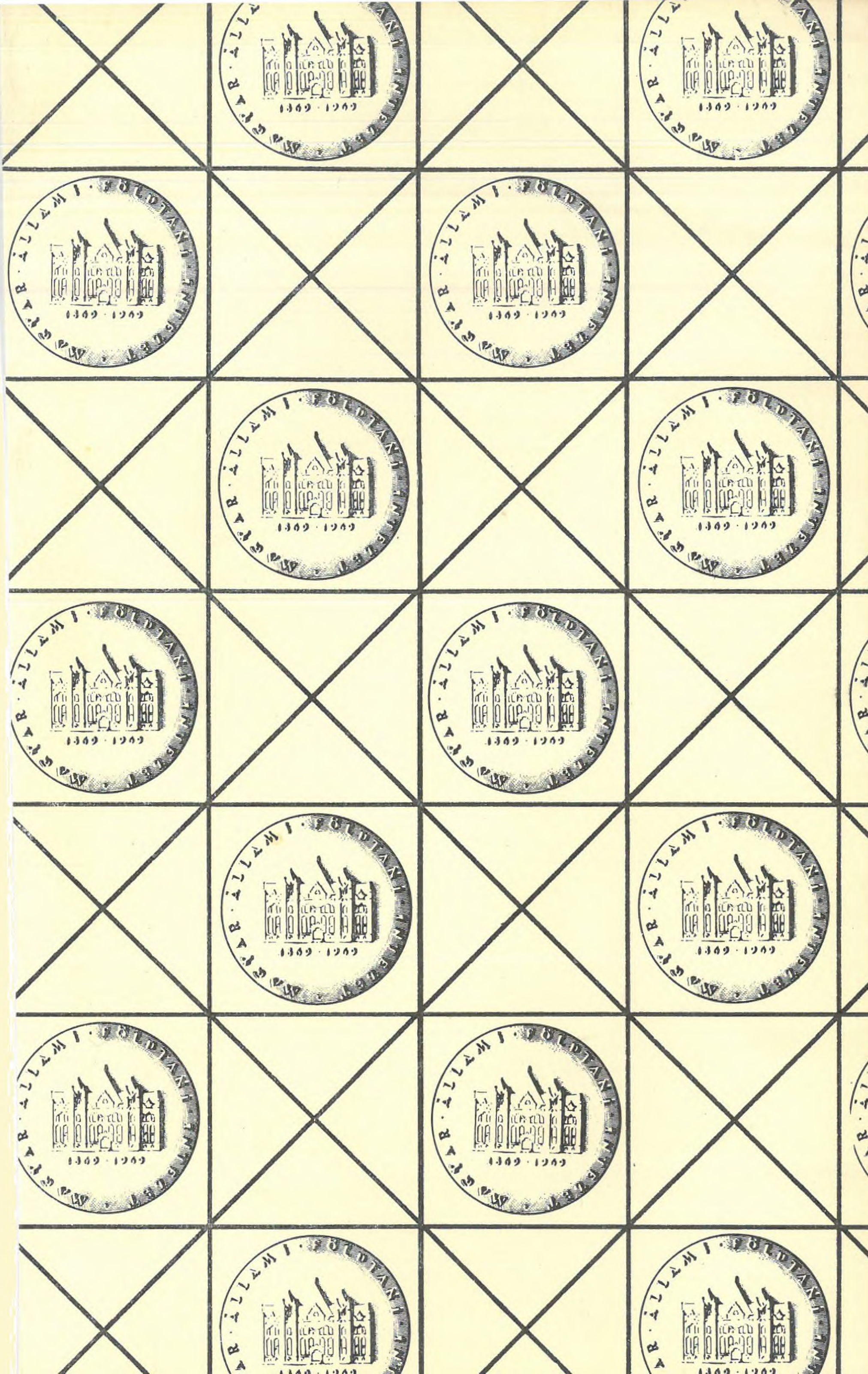
ONE HUNDRED YEARS
OF THE
HUNGARIAN GEOLOGICAL INSTITUTE


MAGYAR ÁLLAMI FÖLDTANI INTÉZET
1869 · 1969

ONE HUNDRED YEARS
OF THE
HUNGARIAN GEOLOGICAL INSTITUTE

HEADQUARTERS
OF THE HUNGARIAN GEOLOGICAL INSTITUTE

ONE HUNDRED YEARS OF THE HUNGARIAN GEOLOGICAL INSTITUTE

Edited
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HUNDRED YEARS OF THE HUNGARIAN GEOLOGICAL INSTITUTE

by

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Director of the Hungarian Geological Institute

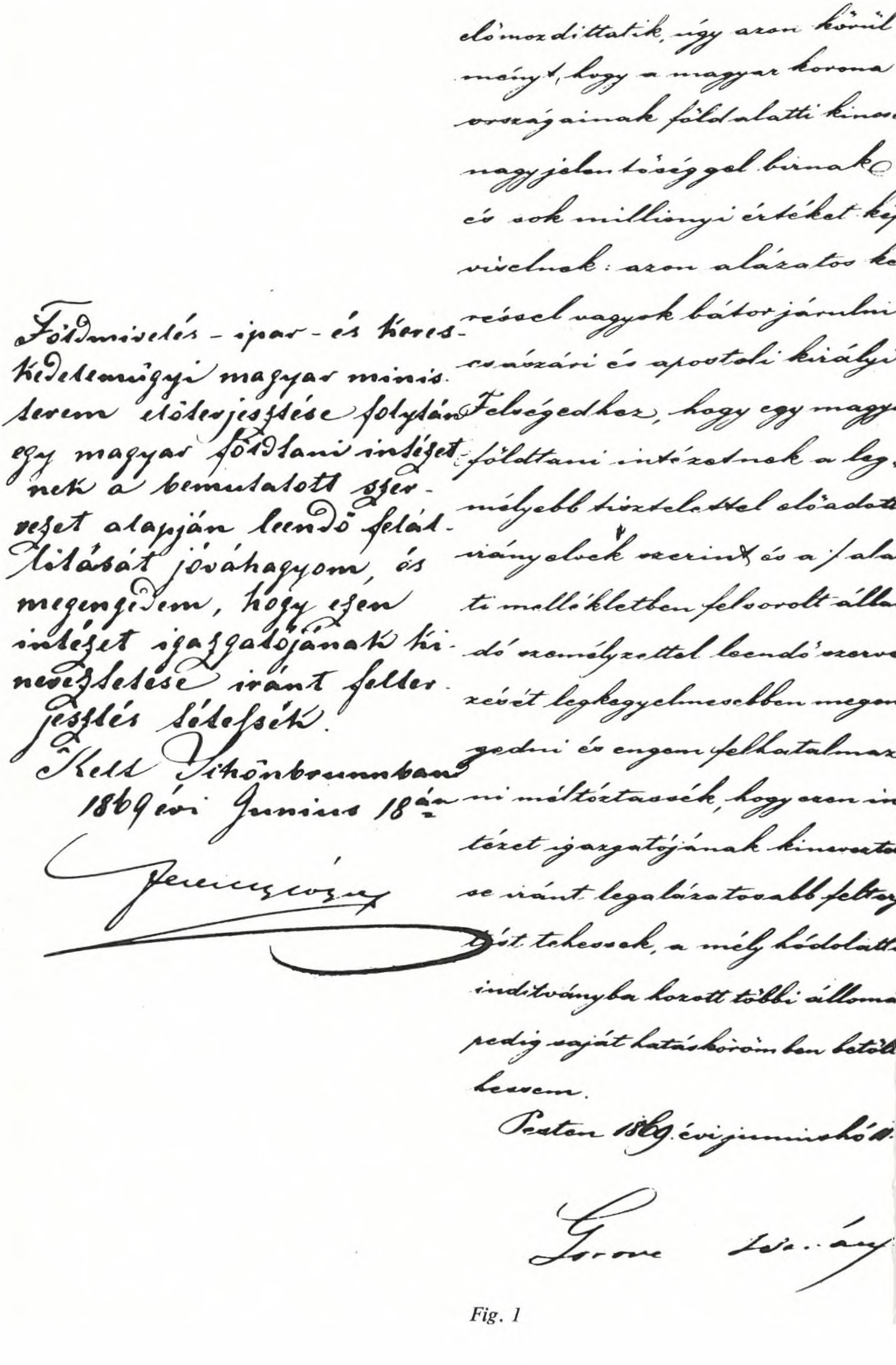
FOUNDING

..."*I consider the geological knowledge of this country to be of great importance for science and, particularly so, for the economy. For this reason, I feel obliged to promote geological surveys and investigations in order that the Nation may profit from these prospective scientific results as soon as possible*" ... Those are the first lines of the letter written on January 16, 1868, by István Gorove, minister of agriculture, industry and commerce, to the Hungarian Geological Society—a message urging the establishment of an independent, Hungarian, governmental geological institute.

These sentences are a clear expression of the compelling need for both Society and state administration—which had just witnessed the Compromise of 1867 with Austria—for exploration, prospecting and for the central registration of mineral resources. Progress in railroad construction, steam navigation, power mills and other industries needed more and more fuel and these needs could only be met by large-scale coal mining developments. In addition, industrial development required an increase in metal production and in the output of other minerals.

The level of science and the skill and number of scientists available were promising for the solution of the urgent problems. The Hungarian Geological Society had been functioning for two decades. Under its sponsorship all efforts had been concentrated on geological investigations. The pride of Hungarian geology, Professor József Szabó, joined by his great contemporary, Vilmos Zsigmondy, developed the plan for founding "a geological institute independent of Vienna".

In July 1868, I. Gorove, with great competence, undertook the initiative measure: he set up a Geological Department for the Ministry of Agriculture, Industry and Commerce, and pro-



előmozdittatik, úgy azon körül-
ményt, hogy a magyar korona
országainak földalatti kincsei
nagy jelentőséggel birnak
és sok millionyi értéket kép-
viselnek: azon alázatos ké-
réssel vagyok bátor járulni
császári és apostoli királyi
Felségedhez, hogy egy magya[r]
földtani intézetnek a leg-
mélyebb tisztelettel előadott
irányelvek szerint, és a /. alat-
ti mellékletben felsorolt állan-
dó személyzettel leendő szerve-
zését legkegyelmesebben megen-
gedni és engem felhatalmaz-
ni méltóztassék, hogy ezen in-
tézet igazgatójának kinevezte-
se iránt legalázatosabb felter-
jesztést tehessek, a mély hódolattal
inditványba hozott többi állomá[sokat]
pedig saját hatáskörömben betölt[e]-
hessem.

Pesten 1869. évi juniushó 11.

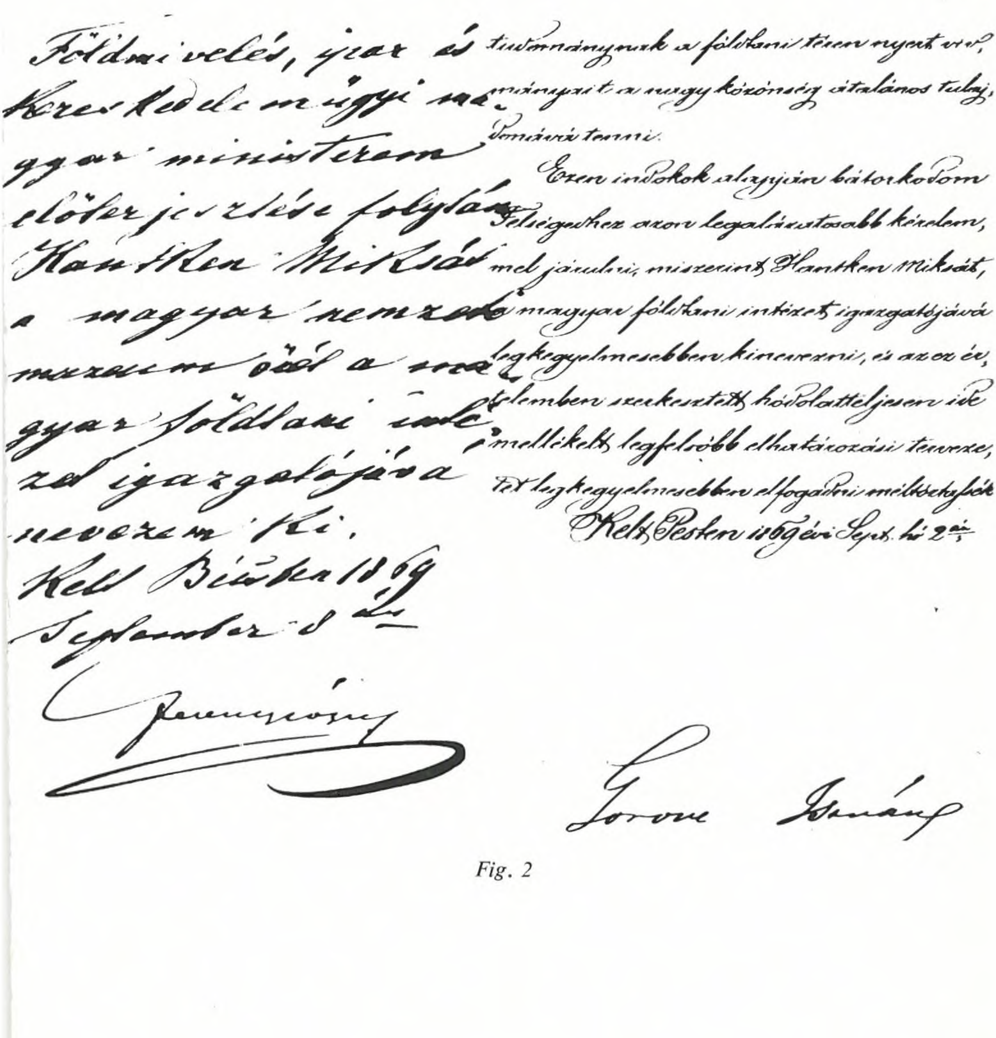
Gorove István

Földmivelés- ipar- és keres-
kedelemügyi magyar minis-
terem előterjesztése folytán
egy magyar földtani intézet-
nek a bemutatott szer-
vezet alapján leendő felál-
litását jóváhagyom, és
megengedem, hogy ezen
intézet igazgatójának ki-
nevezése iránt felter-
jesztés tétessék.

Kelt Schönbrunnban
1869 évi Junius 18án

Ferencz József

Fig. 1



Földmívelés, ipar és kereskedelemügyi magyar ministerem előterjesztése folytán Hantken Miksát a magyar nemzeti muzeum őrét a magyar földtani intézet igazgatójává nevezem ki.
Kelt Bécsben 1869 September 8án

Ferencz József

tudományunk a földtani téren nyert vívmányait a nagy közönség általános tulajdonává tenni.
Ezen indokok alapján bátorkodom Felségedhez azon legalázatosabb kérelemmel járulni, miszerint Hantken Miksát a magyar földtani intézet igazgatójává legkegyelmesebben kinevezni, és azon értelemben szerkesztett hódolatteljesen ide mellékelt legfelsőbb elhatározási tervezetet legkegyelmesebben elfogadni méltóztassék.
Kelt Pesten 1869 évi Sept. hó 2án

Gorove István

Fig. 2

moted MIKSA HANTKEN, who was the curator of the Department of Mineralogy in the Hungarian National Museum, to be its director. KÁROLY HOFMANN, Professor of the Technical University, also candidate officers of mining, BENŐ WINKLER and JÁNOS BÖCKH, and lecturer ANTAL KOCH became members of his staff. On August 20, 1868, the new Department embarked upon regular geological investigations in the area between Buda and Tata. In the same year and during the following one the Geologische Reichsanstalt of Vienna still delegated Austrian geologists to Hungary, to continue the geological surveying of the country organized earlier by the Vienna institute. Nevertheless, the dramatic process for establishing the centre of Hungary's geological investigation continued at a quick pace and the decisive measure was soon taken.

On June 18, 1869, the Sovereign signed the deed for the founding of the Magyar Királyi Földtani Intézet (Royal Hungarian Geological Institute) (Fig. 1) and, shortly after, on September 8, 1869, MIKSA HANTKEN, head of the former Geological Department, was appointed first director of the Institute (Fig. 2). He did not hesitate in taking over all that which had been initiated by the Geological Department; the Institute embarked upon the road which led to the agrogeological and economic-geological development of this one hundred year period.

The choice of the new-born Institute's duties and its approaches to the multitude of problems which had risen through the years were guided by principles (stipulated by the Institute's Statutes) which are still valid today:

(a) Detailed geological survey of the country's territory and publication of the results as required by science, agriculture, and industry;
(b) Preparation and publication of general and detailed geological maps of the territory of the Hungarian State;
(c) Assembling of collections of rocks and fossils to demonstrate the country's geology;
(d) Chemical analysis of soils, minerals and rocks with respect to agriculture, mining, manufacturing and other industries.

THE FIRST DECADE

In the first ten years of its history the Institute, directed by MIKSA HANTKEN, witnessed a dramatic pioneering into the country's geology:

Transdanubia's geological surveying on a topographic base of 1:28 800 and the editing of the resultant hand-coloured map-sheets of 1:144 000 scale were the result of the immediate continuation of the geological mapping commenced earlier in this country by the representatives of the Geologische Reichsanstalt of Vienna.

The results of small- to large-scale investigations concomitant of mapping were published in the Institute's serials "*Évkönyv*" (*Annals*) started in 1871, and "*Évi Jelentés*" (*Annual Report*), launched in 1883.

A long series of fundamental, comprehensive works were published. One of them was MIKSA HANTKEN's monograph on the geological setting of the Esztergom Brown-Coal Area in which the *Nummulina* scale of Eocene stratigraphy was established. In his work devoted to coal deposits and coal-mining in Hungary he reviewed the output and geologic conditions of this developing industry during his time, relying for the most part, on his own observations and results.

KÁROLY HOFMANN wrote a treatise on the geology of the Buda—Kovácsi Mountains, the work being far ahead of its time. The publication is as up-to-date now as it was a hundred years ago. HOFMANN's clairvoyant tectonic observations have invariably been used for reference points by Hungarian geologists ever since. It was he who established the first type section of the Transylvanian Paleogene, which, after the appearance of ANTAL KOCH's monograph, has become an important key section, widely used for international correlations. A paper on the basalts of the southern Bakony Mountains, which showed HOFMANN's excellent knowledge of petrography, is an eloquent proof of his versatile scientific scholarship.

JÁNOS BÖCKH distinguished himself by results of lasting value in the investigation of the southern Bakony Mountains and the vicinity of Pécs.

Among the published works of this period there were such treatises as the monograph on the geology of the Szentendre—Visegrád and the Pilis Mountains by ANTAL KOCH; the monograph on the Székely Land, Southeast Transylvania, by FERENC HERBICH and the treatise of the geology of the Kolozsvár (now: Cluj, Rumania) region by ELEK PÁVAY.

A few outstanding staff geologists managed to review the basic features of Hungarian geology; to develop the first nomenclature of the country's geological formations and to outline their stratigraphic scale with an amazing rapidity.

Great regard was manifested in taking over *observations from* *abroad*. Possibilities for this were provided by the Library, which was growing rapidly and which in 1882 had 95 foreign exchange partners. Personal contacts also played an important role in the understanding of foreign results. In fact, our director visited, one after the other, the geological institutes of Paris, London, Brussels, Munich and Berlin.

The Institute made considerable contributions to the first sessions of the *International Geological Congress* and *international exhibitions*. At the International Exhibition of Vienna in 1873 the Institute's collections were awarded the Medal of Progress; at the 2nd session of the Congrès international des sciences géographiques, Paris 1875, the "Médaille de 1re classe". Our maps and publications exhibited in Paris, at the Ist Session of the International Geological Congress in 1878, were rewarded with the Grand Prix. At the IInd Session of the International Geological Congress, Bologna 1881, HANTKEN had an important part in the preparation of an agreement concerning the standardization of the legend of geological maps. The Institute's geological maps exhibited at the Troisième Congrès international géographique, Venice 1881, were awarded a honorary diploma (Des mentions honorables).

The fame and activities of the Institute lured renowned *foreign scientists* (E. HÉBERT, E. MUNIER-CHALMAS, H. E. BEYRICH, H. WOLF) to visit this country and to enjoy the hospitality and guidance offered by the Institute's director.

Thus we can see that the first decade of the Institute's existence witnessed the dramatic institutionalizing of geological investigations. The grandious and dynamic implementation of nation-wide projects was punctuated by regular geological mapping, by the publication of survey results, by the organization and swift growth of the Library and Museum, by the starting of the Institute's periodicals *(Annals, Annual Report)*, and by the provision for international relations in scientific work.

For thirteen years MIKSA HANTKEN stood at the head of the Hungarian geological survey and could be aware of a well-done job when in 1882, while handing over the directorship to his successor, he became the first professor of the Department of Paleontology at the Budapest University.

DIFFERENTIATION OF THE INSTITUTE'S WORK

After MIKSA HANTKEN had left, the Institute was directed for a quarter of a century by JÁNOS BÖCKH. After graduating from the Mining Academy of Selmecbánya (now: Banska Stiavnica, Czechoslovakia), he began his career in the Geologische Reichsanstalt of Vienna, from where he returned home as a well-trained geologist. Back from Vienna, he first entered the Ministry of Finances and then joined the staff of the newly founded Geological Department. He was among the first geologists on the staff of the Hungarian Royal Institute of Geology founded one year later.

During his directorship both the inner structure of the Institute and the organization of the geological survey underwent large-scale developments. HANTKEN's fundamental research programme took, under his direction, a clear-cut orientation toward completing the requirements of every-day life.

At the very beginning of his directorship, in 1883, he managed to organize *mining-geologist and chemist* posts within the Institute's staff—a landmark of progress towards the practical life. The chief mining geologist, engaged in mapping of ore-producing areas and in geological observations underground, set to work immediately in the vicinity of Selmecbánya. This work was later followed by the geological investigation of Körmöcbánya (now: Banska Kremnica, Czechoslovakia), Nagybánya (now: Baia Mare, Rumania), Felső-bánya (now: Baia-Sprie, Rumania), Kapnikbánya (now: Capnic, Rumania) and of the Transylvanian Metalliferous Mountains.

First the newly appointed chemist left for Heidelberg, Germany, for a one-year post-graduate training in BUNSEN's Laboratory. Back in Budapest, he began to work in the new Chemical Laboratory.

The phylloxera epidemic of 1890, which had ruined most of the vineyards in Hungary's mountainous and hilly regions, demanded the exploration of immune sand areas. These circumstances were largely responsible for the organization in 1891 of an *Agrogeological Department*, sponsored by the Ministry of Agriculture. The "Flach-land-Abteilung" of the Königlich-Preussische Geologische Anstalt in Berlin served as a model for organization. In the following year the equipment of a *Pedological Laboratory* was commenced—a measure that marked the beginning of an expert investigation of the soil cover in the plains and the hilly regions and a thorough study of the vine-growing areas, peat bogs and soda soils.

In 1892 a "special" staff geologist post was established for the protection of medical and mineral water springs, for solving problems of communal and industrial water supply, for authorizing and locating of artesian wells for drilling, and, finally, for providing the geological background for railroad construction developments.

In 1893, following an appeal by SÁNDOR WEKERLE, who was Prime Minister and Minister of Finances, a regular *prospecting for hydrocarbons* was embarked upon. The vicinities of Zsibó (now: Jibău, Rumania), North Transylvania, the northern slope of the Mátra Mountains, and parts of the Northeastern Carpathians were extensively explored for hydrocarbons.

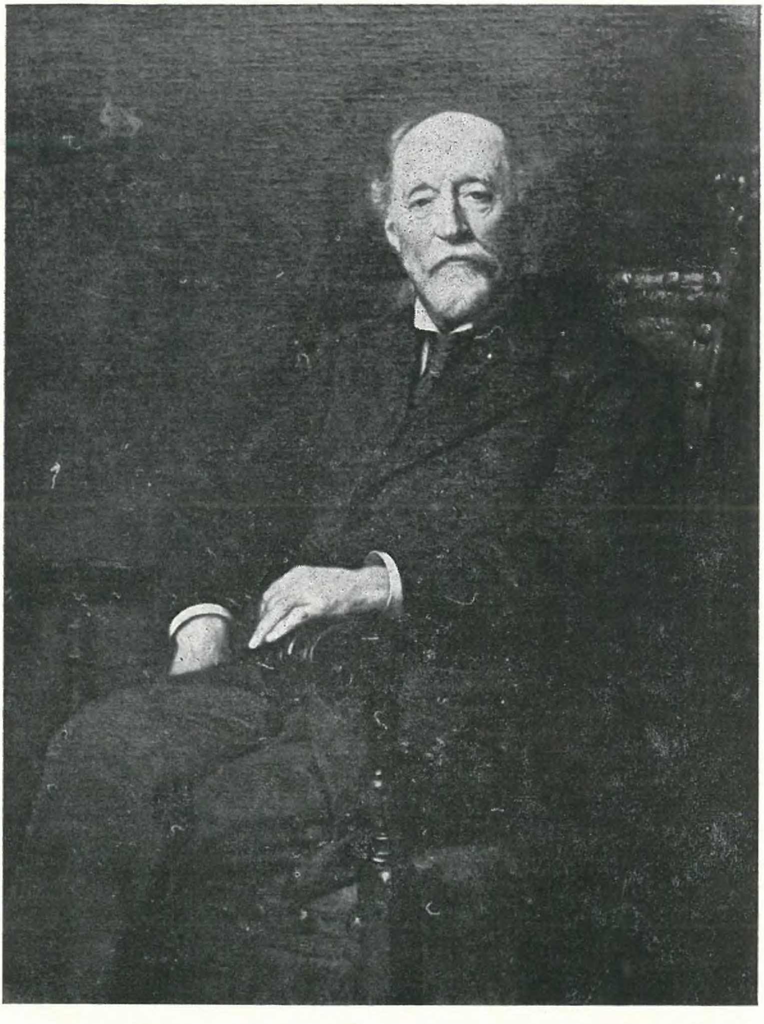
With full-scale development in projects of immediate and practical aims, the *regular geological mapping* of the country's area was continued and greatly advanced. The large-scale geological mapping of the Transylvanian Border Range started as early as the geological surveying of Transdanubia and, with the completion of this project, it soon was developed on a full scale. The regular geological surveys in the north started with the areas of Szatmár, Ugocsa and Máramaros Counties, on the south with the area of the Krassószörény Mountains. Progress in this work was established in the areas of the Godján-Szárkő, the Retyezát, the Kodru-Moma, the Transylvanian Metalliferous Mountains, the Bihor Mountains, the Királyerdő (now: Pădurea Craiului, Rumania), the inselbergs Meszes, Réz, Szatmári Bükk and Preluka, much of the Transylvanian Basin, the vicinities of Nagybánya, Felsőbánya, Kapnikbánya, and the Máramaros Sandstone Zone of the Carpathians.

The *agrogeological surveys* in the Danube-Tisza Interfluve and in the Little Hungarian Plain showed a marked progress. In addition to this, they also began such work in Transdanubia and extended it to the vine-growing zone along Lake Balaton.

Printed for the most part, though partly still hand-coloured, the *geological maps were edited* on new topographic base-sheets of 1 : 75 000 scale. Some of the map-sheets were supplemented with an explanatory brochure. Nevertheless, the editing of maps was considerably delayed in comparison to the progress made in the surveys. All in all, a great number of map-sheets remained unedited.

On the initiative of the Hungarian geological Society, the first, home-drafted, small-scale national geological map, 1 : 1 000 000, based on the geological map material of the Institute and plotted, for the most part, by the Institute's staff, was published in 1896—the year of the Nation's Millenium.

Scientific research was going on in an ample gamme of channels, although resultant nation-wide syntheses were scarce. For the most part, the results of minor essays and studies were published at that time in the Institute's serials.



ANDOR SEMSEY

International relations did not cease to be of primary concern. Many members of the staff undertook important study tours. Among them: JÁNOS BÖCKH was an attending member of the VIth session of the International Geological Congress in St. Petersbourg and also of the VIIth session in Paris; FERENC SCHAFARZIK took part in MÓR DÉCHY's 1886 expedition to the Caucasus and in 1901 at the Strasbourg meeting of this commission he was coopted by the Permanent Commission for International Seismic Recording. In 1907 the Institute's methods of agrogeological survey and investigation were studied by G. M. MURGOCI, the distinguished agrogeologist of the Institutul Geologic of Bucharest.

The archeological aspects of the Institute's activities included the exploration of *caves* by the aid of excavations. In the Seleta Cave outstanding paleontological and archeological results were achieved.

The *library* and *collections* of the Institute, being particularly enriched by the generous donations of ANDOR SEMSEY, experienced a swift growth. It was early in the period of BÖCKH's directorship that SEMSEY purchased for the Institute COQUAND's extremely valuable collection, which was followed by profuse gift collections acquired by Mr. SEMSEY from the Bordeaux and Mainz Basins as well as from localities in the South France and Switzerland. It was under his sponsorship that protective measures to save the famous footprint-patterned sandstone locality of Ipolytarnóc were undertaken. The staff of the Institute has respectfully kept alive the memory of this Great Patron. As an evidence of the appreciation by all strata of society for his great work, a street, *Semsey utca*, close to the Institute's headquarters, bears his name.

The continual growth and potential development of the staff, the Library, the Map Depository and of the mineralogical, petrographic and paleontological collections made it indispensable that the *Institute should be housed in a separate building*. Again initial difficulties were overcome by the generosity of ANDOR SEMSEY who offered 50 000 gold forints for the erection of the Institute's headquarters. The implementation of this grandious project was facilitated by the decision of the Capital's municipal government to donate a plot of land in an advantageous position for the building and by the Parliament's considerable grant to support the construction. Architect ÖDÖN LECHNER, who had developed a so-called "Hungarian" style, was entrusted with designing the building. *Construction* was begun on February 9, 1898, by architect SÁNDOR HAUSZMANN and *completed as early as October 1, 1899*. Thus the Centenary of the Institute, which will be celebrated in 1969, will coincide with the 70[th] anniversary of the birth of the Institute's headquarters.

When entering office in 1882, director JÁNOS BÖCKH had at his disposal ten geologists, a single administrative officer and a junior clerk. By the end of his directorship, *his staff*, which was comprised of sixteen geologists, two chemists, two laboratory assistants, two cartographers, two administrative officers, eight junior clerks, and one mechanic could be proud of working in one of the nicest and best-equipped geological institutes of contemporary Europe.

ATTEMPTS AT COMPLEX SCIENTIFIC WORK

Succeeding to JÁNOS BÖCKH in 1908 at the age of sixty, LAJOS LÓCZY already enjoyed an international reputation. During his post-graduate training at the University of Zürich, between 1869 and 1874, he got acquainted with the geology of the Alps. From 1877 to 1880 he was a member of BÉLA SZÉCHENYI's expedition which toured a considerable part of East Asia. Between 1883 and 1886 he was staff geologist for the Institute. After that, from 1886 to 1889, he came engaged first in education, then as a lecturer in the Department of Geology at the Budapest Technical University and finally, from 1889 on, as an appointed professor for the Department of Geography at Roland Eötvös University. In 1888 he was elected a member of the Hungarian Academy of Sciences and in 1920 a honorary member. In 1896 and 1916 he was honoured with the highest award of the Academy. In 1894 he was awarded a silver medal by the Berlin Gesellschaft für Erdkunde, in 1902 the Tchikhatcheff Prize by the Academie Française. In 1911, at a special session of the Royal Geographical Society, he was given the Society's gold medal and a diploma of honorary membership by Lord CURZON, former viceroy of India.

LÓCZY launched a programme which included numerous reforms in the Institute's activities. Instead of the stereotyped sheet-by-sheet system of geological mapping, he suggested the idea of complex investigations of selected geological spatial units and a comprehensive representation of the results to be the primary objectives of the Institute. First of all, the completion of the unfinished mapsheets and the monographic description of the investigated areas had to be performed. Before these were done, work on new areas could not be commenced. Therefore, the geological surveying of Transylvania, Subcarpathia (now: Transcarpathian Territory, USSR) and Krassószörény County still was to go on for years. These activities were gradually supplemented by the geological investigation by the Institute workers of the Velence and the Bükk Mountains, as well as the Central and Mecsek Mountains by the non-Institute workers.

It was the *comprehensive geological description* of this country which LÓCZY envisaged in extending geological investigations to new and newer areas. In 1910 he started geological mapping on the Adriatic Coast, which was conducted by three staff geologists and FERDO KOCH, curator of the Museum of Zagreb. The resultant papers were also published in the Croatian language in the Évi Jelentés (Annual Report) of the Institute. Enjoying a considerable financial support, he launched in 1913 a geological reambulation project in the Western Carpathians. During World War I the geological surveys were extended to the area of Serbia, Montenegro, and North Albania.

The agrogeologists continued their surveys in Northwest Transdanubia and in the Little Hungarian Plain (Kisalföld). To develop a uniform basis for both a theoretical approach and methodology of agrogeological surveys, the director convened for the spring of 1909 the *I*st *International Agrogeological Congress* in Budapest, a scientific meeting on which occasion also was a good time to celebrate the 40th anniversary of the Institute's founding.

He sent PÉTER TREITZ and IMRE TIMKÓ, agrogeologists of his staff, to Rumania and Russia, to gain experiences there. In Russia they enjoyed the hospitality of professor GLINKA, director of the pedological survey of this vast country, then they made a long trip to the Odessa region, inspecting an ample gamme of soil types from the forest belt through the steppes and up to the high-altitude topography of the Crimean Peninsula. LÓCZY's extraordinary might is evidenced by this recognition of the urgent necessity for developing an independent organization for soil sciences in order to meet the requirements of agriculture.

To improve the situation in the domain of the applied aspects of the geological sciences, where the Institute's earlier activities had been biased by some problems of detail and confined to drafting expertises, he selected some major subjects upon which all efforts were to be focussed. These were the following:

— investigation of coal basins;
— prospecting for rocks suitable for cement making;
— locating of drilling-points in oil prospecting areas;

- geological survey and economico-geological investigation of the zone of the railroad track under construction along the northern shore of Lake Balaton;
- investigation and mapping of peat deposits and bogs;
- compilation of a treatise on the commercial minerals and rocks of Hungary.

Initially bound for prospecting for *potash salt*, the investigations in the Transylvanian Basin lead to the discovery of Transylvania's potential natural gas resources, thanks to the deep borehole located in 1908 by KÁROLY PAPP.

LÓCZY proposed to entrust projects of mineral resources development to other organizations and believed that the Institute's real vocation was to provide a scientific background for economic projects and to perform practical tasks of crucial importance.

He invited a number of non-staff workers such as university professors, assistant professors and secondary school teachers, to contribute to geological mapping and materials-testing. He entrusted ELEMÉR VADÁSZ with editing *Geologica Hungarica*, a serial introduced by him. He actively supported the activities of the Hungarian Geological Society, releasing a special room for the accomodation of the office of the Society's Secretary. He and the members of his staff participated in almost all important international meetings such as the XI^{th} International Geological Congress and the II^{nd} International Agrogeological Congress, Stockholm 1911, the XI^{th} International Congress on Hydrology, Climatology and Geology, Madrid 1912, the X^{th} International Geographical Congress, Rome 1913. In the same year, 1913, a handful of staff members took part in an oceanographic expedition on board of the Naját. Beside these travels, he and his staff geologists undertook research trips throughout the country; made tours of the Alps, the Dinarides and travelled to Italy to study the active volcanoes there. Mr. LÓCZY also supported the members of his staff in their choice of research subject and solicited ANDOR SEMSEY's sponsorship for their postgraduate studies abroad.

LAJOS LÓCZY was a genuine mastermind in scientific research and his work left a lasting mark on the Institute's life. It was not his fault that history crossed his far-sighted plans. The increasing difficulties due to World War I first slowed down the progress, then broke it down completely.

THE INTERWAR PERIOD

On May 14, 1919, the administrative bodies of the *Hungarian Republic of Councils* sent their representatives to the Institute to conduct scientific public opinion polls and to make decisions as to the Institute's future. Róbert Ballenegger and Antal Réthly, representatives of the People's Commissariat of Agriculture, expressed the Commissariat's appreciation of the brilliant 50-year traditions, the current activities and leading officials of the Institute. They proposed that the Institute's staff should temporarily concentrate its efforts on the geological survey of the capital's area and to modernize the collections as immediate tasks to be accomplished. The geologists, who participated in the discussions, maintained that both the scientific and applied aspects of the Institute's work had to be preserved. They considered it necessary to prepare and publish a new small-scale outline geological map of Hungary, to be supplemented with an easily intelligible explanatory brochure. Elemér Vadász, representative of the Directory of Scientific Societies, emphasized the necessity for improving the scientific activities of the Institute; conducting regular geological surveys; completing and publishing the works commenced; the exact formulation of practical and scientific objectives.

The Hungarian Republic of Councils was the first state administration that sought to organize an independent Research Institute of Soil Sciences, but after the failure of the Republic most of its initiatives, including the founding of the afore-mentioned institute, had to be postponed.

The defeat of the Hungarian Republic of Councils was followed by a turbulent period of counter-revolution. Lacking a director and a comprehensive programme, the Institute was temporarily paralyzed, avaiting an issue of the situation. Due to the disastrous impoverishment of the country the government budget could afford only a lean subvention for geological investigations.

Foreign relations were minimized. The exchange of publications remained at the low level to which it had been reduced during the war. That a handful of new publications by the Institute could still be edited and printed was to be thanked to the sponsorship of some industrial companies. The collections grew little, if any. The fact that the Institute did survive and preserved its hegemony in Hungarian geology, despite the adverse circumstances, belongs to the merits of a handful of devoted scientists of extraordinary ability, such as

ALADÁR VENDL, PÁL ROZLOZSNIK, KÁROLY TELEGDI ROTH, ZOLTÁN SCHRÉTER, PÉTER TREITZ and GYULA VÍGH.

The geological investigations were primarily concentrated on the *coal basins*. This was largely responsible for the fact that, in spite of the reduction of the country's area, the coal output still nearly attained the pre-war level by the end of 1923. The geological investigation of the coal basins and the national surveying of coal resources were accompanied by some scientific achievements such as the description of the mining geology of the Esztergom Coal Area (1922), a short paper on the Várpalota Coal Basin and a "mining-geological map" of 1:12 500 scale of the Tatabánya Coal Basin (1924). A synthesis of the Miocene and Pliocene brown-coal basins of Borsod and Heves and one of the Upper Cretaceous coal basin of Ajka, though developed in those years, were completed and published later (in 1929 and 1935, respectively).

Investigations were started in the vicinity of Telkibánya, a locality well-known for its early *precious-metal-mining* industry, in the Eperjes—Tokaj Mountains.

The Institute contributed some efforts to *hydrocarbon prospecting* which was being recommenced during that time.

Purely scientific *geological surveys* were confined to the immediate and broader outskirts of the capital.

The *agrogeologists* partly conducted surveys in Transdanubia and partly examined test boreholes drilled along the planned track of the Danube—Tisza Canal. In addition, experiments attempting reclamation of soda soils were conducted. In 1924, at the *National Conference on Agrogeology*, PÉTER TREITZ exhibited the small-scale climazonal soil map of Hungary.

The first, southwestern, sheet of the country's scheduled four-sheet *geological map* of 1:500 000 scale was completed.

With FERENC NOPCSA's appointment to the post of director on June 20, 1925, the six-year "interregnum" of the Institute, characterized by the lack of a definite programme or suitable direction, came finally to an end.

One of the most romantic figures in the history of science, BARON FERENC NOPCSA is a fruitful subject for bibliographers. Having taken a fancy to KARL MAY's novels in his childhood, he sought as a youngster the fascinating world of the novels "Durch das Land der Skipetaren" and "In den Schluchten des Balkan", which he repeatedly scouted. These travels, however, were not purely adventures. On his travels BARON FERENC NOPCSA recorded all that which he could observe of Nature's phenomena. He developed his observations into scientific conclusions, into a synthesis. It was these journeys that furnished information for his extensive studies in ethnography, geography and, above all, for his geological monograph on North Albania.

His papers on *Dinosaurus* promoted him to the rank of a world-reputed specialist on *fossil reptiles*. Thus he laid the foundations of a new sphere of *science—paleo-physiology*. As early as 1912 he became a member of the Geological Society of London, then in 1917 he was elected corresponding member of the Hungarian Academy of Sciences, to become later an ordinary member of the Academy. The Gesellschaft für Erdkunde of Germany distinguished him with its honorary membership.

In his programme for the Institute he laid stress on scientific work, urging for the compilation of masterful comprehensive works with both high standards of execution and of broad outlook. To facilitate publication, he set up a *printingshop* and a *photographic laboratory* at the Institute's headquarters. For the implementation of his scientific programme, he had at his disposal the staff of the following sections: Geology, Mining Geology, Drilling and Hydrology, Agrogeology, Museum, and Paleontology.

During his three-year directorship he laid very great emphasis on *foreign relations:* in the autumne of 1925 he was himself the Nation's representative at the bicentenary celebration of the founding of the Russian Academy of Sciences; in May of 1926 he and another Hungarian geologist participated in the Madrid session of the International Geological Congress. In 1927 GYULA RAKUSZ was delegated to attend the Internationaler Karbonstratigraphischer Kongress at Haarlem. PÉTER TREITZ was the Institute's delegate to the International Congress of Soil Sciences in Washington D.C. In 1928 the Institute paid host to the Paläontologische Gesellschaft of Austria in connection with the Paläontologentag in which 52 foreign paleontologists took part. In August—September, 1926, the Institute accomodated the Bodenkartierungskommission (Internationaler Bodenkundlicher Kongress).

The co-ordination of *geological mapping* was now given less concern. In the Vértes and the northern Bakony Mountains there was coal- and bauxite prospecting, in the Tokaj and Börzsöny Mountains ore-prospecting was undertaken, in the Gerecse Mountains and the vicinity of the capital purely scientific geological research was conducted.

The agrogeologists continued to work on the Great Hungarian Plain and in Transdanubia. Beside mapping, they were concerned with the investigation of soda soils and the testing of artesian wells.

In 1928, seriously ill, director NOPCSA was forced to give up his post. After his retirement he spent a few years in Vienna, experiencing dramatic ups and downs in health conditions, which finally led him to die by his own hand in 1933.

After NOPCSA had parted, the operations started by him were directed for one year by vicedirector IMRE TIMKÓ. The vacant post of the director was filled on October 1, 1929, by HUGÓ BÖCKH—the son of JÁNOS BÖCKH, the far-famed earlier director of the Institute.

HUGÓ BÖCKH was a man of vision, a scientist of great ability. A professor of the Mining Academy of Selmecbánya at the age of 25, he published in 1909 a top-standard text- and handbook of both a general and historical geology, the first of its kind ever edited in Hungary.

A member of the staff of the Ministry of Finances from 1910 on, he directed prospecting *operations for natural gas* in Transdanubia and then discovered a hydrocarbon deposit at Egbell (now: Gbely, Czechoslovakia). A keen-sighted prospector, he recognized the relationship between dome structures and hydrocarbon accumulations and was the first on Earth to apply *Eötvös' torsion balance* in the *exploration of hydrocarbon reservoir structures.* In 1923 he entered service for the British-Persian Oil Company and undertook oil prospecting in Iran. He was soon put at the head of the Company's geological service which he completely reorganized. A genuine manager, he managed to pursue his scientific vision until something tangible was accomplished. That was the key to his successes.

Taking over directorship at the Hungarian Royal Institute of Geology with the rank of an under-secretary of state, he set immediately to improve the Institute's organization. To ensure higher efficiency in geological investigations, he put the independent Geological Team of the Ministry of Finances under the Institute's control. The Institute's geologists were enlisted in three teams. One of them was entrusted with duties defined by the Ministry of Finances, the second was charged with agrogeological projects developed by the Ministry of Agriculture, the third had to carry out scientific research. HUGÓ BÖCKH strictly regulated the procedure of administration. He organized a high-level Geological Advisory Committee.

He introduced novel methods of *geological mapping*. A *higher accuracy of surveying was envisaged by him* with the introduction of measurements with band-chains, hand-operated surveyor's levels, oil-compass, even locally with surveyor's table as well as by shallow drilling and trenching. Output norms were established with a consideration for the degree of concealment, for the complexity of the geological setting, and for the communication facilities. He emphasized the necessity of a close linking and combination of the *various geophysical methods* and of the most manifold processing of exploratory drilling core materials simultaneously with drilling operations. A *Drill-Core Laboratory* was set up to this end.

