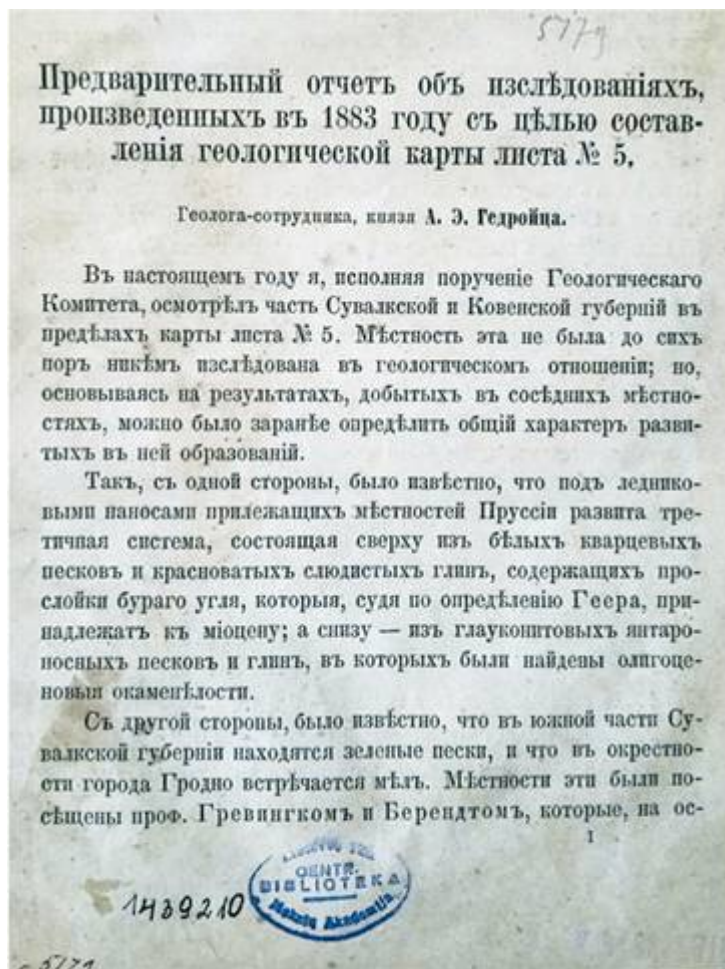


Fig. 6. A fragment of A.K. Giedraitis report on the explorations of Kaunas and Suvalkai provinces in 1883

A. Giedraitis' drawings and descriptions of the observed outcrops' layers, as well as the interpretation of the information suggests that he was very well acquainted with the newly established continental glaciation theory and was proponent of the theory.

The theory of continental glaciation had only recently begun to gain ground in the scientific

world: Swiss pastor Bernar Kuhn (1787), Scotsman James Hutton; the Swiss Jean Pierre Perraudin (Fig. 7) and Ignaz Venetz (1818); Norwegian Jens Esmark (1824); German Prof. Reinhard Bergardis (1832); Louis Agassiz (1837) tried to convince that there was no "global flood" (Fig. 8).



Fig. 7. The house built by Jean-Pierre Perraudin himself is now a museum in the village of Lutjero (Switzerland) (photograph by E. Rudnickaitė)

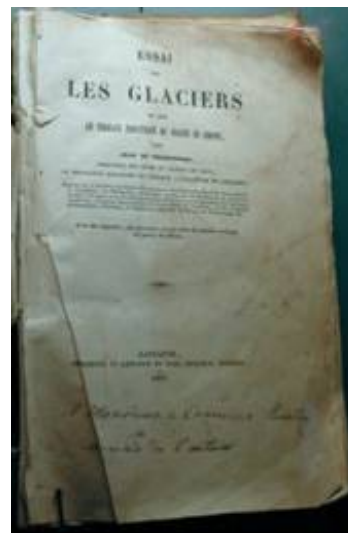


Fig. 8. Agassiz's book *Essai sur les glaciers* published in 1841, title page with inscription of gift autograph to Perraudin (photograph by A. Bitinas)

Finally, in 1880, the scheme of the chronology of the old glaciations was "born".