For the sake of *hydrocarbon prospecting*, geological investigations were carried out between the Tisza and Szamos rivers, on the Danube's Csepel Island and in the vicinity of Bogács, where traces of bitumen had been encountered. *Hydrogeological investigations* were conducted near Sümeg and Ukk with the purpose of solving the problems of water supply in the watering places and spas along Lake Balaton, and for the industrial plants of Fűzfő. Hydrogeologists were also engaged in locating drilling-points for artesian wells. In addition, a number of major landslides were investigated. *Bauxite prospecting* was undertaken in the Bakony, Buda and Villány Mountains. Base metals were prospected for in the Börzsöny Mountains.

A new *agrogeological subject* was included in the Institute's programme in connection with geological investigations forthe scheduled Tiszalök Dam Project. In addition, a Laboratory of Soil Biology was set up, with LAJOS KREYBIG at its head.

A good collaboration was developed with other scientific bodies and with institutions of higher learning in this country. The director did his best to develop and enlarge the Library and to acquire missing publications. Like NOPCSA, he strove to widen the scope of the Institute's foreign relations.

HUGÓ BÖCKH resolutely laid stress upon the most important *economic objectives*. And under his directorship the Institute's strictly scheduled and well-disciplined work was given a strong impetus. This development—promising as it was during BÖCKH's hardly more than two years of directorship—had to come, however, to a temporary end with his sudden death on December 6, 1931.

On July 21, 1932, the Institute's leadership was taken over, by the heir of an old reputed name—LAJOS LÓCZY JR. who continued to emphasize the importance of the applied aspects of our sciences and to widen their scope in the Institute's work. He wished to respect HUGÓ BÖCKH's legacy. However, he greatly deviated from his predecessor's working methods by his liberalism in the management of the

Institute. He suspended HUGÓ BÖCKH's strong measures and proclaimed that the Institute's geologists were allowed to join work on any subject (project). Instead of instrumental measurements along geological sections, he propagated the surveying of selected areas in a dense net of itineries, and the analysis of their structural setting.

In the domain of the exploration of mineral resources it was *oil* and *natural gas* that lay in the focus of general interest. With this purpose, geological and tectonic investigations were undertaken in North Hungary. These activities finally resulted in the discovery, on March 23, 1937, of the *Bükkszék oil-held* from where oil was produced for ten year. The valuable medicinal water uncovered during oil development was, together with the thermal water resources developed at Mezőkövesd, utilized for the establishment of baths and spas.

Prospecting for lead and zinc was conducted at Gyöngyösoroszi and Recsk in the Mátra Mountains and near Szabadbattyán in the Velence Mountains. Iron ore was prospected for in the Uppony and Rudabánya Mountains, near Martonyi. Prospecting for manganese was undertaken in the vicinity of Úrkút. In the Transdanubian Central Mountains bauxite prospecting was continued.

Studies in *coal geology* were conducted in the Mecsek Mountains (Komló, Tolnaváralja, Nagymányok), the Transdanubian Central Mountains (Sümeg, Herend, and Nagyegyháza), and West Hungary (Szombathely, Kőszeg). In addition, the surveying of the *peat area* of Little Balaton was completed.

Busy work was being done in prospecting for refractory clay, magnesite, and kaoline. Searches for native salt and saline water were undertaken in Zemplén County, Northeast Hungary.

In connection with the surveying of the lowland and hilly regions, pedological and agrotechnical maps were prepared. In addition, *geological maps were drafted* in order to illustrate paleostream channels, alluvial fans, terraces, floodplains, and ground-water conditions *on the plains*. It was first in this period that so-called *ground-water check-wells* were drilled on the Great Hungarian Plain. The introduction of a central hydrological register was a necessary measure for the authorization of artesian well drilling and to facilitate the execution and delivery of geological expertises. Under the influence of the Congress on Quaternary Stratigraphy in Vienna, investigations were commenced in *loess-covered areas*.

Besides the scheduled research programme of the Institute, the *geologists worked more and more for extra private benefits*.

Scientific research was conducted as a subsidiary to investigations of practical aim, in order to facilitate publication of syntheses concerning large contiguous areas. At first these works were published in the newly started series, "*Geological Descriptions of the Hungarian Landscapes*". Most prominent among them are: a monograph on the Mecsek Mountains by ELEMÉR VADÁSZ, one on the Cserhát Mountains by JENŐ NOSZKY SR. and one other on the Trans-Tisza Region by JÓZSEF SÜMEGHY. From 1939 on, the problems posed by current researches were discussed *at special meetings*.

Foreign relations were favourable till the outbreak of World War II. Representatives of the Institute participated in the XVIth session of the International Geological Congress in Washington D.C.; in the centenary celebration of the British Geological Survey in 1935; in the VIIth International Congress on Mining, Metallurgy, and Applied Geology in Paris, and in the Vienna Congress on Quaternary Stratigraphy in 1936.

During World War II geological investigations were conducted rather widely even in the temporarily reannexed areas. Aimed at improving the national shortage of raw materials, which was constantly increasing due to the war economy, prospecting for mineral resources was carried on at an increased rate. In the latest period of the war the Nation suffered under the depressing effect of the country's occupation by the Wehrmacht and also the terror of Hungarian nazi arrow-cross men; the country's economic force was exhausted; the army suffered defeat after defeat. Under such conditions the Institute's work was gradually paralyzed.

A part of the Institute was evacuated to Balatonarács. It was very difficult to save the Institute's assets and valuables from being removed to Germany. The Library was divided into three parts; one was evacuated to Akli-puszta, one to Somogyvár, and one to Balatonarács. All maps were packed into barrels and buried in the garden of the Institute of Viticulture; the platinum reserves of the Chemical Laboratory were also buried. The more valuable part of the Museum's materials was packed into boxes and removed to the basement of the Institute's headquarters. Valuable instruments and devices were walled up in the cellar. During the days of blockade the Institute's headquarters accomodated 28 members of the staff.

THE POST-LIBERATION PERIOD

The Institute's headquarters were liberated on January 14, 1945, by the Soviet Army. From that moment it stood under the protection of Budapest's Soviet Commandant until the tempest of the war was over. When fighting ceased, the Institute, battered as it was, began to recover. The first year's activities were mainly characterized by rubble clearance, though geological surveys were also recommenced. The staff then comprised 31 scientists, 25 administrative officers and 17 auxiliary employees. Returning to office, LAJOS LÓCZY JR. and his staff prepared the Institute's working programme as a contribution to the reconstruction of the Nation's economy. In July of 1946, however, he was commissioned as an expert adviser to Turkey, whence he never returned.

After the leave of LAJOS LÓCZY JR. the Institute was directed for four years by vice-director TIBOR SZALAI. Meanwhile, GYULA VÍGH was entrusted temporarily (from February 9 to July 5, 1948) with the Institute's direction. TIBOR SZALAI's conviction of the compelling demand for the Institute's contribution to the economic development of the country is testified to what he formulated such as "... *the Institute would have to concentrate efforts on the scientific aspects of research, as stipulated by the Institute's deed of foundation. I am convinced that the urgent problems of the country's reconstruction require a definite shifting towards the practical sphere.*"

Renewing the Section of Practical Geology, set up by LAJOS LÓCZY SR., TIBOR SZALAI organized a *Section of Practical and Industrial Petrography*, indeed, he considered it desirable to set up a Section of Economic Geology, too. He proposed that the geological and mining organizations be housed under the roof of one and the same ministry. His proposal was partly admitted by the government which, in its decree of April 29, 1948, united the geological and mining bodies under the control of the Ministry of Industry. They let the Soil Science Section remain under the control of the Ministry of Agriculture and it seceded from the Hungarian Geological Institute in the same year.

According to the practical programme, the Institute's staff took part in prospecting for hydrocarbons in the vicinity of Budapest and in North Hungary; continued iron-ore prospecting in the vicinities of Rudabánya and Martonyi; and set to the compilation of a Register of the Bauxite Resources of the country.

Among new projects were prospecting for ultrabasites in the Bükk Mountains, investigation of perlites in the Tokaj Mountains and prospecting for radioactive substances in the Sopron and Kőszeg Mountains. In the vicinity of Felsőcsatár talc- and asbest-prospecting, in the Keszthely Mountains pyrite-prospecting, was conducted.

The staff of the *new Section of Engineering Geology* investigated shallow drilling materials from the Sajó Riverine and the vicinity of Kecskemét.

The primordial efforts for building the Nation's socialist economy included the development of heavy industry. *This hastened the required prospecting for and development of fuel and commercial mineral resources.* It was this heavy industry orientation that has defined the development of Hungarian geology for two decades. This was a large-scale development which, based on the *regular training of geologists* organized by professor ELEMÉR VADÁSZ, gave rise to scores of viable *industrial geological services* facilitating prospecting, development, and extraction of commercial mineral substances. The Hungarian Geological Institute was an active, eventually a self-sacrificing agent, of this unprecedented boom of Hungarian geology. Large-scale development projects required new research methods and organizational reforms, for a while this provoked frequent re-organizations, and changes in leading officials.

On January 23, 1950, the direction of the rapidly developing geological activities, which were still being largely concentrated within the Hungarian Geological Institute, was taken over by SÁNDOR VITÁLIS. A prominent expert of applied geology, he was aware of the fact that expert advisory activities and preliminary geological exploration of selected areas could not provide a solution to the current problems of geological research. Therefore he concentrated his efforts upon grouping research workers in three principal spheres of activity:

(1) Organization of "geological services" in major area centres for the direct solution of local tasks.
(2) Formation of still lacking geological services of single industrial branches, provisionally within the frame of the Hungarian Geological Institute.
(3) Nation-wide, centralized geological investigations and regular geological mapping with a simultaneous consideration of all demands of both industry and agriculture.

On July 3, 1950, SÁNDOR VITÁLIS was appointed to the Geological and Mining Research Centre, then to the head of the Geological Department of the Ministry of Mining and Power Resources. From July 27, 1950, to July 31, 1952, LÁSZLÓ MAJZON was the appointed director of the Institute, but SÁNDOR VITÁLIS' influence on its activities was an invariably determinant factor.

For the sake of the preparation of a *new, up-to-date general geological map* of the country, the *large-scale geological and hydrogeologi-*

cal surveying of the lowland and hilly regions (whose geology had been merely outlined by earlier investigations) was organized. All specialists available were enlisted in the cause of this project which embraced the Trans-Tisza Region, the Danube—Tisza Interfluve, the Little Hungarian Plain, the Mezőföld, and the Hilly Country of South Transdanubia. During the surveys topographic base-maps of 1:25 000 scale were used and 41 different formations were distinguished.

Beside the above project, oil-and-gas prospecting, radiological investigations, extensive coal- and ore-prospecting, and prospecting for building raw materials and foundry ingredients, were conducted. Geological researches such as the geological and tectonic surveying of mountainous areas and karst-hydrological investigations, were carried out in several areas.

The assembling and ordering of geological information in the *National Geological Archives* was considerably advanced.

On October 20, 1952, JENŐ NOSZKY was appointed director. On December 16, however, he changed his post to be the head of the ministry department. From January 15 to July 18, 1953, the director's seat was taken by KÁLMÁN BALOGH. Then JENŐ NOSZKY became again the Institute's director and held this post till September 1, 1956.

In this period the Institute's activities were defined, even in their finest details, by the superintending geological authority of the Ministry. The geological and hydrogeological surveys of the lowland and hilly regions were essentially stopped before completion and evaluation. Thus scientific investigations were overshadowed by projects of immediate practical aim.

From 1953 on, *in accordance with its biased practical orientation*, the Institute's organizational pattern was characterized by the predominance of applied geology, as shown by the following list of sections:

Geological Mapping
Coal Geology
Iron Ore Geology
Base Metal Ore Geology
Geology of Non-Metalliferous Minerals
Hydrogeology
Materials-Testing Laboratory
Chemical Laboratory
Economico-Geological Archives
Paleontological and Mineralogical Museum

(In 1954 a Section for Karst-Hydrology was also formed, but was then soon annexed to the Mining Research Institute.)

A considerable concentration of the efforts of Hungarian experts from throughout the country permitted to assess *the country's mineral resources* as of January 1, 1953.

In 1954, on the basis of the compilation of all geological, deep-drilling and mining in formation available, the Institute was entrusted with the geological analysis and appraisal of the country's commercial mineral deposits. Simultaneous *prospecting activities resulted in a material increase of the commercial reserves* of coal, iron-ore, manganese-ore and base-metal-ore deposits. Workable deposits of manganese carbonate ore, of gypsum and anhydrite and of scores of non-metalliferous minerals were discovered.

The director urged that the gaps in the country's geological knowledge should be filled; shortcomings which did not permit the satisfactory mapping of the development of the geological formations, nor their tectonic setting. Therefore the assembling of the results of earlier *geological surveys* on 1:25 000-scale map-sheets was continued. In 1953 the most important achievement of the Institute was the *preparation of the country's 1:300 000-scale geological map.* In the areas of economically important mineral deposits a geological mapping of 1:5000 scale was begun.

The complex geological investigation of the Rudabánya Mountains, the Velence Mountains and the major part of the Bükk Mountains was completed.

The re-establishment of the Institute's independence and its initiative role belongs to the merits of VILMOS BESE, director-general of the newly established National Geological Authority. Collaborating with the most prominent representatives of Hungarian geology, he developed the guiding principles of up-to-date geological research which were *adopted by the Geological Council in 1955.* Accordingly, both personal and material facilities were to be focussed upon the large-scale and complex geological investigation of selected areas which would be of crucial importance for national economy.

For the accomplishment of these objectives, a new administration, with director MIKLÓS KRETZOI at its head, was appointed on September 1, 1956. The reorganization which had been launched in all channels was cut short for months by the events of a counter-revolution, after the very first measures had been taken.

In 1957 the Institute's leading officers were preferentially concerned with normalizing the Institute's stirred atmosphere and creating facilities for the implementation of the 1955 programme. In December, 1957, director MIKLÓS KRETZOI tendered his resignation which was approved on February 18, 1958.

General-director VILMOS BESE appointed former vice-director JÓZSEF FÜLÖP to take the director's post. The programme of 1955, in the elaboration of which the new director also took part, was rapidly accomplished under the gradually improving political and economic conditions, thanks to the devotion and vitality of the Institute's young staff geologists and to the support of the most skilled representatives of the older generation.

The organizational structure of the Institute became permanent. For ten years the Institute had been divided into *three major departments*. One of them comprises *mapping teams* devoted to single geological spatial units: a system facilitating the development of specialists versed in the geology of the investigated areas, in both their theoretical and practical problems. The second department comprises the *Institute's laboratories*. Their activities in the introduction of up-to-date techniques and the delivery of hosts of homogeneous data, ensured the quantitative cartographic illustration of the geological conditions, upon which stress has been laid. These up-to-date requirements have been accomplished, first of all, by the staff of the Institute's new geochemical laboratory. The *Documentation Department* is constituted by the Library, the Archives and Map Depository, the Geological Collections, the Book- and Map-Editing Groups, and the Plotter-and-Drawer Group. Facilities for the printing of maps and simple written texts have been provided for by the setting up of a printing shop at the Institute's headquarters. Engineering and technical services are rendered by workshops such as the photographic laboratory, mechanical shop, book-bindery, joinery, and electrician's and locksmith's workshops. In addition, the Institute has a materials-testing laboratory at Szolnok, a research base equipped with a laboratory at Balatonfüred, and service building properties at Pécs—Vasas, Nagyirtáspuszta (Börzsöny Mountains) and Rákóczitelep (Mizserfa, Nógrád County). At Balinkabánya a sample depository and working rooms have been put at the Institute's disposal.

On January 1, 1969, the Institute's staff comprised 116 university-graduated members, 180 auxiliary technicians and 120 other employees (skilled workers, chauffeurs, and administrative officers).

Between 1966 and 1968 the Institute's headquarters was restored by the considerable financial support of the government. The restoration of this architectural monument has affected the entire corpus of the property, its communal facilities and furnishings.

Systematic *geological mapping* has been conducted at 1 : 10 000 and 1 : 25 000 scales in the mountainous areas and at 1 : 100 000 in the Great Hungarian Plain. It has become a basic requirement to map the results of investigations in such a way that everybody may easily read them off and check them, and also supplement each geological interpretation map-sheet with a documentation sheet—the exact basis of the former. Thus the map can be perfected or re-interpreted from any new and special viewpoints, and the rather expensive basic data need not be reproduced. Another basic requirement is complexity reflected by a gradually increasing number of map-sheet versions. The preparation of the maps on large-scales to facilitate their utilization for practical purposes has been made possible, in the first place, by the uniformity of research methods and by the considerable growth of laboratory facilities. During 10 years the map coverage of the Mecsek Mountains, the Dorog Basin and the Mátra Mountains has been completed at 1 : 10 000, that of the Northern Bakony Mountains and the Tokaj Mountains at 1 : 25 000. The complex geological mapping of the Great Hungarian Plain (Alföld) at 1 : 100 000, and that of the Lake Balaton region at 1 : 10 000, has been started.

Geological mapping was coupled with *a detailed and complex geological investigation* of the areas being mapped. In this work the surveyors collaborated with mineralogists, petrographers, geochemists and paleontologists. Selected formations or faunas were elaborated following the cases in form of independent monographs or as parts of collective works.

The 1 : 200 000-scale geological map series of the country has been completed. Economico-geological maps, illustrating the Nation's commercial mineral resources and the possibilities for further developments, are being prepared at 1 : 500 000. The country's subsurface geological map, with the Tertiary peeled off, was published twice. For the Borsod Brown-Coal Basin and the Mecsek Liassic Coal Basin, maps of prognosis have been prepared. The manuscript of the 1 : 100 000-scale geological map of the Transdanubian Central Mountains has been completed.

Facilities have been provided for the completion of scientific research projects which had earlier been embarked upon. The works of several foreign authors were published. In the last ten years, along with the regular publication of the successive issues of the *Annual*

Reports, *15 Annals*, *12 volumes* of the two series of the *Geologica Hungarica*, and *29 other works* were published by the Institute's staff editors. Added to this, *82 important*, *independent map-sheets* were also printed.

The Institute's foreign connections have been characterized by close links with the respective bodies of the Council for Mutual Economic Assistance (COMECON), by direct geological collaboration with a number of countries, and by regular study leaves. The Institute's representatives participated in the international geological congresses and in numerous important international meetings. The Institute's staff has actively contributed to the activities of international map-editing committees. We have tried to do our best in paying host and guiding the numerous foreign colleagues who have come to visit our Institute, and to celebrate the Institute's 90^{th} anniversary in 1959. On this occasion we organized a *Conférence Internationale sur le Mésozoïque* in which 72 representatives of 11 countries and many outstanding Hungarian geologists took part.

We consider the present jubilee too as an expression of our endeavours to widen the scope of our international relations. This is why we are addressing the scientific public of the world; exhibiting our history; our faults and accomplishments, and seeking to find the best way of fitting our work with the development of geological sciences as a whole and of fully devoting it to the Nation's welfare and to the progress of mankind.

A century is a long time in both history and science. It is particularly so in the past century during which the spinning wheel of history whirled much faster than before. In the above historical review we could see the Institute grow and develop; achieve brilliant results; endure hardship and how it struggled between fundamental scientific research and activities of immediate practical aim. This brief review is, however, only a rough cross-section, and a number of important questions such as the detailed tracing of scientific achievements and the industrious assembling activities connected with the growth of the Library, Map Depository, Archives, and Geological Collections, have been omitted. For these questions, the reader may consult the subsequent chapters of the present volume.

In concluding our historical account I should like to hint at our plans for the years to come. The exploration and development of the power and mineral resources is steadily increasing in both our country and all over the world. The social and technological progress embracing the entire Globe enhances power consumption and the utilization of metals, and more and more types of mineral substances are being made use of in everyday life. The gradual widening of the scope of prospecting and utilization of mineral raw materials for the amelioration and fertilization of the soils cannot be dispensed with. Civil engineering is developing towards the fullest possible consideration of the geological conditions. The exploitation of subsurface water resources is expected to increase at an unprecedented rate. All these enormous requirements should be anticipated and assessed by scientific methods in order that the means at our disposal may provide the highest possible efficiency in meeting them.

Crossing the threshold of the second century of its existence, the Hungarian Geological Institute is looking forward with great confidence towards its future, for its versatility can be of manifold use to the Society. In the last analysis, Past and Present and also future plans encourage us to hope that the Institute's activities will go on showing an upward trend in the long run.

DIRECTORS OF THE HUNGARIAN GEOLOGICAL INSTITUTE

by

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Head of the Museum of the Hungarian Geological Institute

The history of a research institute, or either a shorter or longer period, is inseparable from the life, career and activity of its directors. One is born for keeping the established working routine of the institute at a uniform pace in time of internal or external crises, wars, economic difficulties, political events, and for the fending off of evils that might overturn the usual life of a research institute for months or even for years. One follows less distinctly marked-out ideals, another is not energetic and independent enough or may not be cut out for facing the situation or avoiding danger by the right sense of scientific policy.

Following the hundred years history of the Hungarian Geological Institute, we see a pageant of most edifying events and developments. One director takes his seat during the prime of his life, at the summit of world-wide success, and from the very first moment this shows through the decade of his directorship. He takes part in the work of his staff. He accompanies them to the sites of surveys and helps them with good advice. The superiority of his great knowledge is a source from which they are welcome to draw. They profit from his having toured the wide world. He inspires them to write publications and monographies. The working plan he puts before them seems immense but they carry it out to the common goal. One publication follows the other under his guidance. That has been said so far makes up the portrait of Lajos Lóczy, professor of Budapest University, propagator and teacher of geography taught on the basis of geology. His activity as a geographical explorer and teacher moved the Board of Berlin University to invite him to take the place of the deceased Richthofen as professor of the world famous Department of Geography. Lóczy did not accept the invitation. He preferred to stay at home and bring up a new generation of geographers and geologists.

Quite another type of director was HUGÓ BÖCKH, the master of prospecting for water, hydrocarbon and ore deposits, who was known and honoured all over Europe. He had other guiding principles to follow: setting the study of practical geological problems into the axis of the Institute's programme. In the very first year of his directorship, he worked out a detailed programme, with the aim to lessen the troubles of raw material supply which Hungary had to face under poor financial circumstances during the postwar period. The main task was to find hydrocarbons, but other questions, such as the exploration of ore, working for a smooth water supply, the development of practical hydrogeology to support irrigation, were not neglected either. He changed his post, as an under-secretary of state in the Ministry of Finances, where he was in charge of mining research on a national scale, for the director's post at the Institute.

BARON FERENC NOPCSA on the other hand, was quite another personality, as he had never acted as a civil servant before accepting his directorship. His aristocratic background, fortune, adventurous life, and activity were well-known even beyond the Continent, which permitted him to make an absolute arbitrary use of his directorial power, unprecedented in the scientific life of Hungary. But — with or without applause — the working pace dictated by him was terrific and relentless. In order to make publications appear quicker, he had a printer's shop set up. All important posts were filled with specialists, This is how KÁLMÁN LAMBRECHT, the excellent paleoornitologist became head librarian of the Institute and the list of casual workers included ELEMÉR VADÁSZ and LAJOS LÓCZY JR.

Changes in the personal of the director reached, deeply into the life of the Institute. Yet summing up the history of the hundred years as a whole, we find that one period of leadership often completed what had been imperfectly or unemphatically done in the previous period. Looking back, from a distance, we may see that the things have found their balance in one way or another.

It was exceptionally fortunate from the point of the Institute's development that the directors appointed to its leadership were remarkable, competent men who had something to say, were respected by their staff and — what is by no means less important — had authority, also, beyond the Institute, as well as, in higher scientific quarters. They were chairmen of the Hungarian Geological Society for one or two cycles and fellows of the Hungarian Academy of Sciences. The importance of the director of the Geological Institute was illustrated by the fact that they were appointed or released by decrees bearing the royal hand.

The directors had fame and respect also abroad. After the death of KARL PETERS, JÁNOS BÖCKH was invited to head the Department of Mineralogy and Geology at Graz University. LAJOS LÓCZY — as mentioned above — could have been Professor of Geography at Berlin University. On the 26^{th} of May 1911, Lord CURZON, himself, handed over to LÓCZY the document of his honorary fellowship in the Royal Geographical Society together with the Jubilee Medal of Geography. The few items selected at random simply serve as an illustration.

Another fortunate circumstance, from the point of the Institute was that the appointment of directors, the solution of vacancies, seldom took more than a few months or just a few weeks. MIKSA HANTKEN was followed by JÁNOS BÖCKH, JÁNOS BÖCKH by LAJOS LÓCZY, FERENC NOPCSA by HUGÓ BÖCKH. It was only after LAJOS LÓCZY had retired that for some time the director's post was taken by temporary directors under rather difficult circumstances.

The death of HUGÓ BÖCKH late in 1931 puts an end to the perspective offered by the past, which makes it easier for the chronicler to draw an unprejudiced picture. The door of the present opens before us, where the characters are living personalities. It is for completeness' sake that we give a brief survey of their activity, as they stood their ground in the most serious period of these hundred years, and in many respects it is thanks to them that the Institute they loved so much and served so unselfishly has been able to see its hundredth anniversary.

MIKSA HANTKEN

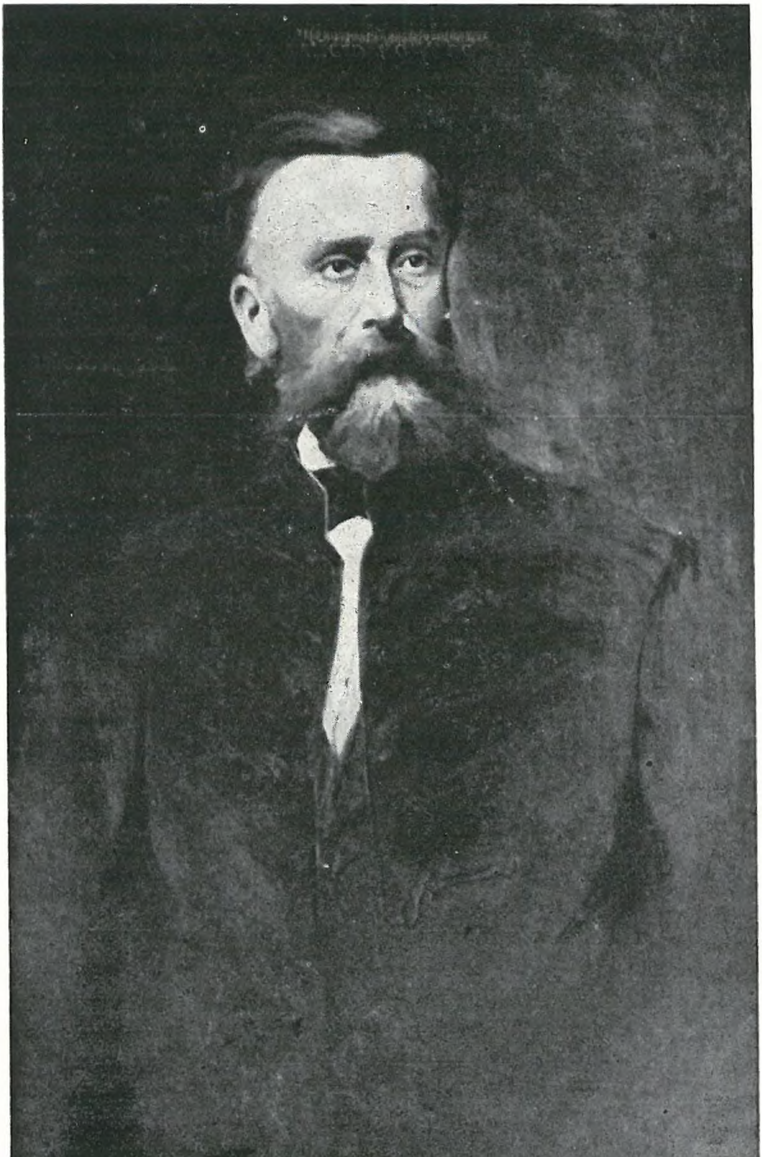
Born on September 26th, 1821 at Jablunka in Austro-Silesia.
Died on June 26th, 1893 in Budapest.

Appointed to director of the Royal Hungarian Geological Institute on September 8th, 1869. Left the Institute on January 9th, 1882. He was director of the Institute for 13 years.

HANTKEN died 76 years ago. This gives a perspective in which the verdict of posterity may be free from any prejudice. According to the opposite portraiture of LÁSZLÓ MAJZON, one of the outstanding personalities of contemporary Hungarian *Foraminifera* research, the pages of HANTKEN's works, "*seem to emanate his miraculous force much ahead of his time, with an abundance of results offering something new, something modern*". His creative works based on good evidence have elucidated regular phenomena and connections which made him the first to explain a number of questions related to the development of earth and life.

What had his contemporaries to say of him? ANTAL KOCH, a pupil of HANTKEN's and his follower, as head of the Department of Paleontology at the University said: "*He was a polite, pleasant and friendly man*". His honour for man is reflected also in his writings: you will never find him bantering or using personal arguments. The opinion of Hungarian experts has been summed up by ELEMÉR VADÁSZ, Academician, the most respectable figure of Hungarian geological research in 1954, as follows: "*His scientific activity is immortalized in Hungarian geological literature by fundamental, classic works, in many respect showing much beyond his time and valuable up to this day*".

MIKSA HANTKEN was a student of Vienna University from 1840–42. Then, he matriculated at the Mining Academy of Selmecbánya, famous all over Europe. He graduated as a mining engineer in 1846. The years 1849–50 see him in Vienna again. He takes a course of fundamentals of geology at the University. In 1852 he takes the job of a mining engineer with the Transdanubian coal mines and works at Dorog. He clearly sees that Hungarian mining — complying with the practice of the time — has taken the wrong way. He writes: "*I*



MIKSA HANTKEN

1821–1893

fas induced to geological investi gations by seeing that prospecting was based, for the most part, on arbitrary assumption without any woundation. Their conclusions are ashaky bases for successful research and often large sums are spent in vain".

In addition to the goal he was setting for himself, the above lines included also the realization of the fact that the continuation of coal seams broken by faults could be found only by a precise knowledge of the geological conditions of the region concerned. This lead him to the problem of the identification of coal beds and to studying *Foraminifera* as a possible means for correlation.

It was not easy to take up and carry out such studies at the time. He had no microscope. József Szabó, famous later professor of Budapest University, lent him one. This was the starting point of one of the most significant series of *Foraminifera* studies of the 19^{th} century.

As said, he went to work at Dorog in 1852. Ten years later, in 1863, he delivered a lecture striking in its novelty, on the role and value of *Foraminifera* in stratigraphy at the Itinerary Conference of Hungarian Physicians and Natural Historians held in Pest. His lecture was based on observations made at Dorog and finding practical application in his research work.

We called him a pioneer, who was much ahead of his time. His strength and talent as a pioneer had many a difficulty to overcome.

This was the time of the first significant deep drilling. The material of the drilling was examined from the aspect of geology to some degree. But who would have thought of extracting a microfaune by washing it layer by layer and then to identify it? It was only upon the initiative of Hantken that the paleontological examination of the drilling material of the artesian wells in Budapest (Margaret Island and City Park) was undertaken by Vilmos Zsigmondy, who was an outstanding specialist in drilling at this time.

Hantken was the first to open up a new way with his *Foraminifera* studies and to elaborate a working method for it. He marked out the direction to follow: "*I cannot fail to mention the deplorable process drilling powder is generally subjected to at drillings. Generally, it is discarded. If we consider the sums this powder cost, its importance for the identification of the strata cut by drilling through, as well as, the use one could make of it in the geological surveying of the region and at possible later drilling in the same region: we must realize that the way in which drilling powder is treated is most regrettable not only* *with a view to science but also from the point of view of the contractors*".

It was HANTKEN who gave voice to such a demand for the first time and which — in spite of all efforts — has not been fully observed by researchers, government and companies even up to this day.

In 1871 we see HANTKEN in Munich engaged in investigations into *Foraminifera* at SCHWAGER's. It was then that he studied *the pores of arenaceous Foraminifera*. This important observation was later attributed, by some, to MOEBIUS, who observed the phenomena, in fact only some ten years later, in 1880.

It was HANTKEN, too, who recognized the *dimorphism of Nummulites*. He reported his observations in a letter written to DE LA HARPE, who published them — together with some other data of HANTKEN's — as original notes by HANTKEN.

HANTKEN was on friendly terms with several notable researchers of the time, besides DE LA HARPE. He exchanged letters with REUSS, SCHWAGER, HERBERT MUNIER-CHALMAS and KARL ZITTEL and sent them a collection of some 150 slides of *Nummulites* in Hungary, with an excellent systematical description of them. These scored an unanimous success at the Vienna World Exhibition in 1873 and later, in 1881, at the International Geological Congress in Bologna as well. The slides prepared with artistic care unusual for the time were made in collaboration with ZSIGMOND MADARÁSZ. The annexes comprised original, precise drawings for foreign experts.

MIKSA HANTKEN's manuscript application and the appointment report of the Minister of Agriculture and Commerce indicate that he was teacher of natural history at the Academy of Commerce for two years beginning with 1861. In 1866 "for services rendered" the Council of the Governor-General appointed him assistant curator of the Plant and Mineral Collection of the National Museum. In the summer of the same year he was promoted to be curator. Later he was made Head of the Geological Department in the Ministry of Agriculture and Commerce.

The appointment released him from the heavy duties of a mining engineer and he could devote more and more time to his scientific activity. His work found special support in a decision by the assembly of the Hungarian Academy of Sciences on January 20th, 1864, by which he was elected corresponding member of the Section of Natural Sciences.

On September 8th, 1869, his career took a decisive turn. Upon the representation of ISTVÁN GOROVE, Minister of Agriculture and Commerce, King FRANCIS JOSEPH I signed his appointment to be Director of the Royal Hungarian Geological Institute.

The main initiators of the establishment of the Geological Institute were Professor JÓZSEF SZABÓ and VILMOS ZSIGMONDY, mining engineer. They had a part in the selection of the first director, MIKSA HANTKEN, too, as his friends, colleagues and protectors.

The Geological Institute had a most difficult start. The Royal Edict, some parts of which were excellently constructed by the participation of experts in the Hungarian Ministry of Agriculture and Commerce and by the wording in which MIKSA HANTKEN also took part, which set meritorious objectives that are worth being aimed at even today. The budget for the exploration of the 325 000 km^2 of Hungary was, however, portioned out with a very close fist, a sum ridiculously small, even then. Accomodation and staff was simply baffling. According to the documents of the National Archives, three qualified workers, two assistants, one clerk and one office servant made out the staff of the Institute. It can be imagined how difficult it was for the newly appointed director to make work "planned" in the Institute. He did it, however, with all his heart, an unbroken will amidst constant disputes. Internal and external controversies, personal fights, lack of money, indifference, and against petty or even unintelligible attitudes. With four hundred on its pay roll, it sounds almost incredible when looking back on those circumstances and knowledge of the tasks for administration, continuous and planned activity of a Hungarian Geological Institute that as much was accomplished.

HANTKEN tried to overcome the lack of experts in his staff by suggesting, that the Ministry should appoint for him the best geologists of the country. As shown by data from the Archives, it was upon his report and with his consent that KÁROLY HOFMANN, Professor of the Technical University, BENŐ WINKLER, JÁNOS BÖCKH and ANTAL KOCH were appointed. He repeatedly asked for and had it included in the deed of foundation of the Institute; that it should be possible to summon university students of natural history for geological surveying as auxiliary manpower during the summer vacation and that the expenses should be covered by the Ministry of Religion and Education. His first report to this effect dates from 1868, one year before the foundation of the Institute and HANTKEN signed it in his capacity of temporary head of the geological department of the ministry.

In 1875 a major work of HANTKEN's, "A Clavulina Szabói rétegek foraminiferái *(The Foraminifera of the Clavulina Szabói Beds)*" was published. LÁSZLÓ MAJZON writes about the book: "*Pointing much ahead of his time,* HANTKEN *tried to propound a stratigraphic synthesis on the vertical and geographical distribution of species.*" Ninety-three new species in the book are marked with HANTKEN's author name.

During his directorship, he wrote two major practical books. One is on the geological conditions of the coal region of Esztergom (1871), the other is a description of Hungary's coal fields and coal mining (1878). The latter is a most important survey of general character and had been for a long time an indispensable reference book for scientists and experts engaged in practical mining.

Not even in the beginning did HANTKEN have any illusions about the task he was in charge of. Still, even this benevolent and friendly man got tired of organization or perhaps of permanent struggle after thirteen years. The material of geological surveys was kept sleeping packed up in heaps of boxes in cellars. After ten years he still was suffering by being crammed up in five small rooms with his men, collections and a "library" consisting of a single book-case. In addition, he had to accommodate the material of his exhibitions as well, since it was included in the report made to the King in the appointment by I. GOROVE, Minister of Agriculture and Commerce: that the collections must be made available for the public. He writes: "*In* MIKSA HANTKEN'*s special qualification is coupled with the instinct to make the fruit of his studies common property . . . he is marked out for the efficient promotion of the aims of a Hungarian Geological Institute. It is the essential duty to make the results of science in the field of geology the general property of the community*". (September 2nd, 1869.)

The office offered to HANTKEN at Budapest University promised a more peaceful and calm life. The interventions of JÓZSEF SZABÓ, professor of mineralogy and geology, resulted in an invitation for MIKSA HANTKEN to take the chair in the Department of Paleontology which opened in 1882 at the University. After Vienna, this was the second Department of Paleontology in Europe.

Hoping for silent and undisturbed years, HANTKEN was glad to follow the invitation which would give more time for his own research work. This took him to the summit. He is teaching again. It is for the first time that in addition to paleontology the geology of Hungary is also spoken of in systematic lectures. Parallel with his excellent colleague, friend and protector, JÓZSEF SZABÓ, they presented the whole of geology and paleontology to their students.

In 1878, he was elected member of the committee engaged in the homogenization of geological maps at the first international congress on geology, held in Paris. In 1886, he determined in Florida the first representative of *Nummulites* in America. In 1888, on the occasion of the 800 anniversary of Bologna University, he was conferred the Honorary Doctor's degree.

His mentality and love of his subject is well illustrated by the following two recommendations which we are going to mention in conclusion.

It was upon his recommendation, in 1869, that the Hungarian Geographical Society decided: "*that in order to spread the science of geology in wider circles, the Society should arrange itinerary conferences in the country, particularly in mining centres*". Let us add, that the plan found full realization only after 1945, that is, in the last two decades of the century following HANTKEN's idea.

Another remarkable idea of his was born on the site of the first geological itinerary conference, at Selmecbánya in 1871. He suggested that the Hungarian Geological Society should found branch societies, opening the first of them at Selmecbánya. It was again only in our days that branch societies have been founded by the reorganized Hungarian Geographical Society.

More then eighty species, one subgenus and three genera of various fossil faunal groups are named after him. Besides SCHWAGER, FISCHER and RUPERT, he is the fourth scholar in whose honour a *Foraminifera* family is named.

He died at the age of seventy-two, leaving to us the rich crops of a life spent in devotion to science.

JÁNOS BÖCKH

Born on October 20th, 1840, in Pest.
Died on May 10th, 1909, in Budapest.

The second director of the Hungarian Geological Institute. Appointed on January 10th, 1882. Retired on July 13th, 1908*. Director of the Institute for 25 years.

He was on the staff of the Geological Institute since its founding. He had thirteen years of service before being appointed its director. Before this, he was at the geological department of the Ministry of Agriculture and Commerce. When — in 1882 — he was appointed director of the Institute, he knew pretty well what he had undertaken. He had taken part in the struggles which HANTKEN had fought with red-tape in matters of organization.

After HANTKEN had left the Institute, KÁROLY HOFMANN and JÁNOS BÖCKH were the two possible candidates for the directorship of the Institute. HOFMANN was the older, a man of more consequence, deeper in knowledge and richer in experience. BÖCKH, on the other hand, was sure to stand his ground better, more energetic in matters of organization and would be more persistent in enforcing his will. HOFMANN's main concern was his scientific work. He withdrew for the benefit of JÁNOS BÖCKH, his brother-in-law. BÖCKH was forty-two when he undertook to materialize what had been wisely planned with a prophetic insight by the editors of the deed of foundation and of which regrettably little had been carried out in the first ten years.

Reading old documents and historical notes, it is astounding how difficult it was to find the strictly necessary financial means; to build up an Institute in small, dark rooms; or later in the scattered rooms of the ministry. To lay the Institute on uniform bases, to get topographical charts from Austrian military organs or to do scientific work without being able to purchase books or periodicals, was a heroic struggle, indeed.

* The date of his pension claim as standing on the original document preserved in the National Archives.

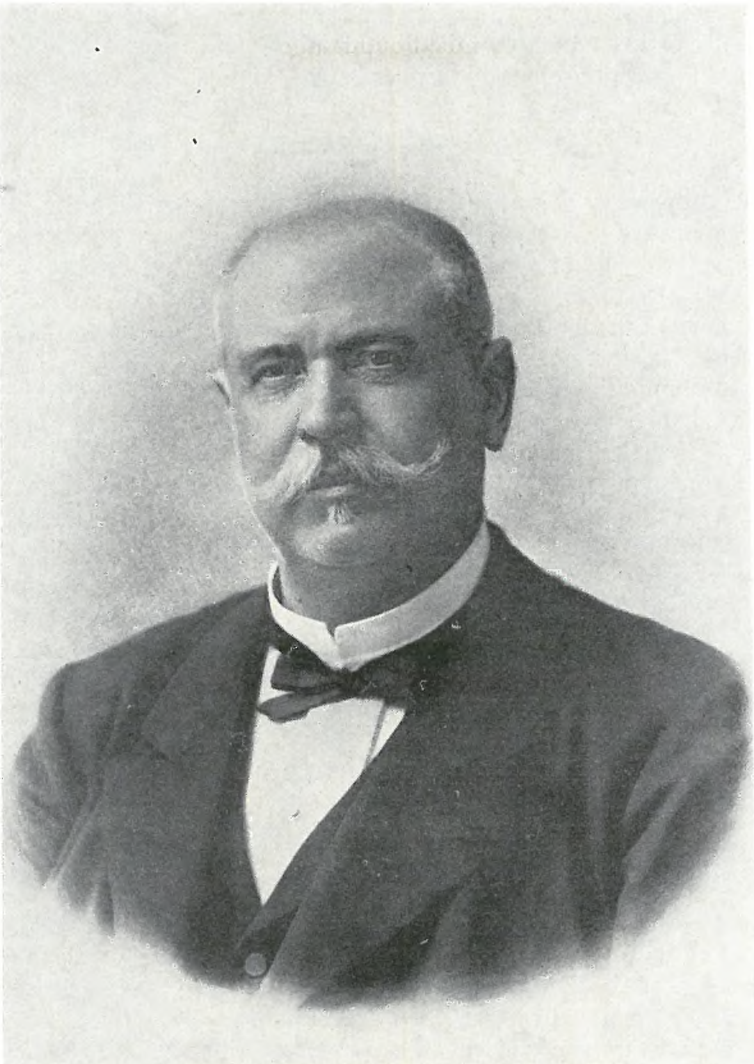
Aware of all this we are surprised when perusing János Böckh's publications to see the superhuman results in science of a man excelling in organization. It needs the exact tracing of facts, a description in details to form the right idea about this remarkable personality.

In 1869, the year of the foundation of the Institute, young János Böckh was entrusted with the surveying of the Bakony Mountains. The summary of his report on the South Bakony of most varied structure was published as early as 1872. Academician Ferenc Schafarzik, former professor of the Mineralogy-Geology Department of the Technical University writes about this work: "*He went into the necessary details and did a most exact work both as regards stratigraphy and paleontology . . . he hit a record in geological surveying that has not been surpassed since and which will probably remain a unique performance in Hungary even in the future.*"

Let us add that he visited the sites on foot or riding in a cart, processed the faunas himself and described them in territories where no surveying had been done before, as the studies of F. Hauer, G. Stache or C. Paul only mentioned some parts of the Bakony at random. Böckh had ample opportunity to make new discoveries and "*these stratigraphic descriptions were classic*" — said Aladár Vendl. "*It was especially his classification relative to the Triassic, which because of its completeness could set an example even for the interrupted occurrences of the Alpine Triassic.*" His statements are also fundamental today. "*He draws up the geology of stratigraphically and tectonically richly divided South Bakony with firm lines based on refined observation*" — says Schafarzik. Forty years later, Lajos Lóczy Sr. worked on the same territory and found Böckh's descriptions "classic".

In 1873 Böckh received the task to do the geological surveying on part of the Mecsek Mountains. The other part was surveyed by Károly Hofmann. Böckh complied also with satisfaction to this task; he also did pioneering work at this time. Recommended by József Szabó, he was elected corresponding member of the Hungarian Academy of Sciences on May 10th, 1876. He delivered his inaugurating address on, "The Jurassic of the Mecsek".

In 1877 he was sent to survey the southern part of the Krassó-Szörény range. He reambulated the territory of intricate tectonics and geological structure till 1892. The primitive villages of the mountains, difficult to approach and covered with virgin forests, could not offer him even the minimum of comfort. Living a nomadic life, finding quarters in a tent, he lived so to say the life of an explorer



JÁNOS BÖCKH

1840–1909

doing his work with utmost care. At the exhibition arranged on the millenium of Hungary, he presented the results of sixteen years' toil in his geological map on the Southland of Hungary.

As an appraisal of his achievements in this line, let us quote SCHAFARZIK again: "*The discovery of* JÁNOS BÖCKH, *i.e. the occurrence of the Pelagic Trias in the Bánság and in the Bihar Mountains is an interesting proof coherent development of the Triassic throughout the south-eastern part of Central Europe as far as the Dobruja, which — according to* VIKTOR UHLIG — *had been destroyed again, with the exception of a few surviving rags, presumably during the denudation period between the Liassic and the Dogger.*"

Some of these busy years coincide already with the difficult period of his directorship. BÖCKH knew a great part of the country by his own observation and there were regions which he had studied most thoroughly. "*This was the reason why he was already generally known as the most experienced Hungarian geologist in the eighties*" — says his contemporary. This is why the Government thought of him when rock oil exploration was taken up in earnest in this country. In 1893 SÁNDOR WEKERLE, Minister of Finances, appointed him for the starting, organization and co-ordination of systematic hydrocarbon explorations. Parliament allotted a sum of 100,000 crowns a year for this purpose.

BÖCKH started work in the Carpathians in 1893 with great enthusiasm. The very next year he published a report on the geological exploration of the region. He marked out the site for the first drill in the northern limb of a flat anticline opposite to the church in the village Izaszacsal.

Drilling, however, was not done by Government agents but was entrusted to a private firm, "JOSEPH DEUTSCH", whose equipment was obsolete with pipes in a poor state. BÖCKH wanted to drill down to a depth of 648 metres but at 546 metres the outbreak of oil and natural gas was so strong that oil not only spouted up but demolished the shaky equipment and burst the pipes, too. Naturally, it was impossible to re-start drilling.

The Government did not think better of it in spite of all the protests BÖCKH made; it was the same gang of scoundrels who were again entrusted with drilling a second time. Unwilling to follow BÖCKH's instructions, they moved so far from the anticline that they could not reach any good result. This is how the 100,000-crown Government undertaking was started in private hands by incompetent contractors.

BÖCKH took up research in another region. In 1894 he studied the outskirts of Sósmező in Transylvania. His report was again ready in a year. He worked quickly and very well. He marked out drills but this time neither the Government nor private firms were willing to start with the job. At the end of the last and the beginning of this century, before a national monopoly was declared, oil exploration was not a good "business" for private firms.

Thus, the unfortunately started and on the part of the Government so clumsily treated oil exploration had come to an end. All efforts made by BÖCKH were in vain. Hungarian geologist could not do much more than share BÖCKH's grief. In 1900, the Geological Society of Hungary awarded BÖCKH the "*József Szabó medal*", the highest distinction of the Hungarian geological research up to this day — "*for his pioneering activity in the field of Hungarian petroleum geology*".

Oil prospecting in Hungary was on its way at the Geological Institute and even, if it come to an impass for some time, BÖCKH's valuable activity had turned the attention to it and the cause has not fallen into oblivion. BÖCKH's charts and publications kept the idea alive. The problem was taken up again by his follower, LAJOS LÓCZY, and also his son, HUGÓ BÖCKH who won world-wide appreciation for the Hungarian team of geologists and geophysicists in the field of oil prospecting.

We have presented the portrait of the creative scientist in outlines. Now we wish to point out the road which ripened him and formed his personality for the role of director.

His contemporary says: "*the properties of the excellent civil servant were favourably coupled in him with a considerable measure of military firmness. In spite of his official strictness he was most benevolent to his subordinates, a good friend to his colleagues and showed due respect to his superiors*".

His upbringing, the first active years of his youth and high education add further traits to this portrait. He is the last of a generation that could not obtain geological knowledge by attending a single university but had to spend years to get the necessary education, now here, now there, in order to acquire the knowledge and practice needed, to find the right master and guide fitting for his intellectual rank and measure. Looking at his curriculum from this aspect, we can easily reveal the secret of his wide education.

His father was county health officer at Somorja, in Pozsony County and was pretty well off at the time for educating his son.

Böckh prepared himself for a military career, which cost a lot at that time. In 1855 he was sent to the Genie school, at Krems, where he made his finals in 1858. Unfortunately he broke a leg in the last year of his studies. So he waived his original plans and changed a military career for mining. His knowledge of technical and practical subjects is due to his years in the army school. A strict military education left indelible marks on his personality for his lifetime.

In 1858, he matriculated at the Mining Academy of Selmecbánya. He graduated as a mining engineer in four years and spent his probationer's time in the coal mines of Eisenerz in Austria. Early in October 1863, he was transferred to the Manager's Office of the Reichenau Roll Mill. On December 17th, 1864 he was moved to the Imperial ministry of Finances in Vienna, the superior authority for mining at the time. He was delegated by the ministry for two years to the Geologische Reichsanstalt in Vienna where he attended a post-graduate course for geologists in theoretical and practical subjects. In December 1866, he returned to the Mining Department of the Austrian Ministry of Finances.

He learnt a lot, became well versed in the practical aspects of geology and mining, but also had an insight into the national administration done by central agencies and had the opportunity to learn to know the devil's kitchen of ramifying factory life, too. All the difficulties of practical ventures revealed themselves before him. In 1867, he had the opportunity to return to Hungary and find a job as an assistant officer of mines in the newly established Mining Department of the Hungarian Ministry of Finances.

Early, in August 1868, he got leave from the Minister to act at the geological department of the Hungarian Ministry of Agriculture and Commerce. After a year — in 1869 — he was appointed to the team of the newly founded Geological Institute as an assistant geologist.

It was here that the personality of János Böckh could fully manifest itself: consistent in expert knowledge, strict in work and reliability, experienced in organization and with a nature astonishingly well fitted for a director's rank and work.

In the middle of the past century, Vienna was the most famous training school for geologists in Central Europe, not only in its university but also in the Geologische Reichsanstalt founded in 1849. It did a lot for Böckh to be trained in Vienna where he could develop into a true geologist at the side of notable specialists. Another important point in his education was his training at the world-famous Selmec Mining Academy.

In 1865, during BÖCKH's time, the director of the Geologische Reichsanstalt was FERENC HAUER, a Hungarian. He had STUR, STACHE, FOETTERLE on his staff. At the University, BÖCKH could attend the lectures of EDE SUESS and EDMUND MOJSISOVICS. He got closer to them and attended their frequent lectures. STACHE took him along on geological surveying in Hungary (in the environs of Vác and to the Cserhát Mountains) and BÖCKH wrote his first scientific reports on these regions. They were published in the year-book of the Vienna Institute in 1865. The next year found him in the Bükk Mountains, where he learned about the Paleozoic and the Mesozoic of the Bükk. His report on it was published in the same year-book, in 1866. Both papers with the annexed military map-sheets count as the first serious geological surveying of the regions described.

When he took over the leadership of the Geological Institute, in cooperation with his brother-in-law, KÁROLY HOFMANN they were the first to introduce exact and systematical geological surveying in this country and — with a few exceptions — taught it directly or indirectly to all those who later joined the staff of the Geological Institute or were voluntary workers.

When, after the departure of MIKSA HANTKEN, JÁNOS BÖCKH was entrusted with the temporary direction of the Institute he was a senior geologist. He was appointed director half a year later, on January 10^{th}, 1882.

He was forty-two years old, burning with ambition to work. First of all he set out to complete the personnel in numbers. He let basic inventories be taken, the library was revised, classified and a catalogue prepared. He put a librarian in charge.

Upon his request, ANDOR SEMSEY, the great patron of Hungarian institutes and museums of science bought the paleontological collection left by Professor COQUAND in France to have comparative material for the investigation of Hungarian faunas. At the time, the collection was big enough to fill a whole room in the Institute.

The new director laid great stress on geological surveying. Beginning in 1882, the Institute regularly issued publications year by year in Hungarian and in German. The reports gave accounts of surveying but BÖCKH found it necessary to let specialized geological and paleontological papers appear as well. Since mining-surveying had a special importance for him, he employed a mining geologist, too. He introduced geological research for practical purposes in general.

By this he laid the foundations of prospectings for ore, coal, hydrocarbon and other mineral deposits (rock, clay, salt, gypsum, etc.) by the Institute. With a view to widening the knowledge of experts, miners and the general public, he had representative exhibitions arranged on raw material research and mining.

It was something quite incredible at the time. The Institute was modernized in every respect. It was engaged in industrial research, aimed at meeting practical demands. BÖCKH supported hydrogeological investigations. He had a special geologist's status for the purpose and found an excellent specialist for it in TAMÁS SZONTÁGH, who later became sub-director of the Institute.

He himself set a good example. In connection with the geological investigations in the environs of Pécs, he also studied the water supply of the town and published his findings in an interesting report. In addition to hydrogeological investigations he also started soil research. In concert with the Minister of Agriculture and Industry an agrogeological department was added to the Institute: the first institutionally established place of research for soil science in this country.

In the eighties and nineties of the past century all this caused a great sensation in Hungary. Industry and commerce seemed to take cognizance of geological research work going on in this country. Requests for expert opinions were pouring in. The charm of novelty won over even the sceptic. The benevolence and appreciation of higher quarters became also more perceptible. Wherever they were opened, the exhibitions arranged by the Institute spoke for themselves by taking home diplomas, medals and distinction. At the Millenary Exhibition of the Institute, in 1896, BÖCKH demonstrated the entire field of activity and scored great success with it.

The Parliament and the Council of Ministers could not postpone the meeting of a rightful demand: to erect an independent building to accomodate the Institute that should be big enough and worthy of its significance. ANDOR SEMSEY offered 100,000 crowns from his own money for the construction. A small fortune at the time. The Minister of Agriculture and Industry allotted the same amount in its budget for the purpose and charged JÁNOS BÖCKH with studying the possibilities of carrying out the plans.

At first sight it was clear, that the contribution made by the Government was too small. BÖCKH writes himself that he realized the "benevolence" with a sinking heart and tried to find a way out. It was a fortunate turn for him and also for the future of Hungarian geological research that the minister was turned out of office. His place was taken by a talented specialist of Hungarian agriculture: IGNÁC DARÁNYI. He immediately saw that the sum was insufficient and with a special consent of Parliament in 1896 secured 800,000 crowns for the purpose. This was completed by the mentioned allowance of SEMSEY's and a plot of 7644 sq. foot offered by the Municipal Council free of charge.

The drafts were made, construction was started and on May 7th 1900 BÖCKH could inaugurate the new Institute in the presence of IGNÁC DARÁNYI, Minister of Agriculture. On May 27th King FRANCIS JOSEPH I visited the Institute.

The inauguration of the Institute was the, "*great day of* BÖCKH'*s life that had richly compensated him for all his troubles over long years and for all the adversities of decades*", writes FERENC SCHAFARZIK.

JÁNOS BÖCKH was director of the Institute for twenty-five years. He claimed his pension by an application dated on July 13th, 1908 with reference to his arteriosclerosis. One year after, on May 10th, 1909 he was killed by a heart attack.

LAJOS LÓCZY SR.

Born on November 4th, 1849, at Pozsony.
Died on May 13th, 1920, at Balatonarács.
Appointed to be director of the Hungarian Geological Institute on August 19th, 1908.* Retired from the Institute on November 3rd, 1919.**

LAJOS LÓCZY's parents lived at Opálos, in Arad County, South Hungary. At the time of the War of Independence, in the autumn of 1848, they moved over to Pozsony for a short time, in order to avoid the riots of the borderland. It was here that their son LAJOS was born on November 4th, 1849.

After the family had returned home, L. LÓCZY went to school at Arad. For his university studies, his parents sent him to Zurich University, where from 1869 to 1874 he was a pupil of the most notable geologist of the time: ESCHER VON DER LINTH. After LINTH's death, he attended the lectures of ADALBERT HEIM and returned back to Budapest in 1874, with an engineer's diploma.

At home, he was invited by JÓZSEF KRENNER, the renown mineralogist, director of the mineral collection of the National Museum to work with him. He was appointed assistant curator on December 1874. In this, he followed the steps of HANTKEN, who left the Museum four years earlier to become director of the Geological Institute. LÓCZY was in charge of the geological and paleontological collections.

In the early seventies, BÉLA SZÉCHENYI, son of ISTVÁN SZÉCHENYI, the great man of Hungarian political life and also the starter of the Reform Age, was organizing an expedition to Central Asia. He needed a well-qualified geographer and geologist. FERENC PULSZKY, Director of the National Museum and EDE SUESS, world-famous professor of Vienna University, both recommended LÓCZY for the purpose. This is how LÓCZY, at the age of twenty-eight, became a member of one of the most important Asiatic expeditions of the nineteenth century.

* Date of the original document preserved in the National Archives.
** Date of the manuscript application preserved in the National Archives.

LAJOS LÓCZY SR.

1849–1920

LÓCZY was away from November 1st, 1877 to May 1st, 1880. This trip had a decisive effect on all of his later career, on his development as a man and a scholar and on the shaping of his sense for self-criticism. The long time that ripened the results of this expedition for the press shows how thorough he was in coping with the tasks set for him.

Let us have a brief survey of the route of the expedition. It was almost a century ago and it may have been forgotten how far LÓCZY had broken new terrain in the fields of geography and geology by his Asiatic expedition. He was a man of no less importance than BARON RICHTHOFEN, supposed to know the most about China at the time. As Professor of the Geographical Department of Berlin University, he defined in the 400 page, the three-volume travel book in German and in Hungarian, that LÓCZY's included observations were "*a masterpiece of geological literature*".

The expedition started on December 4th, 1877. They took a ship from Trieste to Bombay, from where LÓCZY and Lieutenant KREITNER, his Austrian colleague in surveying went to Calcutta to study the library of the Asian Society of Bengal. In the "jungle" of the library, he came upon the manuscript autobiography of SÁNDOR KŐRÖSI CSOMA, Hungarian Asiatic explorer. For a long time, the manuscript had been supposed to have been lost. This confirmed his decision to try to reach Lhasa by following KŐRÖSI CSOMA's route.

He soon set out. He arrived in Darjeeling, where he visited KŐRÖSI CSOMA's grave, then continued on his way in the company of the British officer RICHEE and fifty coolies. For two weeks they and their men marched under very difficult circumstances. They arrived to the 16,500 feet high Djelep Pass. He made maps all the way of his trip and collected rock specimens. They were a mere 40 miles from Lhasa as the crow flies. He prepared the geological chart of the large triangle bordering on Bhutan, Sikkim and Tibet. He discovered a second huge range of mountains behind the main range of the Himalaya, and marking it on his map, he gave it the name Transhimalaya. Many years after, SVEN HEDIN, having reached the mountains from the other side, called the giant range similarly, Transhimalaya. The Royal Geographical Society having doubts about the existence of the range, consulted LÓCZY. LÓCZY confirmed SVEN HEDIN's discovery, but remarked that on his itinerary map he had marked the mountains long ago calling it Transhimalaya, himself.

Lóczy and Richee could not get farther on the road to Lhasa because of the inimical behaviour of stirred up mountaineers. They turned back. Lóczy took leave from Richee and went on to Java. He climbed and studied the volcano Merapi, then set forth to Shanghai in order to study and survey the immense delta region of the Yangtse Kiang and the big lakes to the south of it. He spent several months there in geographical and geological studies.

It was here that he made the arrangements with Béla Széchenyi and Kreitner for the expedition and started for the Central Asian expedition proper in possession of a permission and *laissez passer* of the Chinese Government. Their final objective was the exploration of South Mongolia and Tibet.

Their road took them from the Yangtse basin through the Tsingling Shan Mountains to Hsian, the former capital which was in ruins, from where they proceeded to the classic loess region of China. Lóczy who had studied Richthofen's investigations into the loess, made complementary examinations and perambulated all over the huge plainland.

Having crossed the territory, they followed the line of the Great Wall of China for 400 miles, with Lóczy engaged in drawing maps and collecting geological observations all the time. They crossed the Nanshan, descended on its north side to the Gobi. Here they spent four months in studying the desert and preparing maps of it. Getting to Tunhuang, he came across the cave temple of the Thousand Buddhas and later called Sir Aurél Stein's attention to it, who upon his information went to find and study the place.

On his way Lóczy explored the K'Uk'Unoerh region, studied the lake itself, then turning to the south, the whole expedition reached Tsengtu in 45 days to proceed on Tibetan soil again. The pack horses could not stand the thin air. The baggage of the caravan had to be carried by the Tibetan yak drivers themselves. They arrived at Pat'ang, where they were obstructed by a host of armed lamas. Széchenyi sent a special messenger to Peking. The Imperial Foreign Office seemed to be powerless. They answered that they have but few soldiers in that region and could not, for the expedition's sake, enter into war with the barbarous and fanatic population. The expedition had to turn back to the south passing still crossing Tibetan territory, then crossed the Yunnan to Burma and finally started on their way home.

Lóczy summed up and characterized the use of the expedition as follows: *From the point of geography and geology the repeated* *attempts to reach Tibet were most profitable. We hand an opportunity to cross the high ranges embracing the highland of Tibet, again and again and to reveal their structure.*

He travelled for more than two months in Tibetan territory. He could visit parts of the Tibetan highland never entered by Europeans before. This rendered his observations of a unique value.

Thus, for instance, the finding that the stratigraphical conditions of the Carboniferous of North China are generally closer to the Russian facies than to the facies of the western, say German Carboniferous was made at a time when even RICHTHOFEN was of the opinion that the Carboniferous of China are similar to that of Germany. RICHTHOFEN had more difficulty than LÓCZY, as in North China (Honan, Shensi, Shansi) he could not find any marine fauna.

From a stratigraphical point of view, the greatest achievement of the expedition was when in Batang, near Tsung Tien, LÓCZY found marine (littoral) faunas characteristic of the Middle Triassic.

LÓCZY realized that from a phytopaleontological angle Asian territory between the Amur, Japan, South China and the Altai Mountains is an independent floral region greatly different from the *Glossopteris* flora of India, Australia and the Gondwana land of South Africa. On the route followed by LÓCZY, the Cretaceous and the old Tertiary were also of continental character.

"*Although the very nature of the expedition made* LÓCZY'*s notes, rock and fossil samples incomplete, he could most thoroughly study the geological and physicogeographical conditions of East Asia and brought home a number of results which science will always find precious and for the most part even fundamental*" — says ALADÁR VENDL, about LÓCZY's activity, in his memorial speech at the Academy of Sciences.

Back from his tour of China in the spring of 1880, LÓCZY went on working in the mineral collection of the National Museum. His first concern was to unpack and classify the rich material he had taken home with him. He prepared rock slides, and specimens and drew up maps. Every minute of three years, so to speak, was spent in this work. In the spring of 1883, JÁNOS BÖCKH, director of the Geological Institute offered him a senior geologist's post. He was appointed on March 7th, and sent to his birthplace, the hilly region of Hegyes-Drócsa for geological surveying. This is a range of intricate tectonics about 60 km long. Also later, LÓCZY gave much attention to this region, whose description was published by the Institute.

He was on the staff of the Geological Institute for three years only. His earlier superior, JÓZSEF KRENNER, director of the mineral collection of the National Museum succeeded in gaining him back again. Besides being the conservator of the mineral collection, KRENNER was a Professor at the Technical University and wanted to share the Departmental troubles with LÓCZY. He was supposed to lecture on mineralogy and petrology, leaving geology to LÓCZY. LÓCZY was appointed as assistant professor for "technical geology" at the Technical University on March 10th, 1886.* His first assistant was KÁROLY PAPP, who later became professor of geology at the Budapest University.

When, after three years, he was appointed professor of General Geography at the Budapest University on July 1st, 1889, LÓCZY left the Technical University.* He was teaching for the next twenty-eight years.

He was a most informal, warmhearted and pleasant teacher. His students preserved their high estimation and affection for him till the end of their lives. There were such remarkable men among them as GYULA PRINZ, Asia explorer, ANTAL RÉTHLY, the famous director of the Meteorological Institute, PÁL TELEKI, Minister of Education and Prime Minister, the excellent and well-known geographer, ELEMÉR VADÁSZ and ALADÁR VENDL, the greatest living figures of geological research in Hungary, ISTVÁN VITÁLIS, professor of the Selmecbánya Academy, and HUGÓ BÖCKH, director of the Geological Institute.

To quote one of his biographers, GYULA ANTALFFY: "Little wonder that he left such an exceptionally deep impression on the students of geography when he took them travelling around half of the Continent as a form of instruction. Once, for instance, he made a tour with his students via Lemberg and Kiev to Moscow and Petersburg returning home through Helsinki, East Prussia and Silesia. Another summer the route was București, Odessa, Batum and Tbilisi. They crossed the Caucasus along the great Georgian military road and having left the Caspian Sea behind, returned to Odessa in a great roundabout way. He visited with his students the Balkan Peninsula, Italy, Finland, Turkey, Russia and they travelled all over Hungary together. The fame of his marvellous study tours was spoken about far and wide, and foreign students hurried to attend his lectures from all corners of the compass.

* Date of the original document preserved in the National Archives.

The expenses of the "*wonderful study tours*" were borne by ANDOR SEMSEY, who spent on them a round some of 100,000 gold crowns. "*This old scholar of exceptionally great knowledge followed in his peaceful retirement every movement of natural sciences with a keen eye and was ready to help wherever it was necessary and whenever he could*" — says JENŐ CHOLNOKY when outlining the intellectual portrait of this most generous of Hungarian country gentlemen.

LÓCZY worked at the University till 1908, at which time on August 19^{th} he was appointed director of the Geological Institute, as successor to the retired JÁNOS BÖCKH. He spent the rest of his career at the Institute, till his retirement. In 1919, the last year of his directorship, on March 13^{th}, he was appointed deputy under-secretary of state.*

In the autumn of the year 1919, when he took over the leading of the Institute, he addressed to the Minister a bulky report in which he asked that the word "Royal" should be omitted from the official name of the "*Royal Hungarian Geological Institute*" and the "right" new name should be, "*Hungarian National Geological Institute*". He made another report with the request that "*the Institute be permitted to extend its partial geological surveys to Croatia and Slavonia as well as to Bosnia and Herzegovina,*" since these countries are characterized by imperfect geological knowledge and by the lack of geological surveying and, "*especially the regions beyond the Sava and the Croatian seashore belong to the least-known parts of Europe*". He makes no secret of it, that the possibilities for this purpose should be provided for, "*by the participation of Croatian colleagues, by creating new statuses and by a significantly increased budget*".

LÓCZY took great care of national surveying. He regularly visited all his geologists on the site. He discussed local conditions withthem and made surveying more uniform on a national scale. He took the guidance of geological research going on in the north-western part of the country with a view to completing and modernizing former Austrian research. In his detailed reports he published quite a number of excellent geological sections relevant to North Hungary.

He had immortal merits in rock oil prospecting in Transylvania. He was the first to take up the cause of natural gas and rock oil prospecting after JÁNOS BÖCKH. The exploration originally started fcr potassium chloride. It was at his firm request that in 1907 the Government charged KÁROLY PAPP, senior geologist with the job of the Geological Institute, together with FERENC BÖHM and ERNŐ

* Date of the original document preserved in the National Archives.

BUDAI. KÁROLY PAPP marked out drilling at the Bolygórét near Kissármás, in November 1908. They gained 864 000 m^3 of gas a day from a depth of 315 m. From this time on regular hydrocarbon prospecting has been taken up again in Hungary. Research work was put in the hands of HUGÓ BÖCKH, professor of the Selmecbánya Academy and later director of the Geological Institute.

Some time later, in 1911, LÓCZY, as director of the Hungarian Geological Institute following an invitation of the Rumanian Government, went to prospect for oil in Rumania and to explore the geological structure of the oil fields in that country. In acknowledgement of the good results which he achieved in oil prospecting, the Order of the Crown IInd class was conferred upon him by the King of Rumania.

In 1913, entrusted by the Hungarian Minister of Education, he organized a team of specialists for the description of Hungary. The work was published in 1918 and the introductory study of the volume is LÓCZY's excellent general essay on "Magyarország földtani szerkezete) *(The geological structure of Hungary)*."

Two years after his appointment as professor of the Budapest University, in 1891, he made a recommendation at the committee meeting of the Hungarian Geographical Society, that an investigation of our largest lake, *Lake Balaton*, and its wider surroundings "*should be made the subject of examinations*". With the cooperation of home and foreign specialists he elaborated a working plan which surpassed in details the programme of other countries who were much better supplied by financial means. Again it was ANDOR SEMSEY who came to help. The series of publications filling many a volume cost more than 300,000 Forints — an exorbitant sum at the time. The outcome of twenty years of the hard work by sixty scientists was 33 volumes or 7000 pages of scientific publications. To mention some of the remarkable foreign members of the team: ARTHABER, BATHER, BITTNER, DIENER, FRECH, JAEKEL, KITTL, VINASSA DE REGNY took part in the work.

It was in this series that one of his masterpieces: "*The geological formations of the surroundings of Lake Balaton and their settlement by regions*" — a study of 617 pages, was published in 1913 first in Hungarian and later in German.

By his appointment as director of the Geological Institute, he could make good use of the financial means and expert knowledge at his disposal for making the investigations of the Balaton region even more intensive. He met with full understanding and support on the part of his staff. In 1915 the Hungarian Geological Society awarded him the "*József Szabó Medal*"; in 1916 he received the Grand Prix of the Hungarian Academy of Sciences which had been awarded to him before — in 1896 — in acknowledgement of his explorations in East Asia. In 1920 LÓCZY was elected honorary member of the Hungarian Academy of Sciences.

As mentioned before, he spent eleven years leading the Hungarian Geological Institute; if his predecessors had great trouble with the organization of the Institute or having a worthy building constructed for its accommodation; he had to face the difficulties of the first World War. His men of high qualification were called up one after the other, and so, with those at home and casual workers he had to spend years, from 1916 on, in the geological surveying of Yugoslavia and in the drawing up the general map of the country. This was an important work again. Though edited and sent to print, it was published, only after LÓCZY's death.

When he became director of the Institute, he went to study the geological institutes of twenty-six cities in Europe. His traditional methods in geological work, his wide knowledge of his branch, the ingenuity and riches of ideas reflected in his activity had originated from his wide knowledge of the world. One year after his taking his post as director of the Institute, in the spring of 1909, as a proof of the importance he attached to useful and live connections with other countries, he arranged for the First International Conference on Agrogeology at the Geological Institute.

In the evening of his life, at the age of seventy he was a tired and worn-out man. He asked permission to retire. He wanted to spend the rest of his life in his country house on Lake Balaton. He retired in the spring of 1919 and died one year later, on May 13th, 1920, of a heart attack in the sanatorium of Balatonfüred. He is buried at Balatonarács.

FERENC NOPCSA

Born on May 3rd, 1877 at Szacsal, Transylvania.
Died on April 25th, 1933, in Vienna.

Appointed to be director of the Hungarian Geological Institute on June 20th, 1925. Resigned his post on November 28th, 1928. He was director of the Institute for three and a half years.

After LAJOS LÓCZY retired, the Institute experienced a few troubled years of transition. The lost war, the dissatisfaction of younger, more progressive specialists, re-organizations following one another and, last but not least, the incompetent administration of weak and unauthoritative vice-directors which resulted in disquietude to such a degree, that the Government thought it necessary to find a firm hand to direct the Institute; a man of importance and authority both at home and abroad. Guided by such considerations, ISTVÁN BETHLEN, the Prime Minister thought of BARON FERENC NOPCSA, and his selection was found satisfactory by many representatives of the branch, too.

NOPCSA was living in Vienna at the time. He was not a healthy man. After the Monarchy had lost the war, he waived all political ambitions and devoted all his time and energy to scientific research. When he was invited to guide the Institute, he accepted the post and came home. "*I have accepted directorship*" — he writes in his first budget estimate — "*to turn the Geological Institute into an institute of international authority to the extent which it was during* LAJOS LÓCZY'*s time*".

Judging by the results of his three and a half years of direction, we must approve of his well-done scientific work as well as of his efforts to rehabilitate the Institute. He forcefully defenced the Institute in every case and against everybody in questions of personal problems and budget questions. He called the marvelous series of publications, of the Institute to a new life and took care of the library and the museum, which had been neglected since the war. He set up a printing shop in the Institute for studies and maps published there. He kept goading his men onto work but took care to improve their financial status at the same time.

His activity – like that of LÓCZY's – reflected the effect of many travels, good foreign relations and a thorough knowledge of languages. His theoretical and practical knowledge was unfathomable. He sent his specialists and colleagues on study tours abroad, helped them in their work, supported beginners with great understanding. The tasks he set out were interesting and important and he knew how to appreciate good work.

He had a special interest in the Great Hungarian Plain and for the water supply of the country at large. He was the first to put JÓZSEF SÜMEGHY in charge of the huge complex of water supply and SÜMEGHY came up to expectation all his life.

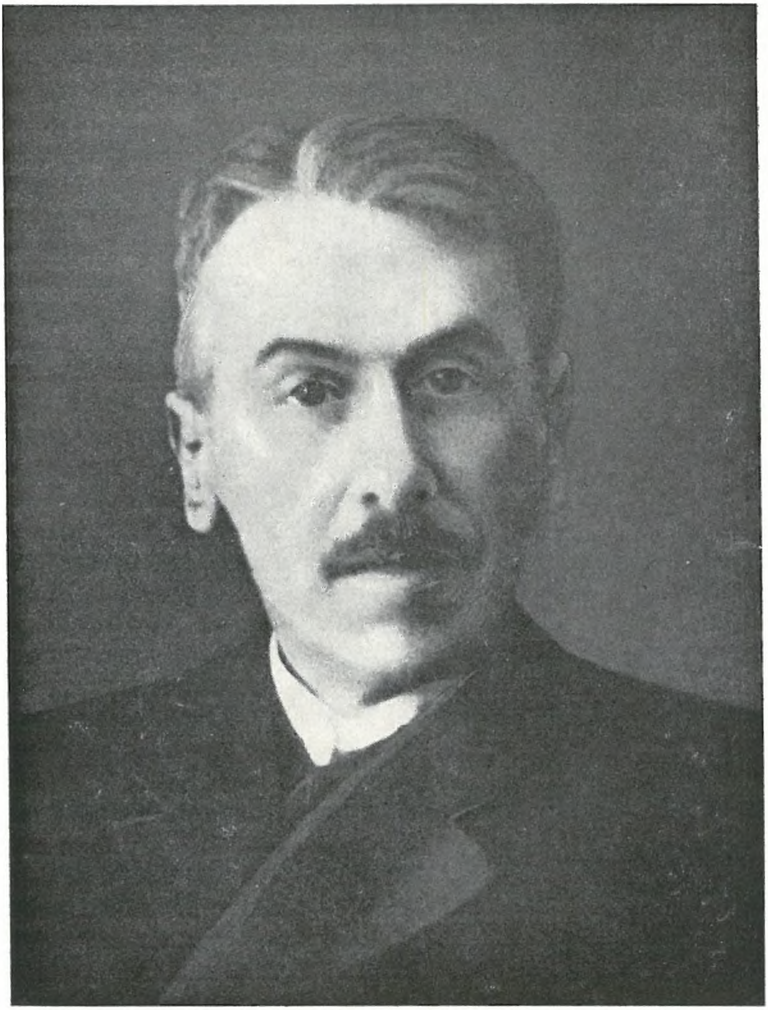
NOPCSA could not become reconciled to the idea that geophysical research should go on without geological support and neglecting serious geological estimations. He prepared one of the most important programmes of raw material exploration in this country, in 1926, and presented it to the Ministries of Agriculture and of Finances. In this he expounded why geophysical and geological research must be planned and realized together.*

In the autumn of 1928, he invited the Paleontologische Gesellschaft to Budapest; the lectures and excursions included in the programme had many Hungarian and foreign participants, just to mention some of the remarkable names: ABEL, BACHOFEN-ECHT, BEURLEN, BERCKHEMER, TILLY EDINGER, EHRENBERG, GLAESSNER, HARRASOWITZ, HUMMEL, KAHLER, KIESLINGER, KRÄUSEL, KÜHN, LIEBUS, PARRINGTON, RICHTER, SCHINDEWOLF, SCHMIDTGEN, SIEVERTS, SPILLMAN, STEINMANN, STENSIÖ, VERSLUYS, WILMAN, WÜST and ZEUNER.

In 1917 he was elected member of the Hungarian Academy of Sciences. In 1928, he was awarded the "*József Szabó Medal*" for his, "*Die Familien der Reptilien*", a comprehensive work published in Berlin. The Geological Society in Hungary elected him honorary member of the Society. Foreign countries highly praised him too. He was elected corresponding fellow of the Zoological Society and the Geological Society of London, honorary member of the Berlin Gesellschaft für Erdkunde, corresponding member of the Österreichische Geologische Gesellschaft and member of the Bologna Academy of Sciences.

There is no need to say that he had a long and adventurous way to arrive at the summit.

* Cf. the original document preserved in the National Archives.



Ferenc Nopcsa

1877–1933

As a grammar school student his attention was turned to geology and paleontology quite accidentally. In 1895, his sister found some zoofossils on the family estate, in Transylvania. NOPCSA soon gathered quite a collection of them including a skull in a surprisingly good state. His findings came from the mottled-clay layers of the region. He took his treasures with him to Vienna and encouraged by E. SUESS began to study them. These were the first specimens of the famous Uppermost Cretaceous paleoreptiles of Transylvania. He was twenty-two years old when the Vienna Academy of Sciences published his monography (in 1899) on the skull of the *Limnosaurus transsylvanicus*. Later he changed the name *Limnosaurus* for *Orthomerus*. The second part of the series was published in 1902, the third in 1904. In both of them *Rhabdodon* skulls are described.

This was the start. From this time on he never lost interest in geology, paleontology, especially in recent and fossil reptiles, in general problems of biology, such as the origin of flying, physiology, taxonomy and phylogenetics. When he took over the directorship of the Geological Institute, he returned — after twenty-one years — to his favourite subject, the description of Transylvanian *Dinosaurus* findings. In 1928 he published his study of the spines of the *Rhabdodon* and *Orthomerus*, in 1929 the discussion of the *Struthiosaurus transsylvanicus*. Both monographs were publications of the Geological Institute.

In the meantime he travelled all over Europe and studied the collections of Vienna, Munich, Stuttgart, Tübingen, Frankfurt a/M, Berlin, Basel, Zurich, Brussels, Paris, Le Havre, Bordeaux, Marseille, Cambridge, Oxford, London, and later of Bologna, Naples and Leningrad. He spent months, often years at one place consulting problems and making friends with the most notable specialists of the line like DOLLO, HUENE, ABEL, VERSLUYS and others.

His main field of research was the world of *Dinosaurus*. He wrote round a hundred studies and monographs of major importance on the subject which were published in the most exclusive international periodicals. It is beyond the possibilities of the present paper to go into any details about the total of his works and we can only refer to KÁLMÁN LAMBRECHT's NOPCSA biography in Volume 15 of the Paleontologische Zeitschrift (1933) and the annexed list of his works. In conclusion, let us quote the words of W. E. SWINTON, the other specialist on *Dinosaurs* from the Preface of his book on *Dinosaurs* published in 1934, one year after NOPCSA's death: "*It is inevitable for all of us to loose some of our scholarly friends as the years pass by.*

I wish to remember with sincere regret the name of BARON FERENC NOPCSA *who has left us so soon. While I was writing my book I kept thinking of hearing his strict but witty criticism, of enjoying his benevolent arguments in word and in writing. I am desperate to have to miss it.*"

NOPCSA did important work in the field of geology as well. He devoted a special series to the geology and tectonics of the Dinarides, to the formation of the Adriatic basin and to the crustal movements connected with it. He summed up the results of twenty years of research in a comprehensive volume of 700 pages on the cartographic material of Albania, on its geography and geology. It was published by the Geological Institute in 1929.

He had a special interest for Albania. His work on the prehistory, ethnography, language and customary law of Albania was published by GRUYTER's, Berlin, in 1925.

In 1966 an inaugural-dissertation was prepared at the philosophical faculty of the Ludwig-Maximilian University in Munich, written by GERT ROBEL bearing the title: *Franz Baron Nopcsa und Albanien.* The book of 191 pages was made with an incredible amount of investigation, full of competent and diligent search. It covers an immense material of manuscripts and publications. It turned out that after NOPCSA's death, the best part of his manuscripts, the most interesting journals and correspondence escaped destruction and could be found in archives and with private persons mentioned by the author. Before 1914 and during the first World War FERENC NOPCSA was sent by the Austro-Hungarian Monarchy as a political observer to Albania. ROBEL's book discusses NOPCSA's role in Albania from various aspects and we see in the pages of his book a grand, strange and unusual life enfold itself before our eyes.

All this, however, does not make NOPCSA's human profile complete. With the same vigour in which he was involved in the shaping of Albanian political life, he also participated in the military policy of Transylvania before and during the First World War. He had most extraordinary adventures when he spent years disguised as a mountaineer or a shepherd. He was a reckless and impatient man often looking for trouble, escaping sometimes by the skin of his teeth or making a fool of himself.

During one of his missions, towards the end of the first war, found in a pool of blood by his men, he was taken to Budapest and operated on. He pulled round more or less but never again regained full health. His nervous troubles kept returning, confining him to bed and straining his body to the utmost again and again. He directed the Geological Institute from his sick-bed for months. In 1928 he inaugurated the international meeting of paleontologists half paralysed, sitting in a push-chair. It was on this occasion that he delivered his memorable lecture on paleophysiology as a new science in the process of formation. He had an incredible force of will that helped him to overcome his illness and to cope with his self-appointed tasks. The struggle went on for more than ten years.

At last he broke down. He resigned from his directorship and moved to Vienna. He was over fifty. His mother and sister lived abroad and he had no family. The companions of his last days were two Albanian secretaries and a nurse. On April 25th, 1933, he shot one of his Albanian secretaries and put an end to his own life, too.

HUGÓ BÖCKH

Born on July 15th, 1874, in Budapest.
Died as director of the Institute, on December 6th, 1931.

Appointed to be director of the Hungarian Geological Institute on October 1st, 1929. He was director for two years.

He was the son of JÁNOS BÖCKH, director of the Geological Institute. He grew to like geology at home and became himself a geologist. He graduated from the Budapest University in 1898. Then his father sent him to Munich to work with WEINSCHENK. He spent a year there and wrote his Doctor's Dissertation on a Hungarian subject: the geology of the Nagymaros region. (Published in the Year-Book of the Geological Institute.)

He returned home in 1899 and was appointed assistant professor at the Mining Academy of Selmecbánya on September 5th, 1899. In 1900, at the age of twenty-five, he became a professor and a member of the mining comission board.

His first concern was to prepare a good textbook for his students. He wrote his *Geology* in two volumes, in which he discussed mineralogy-petrology, geology and paleontology in the high standard of his time. For years this was the only general reference book on geology in this country.

HUGÓ BÖCKH was a specialist of excellent qualification and had a lively sense for practical points. This property of his guided the Minister of Finances to charge him with studying the natural gas fields of the Transylvanian basin in 1910. He arrived to this as the main field of his activity and the exploration of hydrocarbons was the invariable core of his research work till the end of his life.

Upon the initiative and under the guidance of LAJOS LÓCZY, KÁROLY PAPP had drilled for potash salt fields at Kissármás in Transylvania and unexpectedly came upon natural gas.

Also HUGÓ BÖCKH studied the new geological problem; the exploration of natural gas. FERENC BÖHM, one of his students, who played an important part in this field later, came forward with the idea that, "*In the Transylvanian basin natural gas occurs bound to* *anticlines and the case might be the same with oil*". The idea was the more plausible at the time as based on his own research, LÓCZY had stated before that several big "*fold ranges*" can be detected in the Transylvanian basin. In 1914, with the cooperation of American experts HUGÓ BÖCKH made an estimation of the Transylvanian gas-fields and found 140 million m^3 per km^2.

In 1913, he marked out a drilling near Egbell in Nyitra County. It was the first time that the site had been selected upon geophysical measurements. As a result, natural gas and oil were found on the spot. It was a sensational event. He was exempted from his professorial duties and charged by the Minister of Finances with the direction and guidance of all mining research done in this country, from May 25th, 1914 on.

His word was decisive in Hungarian hydrocarbon exploration. In 1911 — according to his studies in Transylvania — he supported LÓCZY's assumption that the Great Hungarian Plain may be of a plicated structure. He instructed explorers *to use the Eötvös torsion balance in their work*. He started hydrocarbon research in Transdanubia in 1917 and on the Plain in 1918, where due consideration was given to the advantages offered by the plicated structure.

As a reward for his good results, he was elected corresponding member of the Hungarian Academy of Sciences in 1915, appointed to deputy under-secretary of state in 1918 and under-secretary of state in 1919.

In the years following the first world war, the Hungarian Government signed a contract with the British-Persian Oil Co. Ltd. to undertake drillings in Hungary at their own expense. The work was instructed by HUGÓ BÖCKH. The explorations proved a failure. Before the end of the undertaking BÖCKH, following the invitation of the same company, left to explore for oil in Persia. He was engaged for years in hydrocarbon exploration in Guatemala, Columbia, on Trinidad, in Venezuela, and in Albania.

In 1928, he was called home to fill the gap caused by FERENC NOPCSA's retirement. He came home and was appointed director of the Institute on October 1st, 1929. He was head of the Institute till his death.

In the spring of 1931 he lectured at London University on the megatectonical relationships of the Earth. In August he participated in the sessions and excursions of the Carpatian Geological Association in Prague, in spite of being severely ill. When he arrived home,

Hugó Böckh

1874–1931

he fell ill and died at 1 a.m. on December 6^{th}. He died of viral hepatitis brought home from Persia.

The line of his scientific works aimed at practical purposes was started — as mentioned — by his studies on the anticlines of the Transylvanian Basin. He summed up in short his own results and those of his colleagues when he said that above the Transylvanian native salt formation the thick sedimentary sequences had been folded. Consequently, enormous quantities of oil and natural gas could be trapped in the anticlines. He was the first in Hungarian geological literature to stress the necessity of geological investigations and deep drillings with a view to gaining natural gas and oil in the Great Hungarian Plain. He writes: "*Gravimetric measurements in the eastern part of the Great Hungarian Plain may render invaluable services*".

His work: "Brachiantiklinálisok és dómok kimutatása torziós mérleggel végzett nehézségi mérések adatai alapján" ("*Detecting of brachyanticlines and domes on the basis of gravimetric measurements with torsion balance*"), published in 1917 was of vital importance. He came to this idea, in 1912, when he was comparing his geological sections with the data of geophysical measurements taken by LÓRÁND EÖTVÖS, DEZSŐ PEKÁR and JENŐ FEKETE in the valley of the river Maros in Transylvania. BÖCKH's report which is of immense significance on an international scale was published in Volume XII of the *Petroleum* in German and counts as the starting point for the use of the *Eötvös balance* all over the world. At home — by his personal intervention — the Finance Minister officially included the gravimetric measurement (using the *Eötvös balance*) in the national mining exploration and prospecting programme.