We don't know if A.K. Giedraitis had read all the works of L. Agassiz (1839, 1840, 1841, 1847, 1866). But it is safe to say that they were known to him.

A.K. Giedraitis discovered that there was more than one glaciation in the areas he studied. Some outcrops had visible sediment from two glaciations at different periods, in others even three.

By supporting the polyglacialism theory he stated that he lacks data to precisely name the number of past icings. In A.K. Giedraitis opinion

the polyglacialism theory is also supported by aging surface relief from north to south.

R. Guobytė (2023) states: «No topographic maps were available at that time; therefore, he could not map the distribution of glacial and post-glacial deposits. He emphasized that the distribution of these deposits depends greatly on the surface features he had so carefully described in his notes. A.K. Giedraitis recognized the most prominent morphological structures: a belt with numerous lakes (present-day marginal Baltija Uplands); a sandy, undulating south-eastern plain grading into dunes; and the lowland of the Nemunas low reaches. He recognized Telšiai-Raseiniai (Samogitian) and Venden (Vidzeme) uplands, nowadays

recognized as insular uplands. He described two depressions stretching southward from the Riga Bay and Peipsi (Čiudas) Lake, which nowadays are recognized as pathways for the Last Glacier flows. A.K. Giedraitis was a follower of the glacial theory and the first scientist to build a realistic, close to modern understanding, geomorphology picture of Lithuania and neighbouring areas. A.K. Giedraitis, by no doubt, is a pioneer of geomorphological mapping».

### Pioneer of Quaternary research in Lithuania

Although only one phase of this scientist's life is related to Lithuania, it is definitely possible to claim that A.K. Giedraitis was one of the pio-

neers of Quaternary research in Lithuania (Figs. 9 and 10). He completed several routes along the banks of the Nemunas, Neris, Šventoji, Dubysa, Jura and other rivers, explored the river valleys of the territories of Belarus and Poland.

The presented geological map of A.K. Giedraitis shows that two routes were in the meridian direction (the first - from the headwaters of the Venta River through the Kaunas, Suwalki and Gardinas governorates; the second - from Vilnius along the Poliesé railway to the city of Rovno in the Voluinés governorate). The third route continued through the governorates of Minsk, Gardin, Suwalki, Lomza to Warsaw. More than a third of these routes fall on the territory of Lithuania (Fig. 27).

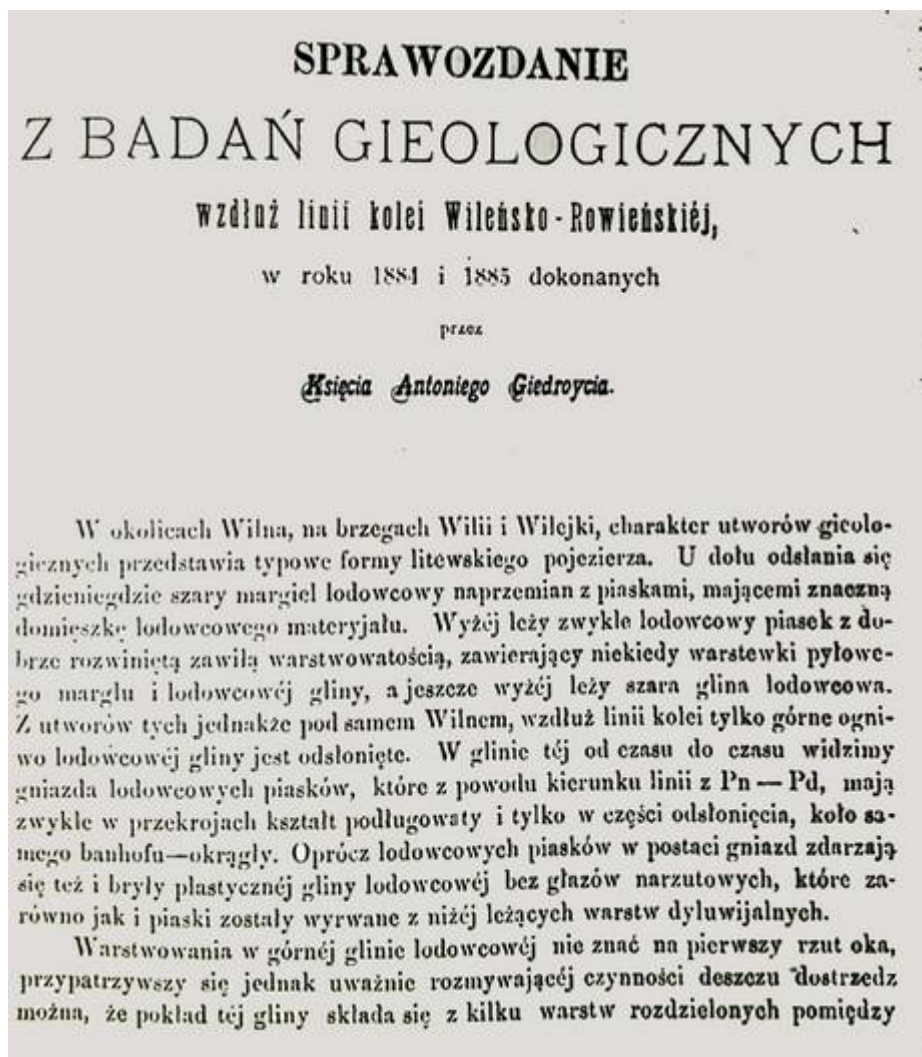


Fig. 9. Fragment of the article about geological research conducted on 1884-1885 along the Vilnius - Rovno railway line

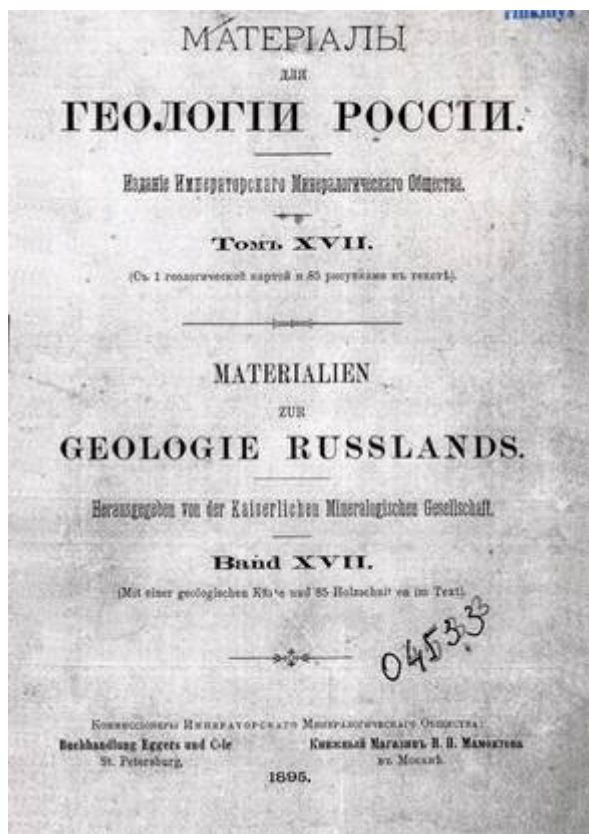


Fig. 10. The cover of A.K. Giedraitis (1895) book and the title of Chapter VI

A.K. Giedraitis was a consistent supporter of polyglacialism, he described and summarized his research data obtained by studying the relief, composition and structure of glacial formations (Figs.11, 12, 13, 14, 15, 16, 21), stratigraphy, soil formation, mineral raw materials. in 1884 in the report, he claimed that in glacial formations it is often possible to find slabs of Tertiary, Cretaceous and Jurassic formations (Figs. 12, 14, 15, 16, 18, 20, 22, 23), for example, Druskininkai, Kaimelis, Gelgaudiškis, etc. areas. Very interesting are the drawings of his outcrops, illustrating the nature of glacial accumulation and the structure of compressed moraines (Dalinkevičius *et al.*, 1969).

When describing clays of glacial origin, A.K. Giedraitis distinguished layered and non-layered clays. According to him, there are layered or banded clays in many areas (in Tauragė, Nemunaitis, near Ukmergė, etc.). He rightly assumed that it was the sediment of preglacial lakes. Unstratified clays are widespread at the margins of stratified clay basins. Peats A. Giedraitis called brown coal and studied them in the vicinity of Gardin, where they sank under red moraine loam.