In 1929, W. J. GREGORY, Professor of Glasgow University published his "*The Structure of Asia*", which included long chapters by BÖCKH, LEE and RICHARDSON giving an account of the tectonic results that were arrived at in the course of their oil explorations. BÖCKH came forward with and described regularities that are of universal validity concerning orogenesis. He mentioned the existence of median masses. In compliance with the structure of orogenic territories, he distinguished the foreland, the folded and peeled-off autochtonous belt, the nappe belt and the median masses. In contradiction to KOBER, he stated that the median masses are not necessarily mountains, as, for instance, regarding Hungary, the Pannonian Basin may also be considered as a median mass. The Carribbean Sea is another median mass. This means that one may be a plainland, the other a sea, but neither of them being mountains the term "*Zwischengebirge*" given by KOBER does not fit either of them. There are no movements of Alpine character in them. The foreland and the median mass may move towards each other or each move apart. If the two parts are approaching another, the orogenic belt between them will be compressed and nappes may develop in them and orogenic chains may arise.

Perhaps this was the most important achievement of BÖCKH's of great significance for international literature.

LAJOS LÓCZY JR.

Born on June 5th, 1891, in Budapest.

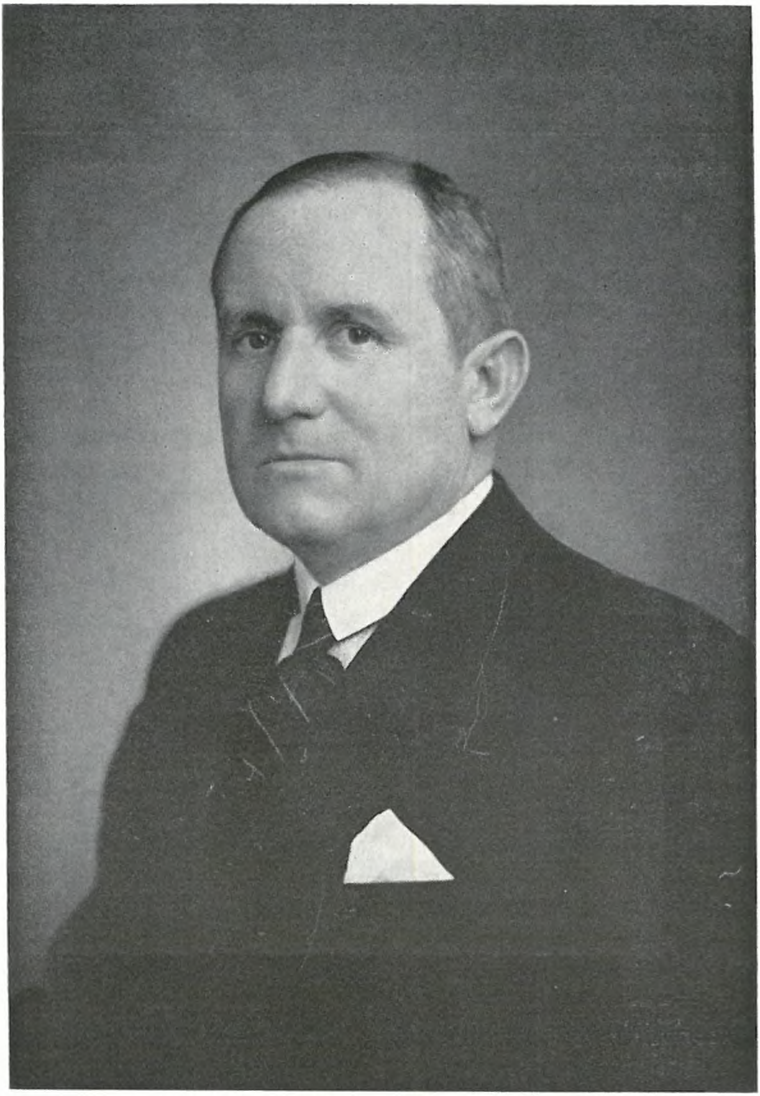
Appointed to be director of the Hungarian Geological Institute in July 21st, 1932. Left the Institute on September 1st, 1948. Was director of the Institute for 16 years.

His father, LAJOS LÓCZY SR. sent him to the University of Zurich in Switzerland, where he was a pupil of SCHARDT and of ROLLIER but also attended the lectures of P. HEIM, GRUBERMANN and NIGGLI, too. He especially had much to thank ROLLIER for, who was a great support to him from the first major work of his to the end. Namely, LÓCZY set himself the task to elaborate the Callovian fauna of the Villány Mountains in Hungary, one of the most characteristic and most important assemblage of *Ammonites* of the Hungarian Jurassic. The bulky work was published in a series of monographs edited by the Hungarian Geological Institute in 1909 and contains the description of 131 species. It is one of the indispensable and fundamental reference books of the Callovian strata and fauna composition which is intensively investigated into all over the world. In 1964 in his book on the Jurassic, HÖLDER underlines its importance and riches in fauna. Important comprehensive works on the Jurassic never miss to quote LÓCZY's monograph.

Having returned from Switzerland, LÓCZY was engaged in the tectonical analysis of Hungary, with special attention on the Balaton Highlands. He was private docent of tectonics at Budapest University.

Early in the nineteen twenties he was appointed professor of geology at the Budapest University of Economics, where he delivered lectures till 1948.

In his work at the University and later as director of the Hungarian Geological Institute he had the possibility to make good use of his numerous travels, his deep insight into geological problems and his knowledge of languages. He was engaged in hydrocarbon prospecting first in Poland then, for years, in Sumatra, Java, Borneo and Celebes and later in South America, in Egypt and Turkey. He visited the river-head of the Amazon, Ecuador and Brazil.



LAJOS LÓCZY JR.

1891–

LÓCZY was a most liberal director of the Institute. His concept was that the Institute should continue with its prospecting for mineral deposits while keeping up its reambulation survey for scientific purposes and that the two trends should finally unite "*in the course of evaluation into regional geological mapping*".

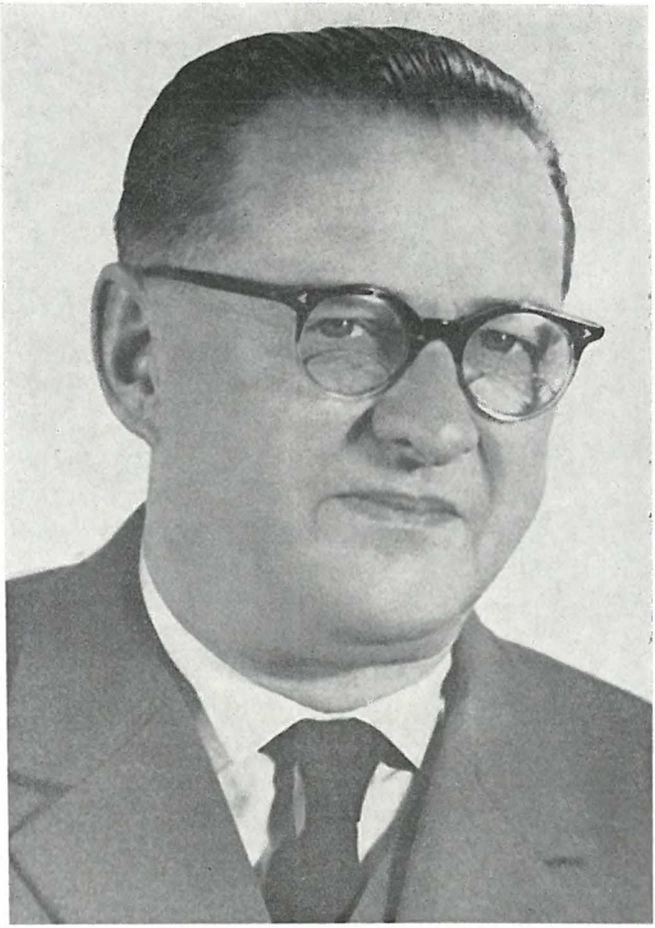
His main objective was hydrocarbon exploration. He was forced to this by the difficult economic situation but, it was also dear to him as an ardent explorer of rock oil. He did not neglect the geological surveying of the plainlands of the country either but completed it by agrogeological mapping, hydrogeological investigations and a systematical processing of artesian well data. In compliance with practical objectives, he laid special emphasis on geological observations of economic importance which were illustrated by maps open for the public.

He started the complementary geological mapping of the Bükk, Gerecse and Mecsek Mountains and detailed stratigraphical, tectonical, paleogeographical and geohistorical investigations in the Bakony Mountains.

Following the efforts of NOPCSA and HUGÓ BÖCKH, the international relations of the Institute were extended during the directorship of LÓCZY. He took care to build up friendly relations with scientific quarters at home (Academy, university departments) as well. It was for this purpose that from 1939 on he arranged yearly "Debates" at the Institute where many valuable lectures were read and a number of new ideas were launched.

He helped the Institute through the difficulties of World War II up to 1944. After the war, he went on participating in the activity of the Institute for a short time and promoted the re-organization of its work. Then, following foreign invitations he left the Institute.

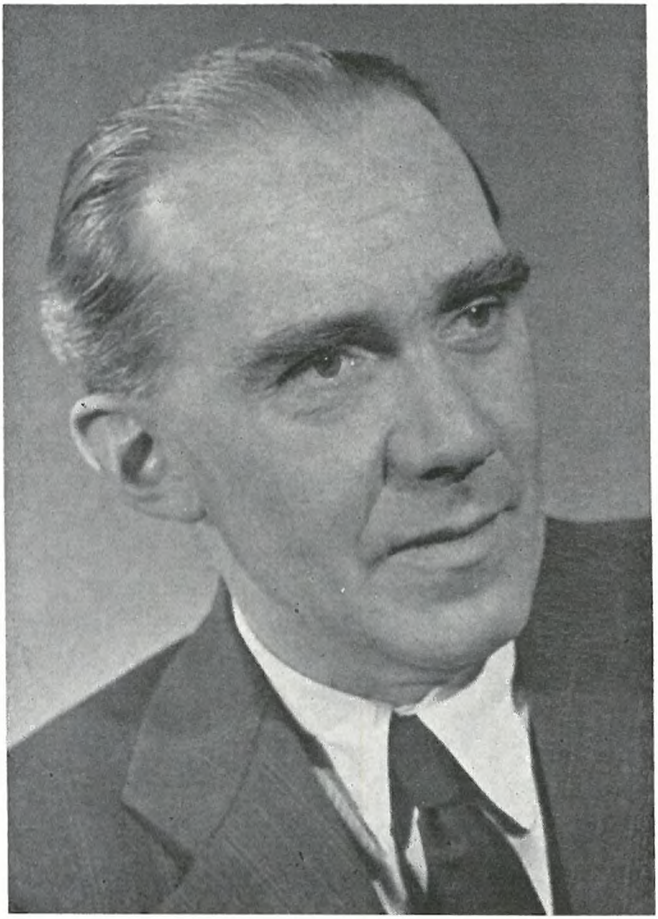
DIRECTORS OF THE HUNGARIAN GEOLOGICAL INSTITUTE SINCE 1948



SÁNDOR VITÁLIS

Professor, doctor of the geological and mineralogical sciences.
Born on April 13th, 1900, at Selmecbánya.

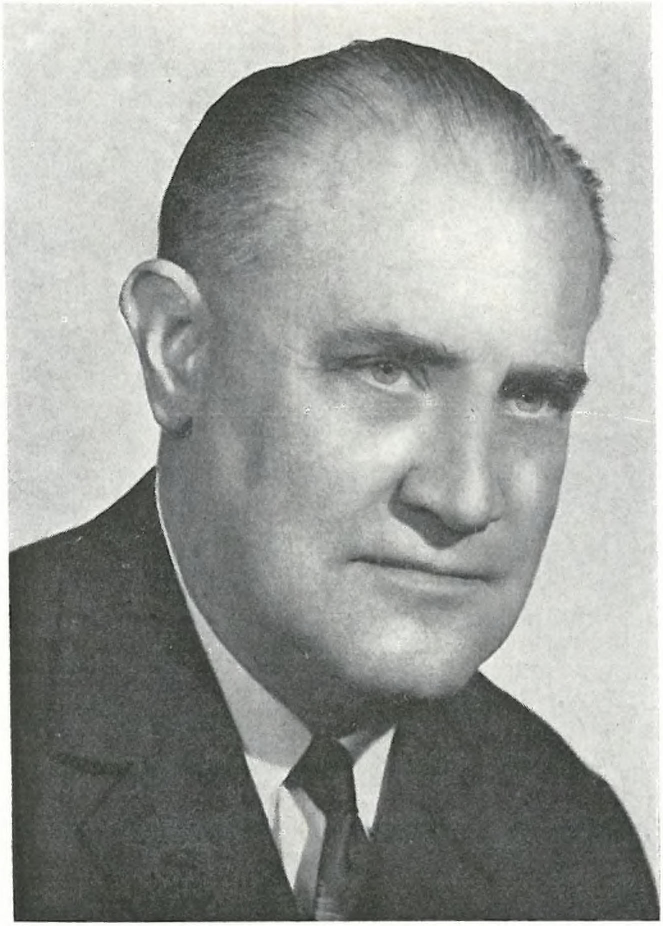
Appointed to be director of the Institute on January 23rd, 1950. Resigned on July 3rd, 1950.



LÁSZLÓ MAJZON

Titular professor, doctor of the geological and mineralogical sciences.
Born on January 12th, 1904, at Érsekújvár.

Appointed to be director of the Institute on July 27th, 1950. Resigned on August 31st, 1952.



KÁLMÁN BALOGH

Professor, doctor of the geological and mineralogical sciences.
Born on October 19th, 1915, in Kolozsvár.

Appointed to be director of the Institute on January 15th, 1953. Resigned on July 15th, 1953.

JENŐ NOSZKY JR.

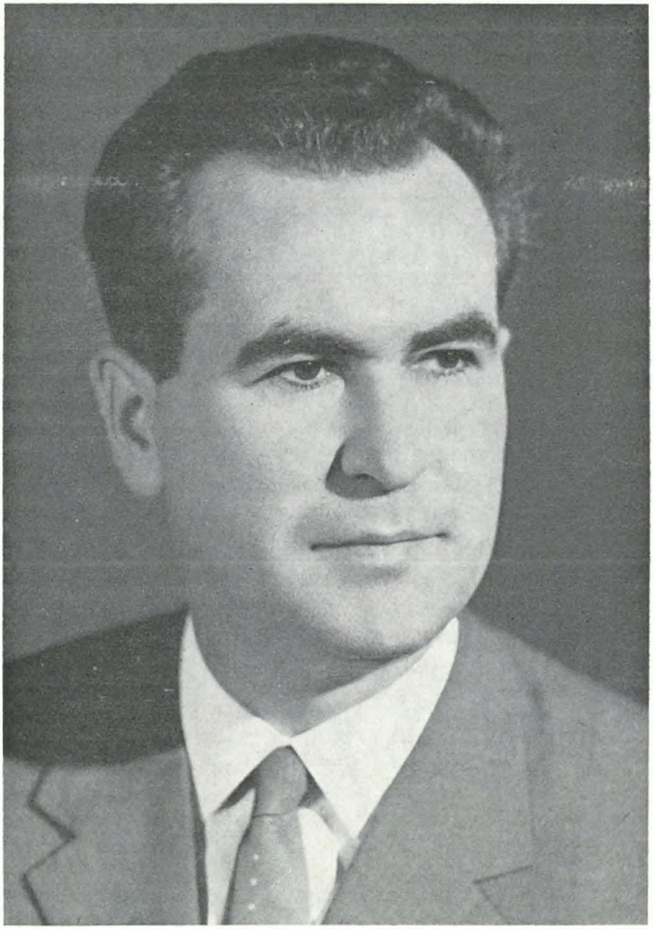
Senior scientist, candidate of the geological and mineralogical sciences.
Born on April 15th, 1909, at Késmárk.

Appointed to be director of the Institute on October 22nd, 1952. Resigned on December 16th, 1952. Re-appointed on July 18th, 1953. Resigned on September 1st, 1956.

MIKLÓS KRETZOI

Senior scientist, doctor of the geological and mineralogical sciences.
Born on February 9th, 1907, in Budapest.

Appointed to be director of the Institute on September 1th, 1956. Resigned in December 1957. His resignation was accepted on February 18th, 1958.



JÓZSEF FÜLÖP

Corresponding member of the Hungarian Academy of Sciences.
Born on January 20th, 1927 at Bük, Vas County.

Appointed to be director of the Institute on April 1st, 1958. Present director of the Institute.

GEOLOGICAL MAPPING IN HUNGARY: PAST, PRESENCE AND FUTURE

by

J. FÜLÖP, DR. PH., DR. SC.,

Corresponding member of the Hungarian Academy of Sciences
President of the Central Geological Office
Director of the Hungarian Geological Institute

Most specific in the hundred-year activities of the Hungarian Geological Institute have been the *preparation and publication of geological maps*. In a historical appraisal of Hungarian geological mapping I consider it necessary to review the relevant activities which had preceded the founding of the Institute.

To this end, we must go back to the 18^{th} century. Even in the most advanced countries of Europe, from this early time only the forerunners of geological maps are known. Areas of different lithological composition were represented on maps by PACKE in 1743, by GUETTARD in 1755, and FÜCHSEL in 1756 who used hachure for this purpose. Colouring was first used by GLÄSER, a Saxon master miner, in 1755. The first classification of the rocks making up the earth's crust and the development of geology to a science of regular observations belong to the merits of ABRAHAM WERNER GOTTLOB who was professor at the Mining Academy of Freiberg late in the 18^{th} century. After the age-determining role of fossils had been recognized, the first stratigraphy-based geological maps were developed by WILLIAM SMITH in the early decades of the 19^{th} century.

Thus the lack of geological maps in 18^{th} century Hungary was, *in se*, no proof of backwardness. Nevertheless, the Nation's political dependence, the rigid feudal conditions, the limitations of the guild system, the exporting of agricultural products opposed to the importing of manufactured goods were drawbacks and, particularly so, in geology and geological mapping, which were delayed for half a century, whereas Central and Western Europe experienced a dramatic development in the first half of the 19^{th} century.

In the 18^{th} century and in the first half of the 19^{th} century *the geological branch of science in Hungary* was mainly confined to *mineralogical studies*, which was due to close ties with the German mining industry and to the influence of the German school. Limited in scope as it was, geology was cultivated by the professors of the mining-engineer-training school of Selmecbánya (now: Banska Stiavnica, Czechoslovakia) founded in 1735 and developed into a mining academy in 1770; by the professors of the universities of Nagyszombat, Buda and Pest; by mining engineers as well as by a handful of secondary school teachers and priests. A stimulus to these activities was in most cases the student's interest in having flamboyant and impressing mineralogical collections.

In the 18^{th} century mining was focused upon extraction of gold, silver, copper and native salt which was monopolized by the King's treasury from 1567 on. The revenues from the mines were absorbed by the Court Treasury of Vienna, and failed to produce any effect on the Nation's economic life. Private enterprises were concerned, in the first place, with iron ore mining. Because of the lack of satisfactory transporting facilities and of poor demand, the utilization of coal advanced at a very slow rate, despite Queen Mary Theresia's decree to reward discoverers of new deposits with 50, their exploiters with 100 gold coins.

Before *the end of the 18^{th} century* it was the afore-mentioned *bias toward mining and mineralogy* that *was reflected* in the occasionally published maps in Hungary. These publications can be classed in three groups:

(1) *Topographic maps* of different scales *with signs referring to geology:*

WOLFGANG LAZIUS: *Regni Hungariae Descriptio Vera* (Vale Vienna Austria, Kal. February. Anno MDLVI). Scale varying by directions = 1:650 000 to 1: 460 000 or so. Contemporaneous mining sites represented by mining figures holding a hammer in their hands.

LUIGI FERDINANDO MARSIGLI: *Danubius pannonicomysicus* (Amsterdam, 1726). One of the volumes of this six-volume work is devoted to minerals, rocks and the mining industry of the Danube basins. Supplementary maps to it were published in 1741 in a separate volume: *La Hongrie et le Danube*. An outline map indicating the localities of mineral deposits is entitled: "*Mappa Mineralographica Fodinas in Hungaria*". Scale: 1:1,635 000 or so.

SÁMUEL MIKOVINY: scores of *mine maps* from the years 1730 to 1750. (ANDOR BORBÉLY: Térk. Közl. Vol. III, pp. 154–180)

JOHANN MATTHIAS KORABINSZKY: *Novissima Regni Hungariae Potamographica et Telluris Productorum Tabula*. Published in 1786 and supplemented with a map at 1: 1,500 000 scale or so, with 29 different signs of geological reference.

The I^{st} Military Surveying of Hungary at 1: 28 800 scale took place between 1766 and 1773 in the frontier zones and between 1782 and 1787 in the inner parts of the country. Because of its confidential nature, this work had no direct influence on geological mapping activities.

What the above maps have in common is that the signs of geological reference are not yet separated from the topographic signs.

(2) *Outline maps of mineral deposits:*

FARKAS KEMPELEN: *Mappa Regii Hungariae Salis Officia designans* (1760).
EMERICUS MILECZ: *Mappa Regni Hungariae* (Posonii 1773). Scale about 1: 1,400 000. A small-scale map indicating the native salt mines and the salt-transport roads of Hungary, with some information on the output of a couple of major mining districts in 1772.
JOHANN FICHTEL: *Geschichte des Steinsalzes und der Steinsalzgruben im Grossfürstenthum Siebenbürgen* (Nürnberg 1780). Supplemented with a map drafted by CARL WAPPLER: *Plan der Andeiitet wie der Unterirdische Salz-Stock.* Scale about 1: 1,340 000.

On the above maps of mineral deposits there are special geological signs already.

(3) *Large-scale maps of mineral deposits* and/or the forerunners of *mining-geological maps:*

FERDINÁND TRINGL: *The Map of the Mines Near Sóvár* (1740).
MATTHAEUM ZIEPSER: *Grund-Riss der ganzen Schemnitzer Revier, samt deren Thälern und Gebürgen...* (GEORG J. C. NICOLAI Sculpt. Vienna 1747). Scale about 1: 21 000.
IGNATZ BORN: *Briefe über mineralogische Gegenstände auf seiner Reise durch das Temeswarer Bannat, Siebenbürgen, Ober- und Nieder-Hungarn* (Frankfurt and Leipzig 1774). Supplemented with a chart and profile entitled "Grund und Profil Riss. Simon u. Juda Kupfer Grube zu Dognaska im Temeswarer Bannat".
L. F. MARSIGLI: op. cit. Inserted charts and profiles on the salt mine of Ocna, Transylvania, and on natural gas emanations at Megies (1780).

On these maps, both topography and mines are still represented by considerably more signs of detail than geology is.

After the above preliminaries of Hungarian geological mapping, which little attention, if any, has been paid; a landmark of transition to real geological maps was the publication, in London 1797, of "*Travels in Hungary*", a book by ROBERT TOWNSON, the famous British world traveler, who toured Hungary in 1793. This book was supplemented with KORABINSZKY's topographic map on which 13 different geological formations are distinguished along the great traveler's routes. *(New Map of Hungary, Particularly of its Rivers* *and Natural Productions by in.* MATH. KORABINSZKY. *Petrography and Post Road.* Added by the Author.) This is the first coloured geological map, embracing comparatively large areas of Hungary.

Historians of science have so far given little appreciation, if any, to the book "*O zemiorodstwie Karpatów i innych gór i rownin Polski*" (The Structure of the Carpathians and of the other mountains and plains of Poland) by STANISLAW STASZIC, the outstanding Polish scientist, which appeared in 1815. Its map-supplement of about 1:1,325 000 scale also illustrates the geological structure of Hungary without Transdanubia. *(Carta Geologica totius Poloniae, Moldoviae, Transilvaniae et partis Hungariae et Valachiae.* Inventa per STASZIC anno 1806.) Slightly modifying WERNER's classification, STASZIC distingusihed 5 groups of geological formations which he indicated by colours (Montagne Primitive, M. Secondaire ou Première Stratiforme, M. Antemarine, M. Marine and Terres d'Alluvion). Within his formation groups he used 153 mineral-, rock- and fossil names which he indicated by numbers on the map. Ore mines and their products were classed as an independent group. Special signs were used for the indication of the strike of the strata.

A comprehensive geological map, embracing the entire territory of Hungary, was first prepared by FRANÇOIS-SULPICE BEUDANT, the outstanding French geologist, who toured Hungary in 1818. On his 1:1, 000 000 scale geological map he distinguished 24 different geological formations divided into four groups. BEUDANT's classification reflects his fairly advanced knowledge of geochronology.

For many decades, BEUDANT's book was used as a highly appreciated fundamental work. On the 150th anniversary of his travels in Hungary, we recall with devotion, the memory of this sincere friend, the pioneer of Hungary's geology. Professor of the Paris University, he was elected a member of the French Academy of Sciences in 1824, and a member of the Hungarian Academy of Sciences in 1833.

A prominent work in the first half of the 19th century was AMI BOUÉ's "*Carte Géologique de la Transylvanie*", a map of about 1:1,900 000 scale, on which were 11 distinguished geological formations. In its legend the lithological and petrographical terms are coupled with stratigraphic ones (système Crétacé, Tertiaire supérieur). *(Mémoires de la Société Géologique de France.* Tome premier Première partie. Paris 1833. Pl. XV.)

In the early decades of the 19th century, in the Austrian part of the Habsbourg Monarchy, fairly extensive geological investigations were sponsored, under WERNER's influence, by the Montanistisches Museum and the Geognostischer Verein. Lots of manuscript geological maps were prepared, first of all, in mining regions. The marked progress of this work is evidenced by the materials the mining agencies forwarded, on the Münz- und Montanistische Hofkammer's order, to the Montanistisches Museum for the compilation of the Monarchy's first geological map. Bergbaurat WILHELM HAIDINGER, who compiled the map between 1841 and 1845, gave a detailed inventory of references he could lay hands on. *(Bericht über die Geognostische Übersichts-Karte.* Wien 1847.) In the *Geognostische Uebersichts-Karte der Oesterreichischen Monarchie*, printed in 1845, the results of the first decades of geological mapping were summarized. The map of 1 : 864 000 scale was printed on 9 sheets and carried the signs of 25 different geological formations. Its legend was still of predominantly lithological character. Names connected with stratigraphic classification still played a subordinate role, but the chronological succession of the rocks was distinctly reflected. The representation of Hungary's territory, rough-and-ready as it was, meant little progress as compared to BEUDANT's work.

In the meantime, from the end of the 18th to the middle of the 19th century, very important changes took place in Europe's economy and society. The introduction of the steam-engine gave rise to manufacturing industry, to the introduction of steam-navigation and rail transportation and to the boom of iron ore- and coal mining. Social evolution was characterized by a tendency towards the development of national cultures and towards the formation of national governments. Natural sciences in general, and geology in particular, underwent a rapid development. *The first geological societies and surveys or institutes were established.*

Scientific progress was enhanced by economic development which was experienced in this country, too. After 1830, steam navigation began to develop at a quick pace and so did a dozen industrial branches based on geological raw materials. It was at this time that Count ISTVÁN SZÉCHENYI, set to action, to introduce large-scale reforms. After that the Nation tried to overtake arrears by revolution under LAJOS KOSSUTH's banner. The defeat of the War of Independence, however, jeopardized the national liberation movement for a long time.

A decisive moment in the development of Hungarian geology was *the formation of the Hungarian Geological Society* at Videfalva *in 1848*. A powerful impetus to the progress of geology in this country was given by JÓZSEF SZABÓ, a scientist of extremely broad outlook and of inexhaustible ability, who occupied the chair of the reorganized Department of Mineralogy and Geology, Budapest University, during the 1849–50 term and held it for a long time with only a temporary interruption.

A measure to ensure regular geological surveys was the *founding of the Geologische Reichsanstalt* of Vienna *in 1849* and its direction was entrusted to WILHELM HAIDINGER, the editor of the Monarchy's first small-scale, national geological map. The impetuous geological mapping just started was based on the 1:28 800-scale topographic sheets of the IInd Military Survey. The information of the surveys was reduced to 1:144 000-scale general maps. In the territory of Hungary regular geological mapping was started in 1858, and by 1867 the northern part of the country and the Bánát, that used to be the Monarchy's southeastern borderland, was surveyed in detail. The rest of the country's territory was surveyed on a small scale. The geological mapping of the Monarchy went on rapidly in the areas outside Hungary too, so that in 1867 the second director, FRANZ HAUER, could begin his work with the drafting and publication of a new small-scale geological map. *(Geologische Übersichts-Karte der Österreichisch-Ungarischen Monarchie.* Wien 1867–1871.) His map was published at 1:576 000, and 102 different geological formations were portrayed on it. The legend was based on the stratigraphic scale, and the representation of lithology, and eventually of synchronous facies, was considered to be of secondary importance. In a simplified form, this map was re-printed several times at 1:2,016 000 scale.

In the period when the scope of the Geologische Reichsanstalt of Vienna still included Hungary, *some Hungarian geologists were also involved in the geological investigations of this country.* They *prepared geological maps* affecting the standard of that time.

In 1855 JÁNOS PETTKÓ, professor at the Mining Academy of Selmecbánya, published a large-scale geological map of Selmecbánya (now: Banska Stiavnica, Czechoslovakia) and its vicinity. JÓZSEF SZABÓ published the geological map for Pest-Buda, the Counties Békés and Csongrád; the geological and viticultural maps of the Tokajhegyalja (the famous vine-growing district at the foot of the Tokaj Mountains), and the geological map of the counties Heves and Szolnok. In his works two approaches can be recognized: an agrogeological one and a geochemical one—an outlook which went far ahead of his time.

MIKSA HANTKEN carried out an exhaustive investigation of the coal basins of the Transdanubian Central Mountains and compiled "The Geological Map of the Area Flanked by the Railroad Tracks Új-Szőny—Pesti Duna and Új-Szőny—Fehérvár—Buda".

Political and economic developments led to a so-called Compromise in 1867. The Geologische Reichsanstalt then suggested to the Hungarian government that it was ready to continue Hungary's geological surveying at the expenses of the Hungarian State Treasury. However, ISTVÁN GOROVE — the minister of Agriculture, Industry, and Commerce — approved the plan proposed by JÓZSEF SZABÓ, VILMOS ZSIGMONDY and by the *Hungarian Geological Society*. According to this the geological investigations of Hungary would have to be carried out by Hungarian geologists, independently of the Vienna Institute. To this end, in 1868, a Geological Department was set up within the Ministry, and one year later the independent Hungarian Geological Institute was founded. As stipulated in the Statutes, which are still valid today, the Institute's duties included: "*the detailed geological survey of the country's territory and the publication of the results as required by science, agriculture, and industry*" *and also* "*the preparation and publication of general and detailed geological maps of the territory of the Hungarian state*".

Theory and practice combined in this programme, were given great concern in the best periods of the Institute's 100-year history.

In 1868 the Institute's staff, a handful of devoted geologists, began geological investigations in the vicinity of Budapest, they included the geological mapping of Transdanubia in their programme. Work progressed at a quick pace and during 8 years almost the entire area was mapped. This mapping took place as a continuation of the activities of the Geologische Reichsanstalt of Vienna in that time when small-scale geological mapping was gradually developing into large-scale geological and stratigraphic investigations. MIKSA HANTKEN's studies in Eocene and Oligocene stratigraphy, KÁROLY HOFMANN's investigations in the Buda and Mecsek Mountains, JÁNOS BÖCKH's works concerning the Bakony and Mecsek Mountains resulted in a basic understanding of the stratigraphy of these areas.

After the surveying of Transdanubia, the stress of geological mapping activities was transferred to the mountainous territory bordering the Great Hungarian Plain on the east; then gradually extended to the Northeastern Carpathians, the Transylvanian Basin and the Southern

Carpathians. From 1879 till 1918 the major part of the Institute's staff worked in these areas.

In the meantime, the topographic base of the geological map was changed. *Between 1869 and 1887 the 1:25 000 and 1:75 000-scale sheets of the III^rd^ military survey were printed for the country's entire territory.* From the 1880's on the surveying and publication of maps were already based on these new base-sheets. The regular representation of the strata and the structural elements on survey map-sheets was begun in this period.

As a rule, the geological mapping of the individual areas was entrusted to one geologist who also performed exhaustive mineralo-petrographic or stratigraphic investigations as required by geological setting. A labour division was apparent in such applied branches as mining geology, hydrogeology, and agrogeology.

The *mining geological surveying* of the major mining districts was nothing else than large-scale geological mapping. This work was started in 1883 at Selmecbánya (now: Banska Stiavnica, Czechoslovakia), then was extended to the areas of Körmöcbánya (now: Banska Kremnica), Nagybánya (now: Baia Mare, Rumania), Felsőbánya (now: Baia Sprie, Rumania), Kapnikbánya (now: Capnic, Rumania); to the gold deposits of the Transylvanian Metalliferous Mountains; and to the Szepes-Gömör Metalliferous Mountains (now: Spišsko-Gemerské Rudehorie, Czechoslovakia). Besides large-scale mining-geological maps, small-scale, national *economic-geological maps* were also prepared for the explored deposits of coal, peat, ore and other minerals. The distribution of rock and clay types being used for practical purposes.

In 1893 SÁNDOR WEKERLE, Prime-Minister and Minister of Finances, solicited JÁNOS BÖCKH, director of the Royal Hungarian Geological Institute to start regular *petroleum prospecting* in Hungary. As a result of the Minister's message, the exploration of the *known hydrocarbon areas* was commenced in that year.

The most significant result of prospecting was the discovery of *natural gas in the Mezőség* in 1910.

JÓZSEF SZABÓ proposed an Agrogeological Department which was organized in 1891. *This was the beginning of regular geological and pedological investigations in the country's lowland areas.* For several reasons, geological mapping and exhaustive examination of the plains of Hungary became urgent. These were the following: the necessity for finding phylloxera-immune sand areas for new vine plantations; extension of agricultural production of industrial crops because of a crisis in the cereal market; the envisaged artificial drainage of marshlands and bogs; planned flood-control and river regulation; introduction of irrigation; and reclamation of the Great Hungarian Plain's soda soils.

In 1892 a special staff geologist's position was established for *hydrogeological problems* and for the geological background for *railroad construction* developments. Beside the hydrogeological investigations which were conducted over vast areas, *a small-scale national map of drilled wells and mineral springs was completed.*

Even in the early decades of the Institute's history, both large- and small-scale maps were prepared. *Small-scale national maps* were based upon the principles of standardization adopted by the first sessions of the International Geological Congress.

From 1870 on, the geologists' desire for organization of international meetings on the problems of geological terminology was announced more and more frequently. Under the effect of the International Exhibition of Philadelphia, where geological maps from various parts of the Globe were exhibited, a special Committee was set up for the organization of an international geological congress.

The International Exhibition of Paris seemed to be the best opportunity for such a congress. The Committee requested the Geological Society of France to convene an *international geological congress* in connection with the International Exhibition, Paris 1878.

The rules for the drafting of geological maps and illustrations and the development of uniform principles in nomenclature and stratigraphic classification were proposed as the principal topics of the Congress. Through intervention of the Geological Society of France, the French government included the Congress on the agenda of the Internal Exhibition. Most of the papers presented at the Congress were devoted to unification of terminology and cartographic representation. At the final meeting a permanent commission was set up for the methods of geological map publication; for the geological nomenclature as well as for the elaboration of rules for the use of paleontological and mineralogical names. It was the result of the widely expanded activities after the first congressional session that the second session of the International Geological Congress, Bologna 1881, could essentially bring into completion the programme launched by the former. The Hungarian specialists had an active part in this work. After the first congressional session, HANTKEN's work in the trend of unification and choice of geological age colour signs was greatly felt. The Hungarian proposal for the classification of igneous rocks was also emphasized in the congressional proceedings.

It was after this that the *preparation of the new small-scale geological maps of Hungary* was embarked upon. First of all, the 1 : 1,296 000-scale manuscript of Sheet D.V (which covered the entire territory of the country) was plotted as a contribution to the International Geological Map of Europe; after that on the basis of a resolution adopted by the Executive Committee of the Hungarian Geological Society in 1887, the editing of a 1 : 1,000 000-scale geological map of the country was begun. Preparation and printing were delayed until 1896. A specific feature of the map is the fact that sedimentary deposits are exclusively shown on it on the basis of stratigraphy.

For the International Exhibition, Paris 1900, LAJOS LÓCZY *prepared another—1 :360 000-scale—version of Hungary's small-scale national geological map, which was awarded a gold medal.* A manuscript map, was later used for education purposes at the Budapest University's Department of Geology and Geography.

Because of the great demand for the small-scale national geological map and since it had some limitations, a new map needed to be published. To meet this demand, LAJOS LÓCZY, who in 1908 has been appointed director of the Geological Institute, sought to gain up-to-date information on which to rely upon in preparing the map. Therefore, beside extending the surveying of Transylvania to new areas, he included additional, unsurveyed areas in his mapping programme. An up-to-date reambulation of the areas which had been surveyed before, was commenced. The forthcoming World War I and the subsequent collapse of the Austro—Hungarian Monarchy jeopardized the execution of his plans.

During the 100 years which passed between BEUDANT's travels in Hungary and with the collapse of the Monarchy, the Hungarian geological mapping made enormous progress. Starting with the pioneering of foreign travelers; continuing with regular, but centralized, geological surveys by the Geologische Reichsanstalt of the hegemony-seeking Austrian government, this led to the birth and flourishing of the independent Hungarian geological survey.

The first maps reflect WERNER's classification of the geological formations; the later maps show alternatively the increasing influence of the French and British stratigraphic approaches. In the international movement for the unification of geological mapping the independent Hungarian geology took active part as a partner already enjoying equal rights. *In the second half of this century large-scale geological surveys were embarked upon.* They were more and more focussed on the complex investigation of separate mountain ranges and basins; the regular surveying of map-sheet territories was gradually pushed back. The method of mapping was invariably characterized by one-geologist-surveying of selected areas; recording of field observations on the map; detailed lithological or stratigraphic studies as defined by the geological setting of the area and by the geologist's skill and professional interest.

Complex investigations of a selected region are exemplified by the Monograph on Lake Balaton edited by LAJOS LÓCZY. Far ahead of its time, the Monograph comprises contributions by 60 scientists who during 20 years assembled informations on Lake Balaton's geology, geography, meteorology, hydrogeology, etnography, archeology and history. It was LÓCZY too who in his work gave a good example of the application of historico-geological, paleontological, megatectonic, and geomorphological approaches and who advocated their universal implementation.

Full-scale development included specialization which rapidly brought about valuable results in both theory and practice. Hungarian hydrocarbon prospecting and hydrogeology of international fame, set roots about the turn of the century. The pedological orientation, initiated by JÓZSEF SZABÓ, attained full-scale development in the last decade of the last century. LAJOS LÓCZY, for the discussion of principles and methodological problems, convened in 1909, the *First International Agrogeological Congress in Budapest.* The Conference gave the agrogeological mapping of lowland areas such an impetus that not even the vicissitudes of the war could binder PÉTER TREITZ, one of the most industrious soil surveyors of that time, in completing by 1918 *the country's first small-scale pedological map.*

The revolutionary-spirited geologists of the Hungarian Republic of Councils sought to improve the scientific foundations of geological work. In the domain of soil sciences *an independent research institute was called to life.* However, counter-revolution soon came to frustrate — in the post-Republic years of turbulence — all expectations of a rapid progress in geology.

Lacking a director and a research programme, the Institute's activities were handicapped by the drawbacks of inflation. Seeking an issue, the Institute's staff joined a project which was to solve the problems of the country's power supply. Detailed geological investigations were carried out in the Dorog, Vértes, Pilis, and Borsod brown-coal basins.

Later on, these surveys were progressively extended to other areas. Agrogeological surveys were also continued, after soil sciences had again been included in the Institute's scope. In this domain, a new meeting on theoretical and methodological problems was convened in 1924. It was at this meeting where PÉTER TREITZ presented the manuscript of *Hungary's climazonal pedological map* and where he and other specialists present, drafted a plan for future developments. However, for nearly ten years no substantial progress could be achieved. Early in the twenties, the Institute's leading officials decided to publish a new small-scale geological map. KÁROLY PAPP cross-cut this project by re-editing the *geological map* drafted by LAJOS LÓCZY in 1910. He published this in 1923.

The interwar history of geological mapping was impressively punctuated by the activities of three successive directors of the Geological Institute.

First was FERENC NOPCSA, the world-famed geologist and paleontologist, who was director between 1925 and 1928. In his programme he laid stress on comprehensive theoretical research. Although agrogeology and mining geology also figured among the topics of his programme, they remained, for the most part, within the theoretical field. Geological mapping which was the marrow of the Institute's activities, continued in the old channels. Nevertheless, FERENC NOPCSA's backing of the publication of earlier scientific works was of great service. Among these publications, ELEMÉR VADÁSZ's *monograph on the Mecsek Mountains*, supplemented by a geological map of 1 : 75 000 scale, was outstanding. FERENC NOPCSA also planned to publish the geological map of the country's prewar territory. Of this, only the southeast sheet was printed at 1 : 500 000.

In 1929 FERENC NOPCSA was succeeded by HUGÓ BÖCKH. In contrast with his predecessor's endeavours, he emphasized the importance of projects of immediate practical value. He reorganized the Institute's activities accordingly. New methods were introduced in this strictly scheduled geological mapping programme. *A higher accuracy of surveying* was envisaged by the use of drilling and trenching; by measurements with band-chains, hand-operated surveyor's levels, and oil-compass, locally even with a surveyor's table. *He strove to make use of geophysical results in great measure.* His sudden death caused a deadlock in this trend of development.

In 1931 the director's seat was occupied by LAJOS LÓCZY JR., heir of his world-famed father. During his directorship the geological surveys greatly depended on the desires of the individual geologists. This was due to an atmosphere of liberalism in the Institute's management. Consequently, many different geological approaches and cartographic methods were applied by various workers. HUGÓ BÖCKH's accurate surveying methods were no longer compulsory. Most efforts had to be concentrated on the solution of *economic-geological tasks* which were, for the most part, closely linked with the Institute's mapping activities. The first important practical result was furnished by *the prospecting for bauxite* in government-licensed areas, leading in 1930 to the discovery of the Harsányhegy bauxite level. It was in connection with geological mapping that *the Lower Cretaceous date of bauxite* deposition in the Bakony Mountains was recognized. Consequently, the *bauxite deposit of Gánt* was soon put into exploitation. In 1937, *the oil-fields of Bükkszék and Zala* County were discovered. The areas of known or *prospective ore- and other mineral* shows were investigated and surveyed one after the other.

The new pedological survey began in 1933. The projects were developed by LAJOS KREYBIG, and also the reorganization of the Institute's Soil Sciences Section. In these surveys the geological conditions were almost completely neglected. All that was left of geology — or of lithology — concerned the representation of the permeability and the water-bearing nature of the rocks on the pedological maps. The consequences of this shifting away from geology were felt particularly in the thirties when important irrigation projects were embarked upon. These projects urged for a more profound geological and hydrogeological investigation of the lowland areas. It was drilling results in connection with the planned canals and storage dams that allowed JÓZSEF SÜMEGHY to recognize the predominantly faulted structure of the late Great Plain deposits and to *prepare the outline geological map of the Trans-Tisza Region.*

From 1939 on, the Institute's geologists conducted surveys chiefly in the reannexed areas, precisely in the vicinities of coal, hydrocarbon, ore, and kaolin deposits. In addition, engineering geological problems were also included in the surveyors' programme.

In the meantime, the dark clouds of history were accumulating in Hungary's skies. On June 27, 1941, Hungary entered war on the side of Hitler's Germany. On March 19, 1944, the country was occupied by the German fascists. On October 15, 1944, the Hungarian Nazi arrow cross men seized the power. *These conditions* *jeopardized any regular geological mapping*, and the evacuation of a considerable part of the Institute put a definite end to organized work.

The recent period of geological mapping began with the Nation's liberation. In the first years the geologists of the Hungarian Geological Institute carried out merely surveys of *immediate practical aim*, as was required by the Nation's postwar economy. The Institute's programme included the respective exploration of areas for coal, petroleum, native salt, bauxite, iron ore, building raw materials, precious metals, and minor elements; the solution of water supply problems and the geological preparations for hydraulic engineering projects.