The scientist concluded that the periods of warm and humid climate that existed during the Ice Age were favourable for the formation of peat (Giedroyc, 1884; 1886; 1887).

After collecting a lot of factual material, the scientist came to the conclusion that two separate morainic horizons (ed. - layers) are spread on the territory of Lithuania (Figs. 16, 18, 20, 21, 23, 26), and even three morainic clay horizons are found in Vilnius (Figs. 16, 19, 22, 24, 25). The author indicates the number of past glaciations very carefully - the morainic loam horizons differ only in colour, while the composition is very similar. The colour of morainic loams depends on the rocks that the glacier scratched as it moved, because it is precisely from them that the ice age formations were formed. By studying the composition of moraine loams and boulders, according to the author, it is possible to trace the composition of the pre-Quaternary rocks of the areas through which the glacier moved. Thus, boulders and slabs of the main layers are indicators of a pre-Quaternary bed (Figs. 18, 20, 22, 23).



A few drawings from A.K. Giedraitis, 1895 (Гедройц, 1895) publication

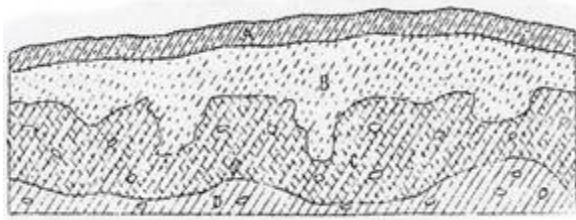


Fig. 11. Periglacial wedges

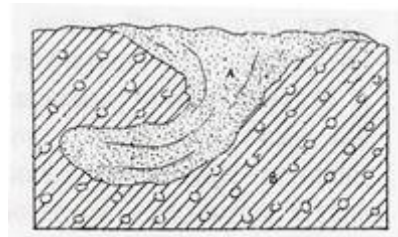


Fig. 12. Inclusion texture

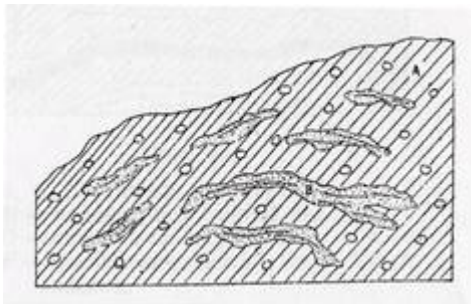


Fig. 13. Sand lenses in loam

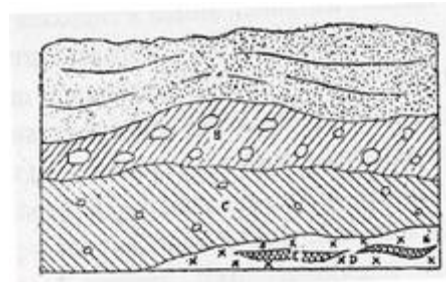


Fig. 14. Plastic clay inclusion texture in loam

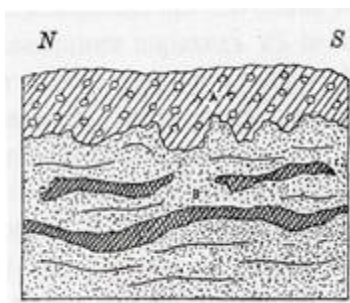


Fig. 15. Layered clay, light and pink sand and loam

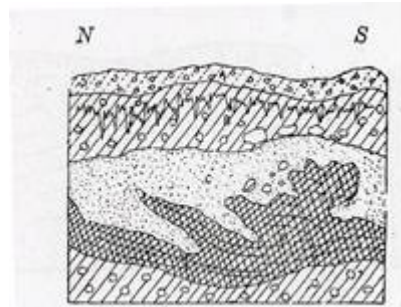


Fig. 16. Inclusive texture between two moraine layers

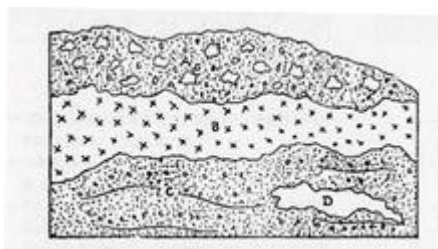


Fig. 17. Black clay layering of gravel yellowish-brown layered clay and boulders

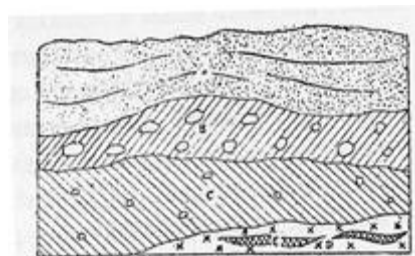


Fig. 18. Layers of glauconitic sand grey plastic morainic loam, red morainic sand and greenish laminated sand

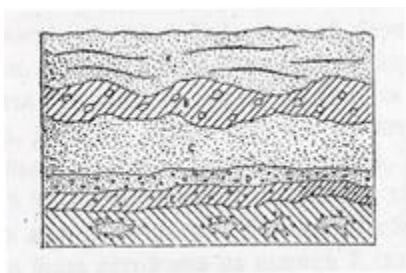


Fig. 19. Outcrop with three layers of different moraines

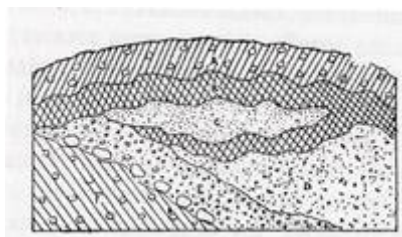


Fig. 20. Between the two moraines layers is the texture of a deformed tertiary clay layer

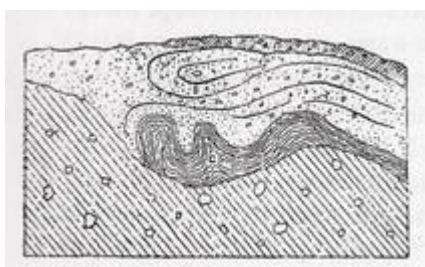


Fig. 21. A push-and-push texture between two moraine layers

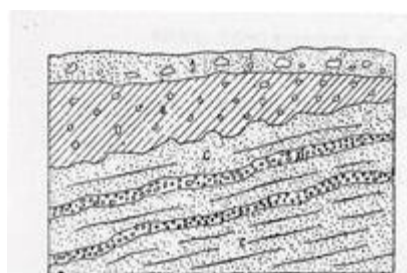


Fig. 22. Sandy clay with boulders, red glacial clay, reddish hardened sand, gravel, grey glacial sand with a predominance of glacial and tertiary material

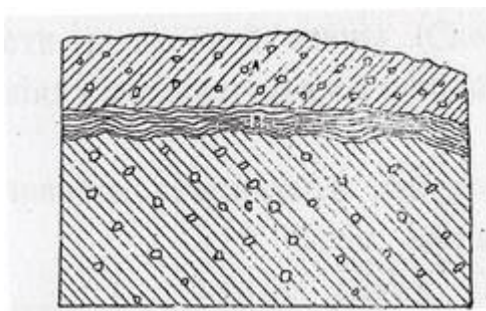


Fig. 23. Red glacial marl, layered shale and clay marl, grey glacial marl with pieces of glauconite sandstone

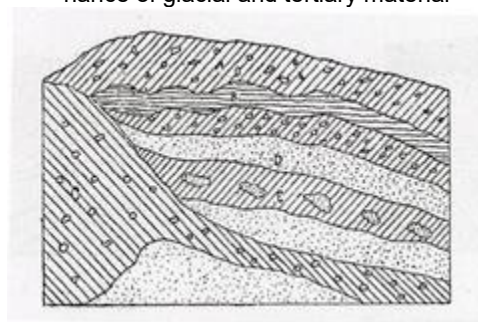


Fig. 24. Glacial sandy clay, greenish layered sandy clay, glacial marl, whitish green sand, glacial grey sandy clay, interspersed with sand, sand, grey glacial marl, greenish grey glacial sand