The large-scale industrial developments, which were started after the nationalization of private firms and factories; the access to power of the working class, required more and more fuel, and ore, and increasing amounts of mineral raw materials for the metallurgical, chemical, and building industries. Thus the Institute's efforts were dissipated and could not meet the plan. This was due to several reasons:

- the insufficient number of well-trained specialists;
- the lack of experience, organization, and methodological background necessary for the envisaged large-scale developments;
- the insufficience and low standards of equipment and research facilities;
- the lack of a general plan and of a uniform management.

The country's geological survey necessitated radical reorganization. *It was the consolidated socialist system of our country that required and backed it in all possible means.*

Professor Elemér Vadász organized in 1948 *the regular training of geologists* and raised it to a high level. The *Soviet Union helped* by sending research facilities, equipment and expert consultants to Hungary, and by inviting Hungarian students to take part in pre- and post-graduate training in the USSR. Soviet experience was taken into consideration when the well-equipped geological prospecting enterprises in the most significant branches of mining and the extracting industry were organized.

Relying on the results of a more and more complex and versatile geological and geophysical investigation of exploratory drilling, the reorganized industrial geological services developed numerous versions of large-scale subsurface- and economic-geological maps to be used for the practice: the locating of new mines, etc. *The small-scale subsurface-geological maps* were prepared — on the basis of geological and geophysical maps and the available deep-drilling information — to reduce the cost of exploratory and prospecting operations which were going on at an ever increasing rate. *The first national subsurface-geological draft-map was published* in 1957 by GYÖRGY KERTAI.

The activities of the National Geological Authority, destined to co-ordinate efforts in the domain of geology, were handicapped by frequent reorganizations.

With the increasing division of labour, with the development of industrial geological services, *the geological mapping* could progressively reassume its regular character and *pave the road toward new developments*. The first major development between 1950 and 1955 was *the organization of the geological mapping of the Hungarian plains*. Here the mapping geologists sought to represent a variety of surface and subsurface rocks by using a detailed lithological legend. The lack of regular drilling and trenching; the insufficient analyses, and the substandard education and training of many involved workers, greatly reduced the value of the map-series produced. The results of surveying were *compiled on topographic base-sheets of 1:200 000 scale*, but the individual sheets failed to be brought into harmony with one another. With the death of JÓZSEF SÜMEGHY, the interpretation of the results was stopped and the map was left in manuscript form.

Lowland-mapping also included the determination of the depth and quality of ground-water. This information, supplemented by additional survey results, has been the basis of *the small-scale ground-water map of the Great Hungarian Plain* edited by ANDRÁS RÓNAI.

After the register of ground-water wells, a similar *register* was compiled for the *artesian wells*. With this second one, the Institute's Hydrogeological Section — with RÓBERT ELIGIUS SCHMIDT at its head — compiled the *Hydrogeological Atlas of Hungary*.

In 1953 the idea of *a new small-scale, national geological map* was suggested. To achieve this, first the manuscript sheets, which lay by the hundreds in the Institute's Map Depository, had to be rendered utilizable. Critical revision and data compilation went on rapidly and most of the manuscripts of the unified *1:25 000-scale geological map series of Hungary's mountainous areas* were completed by the end of the same year. Then, utilizing SÜMEGHY's lowland map-sheets too, the Institute's geologists set to the editing *of the Geological Map of Hungary, scale 1: 300 000*, which was published in 1956. Thanks to the lucky choice of its scale and to the distinction of 30 Quaternary and Holocene and 67 pre-Quaternary formations, this map can be readily utilized for various purposes. It is characterized by consistently developed stratigraphic and lithological legends.

The second stage – now being finished with succes – of the post-Liberation history of geological mapping was launched by VILMOS BESE, director-general of the National Geological Authority, whose relevant programme was developed and approved in 1955. According to the *new programme, 5 regions*, ranking in terms of national-economic importance, *were selected for geological mapping*. These were to be investigated regularly by complex geological research methods and by the concentrated efforts of geoscientists. The programme stipulated a succession of measures to be taken; ways of coordination; and of contributions by various agencies.

Research in the eastern Mecsek Mountains was motivated by the presence of metallurgical coal; in the Bakony Mountains by the occurrence of bauxite, good-quality brown coal, and manganese ore; in the Dorog Basin by the urgent necessity for the widening of the Eocene brown-coal reserves; in the Mátra Mountains by the occurrence of base metal shows; in the Tokaj Mountains by the need for a scientific basin for the exploration of various non-metalliferous mineral deposits. After a temporary setback due to the counter-revolution, the work was developed swiftly and at full scale. Practice warranted the correctness of the new principles. The mapping teams formed of predominantly young geologists prepared map-sheets of 1:10 000 and 1:25 000 scale, respectively, of mountains and basins. In this work geological facts and interpretations first have been strictly distinguished and separated. This, where necessary, has permitted accurate checking and also development of further map versions other than those published. *A new, up-to-date nomenclature* has been introduced for the igneous rocks. The map-sheets have been supplemented with *explanatory fascicles* in which the history of geological investigation of the map-sheet area is reviewed and its geological setting briefly defined. The conclusions drawn from these various methods; the results of mapping; if necessary research analyses; have been published in the form of *monographs*.

Detailed geological researches and surveys have been aimed at laying the *scientific foundations in mineral resources prognosis* and for investigations of immediate practical aim. However, in case of necessity, the field surveys have been extended to prospecting for minerals. For instance, in the Mecsek Mountains we did not restrict ourselves to the locating of potential Liassic coal-bearing areas as to the complex examination of the possibilities for opencast mining, but by taking part in the preliminary prospecting as well as collaborating with the competent coalmining geologists, we solved the problems of coal seam correlation. Beside developing bauxite and manganese ore prognosis in the Transdanubian Central Mountains and brown-coal prognosis in the northern Bakony Mountains and Dorog Basin, we carried out successful preliminary prospecting in the newly explored brown-coal area of Esztergom-Lencsehegy. In the Mátra Mountains the geological mapping was supplemented with a considerable increase of base-metal-ore resources and by the initiative for investigation of deep subsurface ore-mineralization at Recsk.

Additional tasks were the preparation of *mineral prognosis maps and studies* by mapping teams versed in scientific and practical problems in the investigation areas. These groups have to draw all economic conclusions from their results and to take the initial mesures for the execution of new projects. On the basis of results obtained in well-disclosed areas, the investigations had to be extended to broader regions, *and they had to prepare for the exploration and development of buried mineral deposits, by drafting subsurface geological, lithofacial and paleogeographical maps.*

Today the methods and possibilities of geological mapping and map-preparation are manifold and diversified. Common and indispensable sources of geological map-making are the results of drilling and trenching, laboratory analyses and geophysical results, which are now progressively replacing the conventional observations of natural exposures. Because of their rather expensive and time-absorbing nature, it is necessary to select carefully the subject of the map versions, to anticipate their practical usefulness.

In connection with the *geological mapping of the Great Hungarian Plain the region of Lake Balaton*, and with the *national metallometric survey*, which were organized in the past years, dozens of *fundamental map-versions have been prepared.*

The most versatile maps are being prepared for the Great Hungarian Plain, a project backed by the National Oil-and-Gas Trust and by the Roland Eötvös Geophysical Institute. *Geolog-*

ical, engineering-geological, and hydrogeological maps, embracing the Great Plain's geological column from the surface down to 4000 to 5000 m depths, are being prepared. The geological mapping of the Lake Balaton region, at 1:10 000, *is to provide fundamentals in engineering geology and hydrogeology.* This project which also includes geomorphological investigations is carried out in close collaboration with the Geographical Research Institute, Hungarian Academy of Sciences.

The national metallometric survey is connected with a simultaneous development of the most viable methods of cartographic representation of results. Portraying the concentrations of the surveyed elements as found in selected areas and in individual rock and mineral types, is one of the forms of cartographic representation. The chief purpose of the preliminary investigations being carried on is to discern and map the geological conditions controlling the commercial, stratiform, accumulations of rare metals.

Beside large-scale geological mapping, we are also busy preparing *small-scale geological maps.* The heads of the geological surveys of the socialist countries decided, as early as 1955, to draft and publish up-to-date, *national geological maps, scale 1 : 200 000, based on uniform cartographic principles and methods.* The instructions for uniform map preparation were issued, after several years of preparatory work, in 1958 by the Polish Geological Institute. During the past 10 years a considerable progress has been made here too. The last few — near-frontier — sheets will be completed this year. Printed in 2 versions in the mountainous areas and in 5 versions in the plains, the sheets of this map-series, supplemented by explanatory fascicles, *constitute the first complete treatise of Hungary's systematic regional geology.*

An ever increasing number of hydrocarbon and thermal-water exploratory wells have uncovered the Paleo-Mesozoic basement of the Tertiary and Quaternary basins playing a most significant role in the country's geological structure. This permitted the preparation of Hungary's geotectonic map—a versatile Hungarian contribution to the cause of megatectonic syntheses now being widely advocated on an international scale. As *to the origin of the Hungarian Median Mass* — which earlier was believed to be more homogenous, but which has recently been proved by deep drilling and geophysical results, to have a diversified stratigraphic and tectonic setting — academician ELEMÉR SZÁDECZKY-KARDOSS *developed an impressive, far-flung theory.*

The detailed and complex investigation of Hungary's geological formations, using geological key sections as models, has also been greatly advanced. The stratigraphical and lithological results gained this way are enough for the preparation of *up-to-date paleogeographical and paleogeological maps for the periods of accumulation of exploitable mineral deposits and for the dates of crucial geological events.*

The practical consequences of geological investigations and geological mapping are summarized on prognosis maps. These provide a synthesis of all results and of all practical and theoretical conclusions concerning further possibilities for exploration of commercial mineral deposits. Because of their great importance for industrial policy and research- and prospecting management, the Hungarian Geological Institute included the *preparation of prognosis maps among the central items of its programme.* A few maps of this kind have already been published, others are just being prepared for press, and others are being plotted.

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What is conspicuous from the above brief review of the post-Liberation history and the future plans of geological mapping in Hungary is the high rate of development and its definite socio-economic control. Large-scale geological activities have implied a division of labour resulting in the differentiation of three spheres—mining geology, exploration and development, and scientific research. Geological map-making has been developed accordingly.

The main point of our considerations, in the development of regional geological mapping, has been based on up-to-date principles and methods. The results of regular drilling and trenching as well as of complex materials-testing have been relied upon. In the domain of cartographic representation, geological facts have been strictly separated from their interpretations. Geological investigations and detailed geological mapping have formed a uniform entity.

Regarding the efforts of recent years, they seek to replace stratigraphy-based representation gradually by a quantitative portrayal of the facial conditions of the geological formations.

Up-to-date, small-scale maps are envisaged to depict the geological development, subsurface geology, paleogeology, paleogeography, and chronology of single mountains and basins and also of the entire country.

Historical facts remind us of how rapidly the interests of geological policy may change. At the same time, they prove that carefully prepared geological base-maps are utilizable for decades.

The division of labour being granted, it is mainly co-operation that matters. To enhance efficiency by a reasonable concentration of efforts has invariably remained a basic requirement.

Finally, *we have to consider the geological mapping programmes of the international scientific organizations and the geological map publications* of the individual countries, in order to keep pace with the basic international trends of development.

The UNESCO-subventioned Commission for the Geological Map of the World, International Geological Congress, has embarked upon preparing the *stratigraphical-geological maps of the continents at 1:5,000 000 scale*, maps which are to serve as a basis for the preparation of a Geological World Atlas of 1:10,000 000 scale. The *Geological Map of Europe*—with its centre in Hannover—is being published internationally at *1:1,500 000*. The *tectonic maps of the continents* are appearing one after the other. An *International Tectonic Map of the World, scale 1:15,000 000*, has also been scheduled. Its maquette was completed by the XXIIIrd International Geological Congress, Prague 1968, and exhibited there. On this map the megatectonic setting of the substrate of the oceans has also been outlined.

The international editing committee of the *International Tectonic Map of Europe, scale 1:2,500 000*, with its centre in Moscow, is now preparing to press the *second edition* of the map.

A general map of the metallogeny and iron ore deposits of the continents, scale 1:5,000 000, is being edited.

The International Association of Volcanologists is preparing, in collaboration with the Commission for the Geological Map of the World, *the map of the Pliocene and post-Pliocene volcanics of the Globe at 1:10,000 000.*

The *International Map of the Quaternary of Europe, scale 1:2,500 000*, is being edited under the auspices of the INQUA.

The International Hydrological Association is going to publish an *international hydrogeological map at 1:1,500 000.*

Proposals for preparing small-scale, international paleogeographical, geochemical and metamorphic maps have so far remained futile.

The Carpatho-Balkan Geological Association, on the activities of which we are particularly interested, has started the preparation of an *International Tectonic Map, scale 1:1,000 000*. In addition, the publication of paleogeographical, hydrogeological, engineering-geological maps and, on Hungary's initiative, a metamorphic map has been envisaged.

The mapping and map-making activities of certain, highly developed, countries are, of course, more diversified and advanced than those of other countries—a fact particularly conspicuous in international projects. Therefore, it is worth while to review examples in a few selected countries of the development trends and objectives of geological map publication.

The most impetuous development and *the most manifold activities can be* undoubtedly *observed in the Soviet Union*. This is true for surveying methods, range of scales, and the number of map versions alike. In fact, no less than *11 principal types of maps are published regularly*. These are the following:

> Conventional geological maps; genetic and geomorphological maps of the Quaternary; tectonic maps; subsurface geological and tectonic maps; paleogeographical maps; maps of mineral deposits; metallogenetic maps, and prognosis maps; near-surface and subsurface water maps. In addition, the regular preparation and publication of additional ten different geological map types have been envisaged. These would be devoted to the following subjects: paleogeology, paleotectonics, magmatectonics, tectoformations, sedimentary-, igneous- and metamorphic facies, paleomagnetism, building raw materials, and engineering geology. The uniformity of the colossal amounts of survey data is ensured by special instructions stipulating the principles and methods of data processing and interpretation.

Czechoslovakia — Hungary's northern neighbour — *has achieved remarkable results in publishing small-scale geological maps. In the People's Republic of Poland* — on account of the country's geological setting — *subsurface-geological maps have gained particular importance*. Excellent maps have also been prepared on the subjects of hydrogeology, engineering geology, and geotectonics. *In the German Democratic Republic* it is the *metallogenetic and lithofacies maps* that are prepared and published preferentially. Worth mentioning is the preparation of *engineering-geological maps* and also the continuing of traditional *agrogeological mapping*.

Of the capitalist nations, we can refer to *France* and *Great Britain* which once rocked the cradle of geological mapping.

In France a vast practice-bound reorganization was carried out in 1967. The Service de la Carte Géologique was amalgamated with the Bureau de Recherches Géologiques et Minières. The 1 : 80 000 scale of geological *mapping was changed to 1 : 50 000—a big*, 20-year project with a planned production of 50 to 60 map-sheets per year. Geological surveys are coupled with *ground-water and metallogenetic mapping*. The preparation of geotectonic and deep subsurface aquifers maps is still in the experimental stage. A geological submarine survey of the unconsolidated sediments of the continental shelf has been envisaged.

In Great Britain a revision of all large-scale *geological survey* results is on schedule. The chief objective is to carry out geological mapping by complex methods including hosts of geophysical measurements.

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In the final analysis, we see — or at least we believe — that Hungary, with her basic principles and methods of map preparation, has kept pace with the most advanced nations of the world. The rate of development is fast and progressively increasing. A sound basis for further development is provided by our socialist system which takes scientific work to be a productive force, and also by the most viable trend of mineral resources exploration recently adopted in this country.

Bound for the 2000th year, Man has set to the exploration of Space. And the geological mapping of celestial bodies has begun, even though the means of telecommunication cannot yet be dispensed with in getting access to these new objects of mapping. Some of our young colleagues will perhaps live to set foot on and map them forthwith. However promising these future goals may look, let us be reasonable in drafting longterm plans and keep on looking forward to uncovering the secrets of our old Globe's deeper crust, where countless exciting horizons still await mapping.

THE HUNDRED YEARS OF THE HUNGARIAN GEOLOGICAL INSTITUTE: STRATIGRAPHIC ASPECT

by

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EARLY ACTIVITY (1868–1908)

Referring even to today's standards, the early efforts of the Hungarian Geological Institute are worthy of respect. These led in an admirably short time to quite substantial advances in the geological knowledge of the Hungarian territory.

Under the direction of Miksa Hantken, the geological survey of Transdanubia was almost accomplished in the short time of eight years: indeed, as early as 1877 the survey of the western mountains of Transylvania and of the Southern Carpathians could be attacked from three centres. During the directorship of János Böckh, from 1887 on, the study of the Northeastern Carpathians was begun; also, complementing the economic-geological mapping of the Selmec-Körmöc ore region in 1883–1884, a similar study was begun in 1902 in the Szepes-Gömör ore range. The conditions of field work were not the most favourable. The long months of mapping in high mountains were fraught with extraordinary difficulties. The meagre hope, often indeed the hopelessness of publishing in monographic form the knowledge gleaned under such hardships was the reason why the results of this pioneering period of the Institute are preserved in just a few slim reports. Still, even some of the works of outside experts connected with the Institute (F. Herbich, A. Koch, J. Szabó and others) had to be published under the Institute's auspices.

Generally speaking, these early publications of the Institute contain few ideas concerning evolution history or structure. This is due chiefly, to the fact, that the regions reconnoitred by members of the Institute were for the most part absolutely unknown geologically, and this, at a time when international stratigraphy was still far from consolidated. In spite of these deficiencies, some of the Hungarian geologists of that time were veritable masters of geological mapping.

Among them, KÁROLY HOFMANN excelled in the accuracy and detail of his observations.

In keeping with the state of petrography in these times, it was the subdivision of the crystalline that was the least convincingly solved by the workers of the Institute. A classification by J. BÖCKH dating from 1878, essentially based on the hypothetical depth zones of metamorphism, prescribed the distinction besides the gneiss, classified as *Group I*, of mica schists and micaceous gneiss within a *Group II* and of weakly metamorphic rocks (phyllite, chlorite and sericite schist) within a *Group III*. The acid and basic igneous rocks traversing the metamorphics (granite, syenite, diorite, gabbro, serpentinite) even about 1896, were considered Precambrian. Only after the turn of the century was it supposed that the upper zone of epimetamorphics in the Krassó—Szörény Mountains included also the Lower Carboniferous; in consequence, the Variscan granites penetrating them were separated from the granites intruded into the groups I and II of metamorphics.

The fact that the groups I and II of metamorphics in the Krassó—Szörény Mountains locally overlie the less metamorphic crystalline was already recognized by J. BÖCKH himself. However, the key to the structure of the Southern Carpathians lay beyond the Hungarian frontier even in those times. It was then, left to the Rumanian L. MRAZEC to discover (1896) that BÖCKH's Group I was in effect no separate unit, but simply a zone, rich in injections, of Group III, which originally consisted of epimetamorphics only. (His findings were confirmed in 1903 by the Hungarian geologist FERENC SCHAFARZIK.) The relative position of the two groups which remained after this simplification, could not be determined in any other way by G. MURGOÇI (1905), according to him, the more intensely metamorphic micaschist group overlies the phyllite group in the form of a big nappe that had traveled from north to south; indeed it even overlies locally the sedimentary hull of the phyllites which, although intensely mauled in the process, still contains some Mesozoic fossils. The Hungarian geologists who worked in the Southern Carpathians (FERENC NOPCSA, FERENC SCHAFARZIK, ALADÁR VENDL) were quick to recognize the truth in these important discoveries; indeed, their subsequent work largely contributed to their proof.

Although, even then, some of the phyllite-like rocks in our mountains were correctly assumed to be Early Palaeozoic, no sufficient evidence for this assumption could be adduced at that time. This is why the fossil finds of K. HOFMANN *(Favosites, Cupressio-*

crinus and *Heliolites)*, proving the presence of the M i d d l e D e v o n i a n at Egyházasfüzes (in Austrian territory today) were of a particular importance. A further advance was the recognition by F. SCHAFARZIK of the true nature of the porphyroid sequence of the Szepes—Gömör range, misnamed "Carpathian gneiss" by the Viennese geologists.

It was the discovery in 1897, by F. SCHAFARZIK, of the Kornereva fauna that gave a sufficient basis for splitting the L o w e r C a r b o n i f e r o u s of the Southern Carpathians from he main body of the phyllite sequence: this Lower Carboniferous is unconformably overlain by the U p p e r C a r b o n i f e r o u s of Újbánya and Secul. On the other hand, the *Trilobites* found by VILMOS ILLÉS at Dobsina were incorrectly placed — on the basis of identifications by F. FRECH — into the Lower Carboniferous. Furthermore, the lack of system and uniformity in the examinations precluded the development of generally acceptable views concerning the ancient formations of the Szepes—Gömör range.

Above the crystalline of the weaker metamorphism (Groups II. and III) of the Bihar Group, our geologists established the presence of a sequence of crushed quartz conglomerate, graywackes and clay shales which they classified by lithologic analogy as Carboniferous. The correctness of this assumption has lately been verified by research from the Rumanian side.

This phase of research was far more successful in subdividing the P e r m o - M e s o z o i c, relatively abundant in fossils, than in grouping the more ancient formations.

In the P e r m i a n, only a continental facies was recognized, in the form of red beds of sandstone, breccia, quartzite and shale forming complexes of various thickness and often including fragments of quartz porphyry. Wherever it was possible, by the presence of a few plant fossils, or by striking changes in lithology, further subdivisions were also attempted (Béli Mountains). Nevertheless, the gradual transition between Permian and Werfenian resulted in the placing of the entire Permian sequence, or at least of the upper part of it, into the Triassic in the Southern Bakony and Mecsek Mountains.

The studies of J. BÖCKH into the Triassic of Transdanubia discovered two complete T r i a s s i c sequences, of different development although both of Alpine facies. Both had developed along the same trend (of increasing enrichment in carbonates) up to the Middle Triassic: from the Wengenian beds, however, differences became suddenly emphatic, in the sense that the Triassic north of Lake Balaton continued to be carbonatic, whereas the Mecsek Mountains sequences turned clastic fairly sudden. Within the more varied Triassic of the Upper Balaton Highland, J. Böckh succeeded in distinguishing 13 members: 2 in the Lower, 5 in the Middle and 6 in the Upper Triassic. Subsequent surveys have preserved almost all of these units (*e.g. Megyehegy Dolomite, Tridentinus Limestone, Füred Limestone, Upper Marl Group).* In the Mecsek Mountains J. Böckh distinguished besides two Wengenian groups and a twofold subdivision of the Muschelkalk only the Wengenian shale and the "seamless" sandstone (the term indicates the absence of coal seams present in the overlying Lower Jurassic). In the rest of the Transdanubian Mountains only the Hauptdolomit and Dachsteinkalk of the Upper Triassic had been distinguished, but fairly soon a few other Triassic facies of the Buda and Pilis Mountains, of ages still more or less in dispute today (cherty limestone of Mátyás Hill, diploporan and cherty dolomite, aviculan limestone) had also been recognized. A resurveying after the turn of the century of part of the Gömör karst discovered — besides Seisian, Campilian and Guttensteinian strata — a hard-to-subdivide sequence of "Plateau" limestone, and on the Som Hill at Dernő, a crinoidean limestone which contained Noric ammonites mixed with "Kössenian" brachiopods. The repeated resurveying of the Kodru Mountains found no Werfenian shales, but established the presence of a sequence of typically Alpine limestones and dolomites ranging from the Anisian to the Noric, including the horizons of *Ceratites hungaricus*, *Ptychites lóczyi*, Esino limestone, *Tropites subbullatus* and *Cladiscites tornatus*. The sequence end in a Rhetian marly limestone. In the limy—dolomitic Triassic overlying the Werfenian shales of the Királyerdő and Bihar, lack of fossils prevented such detailed subdivision. On the other hand, J. Böckh established one well-documented Triassic sequence at Szászkabánya (a red, coarse conglomerate overlain by a red sandstone with plant fossils; Anisian fossil-bearing limestone; Ladinian marly dolomite). The first reports on the scattered rags of Triassic in the Eastern Carpathians, of small extent owing to subsequent erosion (Upper Permian dolomite overlain by a fossil-bearing Werfenian shale with interbedded red silex, a sandy—shaly Middle Triassic and an Upper Triassic of Hallstatt facies, the Rhaetian represented by a coralline limestone) were those of F. Herbich (1871). The significance of Middle Triassic volcanism in this region was first emphasized by A. Koch.

The two main types of the Jurassic in the Carpathian Basin were distinguished even in the first years of the Institute's activity. An antithesis of sorts was observed between the largely calcareous, ammonitic rags of thin, incomplete Jurassic in the Transdanubian Mountains on the one hand and the much more complete, thick Jurassic of the Mecsek Mountains, on the other: this latter, with seams of hard coal in its lower reaches and clayey—marly deposits in its middle, turned calcareous only in its top portions, and thus resembled the Jurassic of the Gresten locality. (The type of Dogger and Lower Malm established in the Mecsek Mountains could up to the turn of the century be identified only at a few points of the Transdanubian Mountains.) On the other hand, the fact that the Middle Triassic of the Villány area south of the Mecsek Mountains was inundated by the Jurassic sea only after a pronounced hiatus, namely in the Bathonian, was already established by K. HOFMANN. Further occurrences of Gresten type liassic, some directly overlying the crystalline, were observed by members of the Institute in the Krassó—Szörény and Almás Mountains; the complete, easy-to-subdivide Jurassic of the Cserna valley is also to some extent of Gresten type. The description of the Jurassic in the environs of Brassó, in the Persány Mountains and in the Nagyhagymás group was due to F. HERBICH: the scattered occurrences, some of the Grestenian type, constitute among them a complete profile of Alpine Jurassic. It was K. HOFMANN who recognized in the Királyerdő a Jurassic sequence of Mecsek Mountains type, complete except for the Middle Dogger. This is all the more remarkable if one considers that the Jurassic studies in the neighbouring Bihar and Kodru Mountains and Transylvanian Ore Range have given no clear-cut picture up to this day. It is further to be emphasized that the first evidence for the Jurassic age of the so-called Schelea formation, cropping out in the structural window of the Szárkő and Retyezát and originally considered Palaeozoic on account of its crushedness, was a specimen of *Phylloceras mediterraneum* found by F. SCHAFARZIK in a sequence of shales, sandstones and limestones overlying a diabase tuff.

Besides distinguishing the "alpine" and "boreal" types of Cretaceous, the members of the Institute had found it necessary to distinguish just as sharply also the Lower from the Upper Cretaceous.

A continuous sequence of "Alpine" Lower Cretaceous was encountered at Lábatlan, in the form of Berriasian sandstone and breccia unconformably overlying a Lower Tithonian limestone, Valanginian limy marl with aptychi, Hauterivian sandstone and conglomerate. From the Bakony Mountains, the Aptian and Albian stages and even the Cenomanian were described by the names Foraminiferan clay, "*Caprotina*" and *Exogyra* limestone and Turrilites marl. The rich fauna collected by K. HOFMANN from the "augite porphyry tuff" of the Eastern Mecsek at the same time also fixed the Lower Cretaceous age of the volcanism in this region. In the Western range of the Krassó—Szörény Mountains the Barremian—Lower Aptian limestone of Urgonic facies is overlain by sandstones and marls, which reach up to the bottom of the Cenomanian in stratigraphic extent. In the Eastern range of the Krassó—Szörény Mountains, a conformable passage from the Tithonian into the Berriasian was observed; the bluish-grey shale of the Valanginian and Hauterivian is overlain by a Barremian—Lower Aptian cement marl. Barremian clay marl and Aptian "*Caprotina*" limestone were mentioned by T. SZONTÁGH from the Királyerdő. The Lower Cretaceous of the klippen in the Transylvanian Ore Range is closely connected with the Tithonian of the same range and, together with the latter, is embedded in a Lower Cretaceous flysch, which locally contains Hauterivian fossils.

The occurrences of the "Alpine" Upper Cretaceous in Transdanubia (Ajka, Sümeg, Ugod, etc.) are characterized by marls and *Hippurites* limestone overlying a fresh-water sequence including coal seams (Gosau facies). A survey in Western Transylvania established an unconformity due to a partly Cenomanian but mostly Gosau transgression, between the folded Lower Cretaceous flysch of the Ore Range and the Upper Cretaceous. The freshwater deposits overlying the Senonian of the Hátszeg Basin have yielded *Dinosaurs* indicative of the Danian (F. NOPCSA). The Upper Cretaceous overlying the crystalline nucleus of the Fruska Gora includes in its lower portion sandstones, shales and limestones. Among the fossils of the overlying clay and marl shales, interspersed with eruptions of dacite, some are younger than Upper Cretaceous (this is the hyper-Senonian of GY. PETHŐ).

A first profound study of the Tertiary in Transdanubia and Transylvania resulted in the setting up of basic sequences for the entire Carpathian Basin. Even on a world scale, M. HANTKEN's initiative of basing the subdivision of the Eocene and Oligocene on their *Foraminifera* content has turned out to be extremely fruitful. For instance, he divided the Eocene transgressive over the Triassic in the brown coal basin of Budapest—Esztergom into *Operculina*-

Subplanulatus, *Perforatus* and *Striatus* horizons. Within the more widespread Upper Eocene, which represents a distinct cycle of sedimentation, he distinguished *Orbitoides* limestone and a Bryozoan marl, with *Nummulites complanatus* as the leading fossil in the former and with *N. incrassatus* and *N. budensis* in the latter. HANTKEN was not slow to recognize the heteropic facies of his type formations, either. These are most conspicuous in the Oligocene around Budapest, whose lowermost member, the delta-type Hárshegy sandstone, is substituted elsewhere by the Buda marl, whereas both are overlain by the offshore Kiscell clay. The regression of the Upper Oligocene in this region is indicated by a brackwater limestone with *Cyrena* and *Cerithium*, freshwater facies with *Helix* and *Planorbis* and a nearshore facies with *Pectunculus* (now: *Glycymeris*) *obovatus*.

The detailed analysis of the Tertiary of the Transylvanian Basin — which includes four full sedimentary cycles and, within the Upper Oligocene, a multitude of bathymetric facies — was due to K. HOFMANN and A. KOCH. In the Carpathian flysch zone, an Early Tertiary sequence without any Lower Eocene was distinguished with some difficulty from the Upper Cretaceous flysch.

As regards the Miocene, in the Sopron region, in the Transdanubian Mountains, in the Mecsek, Bihar and Krassó—Szörény Mountains the main point was the distinction of the Lower and Upper Mediterranean and of the Sarmatian, with an appropriate differentiation of clastic, calcareous, brackwater, volcanic and often lignitic facies. In the Bakony and the Fruska Gora, only the Upper Mediterranean and the Sarmatian could be demonstrated. The subdivision of the Miocene about Budapest and in the Transylvanian Basin was particularly successful (GYULA HALAVÁTS, FERENC SCHAFARZIK, ANTAL KOCH). It is in this period that the abundant Tortonian faunae of Felsőlapugy, Kostéj, Ribice and Bujtor were first described.

The peculiar conditions of the isolated lake of decreasing salinity occupying the Carpathian Basin in the Pliocene made it necessary to coin the first specifically Hungarian stratigraphic term *(Pannonian stage)* for the Lower Pliocene, as opposed to the *Congeria* stage of the Vienna basin and the Pontian stage of East Europe. The introduction of this term by LAJOS TELEGDI ROTH was subsequently justified in a discussion between GYULA HALAVÁTS and IMRE LŐRENTHEY. In the meantime, attempts were made also, at a further subdivision of the Pannonian outcrops, which included various Lower and Upper Pannonian facies interfingering in space and succeeding each other in the stratigraphic sequence. It was further established that in the Upper Pliocene ("Levantine stage"), no deposits formed in large bodies of water were to be expected save in Slavonia, Southern Transylvania and the Great Hungarian Plains. In the remaining regions of Hungary, a stratigraphy based on vertebrate fossils in subaerial or fluviatile deposits of the Upper Pliocene was being established.

THE REFORMS OF L. LÓCZY SR. (1909–1919)

In spite of its sketchiness, the above summary clearly reveals that the first four decades of activity at the Hungarian Geological Institute laid down a permanent, safe basis for further research. Still, some of the personalities active at about the turn of the century did no fail to recognize that, after the turbulent élan of the first ten years, work at the Institute had become too rigidly fixed in a frame of survey sheets. Instead of a comprehensive analysis of geological problems it was the mapping according to a present timetable of a checkerboard pattern of survey sheets that had become the main goal of the period. This state of facts did not only hinder the expansion of the evolutionary idea, underlying and giving its sense to geological research as a whole, but also the specialization of research workers, which by that time had become indispensable for any further refinement of the results attained until then. The enrichment of knowledge concerning the regions already surveyed was neglected; the monographic description of these regions was not urged; indeed, sometimes even the explanatory notes to the survey sheets remained unpublished. No serious initiative was made towards a geological reconnaissance of Croatia-Slavonia and the Northeastern Carpathians.

These were the reasons why LAJOS LÓCZY SR., the successor of J. BÖCKH considered it necessary to alter the entire system of surveying previously adhered to. This widely travelled, broad-minded personality had before his eyes a geological synthesis of the entire Carpathian region. Although he reserved the task of this final synthesis to himself, he kept the enthusiasm of his co-workers aflame by assigning to them, or to groups of them the many-sided, complete monographic studies of natural geological units, and by taking care of the publication and appropriate remuneration of completed monographs. He exiged an up-to-date activity in which stratigraphic analysis, elevated above the level of self-centeredness, was to contribute substantially to the disentangling of paleogeographical, structural and evolutionary problems, and thus to lead to the understanding even of the present-day morphology, a combination which LÓCZY SR. himself employed to advantage during his travels in the Far East. Moreover, he not only set new, more inviting goals, but by the personal interest he added to their attainment, by the selfless distribution of his broad experience, he untiringly animated and directed those to whom the lion's share of the work was entrusted. He intended to ensure the uniformity of mapping practices by the organization of group excursions and by assigning younger geologists as aides to older, more experienced ones. As a result of his activity, the scope of the Institute was substantially broadened. Not only did he succeed in raising the number of research fellows at the Institute, but also in engaging a number of outside experts and even young people recommended to him from abroad. The number of research workers attached to the Institute thus attained 38 by 1913. It was in this way that LÓCZY SR. became the teacher of an entire new generation of geologists.

Although the number of co-workers was to be insufficient later on, LÓCZY SR. in spite of his advanced age attacked with vigour the tasks he had set himself. Completing the work initiated by his predecessor in the Southern Carpathians, in the Bihar group in the broader sense, and in the flysch zone of the Northeastern Carpathians, he sent teams of outside specialists, Hungarian forerunners, to the Alps, to the basalt hills of the Little Hungarian Plain, into the Transdanubian Mountains, the Mátra, the Bükk Mountains, the Transylvanian Basin and parts of the Eastern Carpathians. In 1913 he initiated a ten-year program of resurveying the Northern Carpathians; indeed, in 1916 he even undertook a preliminary large-scale surveying of the West Serbian Mountains, of which fairly little had been known previously.

This enormous effort, was, however refused the pleasure of achievement. The health of the sexagenarian was undermined by his unrelenting fight for time. The worsening of the political climate, reflected by a number of changes of government, clearly showed up the crisis of the social and administrative institutions of the Monarchy. The supreme illness was, of course, the outbreak of World War I, which at first only limited the scope of field work, but finally resulted in the loss of the most diligently researched regions. This large-scale high-level program turned out to be tragically oversized under the given historical conditions. The surveying personal carried a substantial overload owing to a lack of specialists in the field of mapping and in the subsequent laboratory work as it was largely carried out by the same persons. Although the *Annual Report's* of the Institute, dating from this period, undoubtedly contain a wealth of valuable observations and descriptions, and the *Annals* (Yearbooks) and the volumes of the series *Geologica Hungarica*, initiated by Lóczy Sr. include a number of up-to-date paleontological monographs, regional monographs published (Villány and Velence Hills, Vértes Mountains, Mesozoic blocks east of the Danube) were few and far between, in want of the time necessary to mature such publications. *It should not be forgotten, however, that a number of comprehensive treatises based on detail work done in this period* (Mecsek Mountains, Cserhát Hills, Dobsina, Szeben Mountains, Bihar, Northern Bakony; the two latter fragmentary owing to the premature death of the authors) *were published — with more or less subsequent complements — only a decade and a half to two decades later.*

Under such circumstances, no more than the outlines of a synthesis restricted to the internal part of the Carpathian Basin could be laid down even in the latest writings of Lóczy Sr. This in itself was a rather unenviable task, as the basement of the large Hungarian basins was not yet reached by a single deep well, and all structural and paleogeographical conclusions were of necessity extrapolations from the surface outcrops. Generalizing the Liassic "*Eastern Continent*", concept of E. Mojsisovics (1879), Lóczy Sr. considered the basement of the large Intra-Carpathian basins to be part of an ancient crystalline massif connecting the Central Alps with the Rhodope Massif of the Balkan Peninsula. He assumed that during the Permian and Mesozoic there had impressed themselves into the surface of this massif, some depressions digitating in various directions from the contemporary geosynclines of the East and South Alps, with no essential communication between them. It is the deposits of these depressions that constitute today the insular mountains of Croatia-Slavonia and Southern Transdanubia, as well as the Bakony—Pilis range (The Transdanubian Mountains). The crystalline massif — as revealed by the faunistically proved isolation of the Transylvanian and Transdanubian Early Tertiary basins and by the Mediterranean gravel sheets of the Bakony Mountains — did not subside and acquire a sedimentary cover until the Late Neogene. Its marginal faulting and foundering was accompanied by the outbreaks of the "inner wreath of volcanoes", most intense in Miocene times.

This outline, intended by its author primarily as a paleogeographic sketch but projected by his successors also onto the structural plane, eventually became the surce of L. KOBER's and HUGO BÖCKH's "median mass" concept, of GYULA PRINZ's "Tisia" mass, and its reverberations are present in one form or another in most of our modern ideas. Incidentally, some bad faith was required to derive an idea of resistance to the writings concerning the Pannonian massif of LÓCZY SR., as, it was he who most emphatically pointed out the relative simplicity and autochthony of the structures in the basin, as opposed to the extremistic exaggerations of the Carpathian nappe theory.

The most excellent piece of geological literature of these eleven years is undoubtedly LÓCZY SR.'s treatise on the Balaton Highland, which crowned several years' profound stratigraphic, paleontological and structural research in this southwestern terminal member of the Transdanubian Mountains. This writing is the concluding volume of a series of monographs whose publication LÓCZY SR. had organized under the auspices of the Hungarian Geographical Society when still Professor of Geography at the University of Budapest. This series authored by a number of excellent specialists from Hungary and abroad is not only an inexhaustible source of geological information concerning this country, but one of the best also, on an international scale. Even from this high-class work there emerges an excellence in the monographic treatment of the Triassic, typically the South Alpine up to its middle and the North Alpine farther up, which for this reason still counts as the *basic Triassic sequence* of Hungary.

According to this fundamental description, the lowermost member of the northward-dipping sequence of the Balaton Highland is an Early Palaeozoic phyllite overlain by a Permian basal breccia and by sandstones and shales of Gröden type, overlain in turn, locally with a slight unconformity, by a Lower Triassic subdivided into 12 horizons. Three horizons could be distinguished in the Anisian stage (*Megyehegy Dolomite*, *Recoaro* and *Tridentinus Limestone*), and further two in the Ladinian (*Reitzi Limestone* with diabase tuff and *Subtridentinus Limestone*, locally substituted by a shaly clay marl with *Posidonia*). In the Füred Limestone and the Upper Marl Group the fossil assemblage indicates the horizons of *Protrachyceras aon*, *Trachyceras austriacum* and *Cornucardia hornigi*. Above the fossil-poor Norian Hauptdolomite, the Rhaetian is represented by marly-bituminous Kössen strata of limited extent and by the more widespread Dachsteinkalk.

The main mass of the Vértes Mountains was found by HENRIK TAEGER (1909) to consist of Norian Hauptdolomite and Rhaetian Dachsteinkalk. On the other hand, in the Mesozoic blocks east of the Danube ELEMÉR VADÁSZ (1910) established the presence also of a Carnian cherty limestone underlying these two formations.

The discovery of the Carboniferous fauna of Nagyvisnyó in the Bükk Mountains (E. VADÁSZ 1909) was an event of some importance. It was presumably on the strength of these finds that the surveyor of the main mass of the Bükk Mountains, Z. SCHRÉTER found it fitting to divide up the fossil-poor rocks of the region, now known to be Permian and Triassic between the Early and the Late Palaeozoic, except for some unmistakably Triassic rags. Still, even at that time the separation of the Bükk facies from the Transdanubian Triassic was becoming part of the common geologic consciousness, just as the separation of the Triassic blocks of Selmec from the Subtatric sequence.

Of the results of the research in the Northern Carpathians, the greatest importance could be ascribed to the faunistic evidence (BÉLA DORNYAI, KÁLMÁN KULCSÁR, GYULA VÍGH, LAJOS LÓCZY JR.) *that the Choč dolomite and limestone overlying the Neocomian marl of so-called Subtatric facies (and consequently considered Lower Cretaceous up to that time) was in fact Upper and Middle Triassic.*

As it is well known, it was the Viennese grand master of Carpathian geology, V. UHLIG, who first recognized, that the imbrications (nappes in today's terminology) of Permian and Mesozoic formations on the north flank of the High Tatra granite exhibited, certain changes of facies depending on distance from the granite nucleus, and that above *the inner*, "*High Tatra*" *facies* there follows an *outer facies* called "*Subtatric*". The High Tatra Mesozoic is thinner and less complete, being of littoral and nearshore facies, whereas the Subtatric sequence had been deposited farther offshore.

Although this sharp distinction of a High-Tatra and a Subtatric facies was not adopted by the Hungarian geologists then active in the Minčov, Žiar, the Little and the Dry Magura, and the Inovec (since they found the Mesozoic of the so-called "nuclei" to be uniformly similar to UHLIG's Subtatric facies) their discovery concerning the Choč masses had to be interpreted as signalling the presence above the Subtatric facies of an independent geological unit, of a nappe. In the region from the Little Carpathians to the Minčov they established beyond doubt that the Triassic of the Choč masses widely differs in facies, thickness and fossil content from the contemporaneous deposits of Subtatric facies, being much closer to the facies known from the Transdanubian Mountains. The "mottled Keuper" typical of the Subtatric is nowhere represented in the Choč, and only some local occurrences of "Lunz sandstone" indicate any "Carpathian" affinity at all. The geologists of the Institute were thus amply justified in regarding the blocks of Choč overlying various terms of the Subtatric, and locally even the crystalline ("in a form resembling paperweights") as the remains of an originally coherent nappe, dissected only by subsequent events.

It was presumably his father's refusal of the exagerations of the nappe theory that gave L. LÓCZY JR. (1915) the impulse to look for the locus of deposition of the rocks forming the Choč unit of the Fehér Mountains in a geosyncline that, according to him, had lain between the Bohemian Massif and the Carpathian geanticlines. In his opinion, it was from this presumed open sea on *the outer side of the Carpathian arch* that the klippen in question came to be overthrusted onto the nearshore archipelago of the "nuclei". Remarkably enough, this idea of the external origin of the Choč — in effect, an adaptation to the Choč nappe of V. UHLIG's pre-1907 ideas, which still admitted a relative autochthony — was resurrected in 1959 in a synthesis by M. MAHEL'.

As for the Jurassic of the Transdanubian Mountains, it was E. VADÁSZ (1913) who made an attempt at a paleogeographic synthesis of the literature dealing with the topic. He clearly recognized that the Lower Jurassic does not develop conformably out of the Dachstein limestone except in the Bakony Mountains; elsewhere there is more or less ample evidence of a hiatus. *On this evidence he traced the shoreline of the Lower Liassic sea along the actual limit of Lower Jurassic deposits.* He emphasized the entire Jurassic to be of shallow sea origin and explained the hiatuses, fairly numerous, in the sequence, by the assumption of further regressions. This line of thought, a continuation of some already above-mentioned ideas of L. LÓCZY SR. was a first formulation of one of the concepts surviving to this day of paleogeography in the Transdanubian Mountains.