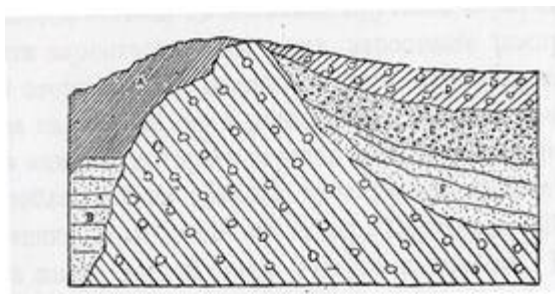


Fig. 25. Scree, glacial guss and partly red glacial clay, glacial gravel, layered sand, grey glacial marl

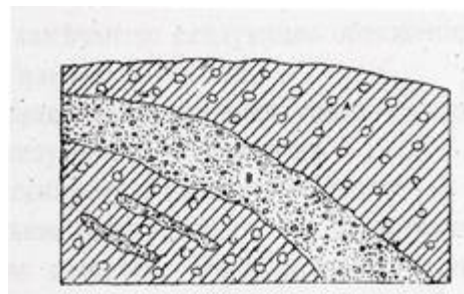


Fig. 26. glacial red clay, glacial sand; glacial red clay containing layers of glacial sand

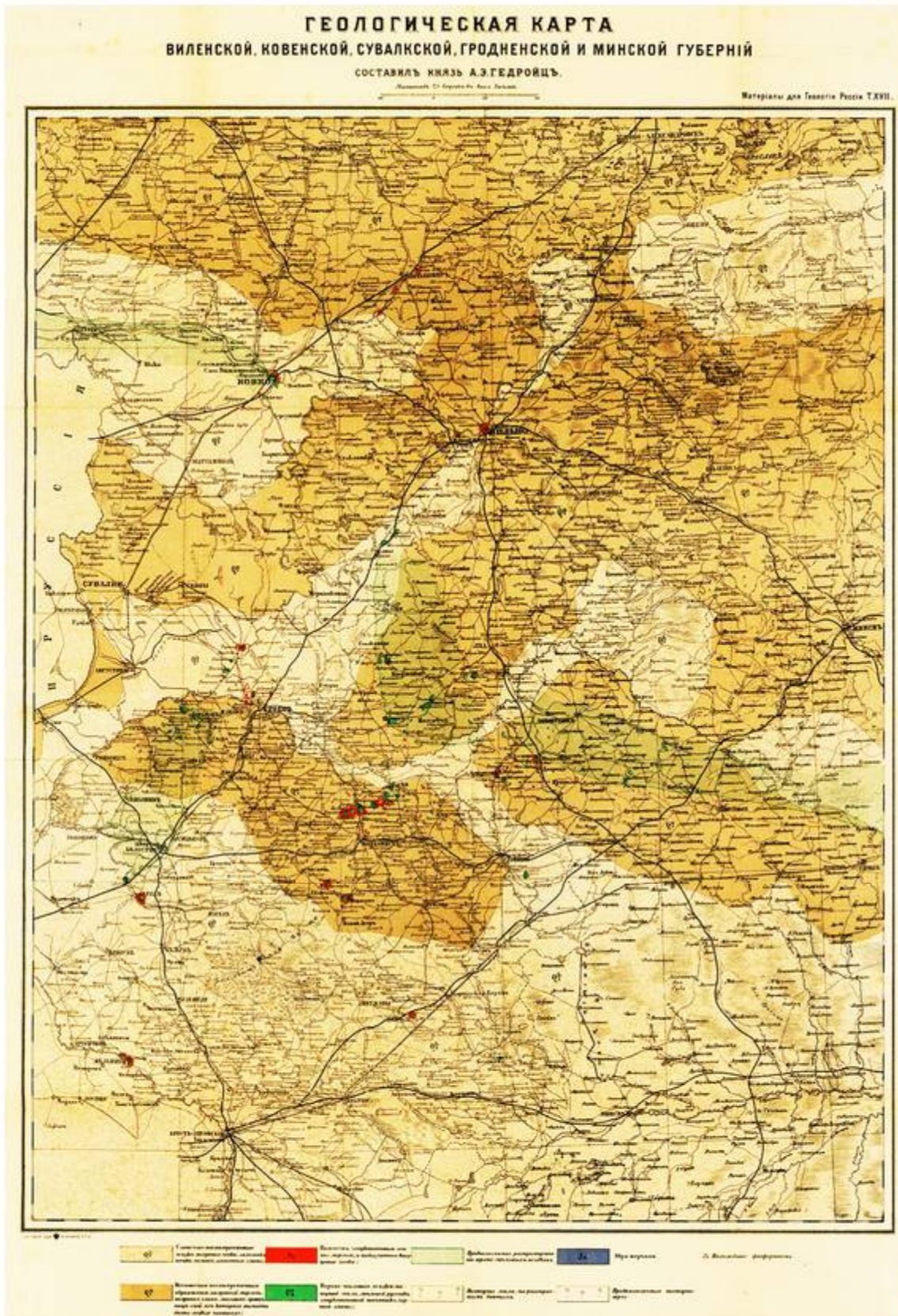


Fig. 27. Geological map. Vilnius, Kaunas, Suwalki, Gardin and Minsk governorates. Created by Duke A.K. Giedraitis. (Гедройцъ, 1895). General view. Digital version from the personal archive of prof. Andrzej J. Wójcik (Polish A Sc)

### Instead of an epilogue

175<sup>th</sup> anniversary of the Duke and geologist A.K. Giedraitis' birth was celebrated in 2023 by the

Lithuanian community of geologists, scientists, Vilnius, Kaunas, etc. and Karvis township citizens.

The conference was organized, the publication dedicated to this occasion was published.

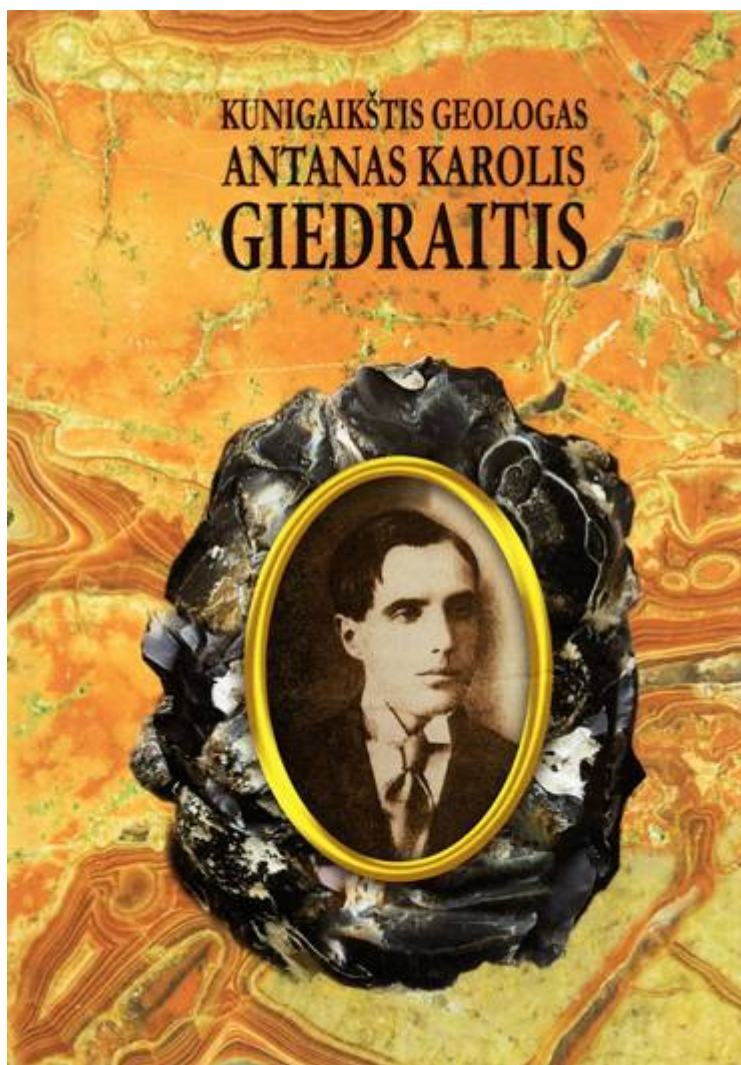


Fig. 28. Cover of the book "The Duke and the Geologist Antanas Karolis Giedraitis"

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