A Middle Cretaceous of Bakony Mountains facies was discovered by H. TAEGER (1909) in the Vértes Mountains. He placed part of it incorrectly into the Barremian, which for fifty years became an obstacle to a correct understanding of Cretaceous evolution in the Transdanubian Mountains.

A substantial result of research in the Bihar Group, due to MÓRIC PÁLFY and PÁL ROZLOZSNIK, was the recognition that the structure of these mountains consisted of a number of truncated nappes. It was these authors who first proved the Permo-Mesozoic in this sheaf of nappes to consist of sequences which, similarly to the High Tatra and Subtatric sequences, had been deposited in near-shore and off-shore basin parts, respectively. The Permo-Mesozoic sequence constituting the autochthonous cover of the crystalline-schist mass of the Kodru-Móma (Béli Mountains) distinctly recalls for instance, with its mottled Keuper of continental deposition, its Kössen beds and with the overlying Lower Liassic of Gresten facies the immediate sedimentary cover of the "nuclei" of the Northern Carpathians. An even more striking feature is the nearshore facies of the autochthonous Mesozoic of the Bihar mass, where continental deposition in the strict sense are kept on even longer (Upper Triassic to Middle Liassic). This Mesozoic of Bihar type and the crystalline underlying it continue in the Réz and Meszes Mountains and in the Királyerdő. From the Fekete Körös valley there were overthrusted onto this series some nappes whose fossil-rich, purely marine facies are, however, sharply different from those of the autochthonous sequence.

Work carried out in the Bihar group, further emphasized the difference between the structure of the Lower Cretaceous flysch in the Transylvanian Ore Range, chaotically folded and complicated with Tithonian klippen; and the Upper Cretaceous of Gosau facies and simple structure, leaning on the Bihar and the Southern Carpathians. At the same time, the overthrusting of the folded flysch upon the much simpler Upper Cretaceous structures was also established and hence also the fact of post-Gosau movements. The discovery and examination of Cretaceous bauxite in the Királyerdő (P. ROZLOZSNIK) fell upon the last years of the war and could for this reason not be advanced to a full stage of evaluation.

Of research in the Southern Carpathians, it is the studies of E. JEKELIUS concerning the Mesozoic faunae of the environs of Brassó that merit particular attention from a stratigraphic point of view. A re-evaluation of the structure of the Krassó—Szörény Mountains jointly with Rumanian geologists, a step in a projected series of exchanges of ideas with Rumanian geologists, initiated by L. LÓCZY SR., was commenced but did not yield a monographic description, only a brief review (F. SCHAFARZIK—Z. SCHRÉTER).

The resurveying of the Mecsek Mountains has yielded a few interim reports only, but the description of *the Dogger ammonites of the Villány Mountains*, which subsequently acquired world fame, was completed by L. LÓCZY JR.

Reports by the Hungarian and Croatian geologists (TIVADAR KORMOS, VIKTOR VOGL, FERDO KOCH, M. SALOPEK) gave a sketchy outline of the Permo—Carboniferous, Mesozoic and Eocene of this region. A still, unparalleled result of these studies is the discovery by V. VOGL, of the Middle Permian *cephalopod facies* of Mrzla Vodica. The typical calcareous algae of the marine Upper Permian (*Mizzia, Gymnocodium*) were also observed, placed just as in the Bükk Mountains, into the Carboniferous according to the state of knowledge of these times.

Deep drilling sited by K. PAPP in the Transylvanian Basin resulted in the discovery of *a vast natural gas resource* at Kissármás. A subsequent reexamination of the entire Transylvanian Basin, necessitated by this discovery, was refused by LÓCZY SR. The discovery of the fold structure of the basin interior consequently fell to H. BÖCKH and his co-workers. Successful prospecting drilling here and at Egbell were the incentives that urged further drilling for hydrocarbons also in Transdanubia and the Great Plains between the wars.

E. VADÁSZ, H. TAEGER, V. VOGL and JENŐ NOSZKY SR., had given an essentially correct picture of the *stratigraphy of the Tertiary* in and around the Mesozoic blocks east of the Danube, in the Vértes Mountains, in the Liptó and Cserhát—Nógrád regions. The same can be said about Z. SCHRÉTER's activity concerning the Tertiary about the Bükk Mountains. The sequences established by them did not change much, even after, some lively discussions concerning the stratigraphic classification and nomenclature of these deposits. From the paleontological side, this work was complemented by an analysis, by KÁROLY TELEGDI ROTH, of a fauna carefully collected layer by layer from the fossil-rich Upper Oligocene of Eger, and a systematic description by E. VADÁSZ of the Mediterranean echinoderms of Hungary.

It was established even, at that time, that the brackwater deposits of the Hungarian Sarmatian represent but a deeper portion of the Sarmatian in the East European sense. From some localities, "transitional strata with mixed faunae" had been described. On the other hand, particularly by the efforts by I. LŐRENTHEY and GY. HALAVÁTS, the first attempts at a subdivision of the Sarmatian on a faunistic basis were born.

THE YEARS BETWEEN THE TWO WARS (1920–1944)

Subsequent to World War I, the structure and aims of the Hungarian Geological Institute underwent a profound change. Although, the members of the Institute made some attempts at summarizing the results attained in regions which fell to the successor states of the late Monarchy, these attempts were hampered by miserable economic conditions, and did not get beyond the first steps. In a Hungary which was now of a considerably reduced area, it was the supply of the industry with such raw materials as could be discovered within the frontiers, which became the task of prime importance, and the systematic geological mapping of the country was suspended.

Field work was first restricted, owing to the economic conditions created by a heavy inflation, to the immediate vicinity of the capital and to the larger coal mines about it. This was but slowly extended to the rest of the coal basins and to prospective iron ore regions, bauxite, precious metals and hydrocarbons. Low workload in other fields made it possible to complete up to the end of 1921 the south-eastern sheet of a 1 : 500 000 scale map of the region surrounded by the wreath of the Carpathians.

The output of the Institute was to no small degree hampered, by the fact, that the post of Director remained unoccupied for a fairly long time. Only after an interim period of six years was L. Lóczy Sr., succeeded by Ferenc Nopcsa and shortly thereafter by Hugo Böckh. These two directors represented two opposing trends: Nopcsa urged the reduction by the publication of monographs of the scientific debt contracted by the Institute under Lóczy Sr., whereas H. Böckh, who introduced more modern and precise methods of mapping, went for practical successes first of all. His premature death was succeeded in the fall of 1932 by the directional nomination of L. Lóczy Jr.

L. Lóczy Jr., attempted to strike a balance between the opposing trends of "practicism" and "science" by giving a broader foundation to prospecting and research for practical ends and by putting on the agenda, as far as this was possible, surveys which promised no direct practical consequence but seemed important to provide insight into some problems of countrywide importance.

Some summary reports published with considerable delay, written by F. Nopcsa, K. Telegdi Roth, I. Lőrenthey and L. Lóczy Sr., and Jr., on the geology of Albania and Serbia, represent the closure of the pre-1919 activity of the Institute. It is here that K. Telegdi

ROTH's book, "*Magyarország geológiája*" (The geology of Hungary, 1929) should be mentioned as *a first attempt in Hungarian geological literature with an evolutionary synthesis* of the uncorrelated knowledge collected that far, and at reconciling the apparent contradiction between the Carpathian mappes and LÓCZY SR.'s Hungarian massif. This compact review does not, of course, enumerate all stratigraphic details but its ideas on paleogeography and evolution history make it highly valuable; it has exerted a considerable influence on Hungarian geological thought although many of its ideas were not correctly understood until much later.

Among the comprehensive treatises, the monograph of the Szeben Mountains by A. VENDL (1932) should also be mentioned. It distinguished the *Sebes* and *Fogaras* masses of metamorphics; both developed prior to the Carboniferous.

The monograph of the *Bihar group*, originally intended to include several volumes, got only as far as the Permian; of which the description by P. ROZLOZSNIK, is highly valuable in spite of its incompleteness; expresses the opinion that the Mesozoic geosynclinal branch between the Béli Mountains on the one hand and the crystalline of the Gyalu, Réz, Meszes, Cikó and Preluka, on the other had begun its development already in the Permian. However, the region east of the Fekete Körös was a swell even in the Lower Permian, since in this region deposition began with Upper Permian strata, whereas in the Béli Mountains area the Lower Permian is also represented. Although, the actual eastern front of the Bihar Mesozoic was undoubtedly sculptured by erosion, the crystalline nuclei east of this front undoubtedly formed an island or an archipelago during part or all of the Mesozoic. Within the basin of Permo-Mesozoic sedimentation, two main facies regions can be distinguished: (*a*) the nearshore swell facies of the Királyerdő, Northern and Central Bihar, and (*b*) the Béli facies, formed farther off-shore, whose most complete sequence is encountered in the so-called Nagyarad unit of the Kodru. The structure here is as follows: starting from the actual Fekete Körös graben, truncated nappes moved towards the west (onto the Nagyarad unit) and also towards the east (onto the Bihar swell facies); each nappe is of Béli facies, but with a dark grey *Lycodus* limestone instead of the mottled Keuper. The unit intercalated between the crystalline and the Permian, consisting of conglomerates, graywackes and clay shales, compressed but non-metamorphic, has been relegated into the Carboniferous. The Lower Permian includes a basal red conglomerate, sandstones and shales with volcanic interbeddings; the Upper Permian, difficult to delimit against the Seisian stage of the Triassic, consists of conglomerates and quartz sandstones with the detritus of a quartz porphyry. Identifying its fossils, E. KUTASSY emphasized the Hallstattian affinities of the Triassic of Kalugyer and Kólafalva (1928).

A number of fundamental ideas cropped up in the Dobsina treatise of P. ROZLOZSNIK (1932). The author of this treatise was the first to state explicitly the necessity of distinguishing the Veporid and Gemerid units (which latter he called the "Szepesség nappe") within the Northern Carpathians. As regards the stratigraphy of the Hungarian territory, the chapter on the Carboniferous of this treatise was of particular interest: it rested on an excellent paleontological foundation laid by GY. RAKUSZ, a highly talented young man whose premature death shattered a number of paleontological expectations. RAKUSZ did not only establish the Moscovian age of the Carboniferous of Dobsina, but also gave an impulse towards a correct re-evaluation of the Bükk Mountains' Carboniferous and was the first to point out the presence of a marine Permian in the Bükk Mountains. The exact age of these layers, of Dinaric type with *Mizzia* and *brachiopods*, was on the basis of finds of *Leptodus* (= *Lyttonia*) soon thereafter established as Upper Permian, by Z. SCHRÉTER.

A "rejuvenation", on the basis of new finds in fossils and of a number of supposedly older formations in the Bükk Mountains Triassic was another substantial achievement of this period, although no incontrovertible result was attained until 1943. The transition from a marine Upper Permian to a marine Lower Triassic came to be established beyond doubt, but no advance was made concerning the stratigraphic position of the older Permian deposits.

The analysis of the Triassic of the Gömör and Rudabánya regions took a more fortunate turn. Based on a number of important faunae, correct stratigraphic sequences were set up by M. PÁLFY (1929) and Z. SCHRÉTER (1935), and it was only in the matter of the age of the dark clay shale, radiolarian silex and quartz porphyry that these authors were subsequently proved wrong. The geologists mapping the Gömör Karst during the war (K. BALOGH, L. BARTKÓ, J. NOSZKY JR., A. FÖLDVÁRI, G. TELEKI) gave a largely correct subdivision on the basis of calcareous algae of the thick Wetterstein limestone into Ladinian and Anisian portions; they recognized heteropic facies and established the presence of Carnian and indeed of Norian deposits (the latter of Hallstatt facies).

The knowledge of the Buda—Pilis Triassic was also being promoted. First of all, the Ladinian age of the diploporan dolomite, recognized already by K. HOFMANN, was confirmed. Various fossil-bearing facies of the Carnian (*Carinthiacus* dolomite, dolomite with chert nodes and dolomite with chert layers, Dachsteinkalk — this latter has, however, since been placed into the Norian) were demonstrated. Within the Norian, *Halorella* and *Monotis* dolomite and Dachsteinkalk were recognized. From the Pilis, besides a dark limestone and dolomite correctly classed as Carnian, Kössenian deposits with *Avicula* were erroneously described (these were subsequently proved to lie at the Carnian-Norian limit). Since owing to subsequent block-faulting, the spatial and stratigraphic relationships of the outcrops could not be established, every author gave reconstructions according to his own taste. Some believed them to represent various terms of a single stratigraphic unit, whereas most suspected the presence also of one or several sets of heteropic facies. The most far-fetched notions were those of F. HORUSITZKY who postulated the existence of three entirely different sequences of facies compressed into a relatively narrow area, although, at most, a number of simple local changes of sedimentary facies can exist here. One thing, that came to be correctly established was that, proceeding northeast from the Bakony Mountains, one encounters a gradual shifting in the ages of the Hauptdolomite and the Dachsteinkalk, the formation of which began earlier than the lower limit of the Norian and Rhaetian, respectively.

The synthesis of the Mecsek Mountains by E. VADÁSZ (1935) differed from the description given by J. BÖCKH mainly in that it relegated the Jakabhegy sandstone into the Permian and the clastic Upper Triassic into the Rhaetian and that it distinguished within the Muschelkalk four terms, three Anisian and one Ladinian.

The subdivision into 12 stages of the Mecsek Mountains Jurassic confirmed the main outlines traced by J. BÖCKH and K. HOFMANN. The facts of a Proto-Cimmerian emersion at the Triassic-Liassic limit in the Gerecse and Pilis and of continuous deposition in the Bakony came to be corroborated. Although new, complete Jurassic sequences were demonstrated in the Gerecse and Bakony, the hiatuses in some Jurassic sequences could not be disproved. These hiatuses were not thought to be due to emersion either by GY. VÍGH or by K. TELEGDI ROTH, however, as both considered the cephalopodan deposits and the radiolarian silex to have originated in a rather deep sea.

A survey of the Bakony in 1934 by J. Noszky Jr., suggested the continuation of Jurassic deposition into the Valanginian and Hauterivian stages of the Cretaceous. No Barremian fossils were known; moreover, bauxite deposits looking obviously redeposited in their top portions were found under an Aptian sequence transgressing directly onto the Dachsteinkalk at Alsópere and Eplény. No wonder, that K. Telegdi Roth (1934) concluded upon the emersion of the relatively thin Jurassic—Lower Cretaceous sequence and upon its locally complete erosion in the "Tisian phase", was succeedea by a rapid deposition of bauxite. The transgressive sequence beginning with the *Ostrea-Orbitolina* (also called *Munieria*) beds and continuing in a *Requienia* limestone and ending in a *Turrilites* marl was considered Aptian—Albian by K. Telegdi Roth and Aptian to Lower Cenomanian by H. Taeger (1936). It was, as a result of a few cursory inspections by K. Telegdi Roth and subsequently by L. Strausz and Gy. Rakusz, that the Berriasian age of the Villány bauxite, considered up till now the oldest bauxite deposit of the country, entered our geological consciousness.

It was the prospecting for coal and hydrocarbons that promoted the more profound study of the stratigraphy of some of the Tertiary regions of Hungary. The subdivision dating from 1922 of the Esztergom brown coal basin refines, as far as the Eocene is concerned, largely the Hantken subdivision, and differing from it mainly in that it considers the "*Nummulites-Orthophragmina* marl" to still belong to the Upper Eocene. The intense denudation termed "infra-Oligocene" by K. Telegdi Roth is succeeded by the transgression of the Hárshegy sandstone. The foraminiferan clay marl regarded by M. Hantken as Rupelian has been placed into the Upper Oligocene, above the fresh- and brackwater deposits.

The stratigraphy of the North Hungarian Oligocene and Miocene developed under the sign of divergent individual opinions and so-called "border disputes" among Z. Schréter, J. Noszky Sr., E. Vadász, I. Ferenczi, F. Horusitzky, L. Strausz, L. Bogsch and others. The main points of controversy were the relations to each other of the various *Upper Oligocene* facies, and the existence, or otherwise the contents of the *Aquitanian stage*. It was as a function from the standpoint of the individual authors that the subdivisions of the overlying deposits were shifted up or down. Finally, a basis for orientation within the Paleogene between Bükkszék, Nagybátony, and Budapest was established by L. Majzon, although his *six foraminifera horizons* turned out subsequently to be largely zones of identical facies. The bases of orientation in the Miocene are, on the other hand, the Burdigalian faunae of Eggenburg type and the *three main levels of "rhyolite tuff"*, distinguished already by the Viennese geologists (even though they merge into a single complex of volcanics in the foreland of the Bükk which was closest to the centres of eruption). The early recognition of the heteropic facies of the Schlier, now unequivocally considered Helvetian (the *Cardium* clay, *Chlamys* sand and sandstone and the lignitic complex) was a remarkable feat of Z. Schréter and F. Szentes. The identity of age was supposed to begin with the Nógrád, Egercsehi and Borsod lignitic complexes, in spite of the different numbers of seams. The leading facies of the Tortonian is the Leithakalk, resp. the foraminiferan tuffitic clay in Borsod. This was construed by E. Vadász and L. Strausz to indicate the Helvetian age also of the Mecsek Schlier, although the earliest terms of the latter are different. The demonstration of the Middle Miocene age of the lignite complex of Várpalota, formerly considered Pannonian, by K. Telegdi Roth was an important result, although the question whether to place it into the Helvetian or Tortonian remained open for some time thereafter.

After a number of publications concerning details of the problem, Z. Schréter in 1943 set up a countrywide scheme to organize paleogeographic knowledge concerning the distribution of the dryland and brackwater facies of the Sarmatian. In respect of the Pannonian, valuable work was carried out mainly by J. Sümeghy and L. Strausz, although it yielded no definitive stratigraphic sequence.

Separate mention is to be made of surveying in the Northeast Carpathians during World War II, where György Wein and Ferenc Horusitzky, working on the flysh of the Ung valley and in the environs of Szolyva, successfully distinguished on the basis of Majzon's microfaunal studies, the sequences of the "internal klippen zone", of the "Magura zone", of the "Uzsok-Dukla folds", "marginal klippen", "Uzsok-Bukovice klippe", and the "central depression". At the same time, T. Szalai cleared up the stratigraphy and structure of the environs of Körösmező.

Successful resurveying of the northern margin of the Transylvanian Basin and of the Mezőség was carried out by a working group of the Geological Institute, headed by Horst Bandat and including Lajos Reich, Lajos Bartkó, László Majzon, Boleslav

Bem, Sándor Jaskó, Kálmán Méhes, Tibor Szalai and Kálmán Balogh. Papers on contiguous topics were written by István Ferenczi, István Mihá1tz and László Strausz. The asphalt occurrence of Felsőderna was investigated by Jenő Noszky Jr., Kálmán Kulcsár and László Majzon; the Pliocene of the Barót-Köpec basin was treated by István Gaál. Jenő Noszky Jr. also visited some fossiliferous Lower Cretaceous localities in the Békás gap.

According to the results of these studies, the folded Palaeogene flysh and the Palaeogene basin facies which substitutes it farther west are overlain by the unfolded Lower Mediterranean, of gentle southerly dip, of the Ilosva hummocks, which is in turn overlain by the Upper Mediterranean and Pliocene, folded by diapirism connected with rock salt deposits, of the Mezőség. The Lower Mediterranean includes the basal conglomerate and the lower, *Cyclammina*-bearing portion of the Hídalmás beds, whereas the upper, fossilless portion of the Hídalmás beds is Helvetian of age. The Tortonian begins with the Dés tuff and the contemporaneous rock salt; these are overlain by the Mezőség beds bisected by the Bálványosváralja tuff; the lower section includes *Anomalines* whereas the upper is almost fossilless. The top of the Mezőség beds is delimited by the Gyéres tuff against the *Syndesmia* clay marl of the Sarmatian. This latter is overlain by the Bázna tuff and by the *Congeria* beds of the Pannonian.

FROM THE LIBERATION TO THE PRESENT (1945–1968)

The end of the second World War opened up an entirely new perspective for Hungarian geology as the nationalization of the mines made it possible and necessary to subsume all prospecting operations under a close geological control. The mining-geological services set up under this principle were manned in the beginning by the workers of the Hungarian Geological Institute. The difficulties raised by this state of facts were soon mitigated by the formation of young geologists at the universities of Budapest and Miskolc. As a result, the spheres of activity of the Institute and of the services could be separated as early as 1955.

Nowadays, such industrial services are not only responsible for hydrocarbon prospecting but attached to the bauxite, coal and ore mines, to the mines of non-metallic minerals and to all drilling enterprises as well. This opened up for the workers of the Geological

Institute the possibility of synthetizing at a higher level the data collected by the local services.

Substantial advances were made in topographic map supply and in the number and quality of prospecting works (test pits 2 to 4 m deep having been superseded by boreholes of 15 to 20, occasionally 100 m depth).

As a result of the increased intensity in research, the analysis of geological substances exploded its narrow limites and, having undergone something of a revolution, now represents a feature which fundamentally distinguishes the new Institute from the pre-war one.

The requirements facing the geologists have multiplied over the last two decades, or so. No detailed mapping can be properly performed without the collective effort of a sufficient number of specialists. The first working group of this type was formed in 1946–47. Since then, all selected priority regions are covered by *working groups* of fairly large numbers of mapping geologists, paleontologists, and laboratory specialists. The first results of this new mode of attack were first presented to the international community of geologists on the occasion of the *International Conference on the Mesozoic*, held in 1959 at our Institute. This event, coinciding with the 90th anniversary of the Institute, had a significance extending far beyond the frontiers of this country, in that it represented a valuable initiative towards a unified evaluation of the problems and results of research on the Central and South European Mesozoic. The scientific contributions to this Conference were published in four bulky volumes of the Annals series of our Institute.

The broadening of the scope of geological research subsequent to the Liberation led to a substantial evolution also of stratigraphic knowledge. Not only were the stratigraphic features of our mountains, intramontane basins and hummocky regions studied in hitherto unknown detail, but the basements and the fillings of the enormous young depressions underlying the Hungarian Plains also became accessible to study. The enrichment of knowledge by this process will soon, we hope, yield new insight into numerous now still hypothetical faciological, paleogeographical and structural features of the Alpine, Carpathian and Dinaric ranges.

Perhaps the most remarkable advances in the field of stratigraphy are those concerning the **oldest formations** of the Hungarian territory. The rocks earlier tagged with the comprehensive terms "Archean" and "Early Palaeozoic" have been subdivided on the basis partly of fossil finds, partly of radioactive dates into Late

Proterozoic, Cambrian, Silurian, Devonian and Lower Carboniferous. Besides the outcrops of crystalline schists of meso or kata metamorphism in the Sopron, Vilyvitány and South Mecsek regions, the paleosomes of the formations of a similar degree of metamorphism, disclosed at a number of points by deep drilling in the northwestern Little Plain, in North Nógrád, in the Great Plain and in South Transdanubia, are also considered Late Proterozoic or possibly Cambrian, together with the basement of the Western Mátra, Börzsöny and Visegrád Mountains inferred from inclusions in the young volcanics. János Oravecz, Principal Assistant of Budapest University, succeeded in proving the *Silurian age* of certain terms in the shale hull of the Velence granite, and in the anchimetamorphic complex of the Southern Balaton Highland, the Uppony Hills and the southern and northern flank of the Mecsek Mountains. His conclusions were based on finds of *hystrichosphaerids* and *graptoloids*. A similar phyllitoid Early Palaeozoic was disclosed also in the basements of the Tertiary basins of Ózd and of the Cserehát. The fact, that the Silurian complex is separated only by a basal conglomerate from a microcline granite in borehole Szalatnak-3 (Northern Mecsek) has displaced also the age of the migmatitic granite of Mórágy in the Southern Mecsek towards the Algonkian and the Cambrian, although radioactive dates do not exclude Hercynian emplacement, either. The range of Mecsek type granites continues in the basement of the Great Plain in a northeasterly direction towards Nagykőrös. Deep drilling in the Tokaj Mountains has disclosed the Ordovician phyllite and porphyroid of the Gölnic series of the Gömörids in the basement of the Tokaj Mountains.

On the basis of concurrent identifications by Moscow and Leningrad paleontologists, we have placed into the *Middle Devonian* the fossil-bearing sequence of the Szendrő Mountains, believed previously to have been Upper Carboniferous. Still, the ages of the formations over- and underlying it are still open to discussion. The nearest Devonian locality is presumably the crystalline limestone of the Szárhegy Hill at Szabadbattyán. The Kőszeg Mountains and Vashegy series, consisting, according to Kornélia Varrók, largely of quartz phyllite and calcareous mica-schist with interbeddings of the so-called *Cák conglomerate* are mostly Devonian and perhaps Lower Carboniferous in their top portions.

A. Földvári in 1952 recognized a fossil-bearing *Lower Carboniferous* limestone and clay shale in the structural unit below the Devonian (?) limestone of Szabadbattyán. At present, this is the only certain Lower Carboniferous in Hungary, because the distribution, based purely on analogies, of certain Uppony Hill formations between the Tournaisian and Viséan will presumably have to be modified in the light of the above-mentioned discoveries of J. ORAVECZ.

The results of B. JANTSKY (1957) seem to confirm the emplacement of the fundamental granite of the Velence Hills in the Sudetan phase of orogeny, whereas the dykes traversing the granite are attributed by JANTSKY to the Asturian and Saalian phases.

There emerge from the latest research two more or less distinct facies regions of the *Upper Carboniferous.* In the southwestern foreland of the crystalline mass of Vilyvitány, in the continuation of the long-known occurrences of the Zemplén Mountains; and in the southern foreland of the Mecsek Mountains, *longshore deposits* of sandstones and shales with plant fossils and stringers of coal have been discovered (G. PANTÓ, Á. JÁMBOR). These facies together with the Upper Carboniferous of Bihar and Krassó—Szörény indicates the shoreline of *that branch of the Palaeotethys*, which can be traced from the borehole Karád-1 south of Lake Balaton through the Bükk Mountains to the Gemerids. After a *Lower Permian* emersion this channel was again inundated by the sea in the *Upper Permian* and thus became one of those zones which, despite the general regression at the end of the Permian, could serve as "beachheads" to the Lower Triassic transgression. The problems of the Late Palaeozoic of the Bükk Mountains, which includes the Namurian-Bashkirian, Moscovian and Uralian stages and, thence, continues up to the end of the Permian, its stratigraphic subdivision, its parallelization with similar sequences in the Carnian Alps and the Dinarids and in the nearby Dobsina region, as well as, the tracing of its world-wide affinities were treated in monographic detail by K. BALOGH (1964) who relied not only on his own observations but also on paleontological evidences collected by Z. SCHRÉTER, S. E. ROZHOVSKAYA, M. HERAK and V. KOCHANSKY. M. MÉSZÁROS (1960) raised the idea that the sediments accompanying the anhydrite and gypsum deposits discovered in and after 1950 in the Gömör Karst and in the Rudabánya Hills belong to the so-called Melléte (Meliata) series described from Czechoslovakia and held to be Upper Permian on the basis of sporomorphs.

Our knowledge concerning **Mesozoic** stratigraphy underwent a considerable process of refinement. K. BALOGH on the basis of *dasycladaceids* distinguished within the Gömör and Rudabánya

Triassic the Anisian and Ladinian terms of the thick Wetterstein limestone complex, recognized a variety of facies within the Ladinian, proved the *Triassic* age of quartz porphyry in the Rudabánya Hills, and delimited the occurrences of Carnian and Norian. G. PANTÓ demonstrated the presence of interbeddings of primary iron ore in the Lower Triassic of Rudabánya and cleared up the sequence of events which by hydrothermal metasomatism resulted in a local sideritization of the Lower Anisian dolomite. Disentangling passages between various deposits, and discovering some new fossiliferous localities, K. BALOGH and G. PANTÓ despite the overturning and local structural reduction of the sequence defined a basic profile of the *Bükk Mountains Triassic* in the Szinva valley at Lillafüred and in the adjacent Répáshuta area. The structure of this region was formerly believed to be much more complicated, owing to the absence of a clear understanding of the succession of the deposits. The Upper Permian limestone passes continuously into a Lower Triassic beginning with a light grey limestone, which is overlain in succession by Lower Anisian dolomite with *Neritaria stanensis*, Middle Anisian porphyrite and diabase. Upper Anisian white limestone, Lower Ladinian cherty limestone, clay shale and radiolarite. The next term, includes the four different limestone facies and the eruptive complex consisting of diabase, porphyrite and quartz porphyry of the Upper Ladinian and Carnian; the sequence is closed by a grey limestone with *Monotis salinaria*. The most important change, due to these novelties, on the map of the Bükk Mountains is the relocation in the Ladinian stage of the "Carboniferous" shales of the Southern Bükk.

The continuation of the *Middle Triassic* limestone and dolomite of the *Zemplén Hills* has lately been discovered in boreholes at Sárospatak on the east margin of the Tokaj Mountains.

The most substantial advance in respect to *the Triassic of the Transdanubian Mountains* has been the clarification of the Triassic sequences of the Vértes and Gerecse, due to two Assistants from the Budapest University (E. VÉGH-NEUBRANDT and J. ORAVECZ) working in collaboration with the Geological Institute. In their opinion, the Vértes sequence is a counterpart of the easternmost Bakony profile (that of the Iszkahegy Hill), except that the older terms of the Triassic, exposed on Iszka Hill, facies identical to those of the Balaton Highland (from the Seisian to the "Muschelkalk") are covered by young sediments in the southeast foreland of the Vértes. The Ladinian diploporan dolomite overlying these deposits is in its turn overlain in both regions by Raiblian marl and limestone and Carnian dolomite with small *Megalodus;* it is only above these that the Carnian—Norian Hauptdolomite and the Dachstein limestone turn up. The lower Dachsteinkalk interbedded with banks of dolomite is still late Norian on the basis of *Worthenia escheri* found in the analogous Gerecse Mountains deposits, whereas its dolomiteless upper portion is proved by *Paramegalodus* and *Conchodus* to belong to the Rhaetian. The passage between the northeast and southwest types of the Transdanubian Mountains Triassic has thus been established.

The similar but much more variegated facies of the *Buda and Pilis mountains* could not so far, despite numerous revisions, be summed up into a coherent image. All that the advance here consisted in was the placing onto the Carnian—Norian limit of a deposit believed to be Kössenian (J. ORAVECZ) and the discovery of a *Halobia*-bearing facies of the Norian (K. BALOGH, G. NAGY). On the other hand, the presence of Kössenian strata with *Avicula contorta* between Norian Hauptdolomite and Upper Rhaetian Dachsteinkalk in the Bakony Mountains became firmly established by S. VÉGH.

The cause of stratigraphic correlation was considerably advanced by a monograph, including a large-scale fauna revision, on the life spans of Transdanubian and Alpine gastropod species by F. GÓCZÁN.

A point, of incertitude of several decades' standing, was eliminated when it turned out that the "seamless" sandstone of the *Mecsek Mountains* Triassic exhibits a continuous passage into the "Wengenian" strata of the Ladinian and that, consequently the "seamless" sandstone represents the entire Upper Triassic rather than just the Rhaetian. As a result of recent work by ELEMÉR NAGY and Á. JÁMBOR we can today distinguish 20 horizons within the Mecsek Mountains Triassic. The novelty here is the discovery of the Lower Campilian gypsiferous beds and a conglomerate of abrasion disclosed by boreholes and including pebbles of Anisian limestone in the southern foreland of the mountains. The lower portion of this conglomerate is Upper Triassic, whereas its upper portion, overlain by the upper seam group of the Liassic coal measures, is contemporaneous with the lower seam group of the latter. Paleogeographically this means that the Middle Triassic sea floor of the Mecsek Mountains became asymmetric from the Ladinian onwards: it was bordered by flat beaches on the north and by high cliffs of abrasion on the south. This abrasional nature of the south shore did not disappear until the formation of the upper seam group once more when the sea floor owing to a substantial transgression became symmetrical.

Considerable attention was paid subsequently to the Liberation to the *Jurassic* of the *Transdanubian Mountains*, which contains traces of manganese ore almost everywhere. Interest in these deposits was considerably enlivened when, besides, the long-worked Liassic oxydic deposits, the manganese carbonate beds, which undoubtedly represent the primary ore, were also found (J. NOSZKY JR.—L. SIKABONYI, 1953; M. SZABÓ-DRUBINA). It was established that the Lower Jurassic develops gradually, almost indistinguishably from the Dachsteinkalk, whereas, in the rest of the Transdanubian Mountains there is between them a hiatus, although no angular unconformity, with the first term of the Liassic overlying an undulating, locally dissected surface from the last member of the Triassic. The Jurassic profiles, rather thin almost everywhere, are complete only in certain Bakony Mountains localities, on Kálvária Hill at Tata and in the Eastern Gerecse, whereas elsewhere they exhibit the incomplete development typical of the Alpine Jurassic. The hiatuses of varying amplitude are emphasized by the ruggedness of the base and by intercalated layers of detritus including material from the eroded layers (J. NOSZKY JR., J. FÜLÖP, G. VÍGH, J. KONDA). The phenomenon has lately been interpreted by J. KONDA as a result of faulting combined with simultaneous sea-level oscillations rather than by bottom-current scour. Emphasizing the continental origin of the material from which the manganese ore developed, J. KONDA means that the shorelines of the Jurassic sea of the Transdanubian Mountains region did not essentially reach beyond the present limits of the Mountains. On the other hand, BARNABÁS GÉCZY, monographer of the Jurassic *Ammonites* of Csernye, retained the earlier hypothesis of a possible substantial deepening of the sea in the Upper Dogger and Lower Malm.

The main emphasis of research was placed on the *Mecsek Mountains* Jurassic, however, there the effort was mainly aimed at seam parallelization and swamp zone analysis in the coal measures. One substantial advance was the subdivision into six rather than three terms of the Lower Liassic overlying the coal measures: this complex is thicker than 1000 metres. Changes in lithology permitted the distinguishing of six further terms within the Middle Liassic of similar thickness and four within the 200 m of the Upper Liassic (R. HETÉNYI). In the absence of macrofossils, I. NAGY and J. KNAUER relied on microfaunal evidence *(Lombardia, Globochaete, Calpio-*

nella, Cadosina and *Stomiosphaera)* when distinguishing the Oxfordian, Kimeridgian and Lower and Upper Tithonian. In the Villány Hills, A. KASZAP in connexion with the discovery of a further locality at Siklós, of the Bathonian-Callovian *ammonite* fauna of world fame, established the distribution over the various stratigraphic horizons of the faunal assemblage.

The most recent subdivision of the Hungarian *Lower Cretaceous* is due to J. FÜLÖP and his co-workers (L. BENKŐ-CZABALAY, M. BÁLDI-BEKE, F. GÓCZÁN, M. KURUCZ-SIDÓ, M. HORVÁTH-DEÁK, I. Z. NAGY) who in a number of essential particulars modified the tables dating from 1959 of J. NOSZKY JR. According to J. FÜLÖP, the Gerecse Mountains sequence overlying the Tithonian with a hiatus and consisting of a succession of marls, sandstones and conglomerates covering the range from the Lower Valanginian to the end of the Barremian, with the zoogenic limestone lenses of Urgonian-like facies of its top portion, is a sub-basin of Carpathian affinities unconnected with the Bakony-Vértes basin of sedimentation.

Within the Lower Cretaceous of the *Bakony*, J. FÜLÖP distinguished a marginal facies (Zirc), a transitional facies (Hárskút) and a mid-basin one (Sümeg). The mid-basin facies is from the Berriasian through the end of the Hauterivian represented by a white calcareous marl of "biancone" facies, replaced by a radiolarian marl in the Barremian. In the transitional and marginal facies, there are besides marls also limestones containing cephalopods and sand, or chert and crinoids. As opposed to the continuity of deposition in mid-basin, he established the direct superposition of younger terms (e.g. Barremian) onto the Tithonian. In his opinion, the Hauterivian—Barremian sea was confined by shores of Triassic rock, on which deposits of bauxite were forming. The deposition reaching into the Cenomanian of the mid-basin region was interrupted only after the Barremian and before the Upper Aptian (i.e. in two instances) by emersions of short duration. The large-scale transgression of the Lower and locally of the Upper Aptian covered the nearshore bauxites with Aptian and Cenomanian strata. J. FÜLÖP placed into the Lower Aptian that grey crinoidean limestone which, delimited by unconformities both below and above, can be traced from the western margin of the Bakony through the northern margin of the Vértes to the Kálvária Hill at Tata. In the two latter localities it directly overlies the Tithonian or Berriasian and was in consequence considered Hauterivian or Lower Barremian by earlier authors. Owing to its re-positioning all the terms overlying it (*Munieria* clay, to glauconitic marl) had to be shifted slightly upwards. The justification of doing so was given by the pollen studies of M. HORVÁTH—DEÁK and the gastropod studies of L. BENKŐ—CZABALAY.

Recent studies have confirmed continuous deposition on the Tithonian-Berriasian limit also in the *Mecsek Mountains*. The submarine alkali diabase volcanism produced only explosive material in the Lower Valanginian but also lava in the Middle Valanginian. The normal marine sedimentation recommenced in the Upper Valanginian and, locally including a biogenic iron ore, continued up to and into the Barremian. There is a remarkable difference between this process of evolution and that recorded in the near-by *Villány Mountains* sequence. Namely, the limestone complex, overlying the Tithonian with a local bauxite-filled hiatus and typically Urgonian in some of its occurrences, was by a modification of the 1959 subdivision of J. NOSZKY JR. distributed over the Barremian, Aptian and Lower Albian by J. FÜLÖP (1967). Hence, the hiatus thus far supposed to cover only the Berriasian now extends also to the Valanginian and Hauterivian: indeed, in the Mount Tenkes thrust unit it includes also the Aptian. Facially the deposits agree with those of the Királyerdő.

The post-Cenomanian hiatus in the Bakony Mountains sequence had also to be extended. Palynology by F. GÓCZÁN and gastropod studies by L. BENKŐ—CZABALAY have shown the six terms of the Gosau complex present there, to cover the range from the Upper Santonian to the Maastrichtian, and the Coniacian and Lower Santonian were proved to be times of emersion. This practically wiped out the formerly supposed age difference from the Bükk Mountains *Upper Cretaceous*, despite a substantial difference in facies (K. BALOGH, M. KURUCZ—SIDÓ). The separate line of evolution of the Mecsek Mountains is underscored by the fact that an Aptian-Albian hiatus was followed there by a Cenomanian transgression (M. KURUCZ-SIDÓ), whereas the rest of the Upper Cretaceous is absent.

Considerable advances were made also in the interpretation of the origin of the *Hungarian bauxite deposits* (GY. BÁRDOSSY). It follows from the paleogeographical picture outlined by J. FÜLÖP and J. KONDA that the evolution of the low cone karst (K. BARNABÁS) suitable for the accumulation of bauxite could begin already in the Jurassic. Also, the possibility of bauxitization of the clays deposited onto this surface existed throughout the Cretaceous, although substantial portions were redeposited or entirely destroyed. The original material of the pre-Barremian, pre-Aptian, pre-Senonian, pre-Eocene and pre-Oligocene bauxite levels so far distinguished were deposited essentially on the same surface in all instances and the deposits differ only in the age of the sediments covering them, which in turn depended on the particular paleogeographic conditions prevailing at the time of coverage.

This line of thought then rejects for the Transdanubian Mountains the idea that all Mesozoic deposits were laid down by one and the same geosyncline and supposes instead — in agreement with L. Lóczy Sr., — a number of rather narrow geosynclines whose extent — according to the standpoint represented in 1913 by E. Vadász — was considerably reduced against the Triassic in the Jurassic and Lower Cretaceous, at least, in the Bakony—Vértes—Pilis range. It therefore proposes the idea, startling at first sight, that the limits of the present-day extent to the north and south of the main units of the Transdanubian Mountains Mesozoic coincide more or less with the ancient shorelines.

As regards, the study of the *E o c e n e,* three main lines of research were followed at the Geological Institute. The first is represented by E. Szőts who by a correlation of his own observations and relevant literature, aimed at a country-wide synthesis. The two other lines are characterized by rather profound but so far, not too well coordinated local investigations. About *Dorog*, an unconformity was established between the Lower Eocene brown coal complex and the Upper Lutetian *Perforatus* and *Striatus* beds. The overlying *Millecaput* and *Discocyclina* beds were placed into the Upper Eocene (L. Gidai 1966). On the other hand, G. Kopek in the Bakony included in the Lutetian, unconformable and transgressive over rags of likewise transgressive Lower Eocene, the *Millecaput* and *Discocyclina-Millecaput* limestones and glauconitic marl as well as the *Assilina spira*, *Perforatus* and *Striatus* beds. According to Kopek, the basin margins had emerged during the Upper Eocene, whereas, about Balinka and Halimba tuffaceous sand and marl, and gravel and lithothamnian limestone came to be deposited. The knowledge of the Eocene in the foreland of the Bükk Mountains and at Rudabánya was enriched by faunal studies (L. Vitális-Zilahy, M. Sidó).

The stratigraphic frame of our *O l i g o c e n e* did not change essentially. As regards the Oligocene-Miocene limit, zoofossil studies by I. Csepreghy-Meznerics confirmed the standpoint of Z. Schréter that the faunae of Eger type belong to the Upper Oligocene;

the *Miocene* begins with the Burdigalian stage, and between the Rupelian and Burdigalian there is just a single cycle of sedimentation which can be called Upper Oligocene, Chattian or Aquitanian according to taste. The fixing of the Burdigalian age of the beds with large *Pecten* and of the overlying dry-land and fresh-water deposits definitively established the Helvetian age of the North Hungarian lignitic complex and of the interfingering facies covering it, up to and including the Schlier (L. BARTKÓ). A novel element was introduced by the discovery of the formation (presumably Burdigalian) including the sixth seam of the Sajó Basin (L. ALFÖLDI, GY. RADÓCZ).

In the Miocene sequence of the Eastern Mecsek, highly detailed work by GÉZA HÁMOR delineated three cycles of sedimentation. The first cycle begins with a layer of *rhyolite tuff:* its two lower terms are of dry-land, its two higher terms of limnic origin (including a *clay marl with fish scales* and *seams of lignite*). The second, marine cycle begins with the "*Congerian beds*" and the so-called "*upper fish-scale marl*" and turns into *a regression* after the deposition of the heteropic facies of the "*Budafa sandstone*" and the "*Schlier*". The second cycle overlies either the first or directly the Mesozoic. It was before the second cycle that the eruption of the *Komló andesite* took place, whereas near the end of the second cycle one encounters the products of the *second* Miocene *tuff scattering*. The third cycle, likewise marine, includes the *Leithakalk*, *lignite*, and *a turritellan-corbulan clay marl*, and moreover also the *Sarmatian* and *Lower Pannonian*. The second and third cycles are separated by a pronounced unconformity. The sequences at different localities of the individual cycles vary, of course, in the function of local paleogeography, which led to considerably misunderstandings as, to the stratigraphic positions of the individual terms. The second cycle belongs to the Upper Helvetian of the Southern Paratethys, and the two lower thirds of the third cycle to the Tortonian. There is still no paleontological evidence concerning the age of the first cycle, but regional analogies tend to place it into the Lower Helvetian. After the emersion succeeding the Helvetian, the Tortonian sets in with a new transgression almost all over the country.

A correlation of the first appearances of *Hipparion* reveals with increasing clarity that our Lower Pannonian is contemporaneous with the East European Chersonian and Bessarabian stages (M. KRETZOI 1959). Highly detailed studies by FERENC BARTHA, into the Upper Pannonian of Transdanubia resulted after the recognition of the true relationships of the faunal horizons distinguished earlier in a substantial reduction of the number of the same. According to F. BARTHA (1964), the Lower Pannonian is characterized by *Orygoceras*, *Paradacna abichi*, *Limnocardium lenzi* and *Congeria banatica:* the lower portion of the Upper Pannonian has *Congeria rhomboidea* and *Congeria ungula caprae*, the upper portion of the same *Prosodacna vutskitsi*, *Congeria balatonica* and *C. triangularis* as its dominant fossils. The difficulties encountered thus far in parallelization were largely due to the circumstance that the latter will occur together with *C. rhomboidea* in the lower portion of the Upper Pannonian, whereas *C. rhomboidea* will penetrate also in the upper portion of the Upper Pannonian, although, in lesser abundance.

* * *

It is with some reluctance that the writer now puts down his pen. The presentation in all detail of a century of activity in a variety of fields by the central and only geological institute of a country would require volumes. The lacunary and probably one-sided excerpts presented here do not even approximately reflect the magnitude of the effort that went into the stratigraphic exploration of this country, the effort made during one hundred year by the workers of our Institute under a variety of political social and economic conditions. It would be a real pleasure if the modest collection offered to the reader were sufficient, also, as a reference for the future, to trace out the main lines of our doings.

CONTRIBUTION TO THE INVESTIGATION OF IGNEOUS AND METAMORPHIC ROCKS

by

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The "specialized" historiography of the scientific activity of the 100 year old Geological Institute, both in former and recent times encountered the difficulty, that research in different groups is not sharply separated, neither by the researchers, nor by the publications.

If we want to examine the research into magmatic and metamorphic formations, to follow its evolution and to evaluate it, we meet the problem of separation. The title not necessarily means only mineralogical-petrographical, or special – mainly laboratory – analyses, but also fact-finding and evaluation too, concerning the presence, development and geological connections of endogenetic formations.

We are not separating these non-professional geological examinations of the eruptive and metamorphic territories from the "mapping" activities, unless these were made by a specialist in this field (e.g. by a Tertiary malacologist or Quaternary researcher). Today, it is impossible to imagine roaming so far from the working territory; even so, the map making came out successfully and also, the knowledge of magmatic and metamorphic formations, which by the standards of the age, reached a high state of development. Specialists not interested in mineralogical-petrographical materials had a great share in it, too. The help naturally was a mutual one: petrographers could devote only a small part of their worktime for research on their favourite subject. The greatest part of their worktime was occupied by work in other fields (peat research, pedology, hydrogeology, seismology or mapping only of Tertiary or Quaternary sediments). It would be improper to criticise the distribution of labour at that time. We have to appreciate this wide grasp by most members of the Institute, which are hardly attainable today. With the extensive knowledge of magmatic and metamorphic formations, it must be pointed out, that scientific results of that period could have been better and more highly appreciated by foreign countries, if employment and working conditions for the petrographers of enormous knowledge, had been used for higher scientific purposes.

In the first research-staff of the Geological Institute JÁNOS BÖCKH and SÁNDOR GESELL were the most excellent representatives of "universal specialists" in igneous formations and crystallized slates.

A great part of the activity of BÖCKH was occupied by works in igneous and metamorphic territories of Southern Transylvania. With a sharp sense for geological observation and judgement he analysed only macroscopically and evaluated these formations with the precision of the Vienna school (HAIDINGER, HAUER, STACHE). His basic statements of great number determined for a long time the main direction of research. On the other side, his misinterpretations and erroneous generalizations aggravated many of his followers.

The working method of the first mining-geologist of the Institute, SÁNDOR GESELL, was very similar. In the 25 years of his activity he studied exclusively the igneous formations of mining-disctricts. With the guiding of his Vienna masters, and his strict preciseness in handling of data, his life-work displays a good practical sense of a miner and metallurgist. His basic informations, concerning old liquidated mines, were used in the last eight decades as reliable, and probably will be used in the future too. GESELL was a very good observer. His sharp miner's eyes registered a lot of petrographical, ore-geological phenomena, but he only recorded them, and was not immersed in their interpretation or theoretical analysis. His attitude and working style produced a school. We consider him the pattern for the brief mining-geological activities of KÁROLY PAPP, VAZUL LÁZÁR, MÁRTON LŐW, DEZSŐ PANTÓ, ZOLTÁN GLÜCK.

The great pioneer and ideal, KÁROLY HOFMANN, introduced into the Institute the out and out mineralogical-petrographical attitude transplanting to us the ideas of the greatest mineralogists, petrographers, and chemists (BREITHAUPT, COTTA, KIRCHHOFF, BUNSEN) of his age, through the permanent brotherly support and guidance of JÓZSEF SZABÓ. We could not monopolize his extraordinary rich and meritorius scientist's personality, his wide-ranging activity in the field of investigating the magmatic and metamorphic formations. Through his enormous knowledge, outstanding working capacity and friendly readiness to help, he was deservedly designated in his necrology as, "the irreplaceable pillar of Hungarian geology".

His publications do not reflect a complete image of his large activity, his richness in ideas, or his prominence in the theory. During his service of 23 years (1868–1891) undoubtedly, he was the representative of the most advanced, most progressive mineralogical-petrographical knowledge in the Institute. He was not at all stingy with his knowledge. His comprehensive knowledge concerning the evolution and geological importance of magmatic and metamorphic formations is to be found "in small change" in rock-identifications and advices given to his colleagues, and first of all in his geological maps (Preluka, Meszes), constructed with a petrographer's eyes.

At home his most important pioneering work was the introduction of microscopic analysis of igneous rocks, and the very detailed and exact mineralogical determinations and the resolute observations on particulars, concerning textural-structural characteristics. This new method of analysis, the detailed description, representing the highest scientific level at that time (ZIRKEL), did not satisfy his claims. His description of basalt specimens, as a completion for BÖCKH's monography about the southern Bakony Mountains, supplemented by wonderfully lifelike, coloured drawings of STÜRZENBAUM, were abandoned for nearly 10 years before having the occasion to use them for field researching of volcanism. Then, he set an aim for himself: "*I intend to search the whole interrelation of the geological and petrographical structure of basalt formations of the Bakony Mountains, which form a coherent volcanic system, and to study their connection to products in other centres of the great Hungarian Neogene volcanic territory*" (HOFMANN, 1879, p. 417). His study, of about 100 pages, is ahead of the age; a work of classical value, a petrogenetical-volcanological reconstruction of clear reasoning, and of *chemical aspect*, with new bold ideas. As a whole, it needs very little alteration according to our present knowledge. Some contemporaries appreciate very highly this work as, "*the most considerable step in an almost fallow field of our geological literature*" (BÉLA INKEY). The greater part can neither understand nor appreciate it. As he always preferred public interests to personal interests, no other work of similar perfection was made by him, his dissipated intellectual energy enriched only the total mental production of the Institute.

FERENC SCHAFARZIK, one of the best pupils of JÓZSEF SZABÓ, an enthusiastic follower of his "petrographical-geological school" came to the Institute in 1882. Unfortunately, there was not a helping hand, to allow him the continuation of his important basic researches. Such a productive excellent petrographer was given an order for mapping the Mesozoic territory (Pilis Mountains). His only petrographical monography (Cserhát Mountains) could only be made in "stolen" time, with the support of the Society of Natural Sciences (SCHAFARZIK, 1892). The duty of mapping engaged him to his loved Krassó—Szörény Mountains. The secrets he examined also after leaving the Institute (1905), for 44 years, till his death. The hard conditions for becoming a specialist of the wonderfully varied igneous metamorphic complex was: to be a busy mapping geologist, interested in many directions. His conscientiousness, profoundness and preciseness were exemplary; as a result, he was very familiar with all parts of the geological complexes, represented on his map sheets. This is attested by his reports for 29 years. He had no occasion — except the first 1–2 years — to immerse in studying the igneous and metamorphic formations. He created a classical mapping school, where he planted into his assistants (KÁLMÁN ADDA, IMRE MAROS, ALADÁR VENDL, BÉLA MAURITZ, AURÉL LIFFA) the method of regular field observations and the love for crystalline rocks.

His wide mapping work and his many other jobs (seismology, a professorship) hindered him from writing a monography about his numerous observations in Krassó—Szörény. Only 30 years after the beginning of the mapping, he made up his mind to do a first summary (SCHAFARZIK, 1913). In his petrographical and structural revision he decides to eliminate the erroneous grouping of crystalline slates made by BÖCKH, and so he lays the uniform and lasting foundations of researching in the Southern Carpathians.

SCHAFARZIK introduced to our country the technical petrography. His prospectus of quarries (SCHAFARZIK, 1904), maps and rock collection lastingly attest his pioneer work in this field. For improving his knowledge and through the generosity of ANDOR SEMSEY he had the occasion to study the stone-industry in Austria, France, Greece, Germany, Norway, Italy and Serbia; moreover, he went to the Caucasus in the expedition of MÓR DÉCHY.

We can not revive without emotion the memory of two petrographers: BÉLA INKEY and GYÖRGY PRIMICS. They started from very different, almost contrary milieus; but during the time of their short rise in petrography they went in very similar ways.

BÉLA INKEY a famous personality of Hungarian geology about 1880, was the enthusiastic secretary of the Geological Society, formerly the excellent student of B. COTTA, Freiberg Academy. No less renowned was his colleague, GYÖRGY PRIMICS, an assistant at the Kolozsvár University who, 2 years younger than he, was introverted, and a little morose because of the rugged, hard conditions of his life.

They were offered, by the Geological Institute, a possibility to join works of mapping (1876) as "volunteers" which meant, as unsalaried participants. Supported by a prize of ANDOR SEMSEY and by a stimulation of the Society for Natural Sciences they could do their favourite job: monographic works on petrography and ore-geology. The first Hungarian ore-geological work dealing with questions of ore- and rock-genetics, worked out on a high scientific level, acceptable up to this time, is the monography of Nagyág written by INKEY (1884). An excellent counterpart of this monography is the other one, written by PRIMICS and dealing with the Csetrás (Brád) Mountains, to which the motive was given by the generosity of INKEY, who renounced his part of the prize and gave it to his talented colleague, who was living in need. Both of these works are essential; witty, clear and follow JÓZSEF SZABÓ's French school. The reasonable and systematic separation of magmatic and postmagmatic processes started here in our geological literature.

The great international undertaking of the Bologna Congress, was the redaction of the map of Europe, for which the preparations in Hungary were made by JÓZSEF SZABÓ. But works connected with it, as regards the crystalline of the Southern and Eastern Carpathians, came for the Hungarian geology unexpected. SZABÓ got the Ministry of Education to grant INKEY and PRIMICS a commission for this work. Both of them undertook the mapping of the Carpathians, for two years, on a tract of about 250 km; a subdivision of the "white" crystalline range, with the connecting Rumanian territory was included. The map was ready according to terms (PRIMICS, 1883), completed by classification of metamorphics, based on microscopic analyses, which are acceptable up to this time. He mapped Vlegyásza, also as a volunteer, for the Geological Institute, where he fulfills the first clear delimitation of intrusive and extrusive types. At the age of 44, he was appointed and committed to the mapping of the Bihar Mountains. A half year later, he suddenly died while mapping.

At the Institute, the career of the financially independent BÉLA INKEY was less tragic, but from the scientific point of view also unsuccessful. He came as a pedologist to the Institute at 1891. His duty was, according to the instructions of J. SZABÓ, to develop a new type of mapping. With the right ideas and a refined scientific demand he fulfilled the soil-mapping on a strong petrographical basis (INKEY 1896), which has not been made since that time. He studied all over Europe the petrography and ore-geology. In 1906 he took part in the Geological Congress in Mexico, where he delivered a lecture on the connection between mineralization and metamorphism. The clarification of concepts made by him was a prototype for newly renascent ore-genetical theories, and accepted with great interest and debate. His last geological publication was a critic on MÓR PÁLFY's "chimney"-theory (1912). It was a fine example of objective and scientific debate.

The next pupil of the French-like SZABÓ is GYULA SZÁDECZKY, professor of the Kolozsvár University. He had a role in the life of the Geological Institute from 1904 till 1906. It was relatively only a small part of his life-work, which falls into this period, but from the point of view of the further activity of the Institute and of Hungarian geology — this part is a very important one. He corrected the former paralogism concerning eruptives of Bihar-Vlegyásza. In this important recognitions lay the foundations of the estimation of magmatism in this territory.

In the place of the departed PRIMICS — Bihar geologist of the Geological Institute — comes again in 1895 an assistant of Kolozsvár: MÓRIC PÁLFY. He likes very much Transylvania's border-mountains, first of all the Bihar. He is a pupil of Professor ANTAL KOCH. His life-work is not a continuation of his predecessors, nor does he form a school. His work is first of all of a petrographical — mine-geological direction. He made microscopic analyses too, but he did not develop them to SZABÓ'S, HOFMANN'S, SCHAFARZIK'S, INKEY'S, PRIMICS'S classical completeness, neither by number of slides, nor by identifications of minerals and textural elements. On the other hand, he was a pupil of the late mineralogist S. GESELL; but, geological ore-genetic *explanations* are more important for him then exact date registration. After more than a half century we must condemn him for his working method. Characteristic of this method was, that he generally looked for evidences in field or mines, according to his formerly created theories. So he registered tendentiously selected facts. It was so in the case of Rudabánya, Telkibánya, Recsk, where the author of this paper went. There is every reason for taking INKEY'S side against PÁLFY, concerning the Transylvanian Ore Mountains (Munții Apuseni).

He formed a rule saying, "that Transylvanian veins containing ores of noble metals are richer in areas near eruptive centres" ("chimney-theory"). Because of expected practical advantages this theory was highly appreciated both by the Institute and the Geological Society, which suddenly overstressed the importance of applied geology. (The first work in this field, rewarded by the *József Szabó commemorative medal*, was written by Pálfy, 1911.) Now we must say, that his theory was based on considerably subjective observations, and therefore it is of limited validity. The basic problem is the spatial relation of "volcanic envelope" and "chimney-filling", which are however not sharply defined regarding either rock-material or structure. As both of them may contain pyroclastics, intrusives and effusives, the demarcation between them might only be a subjective one. The distinction to hypo-, meta-, endo-, and exo-types of "post-volcanic effects", which began unfold by Szabó and Inkey, here arbitrarily entwines each with other and represents an inexhaustible topic of debate (the question of propylitization). He doggedly insists, even without evidences, on his thesis (e.g. sequence of eruption). So his problems often have an autotelic, and blocking development.

The first 50 years of the Geological Institute, the era of heroic development but some rigidity, too; a nearly homogeneous spiritual era, was finished by the first World War. This was a pioneer-era, in which a little group of specialists fulfilled a great work on an enormous, almost unknown territory, by great physical efforts and hardships. The greatest part of the results give a general picture of magmatic and metamorphic formations, but specialists of the Institute had no occasion, no stimulation (not even within the frames of the Institute) for losing themselves in detailed researches.

This situation in the field of researching the magmatic and metamorphic formations, the new director of the Institute, Lajos Lóczy Sr., could not change at the end of the first 50 years by any means, by any ideas, plans and initiatives, or even by his qualified scientific mentality.

For the first years following the first World War depression and inertia were typical. The forming of a new, homogeneous era was hindered by unfavourable conditions, often by changes of management. New management usually contrasted strongly with the former ones, so, a new course was changed by a newer one before reaching any results.

In 1927 Ferenc Nopcsa, an internationally known specialist, became the director of the Institute. He was an impatient scientist, unfamiliar with administrative problems. His announced programme was: *1.* to ensure an international respect by qualified scientific work; *2.* to rehabilitate the home respect with scientifically based practical activity. This proved to be a right course, which was completed by administrative measures (ensuring financial means and more study-tours abroad) and the using of his personal contacts abroad.

NOPCSA strived to give corresponding tasks for subjective scientific interests, to further the free evolution of scientific research. In his era the paleontology prospered, but he did not repress the mineralogical-petrographical course; the explanation for the fruitless period in the field of magmatic-metamorphic formations is, that the main research centres were the sedimentary territories, and that researches in igneous-metamorphic formations needed more and more microscopic analyses.

One and a half years after NOPCSA's death, HUGÓ BÖCKH became the director of the Institute. This change caused a new switch-over: "*he transforms the working style and mapping methods of the Institute, corresponding to his strong individuality*" (ROZLOZSNIK). Under his leadership the practical geological research takes the first place. In the next 30 years it remains the aim and frame of the activity of the Institute. Losing sight of the importance of "*basic research*" he mobilized for direct practical tasks the total capacity of geologists. These limited and strictly defined tasks divested the members of the Institute of their regional attitude and wide horizon, and was characteristic of geological-petrographical work in the years between the two world wars. This particularization did harm to geology as a whole. Very often just the essence was barred because of the limited diaphragm, and because the practice of basic interrelations was omitted.

Analysing the petrological ore-geological results of the period between the two world wars we must see the troubles of development in that time, and correspondingly appreciate the work of those, who created something permanent, valuable and progressive, in spite of unfavourable circumstances. First we must name PÁL ROZLOZSNIK. He was one of the great, classical personalities not only of the Institute but of the whole Hungarian geology, the most comprehensive, industrious, creative scientist of this period. He started in 1905, in the first period. His works, finished before World War I. (petrology of banatits; monographical evaluation of Aranyhida's mining district; genetics of the "Macskamező"-type iron-manganese formations) are of great importance and of classical value — first of all from the point of view of ore-geology. However, his researching character really gets rich and full in the years between the two world wars.

As he got beyond the borders of his loved research territories (Bihar, Dobsina) he was given a new duty, the study of a new discipline: the *Nummulites*. In this field too, he does not give up qualified sciences (paleontology, methodical-oecological monography) or his original aim. In 1939, he personally published a part of the Bihar monography, which is, as he says, only "a modernization of old analysis results"; but this work gives the essence, from the magmatic-metamorphic point of view with excellent fullness and modernity. There is almost no similar work in our geological literature, which demonstrates a group of mountains with such familiarity and certainty, concerning dimensions (mineral grain—tectonic nappe) and disciplines. His definitions, pointing ahead, on petrogenetics and tectonics, are often used treasures of geological literature on our mountains and basin-system.

An equal work is the monography on Dobsina (1935), which is only a fragment of a large general work on mountains, but even so, it is a full, finished work. With his wide horizon and sure observation, the whole problem of the Szepes-Gömör Ore Mountains is concentrated in this work. This lasting scientific work has only been further developed in latest times (LADISLAV ROZLOŽNIK, 1966).

The Mátra-research occupies a relatively small part in the lifework of ROZLOZSNIK, and it remains mainly in notes. We have to look for the foundation of his modern geological contemplation in his general attitude, considering the oil- and ore-genetic as a unit. In todays expansion of the geology and ore research in the Mátra Mountains, his basic conception proved to be right.

The rigorously precise mineralogical and petrographical base of SCHAFARZIK's school was transplanted, to the period between the two world wars, by activities of ALADÁR VENDL and AURÉL LIFFA. VENDL gives a classically concentrated and full monography to our literature by his work on "The geology of the Velence Mountains", in 1914. He also undertook to elaborate (1932) the common mapping of the crystallines in the Southern Carpathians, fulfilled in 1912–1914. This is a great work with precise microscopical analyses but without a comprehensive addition of geological occurrences. The fact, that his studied territories were seceded; that he worked on partly transferred material; hindered him, in a larger evaluation ("*Kühne nicht genügend begründete Folgerungen sind streng vermieden worden.*").

The scientific life-work of the mineralogist-petrographer AURÉL LIFFA, especially shows the over-practical and disunited period of the fourth decade of our century. His activity of more than 40 years survived in annual reports, dispersed on some territories and disciplines. At the same time his striving for meticulous preciseness hindered him in discovering larger correlations, and his working circumstances did not allow him to elaborate his subject on such a high level, as was set by him. Therefore, his life-work became a round of "previous" fragments. His general works (Telkibánya) was published almost 20 years after his pensioning (1953, 1955); considerably shortened. But in this form, too, they became basic and important informations in our literature on igneous and metalliferous formations.

At the end of this period ALADÁR FÖLDVÁRI came to the Institute (1939). From that time began the start or reestablishment of modern mineralogical-petrographical and ore-geological research of geological contemplation. It was a hard way with lots of fights, for revival of forgotten traditions, for introducing new methods, style and spirit. It was an opportune, effective and perfectible course. The sedimentary-petrological laboratory established by him, was later enlarged to an important institution.

He represented the type of geologist, who with a geological attitude to petrography, studied by petrographical methods the basic problems of ore-geology; this was a type which was missing since ROZLOZSNIK died. FÖLDVÁRI's course broke through only after the second World War. At that time he was not at the Institute, so his individual activity could not unfold in its fullness. However, his torsos are pre-eminent among the "previous" reports of his age. His intensive scientific interest enabled him to see and to find everywhere and in everything the essential problems, and to further geological science in the most important fields.

The growing possibilities for work attracted many specialists to the Institute after the Liberation in 1945; those employed in other field and first of all pedagogues. According to their faculties and age they joined in different fields of mineralogical-petrographical works of the Institute. A great number of methodical advices, special guiding and exact microscopical diagnosis, was given by BÉLA MAURITZ; a considerable evolution in eruptive-technical petrography was the activity of LAJOS JUGOVICS; prospecting for non-metallic ores was furthered by the rich experiences of miner JÓZSEF FRITS.

BÉLA JANTSKY and ALADÁR VIDACS joined, with fanatical enthusiasm and youthful ardour, into ore-geological research, and both of them reached considerable results in cognition and evaluation of magmatic activity — also, important practical successes. ENDRE LENGYEL has great merits in petrographical mapping of the mountains Börzsöny, Mátra and Tokaj. EMIL SCHERF devoted the two last decades of his life to the clearing up of large problems in mineralization in Telkibánya.

The lead of the older generation, followed by the populous staff of young researchers, the majority of which brought an excellent teaching and dialectical-materialist attitude from the university. They not only increased the intensity of researching of magmatic-metamorphic formations, but also directly based on the considerable theoretical foundation of ELEMÉR SZÁDECZKY-KARDOSS, they built up a fuller, modern science.

HUNDRED YEARS OF PALEONTOLOGICAL RESEARCH

by

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The evolution of a scientific discipline is determined by the decisive coincidence of numerous factors. The fundamental ones are constituted by the degree of world-wide development of the given discipline on the one hand and by the individual faculties and properties of its devotees on the other. These are intricately interwoven by a number of determinants.

The chronicle of a scientific institution — regardless of its eventual bearing on the century-long progress of natural sciences — obviously cannot deal at length with all these influencing factors; nevertheless, it would be wrong to neglect them. They may be of varying importance, yet this provides the possibility to select a few for the evaluation of our topic.

It is with this restriction that the subject has been treated. "One hundred years of paleontological research" has been evaluated as an essential, organic part of the Institute's activity.

* * *

The sixties of the nineteenth century represent a turbulent and unsettled period in the history of paleontology. Europe had already passed the great mental transformation brought about by the French Revolution. Ch. Darwin had already appeared on the scene; the controversies between his followers and adversaries had not yet reached the battle-fields of politics and ideologies, which were to become their particular domain. An incessant procession of newly found scientific "treasures", fossil plants and animals from all possible formations rich in organic remnants were deposited by tireless devotees of paleontology in an admirable series of monographs. These high-standard monographs excel by their exact descriptions and highly artistic illustrations, and they became the base of half a century's paleontological research. In determining and describing his own collections, each paleontologist relied upon one or two reference books covering his particular field of research — those by DESHAYES, GOEPPERT, BRONGNIART, BARRANDE, MEYER, QUENSTEDT, OPPEL, SOWERBY and a score of others. The fossils to be found in these "Bibles", were regarded as already known; all others were introduced as new. The need for systematizing and synthetizing work already felt was undertaken somewhat later by ZITTEL and SCHIMPER (1876–1893).

It was in this period that the Hungarian Geological Institute was founded. The first paleontological works of the Institute were useful contributions to regional stratigraphy, furnishing valuable data for the country's geological mapping, which constituted the Institute's main activity.

FIRST PERIOD (1869–1908)

The recently founded Institute's activity was started by three mining engineers, who where well versed in both pure and applied geology and familiar with the 20-years' experience of the K.u.K. Geologische Reichsanstalt (Vienna) in geological mapping. The regional geological survey of Hungary was accompanied by regular collecting and examining of fossils. This represented the specific paleontological task of the geologists during this period. In order to prepare correct maps, they had to settle a number of stratigraphic problems by collecting and evaluating paleontological evidence. In this way all-round mining engineer-geologists had to become also research paleontologists. They rank among the leading specialists of those times, a highly esteemed accomplishment.

Their mentality, scientific approach and working methods were motivated by their particular point of view; the intention of furnishing valuable evidence for geological mapping. Accordingly, their work consisted primarily of composing faunal lists, restricted to the simple enumeration of the species determined, as was required for the geological description and stratigraphic datation of the formations studied. This "faunal list" character was surpassed only when new taxons have been introduced or when some determinations required an explanation. In such cases, the paleontological description of the fossil record found in a given district has been published as an "Appendix". It did not depend on the authors, whether their study was limited geographically only or could be subdivided systematically. In the latter case they are worth being looked upon as independent paleontological monographs. More than one of them has become a reference work; a starting point for Hungarian paleontological research in its particular field.

In the Hungarian Geological Institute, this type of paleontological research was begun by 4 geologists: M. Hantken, K. Hofmann, J. Böckh and E. Pávay. Later on they were joined by younger workers, eminent graduates in geology or biology from the Hungarian university; the first disciples of professor J. Szabó. (L. Róth, Gy. Halaváts, M. Staub, Gy. Pethő, M. Pálfy and others.) It did not occur until the advent of the twentieth century that another mining engineer, P. Rozlozsnik, become a paleontologist. O. Kadić came to the Institute from Munich, having studied there under professor Zittel.

These two generations, of mining engineer-geologists and geologist-paleontologists, respectively, mark two distinct stages of this first period. The first generation processed the paleontological-stratigraphic data collected during the field surveys as an "Appendix"; the members of the second one became specialists of particular fossil groups while studying the paleontological record of the mapped area, under conditions more favourable for paleontological research work.

M. Hantken — *the pioneer of stratigraphic micropaleontology*

Serving as a mine geologist in the Dorog coal basin, M. Hantken had an excellent opportunity to note the rather variable geological settings and rich fossil content of the Paleogene sequence. Studying the succession of beds, he observed the alternation of freshwater, brackish water and marine deposits. The abundance of fossils in certain layers strongly impressed him. He realized that some of the rocks were composed almost exclusively of *foraminifers*, these unicellular animals captured his attention. He never ceased to be interested in this group, whose importance could not be foreseen in those times.

In the beginning of his career, Hantken also based his stratigraphic conclusions on molluscs. However, the better acquainted he became with *foraminifers*, the more he relied upon these. At first his attention was focussed on the larger foraminifers, particularly on *Nummulites*. Later he switched over completely to the small ones. In 1868, when he was appointed to organize the Institute, he had already made his first important steps in the establishing of a stratigraphic chronology based on the stratigraphic succession of *small Foraminifera*. His foraminiferal studies were suspended several times, in consequence of his other assignments; e.g. the comprehensive study of Hungary's brown coal deposits; the surveying activities extending to the Bakony Mountains, to South Hungary and to other territories; all resulting from his duties as the Director of the Institute. He described *Ammonites* and other molluscs; but he persisted in tracing consistently the horizontal extension, vertical range and faunal composition of the "Buda marl", the "Kiscell clay", the "*Clavulina szabói beds*", even extending his comparative investigations far beyond the country's frontiers (to Lombardy for instance).

Nowadays, when the world catalogue of *Foraminifera* makes an entire library, foraminiferologists represent the most numerous group of paleontologists, and both theoretical and applied stratigraphic studies are unthinkable without micropaleontology, this is quite evident. One must keep in mind, that it was not so natural in those years, when HANTKEN devoted his life to the *foraminiferal* studies mentioned above.

It was not his fault, that he had no true follower in Hungary; the world-wide explosion of foraminiferal research set in only towards the end of World War I, when it was given a decisive impulse by the vigorous boom in oil exploration.

Appreciating HANTKEN's paleontological lifework — putting carefully aside the not expressedly paleontological aspects of his mapping and stratigraphic activities — the biostratigraphic character of his studies appears very clearly. He described a great number of foraminiferal species and contributed with relevant remarks to the classification of *Foraminifera* in that period. The descriptions given by him of faunas from both within and without the Carpathian Basin represent a fundamental contribution to the knowledge of foraminiferal assemblages in general. Moreover, the most characteristic feature, the final aim and very essence of his studies is that he always drew final stratigraphic-chronologic conclusions. These reveal the real significance and prophetic talent of HANTKEN's scientific mind. He foresaw that in the marine stratigraphy of the next century *Foraminifera* would play the greatest role. The significance of this anticipation is specially emphasized by the fact, that in the first half of our century foraminiferal research became one of the major factors in world economy, being of capital importance for oil exploration.

It is surprising that another topic of HANTKEN's foraminiferal research of almost equal value has remained practically unpublished; it is only suspected rather than directly known. He studied the *larger foraminifers* very thoroughly for several decades, as witnessed by his preparates sent to numerous scientific collections abroad and by passages from his letters quoted by his French friends. The microstructure of the larger foraminifers intrigued HANTKEN for thirty years, but it is mentioned only in a paper by DE LA HARPE that he was the first to recognize the dimorphism of *Nummulites*. The significance of this result is that it not only put an end to the previous chaos in the systematics of this group by indicating a way to the morphological identification of the two generations or forms of the same species, but also represented the discovery of a peculiar property of the unicellular animals that was unknown even in contemporaneous neobiology; and, in fact, by far, surpassed the reigning concepts in paleontology.

HANTKEN's greatness appeared in both the faunistic investigations he made on *small foraminifers*, with *a stratigraphic-chronologic* aim; and in the *Nummulites* studies characterized by his very progressive and up-to-date *biological approach*. He set a faunistic-biostratigraphic aim, when required by material and by exploration possibilities. Where the micromorphological method was applicable — i.e. in the *Nummulites* group — he investigated in detail the microstructure of the tests, initiating another modern branch of foraminiferal research, the study of larger foraminifers — which is greatly expanding nowadays — and thus be became a precursor of microbiostratigraphic research.

HANTKEN was capable by his unusually clear scientific view to make through a century-long evolution of micropaleontology in fourty years. It was not by chance that his contemporaries and fellow-workers did not understand him. His due appraisal was brought about by the revival of foraminiferal studies — the small ones after World War I and the larger ones during the past decade.

When HANTKEN, as the first appointed Director of the Institute, started his organizing work, he had to undertake the principal task of the geological surveying of Hungary, with the assistance of only a few fellow-workers: K. HOFMANN, J. BÖCKH, GY. HALAVÁTS, and E. PÁVAY. Of these four, PÁVAY was the oldest, being already fifty when he joined the Institute's staff. He graduated as a chemist, but was experienced in many other fields of research and also travelled very much; not only in Europe, but in North America, Brasil, and

Southeastern Asia, as well. In the Institute he was charged with the mapping of Transylvania, his native land.

PÁVAY, although he spent only three years in the Institute's service, succeeded in making his name memorable for the history of Hungarian paleontology. His *Echinoidea* studies not only laid the foundations of this branch of paleontology in Hungary, but ranked among the best echinological works of the period, published mainly in West Europe, particularly in France. Every sentence of his works reflects his broad education, linguistic knowledge and sharp critical approach. Beside these, it should be mentioned that PÁVAY recognized the necessity of a correct nomenclature and terminology. He drew practical conclusions and created the Hungarian echinological terminology, thus assuring a flexibility of language appropriate even for the highest standard works.

J. BÖCKH's personage stands out in definite contrast to the all-round, broad-minded, but somewhat undisciplined figure of PÁVAY. He was an outstanding surveyor-geologist and remained such till his death. For him, and to a certain measure to K. HOFMANN, too, paleontological record did not mean more than tools which could be used in elucidating the stratigraphic, chronologic and facial conditions. They considered paleontology always as an auxiliary science of geology; and used it only to the degree required by stratigraphy and map preparation. They gave faunal descriptions, wrote paleontological monographs, if such were necessary for describing new species or delimiting parent species from each other; but all this was not more, in fact, than an "Appendix" of their genuine work. In consequence, their activity cannot be regarded — not even from the biostratigraphic point of view — as a really paleontological one. It was rather of a surveying and stratigraphic nature, although they gave precious contributions to the knowledge of *Ammonites*, *Brachiopoda*, *Gastropoda* and *Lamellibranchiata* faunas of Hungary by recognizing, describing and depicting the several new forms.

Mapping or paleontological research

When HANTKEN had given up his position as the director of the Institute and began to organize the Department of Paleontology at the Budapest University, his successor, J. BÖCKH realized his ideas concerning the priority of geological mapping without opposition. In order to assure the continual transplantation of the quasi-military surveyor's mentality from generation to generation, he appointed every young, newly employed graduate to assist one of the experienced elder geologists, until they were skilled, independent surveyor-geologists. All young geologists, including those of paleontological ambition, had to go through this "post-graduate geologist-education". Among these were GY. PETHŐ, O. KADIĆ, and P. ROZLOZSNIK.

M. STAUB, devoted every free minute of his life to the organization, amplification, thorough examination of the Institute's paleobotanical collection and to the publication of the results. He died as a teacher in a public school, having acted as an outside collaborator of the Institute for three decades. No wonder, that — under such circumstances — the geologists of the Institute rarely, if ever, could perform any independent and "l'art pour l'art" paleontological research, even any coherent biostratigraphic activity. Such attempts encountered the Director's disapproval.

If there is anything worth mentioning from this period, it is the work of GY. HALAVÁTS, who from his mapped territory — built up chiefly by Miocene marine sediments — gradually turned to the investigation of the Pannonian deposits.

Beginning in the middle of the last century, the varied succession of the Pliocene Paratethys sediments — exposed in a contiguous chain from the Vienna Basin to the Caspian Sea — attracted the attention of an increasing number of geologists and paleontologists. Towards the end of the century, a classical team of research workers was engaged in studying this very agitated period of the Earth's history. SINZOV, ANDRUSOV, LASKAREV, HÖRNES, BRUSINA were the most brilliant names abroad. They were soon joined by GY. HALAVÁTS in Hungary. His pen, sharpened in passionate disputes with professor I. LŐRENTHEY, contributed enduring papers to the knowledge of the Pliocene time (and especially of the Pannonian) and to its development in Hungary. He invested more than thirty years of continuous effort into the study of distribution, subdivision, facial conditions of the Pannonian formations in Transdanubia, in many cases anticipating later results. He gave an exemplary paleogeographic and historical reconstruction of the Pliocene and the subdivision of the Pliocene. Our ideas about animal life in the sea, of the gradually decreasing salinity of that age depend largely on the solid basis laid down by HALAVÁTS's patient and passionate work.

SECOND PERIOD (1908–1944)

Towards the end of the century A. Koch, professor of the Kolozsvár University, was appointed professor of geology and paleontology at the Budapest University. He was already internationally renowned as the author of the first up-to-date monograph on the Tertiary of the Transylvanian Basin. He educated many widely recognized experts for Hungarian geology; some of which became prominent figures in the following decades. If J. Szabó is called the pioneer of modern geological education in Hungary, A. Koch may be called the great master of Hungarian paleontology, principally through his disciples. It was not his fault, that this school was decimated in number and broken in spirit by the fatal tragedy of World War I, a real disaster for several generations. Even under such circumstances, this generation marked the highest standard in the history of earth sciences in Hungary, which is an outstanding proof of the excellency of A. Koch's school, and of the individual talent of the young geologist-paleontologists who graduated at the turn of the century.

If the first period is called "the period of geologists", the second one may be aptly named "the period of specialists" in the Institute's life.

The second period launched — and this is a rememorable merit of A. Koch — specialists of a thorough general knowledge, who started to work in a narrower branch of science equipped with fundamental knowledge concerning the entire range of life and earth sciences. Owing to this, almost all of them have acquired fame even far beyond Hungary's frontiers. This new spirit was reckoned with by L. Lóczy Sr. when he succeeded J. Böckh as the director of the Institute, and unlike J. Böckh he did not uniformize the increased geological staff. On the contraty, he threw open the gates to specialization improving the general standard of research. It was he who invited T. Kormos, Z. Schréter, K. Telegdi Roth, V. Vogl, Gy. Éhik, Gy. Vígh, E. Jekelius, L. Lóczy Jr., V. Jablonszky, B. Zalányi, K. Lambrecht, Gy. Leidenfrost to the Institute. These were the members of the Institute's staff of paleontologists, assisted by a few outside collaborators such as Gy. Prinz, who remained with A. Koch, E. Vadász, and J. Noszky Sr., the latter being a specialist in paleontology at the National Museum. During this period, three other renowned specialists were active in the field of paleontological research in Hungary: F. Nopcsa, G. Gy. Fejérváry and I. Bolkay.

After L. LÓCZY SR. had taken over the position of director, this team attacked the almost virgin field of paleontology, not only tripled in number the stiffened staff of the Institute, but also renewed and radically changed its mentality. Unfortunately, this very promising evolution was broken and almost completely annihilated by World War I. Of the paleontologists only a few remained in the Institute; the others had to seek employment elsewhere, and they had to resign their favourite work.

The war was followed by several years of directoral crisis. Only F. NOPCSA, by means of his vigorous and broad-minded directives, made an attempt to turn this inactive period into an up-to-date and progressive scientific period of research in the Institute; but his rule was too short to succeed.

Another interregnum followed, which was characterized by mere administrative activity. This was ended by the appointment of H. BÖCKH as the Director of the Institute, who was expert of international fame in the oil industry. His unforeseen illness and premature death prevented him from promoting the paleontological research in the Institute.

L. LÓCZY JR. preferred the way of compromise between requirements, circumstances and possibilities, when he took over the Director's chair after the death of H. BÖCKH. He tried to make use of the conclusions drawn from the period of the directorship of L. LÓCZY SR., F. NOPCSA and H. BÖCKH. The alternating influence of this "trinity" characterized the final fifteen years of the Institute's second period.

It was in the field of paleontology, that A. KOCH's special education and L. LÓCZY SR.'s liberalism towards the research workers, facilitated the unfolding of individual talents and proved the most fruitful for the Institute's life. Several branches of this science which were not rooted in the Institute's official scope, but only in personal ambitions, could now flourish.

In consequence of LÓCZY's being primarily a geographer and because of the great publicity gained by PENCK and BRÜCKNER'S newly conceived subdivision of the Quaternary—paleontological research became focussed on multivariate investigations into *vertebrate paleontology*, serving the Quaternary chronology. These were completed by a revival of paleobotanical studies, providing a more and more complete evidence in the physiography of the continent. In his conception L. LÓCZY Sr. relied essentially upon T. KORMOS, who — due to his agility and all-comprising organization activity —

practically "appropriated" the Institute for himself and his immediate collaborators.

Towards the end of the World War paleontological activity became very much restricted and gradually changed its ways. Drilling activities required the examination of borehole samples. Besides the classical research carried on by SÜMEGHY, TELEGDI ROTH and HALAVÁTS on the Pannonian molluscs K. KULCSÁR organized the borehole sample testing laboratory of the Institute. This innovation was of world-wide significance. A decisive role was played in this by L. MAJZON (see below).

Investigations into Quaternary Malacology

World-wide interest was revieved in both Quaternary research and in the detailed problems of agrogeology, which figured among the major items of the Institute's programme. LÓCZY SR. was stimulated to promote as far as possible the chronologic studies in Quaternary malacology, which became particularly well-known in the works of H. HORUSITZKY. To this purpose, he charged one of KOCH's most talented disciples, T. KORMOS (1881–1946) with the study of the molluscan faunas of the Quaternary deposits. In the beginning, he was interested most of all in the species stand of the Pleistocene molluscan fauna; accordingly, he described quite a number of species new for the Carpathian Basin, and for science altogether. HORUSITZKY had already elucidated, which species occur in the loess and in its various facial varieties. KORMOS made considerable efforts to increase the fluviatile, palustro-limnic faunas and the species stand of freshwater limestone deposits and thermal waters. In the course of these studies he examined numerous occurrences of tufa and the Sárrét, and he collected — with perseverance — the relicts of the Püspökfürdő thermal water fauna.

Later, when the polyglacialistic view had prevailed in Pleistocene chronology — chiefly as an echo to the works by PENCK and BRÜCKNER — his attention turned to the possibilities of a malacological subdivision of the Quaternary. In doing so, he could not avoid opposing HORUSITZKY's rather arbitrary and speculative ideas, and decided not to draw other conclusions than those suggested by the objective examination of the fauna itself. This critical approach resulted in the assertion that on the basis of the molluscan fauna one can distinguish — with certainty — only a lower, older Quaternary fauna and an upper, younger one.

The decisive denial of the stratigraphic value attributed to the molluscan fauna, as professed by T. KORMOS, is due to factors which were inevitably unknown to him, and thus, of course, could not be taken into consideration by him.

The first and possibly the most important factor, causing his failure lies in the fact, that in those times it was only the qualitative composition of the faunas that was examined, i.e. the faunal list. Nobody was concerned with relative frequency relationships of species within a fauna. This provides an explanation of why the ecologically very sensitive faunas, collected from very restricted biochores, were considered as representing an ecologically contradictory mosaic of a series of small biotopes. The evaluation of these could have resulted in a *general* ecologic picture only by means of careful statistical study, even using the microstratigraphic method, which was, however, unknown in those times. This picture could have reflected on the basis of collecting according to microstratigraphic horizons, and of statistical processing of data, the oscillations of temperature, moisture and vegetation. Such investigations were still premature at that time, indeed, they remained so for a long time on.

The other cause was of a geomorphologic and stratigraphic character. In KORMOS' time it was widely believed that one exposure represents one stratigraphic unit. This obviously excludes the possibility of more detailed stratigraphic subdivision. Moreover, the geologists were not aware of the aid provided by the decisive stratigraphic and even microstratigraphic significance of the laws of terrace formation and of the relevant data furnished by simple morphological — elevation — differences.

Consequently KORMOS after 1910 — although he went on publishing papers on Quaternary molluscs — did not attribute any serious importance to their stratigraphic-chronologic implications. Thus, disappointed, the Institute's paleontologists lost their interest in the study of Quaternary molluscs. For a long time, only zoologists studying the history of Hungary's recent molluscan fauna became in a certain degree interested in Quaternary gastropods. It is due to this, that a few papers by M. ROTARIDES and K. CZÓGLER on the loess fauna and one or two doctor's theses (J. MURÁNYI) on the same topic came into being. There was only one exception: L. SOÓ, neomalacologist of the Hungarian Museum of Natural History, did not share the universal pessimism and, evaluating "periglacial" molluscan faunas, he described, from Hungary's lower and middle

Pleistocene deposits, an increasing number of recently (at least in Hungary) non living species.

But the real significance, the fine ecological marker role of the molluscan fauna could not be detected without the application of appropriate statistical methods. This discovery was to be made only during the next period.

Vertebrate Faunistics and Stratigraphy

In order to settle the passionate disputes going on since 1893, the Institute undertook in 1905 the definitive geological age determination of the archeological finds hit upon at Miskolc while laying the foundations of the so-called "Bársony" house. K. PAPP, charged by the Institute with these investigations, proposed to enlarge further research by undertaking excavations in the surroundings of Miskolc.

In 1906 O. KADIĆ started the preliminary excavations in these caves; the task was assigned to him by Director J. BÖCKH. Very soon paleoliths of incomparable beauty were found in the undisturbed Pleistocene layers of the adjacent Szeleta cave. This discovery marked the beginning of a period characterized by the study of fossil bones found — in an increasing quantity — during the excavations carried out in caves, thus introducing the most eminent years of vertebrate paleontology in Hungary.

In the beginning, it was KADIĆ alone who determined all the bones found in the caves of Szeleta, Büdöspest etc., which turned out to belong almost without exception to the species *Ursus spelaeus*. Abundant faunas of small mammals were found as well (in the Balla-cave etc.). J. HILLEBRAND joined in the work, who became the prominent paleoarcheologist of the Hungarian National Museum during the subsequent decades. Very shortly it turned out, that this task could not be disposed with as an auxiliary item. K. MAŠKA and K. ČAPEK, both skilled experts of the Moravian Museum, being in possession of a rich experience gained while working on the immense fossil material of mammals and birds found during two decades of continuous excavation in Moravian caves, were requested to assist. Although both of them readily accepted this surplus work, it soon became obvious, that even they were not capable to master completely the flood of fossil record produced by the joint excavation efforts of the Institute, the National Museum, the Miskolc Municipal Museum, not to speak about the material furnished by the independent excavation activity of the Speleological Society.

This recognition was accompanied by the above mentioned disappointment in Quaternary malacology. A decisive impulse was given by the fact that at that time (1909) LÓCZY discovered, in a crevice of the Paleozoic limestone of Mount Szárhegy at Polgárdi, a very rich paleomammal find, which became famous all over the world under the name "*Hipparion fauna from Polgárdi*". This was the first locality of *Hipparion* fauna bearing a microfauna as well. Working on this fauna — a task assigned to him by LÓCZY— T. KORMOS, a former malacologist, became a life-long devotee and an outstanding figure of European Late Neozoic paleomammalogy. He published very soon (1911) a study on the Polgárdi fauna, putting into the limelight its utmost significance and laying the very foundations of its enduring fame. Afterwards, he began systematic excavations at Baltavár, which was already known as a classical occurrence of *Hipparion* fauna, having been briefly mentioned by E. SUESS and described in an excavation report by GY. PETHŐ. At this time KORMOS developed his individual style, determined by the febrile tempo of his activity. He described in concise preliminary reports the very essence of the new finds, emphasizing their importance according to his best knowledge. In less agitated times, this method could have been justified by the completion of monographs. Unfortunately, this was made impossible by the national decay and political crisis that followed World War I. Thus his preliminary reports have been left to posterity in fragmentary pieces.

Nevertheless, KORMOS' activity was not at all restricted to Polgárdi and Baltavár. He returned to the localities of his previous malacological studies, which yielded vertebrate remains as well: to the occurrences of travertin and calcareous mud, and to Püspökfürdő. He collected enormous masses of bones from these "terra rossa" occurrences. Then — stimulated by the problems arisen in connection with the fossil vertebrate find of Mount Cenkhegy at Brassó, which was collected by (and described in the doctoral thesis of) GY. ÉHIK, young zoologist, who joined in the Institute's fossil vertebrate research in 1913 — KORMOS extended his studies to the field of the classical materials collected by S. J. PETÉNYI about 1850.

KORMOS would have to deny his very self, if — having appropriated the aforesaid two field of research — he had abandoned all other promising themes. It was simply impossible for him not to join the buoyant paleoarcheological-paleontological research work in the domain of paleoanthropology. From the very beginning of the 1910's, he was active not only in paleontological investigations, but also in the evaluation of the Mousterian settlement found at Tata. In this later work, he excelled also as a successful paleoarcheologist, as it can now be judged, half a century later. He created that exemplary research team, which produced a series of small speleological monographs: paleoarcheological materials by KADIĆ, and the various groups of fossils by several outstanding disciples of KOCH: fishes by LEIDENFROST, amphibians by BOLKAY and FEJÉRVÁRY, birds by LAMBRECHT. It was in 1915–16, that KORMOS published his greatest and most enduring work, the monograph of the Pilisszántó niche. This work represents not only an exemplary study of an important settlement of primaeval man — including his cultural relics and very rich materials of fossil vertebrates, chiefly small mammals and birds — this also was a significant landmark in Quaternary chronology.

It is to be noted in this connection, that, Hungarian researchers disposed of a peculiar complex of data, which was of a completely deceptive nature. In possession of our present-day knowledge, it would be rather difficult not to attribute a decisive role to the not too fortunate fact that the Quaternary faunas known in those years consisted of finds representing the lowermost to lower and the uppermost part of the Pleistocene only. I.e., known fossil records were derived only from the first preglacial, the last glacial and from the postglacial epochs. In addition, one has to keep in mind that Hungary's territory has never been covered by inland ice. Consequently — in contrast to northern regions, like Germany — faunas were furnished not only by the interglacials, but moreover, the composition of the faunas was heavily affected by influences from the south.

Owing to these difficulties, which could not be overcome during several years of research, Hungarian experts, having tried in vain to divide Hungary's Quaternary fauna among the numerous cold and warm epochs, rejecting the entire polyglacialistic concept, concluded that by biological and faunistic methods only a preglacial, a glacial and a postglacial epoch can be distinguished.

KORMOS' unlucky and erroneous grouping of fossil record failed to reconcile the new concepts with the old; retaining his monoglacialistic view, he became, nevertheless, a pioneer of European Quaternary vertebrate research.

The lost war, the revolution and the dictatorship of the proletariate were followed by a counter-revolution, which forced also KORMOS — elong with LAMBRECHT, LEIDENFROST and others — to give up his post in the Institute.

Radically changed circumstances prevented him from carrying on his former large-scale activity. He had to concentrate his forces to a narrower field. This by the way did not show a disadvantageous effect on his style of work. Having been a research worker on the largest possible scale, making use of all the facilities provided by the Institute's rich collections, he became a specialist concentrating on one topic. This — after two or three smaller essays — was the study of the fossil mammals found in the Lower Pleistocene crevice localities in the Mészkőhegy Mount at Villány in the Villányi Mountains. In choosing this subject of research, he was essentially influenced — by the advantageous existence of material furnished by previous excavations and by enthusiastic collectors. He was also influenced by the fact, that the fauna in question represents an assemblage preceding the typical Pleistocene faunas, being related in many respect, but differing from them sharply by its many ancient elements. S. J. PETÉNYI was the first to recognize this fact, towards the middle of the last century. He was followed by A. NEHRING, and by L. MÉHELY, who in his work entitled "Fibrinae Hungariae" presented a monographic study of the voles which had been determined almost uniformly as voles with rooted teeth. On the one hand, he stated that more than half a dozen species belonging to 3–4 extinct genera had been described under the name of one species. (These can be distinguished from each other by consciously studying the finer morphology of the teeth.) On the other hand, MÉHELY not only pointed out the phyletic relationships of the different species and genera, but also sketched the relative chronological succession of the layers from which they had been collected.

The important results of MÉHELY's work were applied on a large scale by M. A. C. HINTON to the study of the rich vole material of the Crag Series in South England and in his great monograph on "Voles and Lemmings" as well (1926). He forwarded a chronological subdivision of England's well-developed Plio-Pleistocene and Lower Pleistocene formations, using the principles established by MÉHELY. HINTON placed all these formations into the "Cromerian" stage, which he considered as the final member of the Pliocene, subdividing it by characteristic vole species into a Lower, a Middle and an Upper substage. This opened new vistas to KORMOS. He revised his collections from the Villányi Mountains and from Püspökfürdő. By his untiring revision of the voles, instead of their previously assumed Lower Pleistocene preglacial age, he succeeded in assigning the respective positions of these localities in HINTON's tripartite chronology.

The results of these revisions were incessantly added to by renewed collecting. Finally, he was in possession of such an abundant material, that the "preglacial" fauna of Hungary comprised more than 150 species – an unmatched assemblage of unique completeness. He proceeded from taxon to taxon. Thus his smaller paper were no more "preliminary reports", but complete units by themselves. Towards 1935 KORMOS had ready for print the precious monograph of the Villány–Mount Mészkőhegy locality, which became a classic.

These years of his life (1926 to 1935) and his monograph assured for him an enduring name in the history of mammology and of chronology based on the careful study of the evolution of mammal faunas. By means of the exemplary exploration and examination of the Plio-Pleistocene and Lower Pleistocene vertebrate faunas in the Carpathian Basin he created a solid basis that is an indispensable starting point of every relevant, detailed study of this kind both in Europe and North America.

GY. LEIDENFROST joined the Institute's research team towards the end of World War I, by studying the scarce fossils of non-marine fishes. (The marine ones had been described by GORJANOVIĆ-KRAMBERGER in Zagreb, and a few even by A. KOCH and I. LŐRENTHEY.)

K. LAMBRECHT's work, however, was by far the most excellent. In the first period of his activity, as a specialist at the Hungarian Ornithological Institute, by studying the bones furnished by the excavations in caves and a few other dispersed finds, he brought order to the rather scarce material of fossil birds.

As it has been mentioned above, LAMBRECHT also had to share the fate of KORMOS and his comrades after their active collaboration with the political left in 1919. After the war he sought employment as a journalist. It was F. NOPCSA, who called him back to the Institute, as his very first decree, although only the position of librarian could be assigned to him. Unlike KORMOS, he found no enormous unstudied collections to work upon; but the library provided him with the possibility for a thorough bibliographic study.

The fruit of these studies was one of the most important books on paleoornithology entitled "Handbuch der Palaeoornithologie" consisting of more than 1 000 pages, containing the digested and appreciated essence of the complete relevant bibliography. Its value may be characterized by pointing out that nothwithstanding the rapid increase in research results in the last 30 years – it was recently reprinted in its original form, without any alteration. Having published this standard work, LAMBRECHT undertook the study of a few tropical materials. Later he was invited by the Pécs University to a professorship in the Department of Ethnography. His extraordinarily fertile life was put to a premature end by his death in 1936 (aged 49).

LAMBRECHT's name became inseparable from that of the Institute, although he was only an active member for a few years. This was due to two circumstances. There he found the collections providing the material for his studies and the bibliographic facilities as well. He was the Institute's employee when he was making those studies which made him one of the outstanding figures in vertebrate paleontology.

His life work — comprising not only his chef d'oeuvre, the "Handbuch", but also the preceding studies — summed up and systematized the entire preexisting knowledge in this respective field with such a logical and coherently critical view, that his handbook in a far higher degree than the work of any other author, became a basis for all further research in paleoornithology.

F. NOPCSA joined the Institute as its Director only in the last years of his life, nevertheless it should be especially emphasized, his internationally renowned activity in the study of fossil reptiles, reached far beyond Hungary's frontiers.

The beginning paleontologists of those years were very much indebted to O. KADIĆ, for his encouraging and helpful enthusiasm. If there was anybody at the Institute, or elsewhere in Hungary, to bring up and to launch a new generation of vertebrate paleontologists, it was KADIĆ. Although his paleontological activities were confined to his university courses, it belongs to his merits that he organized and directed with infatiguable perseverance the Hungarian speleological research movement. From year to year he repeated the excavations in quite a number of caves containing paleoarcheological finds and Quaternary faunas. For himself, he reserved but the study of the finds of paleoarcheological interest; all others he turned over to the disposal of his collaborators. These were chiefly young and ambitious scientists called to assist his excavations and to study the paleontological finds. Thus providing them an excellent occasion of research, he launched an entire series of young experts for a career in the field of vertebrate paleontology. Some of these became engaged later in other problems of the geosciences; but these are not less indebted to KADIĆ for their start, than those who have remained true to their first scientific love. Mention should be made of the following names: A. TASNÁDI KUBACSKA, I. MAIER, L. BOGSCH, M. MOTTL and

M. KRETZOI, the author of this chronicle. TASNÁDI KUBACSKA's name appears in the Institute's staff during the next period only. Before that, he was active at the Paleontological Department of the Hungarian National Museum, principally in the field of paleopathology. I. MAIER, after having studied *Ursus spelaeus* for a couple of years, turned chemist. The author of this review spent a decade in the field of applied geological research. It was only M. MOTTL who joined in the Institute's regular and official research. It is with the appraisal of her activity that this period of vertebrate paleontology may be finished.

Beside her works, it is only the aforementioned study by I. MAIER and that by the author on the Csákvár cave which are related in the respective research done at the Institute. MAIER performed a statistical evaluation of the Institute's enormous *Ursus spelaeus* collection. (Only from the Igric cave there were about 300 more or less complete skulls at his disposal.) The results were very interesting and contributed to the solution of several general problems of evolution. Unfortunately enough, he had no occasion to publish them in a proper form. Consequently, beside the elucidation of some detailed problems, there is only a paper critically reviewing the phylogeny of bears that testifies to his work.

The author started his researches towards the end of this period at the National Museum, and continued them at the Institute already in the third period; nevertheless they should be mentioned here as the first description of the rich *Hipparion* fauna found in the lower member of the Esterházy cave near to Csákvár, exposed during the 1926—1928 excavations directed by O. KADIĆ, which represent the first attempt to subdivide the continental Pannonian (Pliocene).

Passing to the appraisal of M. MOTTL's work, the reader should be reminded as to the general situation in the early thirties. Paleontological research consisted essentially of the excavations directed by O. KADIĆ and eventually by the assistence of young scientists. Beside acting as a vertebrate paleontologist, M. MOTTL gradually took over all the tasks of KADIĆ. She took part not only in the paleontological investigation into the fossil record furnished by the cave excavations, but also became deeply engaged — particularly so after KADIČ retired in 1935 — in the scientific study of the paleoarcheological founds. These two types of research were performed by her simultaneously, providing a far more exact basis for the biochronological datation of the sequence studied. The only drawback on her high-standard work in the domains of Quaternary paleontology, paleoarcheology and Quaternary chronology during the whole period was her rigid monoglacialistic view which she maintained even in the exemplary study of the paleoarcheological and fossil mammal materials found in the Subalyuk cave. This heritage of KORMOS shades her works on Quaternary chronology as well, which are excellent in all other respects. Nevertheless she worked, beyond doubt, in the highest scientific standard of those times.

Paleomalacology

It always means a considerable damage to a discipline, if it is used accessorily, in routine work, by another. This applies to the study of molluscan faunas, too, if it is made in a routine way, as a mere aid to settle stratigraphic and chronological problems for the surveyor-geologist. The classical geologist's work is based on the faunal changes of molluscs, this being considered as the key to correct stratigraphy. It represents a constant, imminent danger in restricting the study of molluscs collected to this aim to a more or less superficial determination of certain characteristic forms, "guide fossils". If the determinations are made by the geologist himself, they would usually be "routine work", with very rare exceptions. In this chapter, those geologists should be dealt with, who were inclined and capable to do proper paleontological work while determining the stratigraphic evidence. No others can be enumerated, as there was no professional paleomalacologist in the Institute during these four decades, except the devotees of Quaternary malacology already mentioned.

Even, with the above restrictions, only three names can be pointed out as being of importance in this period. These are Z. SCHRÉTER, GY. VÍGH and J. SÜMEGHY. (Since the studies by J. NOSZKY SR. were performed mainly in the last period, they will be dwelt upon in that chapter.) L. LÓCZY JR., and K. TELEGDI ROTH had already finished their particularly high-standard paleo-malacological researches before they joined the Institute. (The former performed a very conscious study of the Oligo-Miocene pelecypod and gastropod fauna of Eger; the latter is the author of a monograph on the Callovian (Kalloway) *Ammonites* of the Villányi Mountains.)

Z. SCHRÉTER, who spent six decades in the Institute's service, was always aware of the fact, that stratigraphic results are a direct function of the paleontological work performed. A stratigraphic — and indirectly, the whole geological — knowledge about a region is worth as much as the correct and scientific evaluation of the paleontological evidence is, which provides its very basis.

SCHRÉTER was a surveyor-geologist in the most noble sense of the word, during all his activity, which has already entered its seventh decade. He belongs to that generation of geologists, the members of which considered it their fundamental duty to work consciously no matter what region they were ordered to survey, and to fulfil all tasks in the highest possible standard.

The very fact, that under such circumstances and on an incredibly large scale he was capable of performing enduring paleontological research, is an excellent proof of the thorough biological education provided by KOCH's school, on the one hand, the simple fact is that the non-lithological part of stratigraphy is a paleontological, and i.e. biological discipline, on the other.

An outstanding geologist, he never neglected any data worth being noted. Hence, his numerous small papers, recording important sporadic founds of mammals, etc. But these are his paleontological works of lesser importance. SCHRÉTER's most important works are of a complex faunistico-ecologico-chronological nature based on the critical study of his three main fields of activity. These are the following.

The study of the Sarmatian faunal succession in the Hungarian Basin, was based on thirty years' field observations, collecting, evaluating and reviewing literature. In this work, SCHRÉTER provided a solid basis for the international discussions about several problems, such as the Mio-Pliocene boundary, the Tortonian-Sarmatian boundary, and the subdivision and long-distance correlation of the Sarmatian sequence of the Hungarian Basin.

Another subject of SCHRÉTER's investigations, was the very complicated stratigraphy of the Borsod Basin, which could be elucidated only by means of a paleontological approach, the region being strongly disturbed by multiple tectonic movements. While working on the Sarmatian problem, he studied and critically revised the fossil record of the Late Miocene brackish deposits. In this latter study, he had to deal with all problems posed by the complete Miocene formation of the Hungarian Basin, and with the special difficulties of that particular basin. In this work, too, paleontological remarks are scarce, except for the faunal lists. His final conclusions, however, are well-founded results of a thorough paleontological analysis.

The best proof of this is furnished by SCHRÉTER's third great work, the monograph on the geology of the Bükk Mountains. This synthesis, as well as, the two preceding ones, apparently do not differ in any essential feature from other stratigraphical works based on ample paleontological evidence. After he had irrevocably retired, he issued a series of paleontological monographs presenting the different aspects of paleontological documentation of the stratigraphic synthesis, and revealing the minucious and detailed paleontological basis. It was only in this situation that he had the opportunity to publish such; no new task was awaiting him. In both former cases, this was rendered impossible by the impending next survey.

Gy. Vígh, another skilled surveyor-geologist from Koch's school, was overcome by the manifold tasks. The immense documentation compiled by him during his life-long ammonitological studies has remained unpublished. Thus, his paleontological talent is reflected by a few careful studies on detail-problems and by his small monographs written in his younger years.

J. Sümeghy's life work reveals a quite different character again. He was not a Koch disciple, not even a member of that generation. He joined the Institute in 1926. Intending to acquire a general view of the — almost exclusively Pannonian — materials to be studied, he tried to divide them into regional units and zonal faunas. This was a realizable aim. He succeeded in contributing considerably to the knowledge of Pannonian stratigraphy by adding the regional concept to the faunal syntheses given by Halaváts and Lőrenthey. He removed the greatest error of their stratigraphic system, the superposition of local facies in different part of the basin as independent horizons. Comparing the facies developed in the different parts of the basin he made a significant progress in stratigraphy. If this step had not been done by him, it is rather doubtful whether the microbiostratigraphic method which opens new vistas to biostratigraphy by establishing subzonation within one hemaera could have been elaborated during the next period.

Before changing the subject, a number of other geologists or paleontologists specializing in other groups may be mentioned in this chapter on malacology. Although they carried out no extensive independent research in this particular field, they at least gave an exact determination and faunistico-stratigraphic evaluation of the molluscs collected during their surveys or collecting work directed to other fossils. (Such are V. Vogl, P. Rozlozsnik, E. Jekelius, T. Szalai, A. Földvári, J. Noszky Jr., E. Szörényi, L. Bartkó and others.)

Other Multicellular Invertebrates

Continuing this historical review of stratigraphic paleontology the research performed on three fossil groups should be mentioned. These are the *brachiopods* of the Paleozoic and Mesozoic, the *corals* and *echinoderms* of the Tertiary, and the *ostracods* of all these ages. Adding the *bryozoans*, we get a complete picture of the groups that have been studied more thoroughly in the Institute.

Paleontological investigations aiming at the stratigraphical subdivision of Hungary's alpine Triassic were focussed on the study of *gastropods*, while those concerning the Jurassic and the Cretaceous relied, above all, upon the *cephalopods*. *Brachiopod* studies were rather neglected.

In consequence of their facial sensibility and relative abundance in Hungary's Tertiary, on the one hand, and of the traditions inherited from the nineteenth century, on the other, the surveying geologists' interest was more and more attracted by the echinoderms, particularly by the *echinids*. As a result, a relatively rich collection has came into being, providing an opportunity to E. SZÖRÉNYI to specialize in this particular groups. The major part of her activity was performed during the period to be dealt with in the next chapter, but notwithstanding it should be mentioned here also as, it was aimed to establish a Tertiary micro-stratigraphy based on echinids, taking into consideration the facial conditions and the paleogeographic characteristics as well.

Just as, in the case of the echinids, a significant tradition existed also in *ostracod* research, although only loosely connected with the Institute (HÉJAS, MÉHES). The renewal of ostracod studies was undoubtedly stimulated by the personal example and the top-standard zoological monographs (concerning world-wide materials) of J. DADAY.

But above all, the merits of B. ZALÁNYI in developing *ostracod research* in Hungary are to be specially emphasized. The half century's work done by him as a specialist in this group made him one of the internationally most renowned Hungarian paleontologists.

He started his career as a systematician, adding numerous new taxons to Hungary's Pannonian ostracod faunas. Later the stress was shifted to establishing microstratigraphic faunal successions, and to examining their relationship with environmental changes. He did not concentrate to the effects caused by the changes of the usual physical factors such as temperature, salinity, depth etc., but rather to the finer physico-chemical changes influencing the fauna. He particularly attempted to demonstrate the causal relationship between the pH changes as reconstructed — according to their measure and tendency from "fossilized" remnants — with the faunal succession.

This approach could not be as welcome at this given stage of evolution in microchemistry, as it would be nowadays. It would be a mistake, however, to take, as the single positive result of this research, that statement of utmost importance in applied geology, which was generally accepted even in those days, i.e. "that the Latest Sarmatian was characterized in the Carpathian Basin by the broad extension of the sapropelitic facies (in connection with a large-scale regression); the major part of the fauna of the Sarmatian brackish sea perished and the Pannonian transgression brought about an immigration of new forms."

It is the morphological terminology established by ZALÁNYI in the early thirties, that enabled the species determination, which made his name appear frequently on the pages of ostracod handbooks.

This became a starting point for all later descriptions. Having furnished a detailed morphological topography and terminology for the exact description of the ostracod shell, he facilitated the examination of many fine details that had been neglected before but which are of good use in distinguishing the taxons from each other. This was, in fact, a revolution, a dawn of a new era in ostracod systematics. It is a great pity that because of the isolation during World War II his micromorphological studies, only lately became adopted as the basis for further research. He himself, being already too aged, made practically no use of them in his own detailed studies. While nowadays ostracod systematics is based all over the world on the shell morphology as outlined by him, he rarely used it, restricting his further activity mainly to the faunistical evaluation of routine determinations.

Microfaunistic Research

In consequence of ZALÁNYI's detailed micromorphological method and of paleontological tradition the ostracod studies were dealt with in the preceding chapter, while "micro-faunistics" include all research of fossil *unicellular animals*.

Although HANTKEN had laid solid foundations, and Á. FRANZENAU's activity was large and very successful, *foraminiferal* research seemed for a long time to loose its importance in Hungary. But this was not the case. On the contrary, in the decisive moment when micropaleontology, and particularly foraminiferal research started to flourish all over the world, an unforeseen revival occurred in this field in the Institute as well, thanks to two specialists, K. KULCSÁR, who with his silent pertinacy started, and L. MAJZON, who carried on with a tenacious and new-spirited work, the progress of Hungarian micropaleontology for 25 years.

K. KULCSÁR — also one of KOCH's disciples — started his career at the Geological Department of the Technical University in the early 1910's. After a few years of promising activity, however, a serious illness forced him to retire. More than ten years later, when he could resume his work, it was H. BÖCKH who took over the direction of the institute. As an important item of his practical programme of applied tendency he ordered the regular and up-to-date material testing of the state-financed boreholes to be performed. In order to assure this, he founded a borehole sample testing laboratory. The organizer, coordinator and chief collaborator of this laboratory was K. KULCSÁR, who gave the directives, trained the staff and worked himself in it for almost one and a half decades. In the papers, issued by the laboratory, his name was simply mentioned. This does not mean that he was deliberately ignored. KULCSÁR abhorred publicity. He played a silent and shy role, in creating the laboratory team work, anticipating the collective research methods so widespread in the present time.

KULCSÁR's disciple, L. MAJZON, began his scientific career in KULCSÁR's laboratory. Doing routine work, he became an essentially self-made specialist in micropaleontology and particularly in *foraminiferal* research. Through there was not always a smooth development, his original research was in continuous search of new ways to settle problems. He was assisted modestly, almost invisibly, but very effectively by KULCSÁR. There was practically no debated stratigraphic problem from the Cretaceous to the Miocene inclusively, which would not have been submitted to his judgement. It is beyond the scope of the present review to deal in detail with his accomplishments. Only two fundamental aspects should be pointed out.

The greatest work performed in the Institute's laboratory for borehole sample testing in the thirties was the examination of the materials furnished by the Bükkszék state-financed oil exploration project. The lion's part of this work consisted of *foraminiferal* studies by MAJZON. The success of these opened new ways to micropaleontological research. The Oligocene sequence studied was of a thickness of about one thousand metres, developed in a rather monotonous pelitic-psammitic facies and bearing an apparently invariable fauna. The only advantage was that this fauna was very abundant, a point promptly relied upon by MAJZON. Profiting in the small-interval core-sampling, he traced from layer to layer, from horizon to horizon the frequency percentage of the occurring species. It slowly, but convincingly turned out that the apparently homogeneous and indivisible sequence may surely and distinctly be subdivided into several members, by taking into account the differences occurring in the frequency percentages of the different species. The very essence of the discovery consisted in the fact, that these members were found in different boreholes according to the same succession, i.e. they were correlable horizons. Thus, MAJZON succeeded in introducing the *dominance zonation* in foraminiferal micropaleontology, thus making it possible to discern subdivisions within the smallest units of hemaera zonation. It is of secondary importance that his method was based on the relative dominance ratios of the assemblages, thus differing from the absolute percentage method used contemporaneously by palynologists in Scandinavia and vertebrate microstratigraphers in Hungary.

The other field of research, in which MAJZON's production, by far surpassed, what was requested from a micropaleontologist, was the jump-like progress achieved in the intricate and controversial stratigraphy of the Carpathian Flysch zone by a systematic revision and stratigraphic evaluation of the various *Globotruncana* forms. By the way, this work brought him far more publicity and acknowledgement, than the elaboration of his microstratigraphic method for the subdivision of the Oligocene, although the latter was, in principle, much more important.

THIRD PERIOD (1945–1969)

It is a rather difficult task to characterize the period in which we live, i.e. for which we are — at least partly — responsible ourselves, having the opportunity to influence it actively. Nevertheless, two decades can not be done with by a simple enumeration. Therefore, an attempt should be made to assume the objectivity of a historician, avoiding the critical vivisection of living scientists, for which the author has neither the privilege, nor the proper historical perspective.

It is the most suitable to begin with the micropaleontology. MAJZON's presence assured the unbroken progress of the high-standard work begun in the thirties. Being the Director of the Institute in the years of his activity in question, his numerous other duties, prevented him from taking a too active part in research. Nevertheless, he had enough time to bring up a new generation of micropaleontologists and to assist their first steps on the way broken by him, in the field of foraminiferal research.

Applying his method, M. SIDÓ established a micropaleontological zonation of the Cretaceous in Transdanubia. The microstratigraphic horizons established by her, based on the dominance dynamism of the various species of the foraminiferal assemblages, provoked discussions; nevertheless, their basis is of enduring value and warrant the stability of MAJZON's school.

The spiritual inheritance of the great predecessors — HANTKEN, ROZLOZSNIK, MAJZON — found adequate successors. This is aptly demonstrated by the foraminiferal researches in Eocene stratigraphy and paleophysiology by L. VITÁLIS-ZILAHY and by the Nannoplankton studies by M. BÁLDI-BEKE, which supplied a sore want in the Institute's scope. At the same time, the Tertiary foraminiferal studies by Á. NAGY-GELLAI and I. KORECZ-LAKY illustrate very well the fact that new research can detect new problems — which are not only of local, but of fundamental importance — even in the classical domain of micropaleontology.

Beside zoological micropaleontology, in the new period pollen analysis has been introduced to the Institute's laboratory items, putting an end to the badly felt lack of paleobotanical research, F. GÓCZÁN and M. HORVÁTH-DEÁK are active in Mesozoic, E. KRIVÁN-HUTTER in Eocene, and E. NAGY-KOVÁCS in Mio-Pliocene palynology, respectively, representing this branch of science in a manner corresponding to its importance.

Another branch of paleobotany has been introduced by the *Diatoma* studies by M. HAJÓS-OROSZ. Fundamental research performed by her on marine Miocene sediments has been accompanied by diatomite examinations of immediate use for applied geology.

Passing over to the circumstances and results of the research concerning multicellular invertebrates, the synthesis of Hungary's Sarmatian molluscan fauna by J. BODA should first be mentioned. He revised critically the molluscs of this both stratigraphically and faunistically but insufficiently known Late Miocene stage, which is of particular stratigraphic significance in Central Europe. Thus, he has laid the foundations for a more detailed microstratigraphic study.

Another relevant example is the activity of F. BARTHA in Pannonian faunistics and stratigraphy. As a result of almost two decades of diligent work — collecting very minutiously from layer to layer the fauna and the sediments themselves of quite a number of localities rich in fossils — he succeeded in establishing a new basis for molluscan faunistics and stratigraphy of the Pannonian. Relying upon previous classical studies, examining an enormous "routine" material, he extended the conclusions drawn from the investigation of his own collections to the entire Pannonian Basin. Thus he obtained a much clearer and more synthetic picture not only of the Early Pliocene faunal evolution, but also of the geological history of the basin in that period. And what is even more important, it became possible for him to subdivide the sequence studied into such small chronostratigraphic units, that the slightest changes in the fauna and/or in the environment could be recorded. Thanks to his new method it turned out that there are no faunistic transitions between freshwater and brackish faunas: such were brought about by inaccurate collecting only. The different horizons contain sharply different faunas; the facies changes are accompanied by respective faunal changes; the fauna of a preceding facies which disappeared, may return later, on the occasion of another environmental change. By this he proved beyond doubt, that Hungary's freshwater faunas were not developed continuously from the brackish ones, but they immigrated in consequence of the alteration of the environment which was disadvantageous for the brackish fauna which perished completely.

Having recognized this, he created new possibilities of faunal research, a new method of microstratigraphy. This provided new possibilities for subdividing the Pannonian in the Hungarian Basin. Particularly towards the end of the Pannonian, a characteristic oscillative period set in, with a rhythmicity comprising in some parts of the basin 7 to 11 oscillations. The study of these oscillations facilitates not only the fine subdivision and the delimitation of the various parts of the basin, but also, the elucidation of the geotectonic alterations which took place.

The essence of BARTHA's microstratigraphic method, combined with the practice of microfaunal dominance analysis, constituted the basis for the microstratigraphic-climatological investigations made recently by E. KROLOPP on Quaternary molluscan faunas.

MRS. L. BENKŐ-CZABALAY is studying Cretaceous marine molluscan faunas, with a new, mostly faciological and chronological approach, taking into account the recent results of up-to-date marine biology. MISS A. HORVÁTH has achieved important results by examining structure of pelecypod shells.

Leaving unmentioned several groups of multicellular invertebrates, which are of minor importance for the Institute's work, the coral studies by G. Kopek and Gy. Hegedűs should be mentioned, which were very useful additions to the coral monographs written by G. Kolosváry.

The continued ostracod studies by B. Zalányi provided important contributions to the knowledge of the ostracod faunal successions in the Hungarian Basin, demonstrating the practical applicability of this group in stratigraphy.

The major part of E. Szörényi's studies on echinoderms (particularly echinoids) should be dealt with in this chapter.

The echinoderms, as well as the ostracods, constitute one of the "difficult" groups of invertebrates. Their complicated structure and multivariate external features make their study practically impossible for a non-specialist, as an accessory item in fauna determination. Owing to this circumstance, the specialist usually has very much to do when revising for a monograph an already determined collection. E. Szörényi spent almost four decades in the patient, careful and conscious study of this group. Thanks to her, we are now in possession of such a complete picture of Hungary's echinoderm faunas from the Jurassic to the Miocene, which is scarcely matched by any other European country. This is due to the new investigations and careful, systematic revisions based on micromorphological analysis by E. Szörényi.

A. Tasnádi-Kubacska's activity in the Institute was concentrated to the paleopathological research, begun in the twenties. The final product of his critical literature studies and his original investigations, extended to the invertebrates as well, is his book, "Paleopathology of animals". This represents — 40 years after Moodie's pioneer work, which was, however, restricted to one part of the subject only — an unique synthesis comparable only to Lambrecht's "Handbuch der Palaeoornithologie". The multiple and enthusiastic international echo of this standard work — the completed German edition of which closed a period in paleobiology and opened a new one — is a sufficient proof of Tasnádi Kubacska's being one of the most renowned and appreciated specialists of the Institute.

In the field of vertebrate research aiming at stratigraphy by means of studying faunal evolution, a pause of several years set in, M. Mottl having gone abroad. Then the work was resumed and continuously carried on by the author. He has done his best in assuring a solid basis for microstratigraphic faunistics by making use of the Institute's classical collections and of the much improved collecting and excavating facilities. Especially in the establishment of stratotypes for Upper Pliocene—Lower Pleistocene continental chronology, in connection with the description of the Bihar, Villányi and Csarnóta faunal stages represent a considerable contribution to the Institute's vertebrate research. The rich materials collected mainly at the Villány Mountains localities provided a good opportunity to advance the phylogenetic system of *Arvicolidae* which plays a predominating role in all Plio-Pleistocene faunas. The recently started revision of Pannonian faunas, aided by new collecting activity furnishing also a microfauna, seems to authorize the hope that the stratigraphic system — based on continental faunal successions and subdivided into dominance phases — which is practically continuous back to the Upper Pliocene, may be extended to the Lower Pliocene inclusively.

It is not its systematical position, but the role played in continental stratigraphy and the fact that it flourished principally during this period, that motivate the paleobotany's being dealt with here. Its pollen analytical branch has already been treated in connection with micropaleontology.

The multivariate development of paleobotany entered a new, critical period in the last decades. The knowledge of tropical and subtropical floras, the increased requirements concerning stratigraphy and ecology pointed out the incertitudes of the work done by classical methods. Even the micromorphological approach could not remove the difficulties. Similar problems arose also in numerous other morphological branches of natural science; and if one is not deceived by some false appearance, the way of solution will be similar as well: to make as many as possible check examinations by complex methods, in order to control, to complete, and — if necessary — to correct the results furnished by the classical morphological methods. The complex technique of investigation opened new vistas, possibilities and research trends to paleobotany.

Paleobotanical research on the Institute's collection was reassumed in this critical period by I. Pálfalvy, including up-to-date collecting and determination of floras. After having established a characteristic picture of the Upper Pannonian flora, his work was focussed on the ecological paleogeographic, climatological and evolutive study of the Miocene floral assemblages. His studies represent a very important step forward in the knowledge of the evolution of Hungary's flora, contributed to principally by his monograph on the Miocene floras of the border of the Mecsek Mountains.

* * *

We have reviewed the Institute's paleontological research done in the course of a hundred years, divided into three periods. During the *first period*, paleontological research was closely connected with geological mapping and produced precious descriptions of the country's fundamental faunas. The Mesozoic of the Central Mountains, the classical Palaeogene, the fossil-rich Miocene and the characteristic "Pannonian"-type Pliocene of Hungary have been presented to the world's geologists, paleontologists. And — through HANTKEN's lifework — this period contributed essentially to the recognition and the foundation of the most important paleontological discipline: stratigraphically applicable foraminiferal research.

The *second period*, characterized by specialization and individual top-standard results, gave to paleontology such prominent workers as KORMOS, LAMBRECHT and NOPCSA, and prepared the development of complex methods so widely used in the third period.

The most characteristic feature of this *third, unfinished period* is the development of complex research based on detailed series investigations. Its balance will be set up by posterity, pronouncing the judgement on what will have been inherited from the present generation to the specialists of the Institute's second century.

A REVIEW OF QUATERNARY AND LOWLAND RESEARCHES

by

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I. THE PERIOD OF AGROGEOLOGICAL MAPPING (1869–1918)

1. The First Students of Lowland Geology

After the vast geodetic surveys had been carried out throughout Middle Europe in the 1800's, the regular geological mapping, at first confined to the mountainous areas, was also commenced. In Hungary too, the staff geologists of the Geologische Reichsanstalt of Vienna mapped the mountainous and hilly regions — areas of crucial importance for the mining industry; whereas in the territory of the Great Hungarian Plain (The Alföld) they restricted themselves to adding some incomplete information to that represented on the topographic maps.

The first Hungarian students of geology, however, consciously included the country's level lowlands in the sphere of their investigations, as they were aware of the fact that the natural sciences are of the same value for the agricultural harnessing of the fertile soil as they are for the exploitation of mineral resources. Economic progress also was a stimulus to the scientific investigation of the Great Hungarian Plain. The second half of the 19^{th} century was not only a period of large-scale railroad-, industrial and mining developments, but a period for the reorganization of agriculture as well. Big drainage projects, river control and road construction provided possibilities for a change-over from the extensive animal husbandry to intensive agricultural production. Railroad development required masses of mineral raw materials, but the railroads were mainly used for the mass-transporting of agricultural produce without which the railroad companies could not have subsisted.

The Austrian geologists also carried out research in the Great Hungarian Plain. Beside making outline survey trips, F. Richthofen undertook studies in the sand-covered areas of the Nyírség, North-eastern Hungary (1860). At the same time A. Wolf studied the Körös Riverine. The first specifically approached geological treatise on the

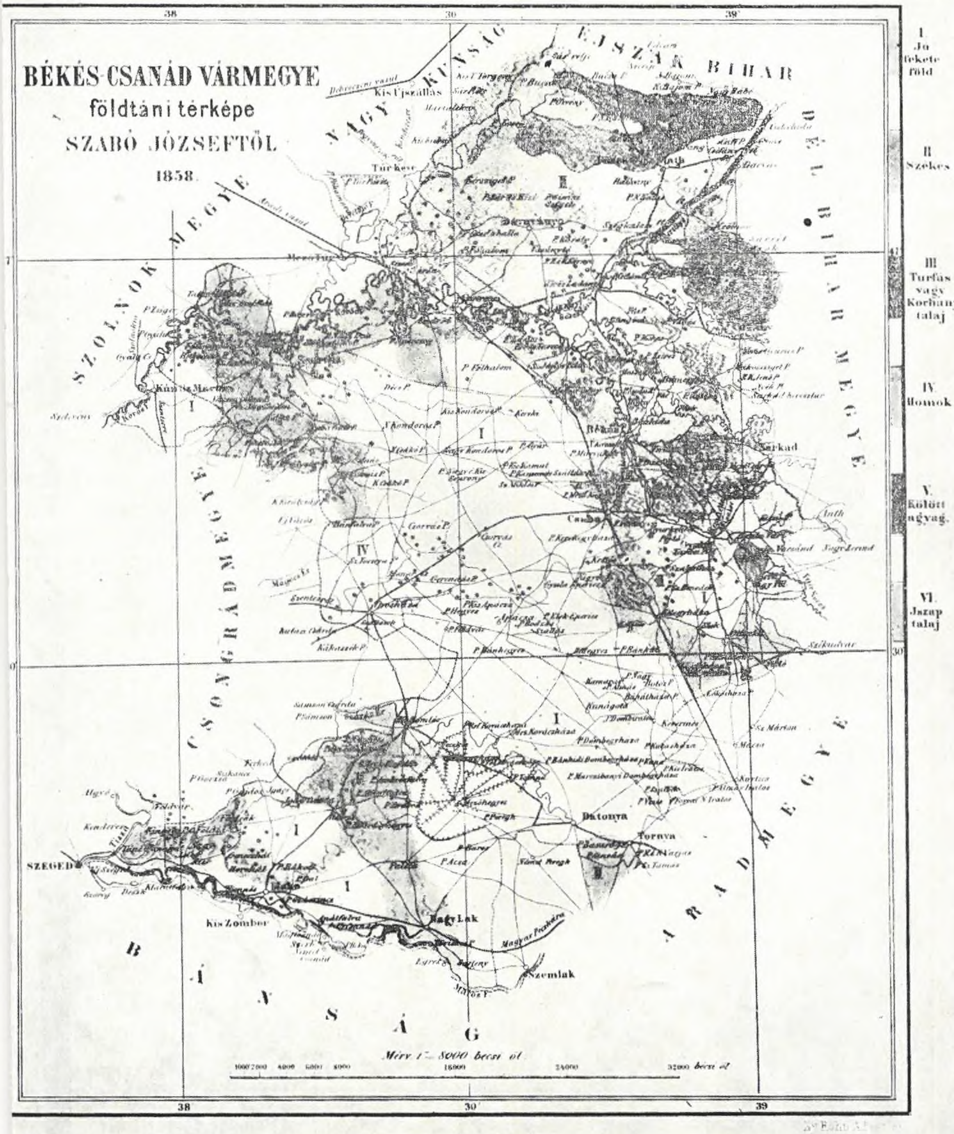
BÉKÉS-CSANÁD VÁRMEGYE
földtani térképe
SZABÓ JÓZSEFTŐL
1858.

Fig. 1

Great Plain was developed by JÓZSEF SZABÓ, the first Hungarian geologist.

JÓZSEF SZABÓ (1822—1894) published in 1861 an essay on the geology and the soil types of Békés and Csanád counties. His work was supplemented by a coloured geological map of 1 : 576 000 scale (Fig. 1). In its legend six different formations were distinguished. Beside a detailed description of the different soil types, SZABÓ's essay gave a complete list of the chemical analyses of 24 soil samples with recommendations as to the means of reclamation of poor soils by mineral fertilizers. In describing the hydrogeological conditions of the region, SZABÓ discussed the ground-waters and their chemical characteristics. In spite of the amplification of the soil classification; of the changes in the relevant technical terms; of the multiplication of the research methods, and of the marked growth in the soil survey records, we can see that SZABÓ's work comprised all the essential elements of a modern study of this kind.

A scientist active in many branches of knowledge, JÓZSEF SZABÓ did not incidentally tackle the problem of the Great Hungarian Plain, nor did he touch this subject superficially. In fact, he wrote several papers on the soda soils and the possibilities of their amelioration. Out of the Quaternary formations, he paid particular attention to the red clay soils of the Great Plain border zones, i.e. to the so-called ,,nyirok"* of the andesite slopes.

After the Royal Hungarian Geological Institute had been founded JÓZSEF SZABÓ's extraordinary vision was manifested by his farseeing attitude in which he urged for the organization of a special Great Plain team (1886).

JÓZSEF SZABÓ was a pioneer of agrogeology, but his activities were not limited to the rigid scope of this peculiar discipline. A geologist "ex asse", he was inspired by all phenomena of the Earth's crust. He sought to deal with each phenomenon according to its relative importance. A voyage on the Danube gave birth to his excellent essay, "On a continental uplift and subsidence in the south-east of Europe" (1862). In this work he called attention to the latest tectonic movements, suggesting that geology is still an unfinished historical record of the Earth's bygone days and that, consequently, the fundamentals of its understanding can be acquired by an observation of the present-day and near-past phenomena.

* A Hungarian popular term for the humified product of weathering of the andesite.

These studies of his were of no little significance, for they were carried out in an epoch in which hardly any mention was made of the latest chapters of geological history. As for the Quaternary, not even its name, now of common usage, was mentioned in the literature. Its rank in the hierarchy of the geological column was something equal to nothing, whereas nowadays, one hundred years later, its significance nearly overshadows the earlier geological periods which comprise hundreds of millions of years. The obscure prehistoric epochs of glaciations and deluges – Diluvium and Alluvium— then figured as an unfriendly, neglected final division of the geochronological scales of that time. This disinterest was due to the fact that the investigation of these two epochs did not look promising for the early 19th-century geoscientist. His brain, biased as it was by the fancy of "classical" geology, could not grasp the real value of a geological period of extremely limited duration, having a rather meagre inventory of events and potential natural resources.

2. The First Geological Surveys in the Hungarian Plains

After the founding of the Royal Geological Institute of Hungary (1869) the geologists' interests were shifted toward the mountainous regions. Nearly two decades had passed before József Szabó addressed the Hungarian Geological Society with the following appeal: "*It is desirable that a special Great Plain Survey Team be organized at the Geological Institute*" (January 13, 1886). János Böckh, the director of the Institute and the geologists on his staff accepted the proposal which was then approved by the Ministry of Agriculture. As a result, in 1891 they set up the Agrogeological Section of the Institute.

The setting up of the Agrogeological Section was an important event in the Institute's history. One third of the State territory was occupied by the Great Hungarian Plain – Europe's largest, young, filled-up lowland area. The geological explorers could not neglect this region, if even its investigation did not promise the discovery of any conventional mineral raw material. Here, "raw material" was the fertile soil which produced the bulk of the country's national income. It is not by chance that the Institute was established under the control of the Ministry of Agriculture, Industry, and Commerce. After the division of the afore-mentioned Ministry into two independent ministries (1889), it remained under the control of the

Ministry of Agriculture till 1948, i.e. for three-fourths of the century now being celebrated.

The geological mapping of the agricultural areas was also required for the Nation's economic progress. At the turn of the 18th and 19th centuries big drainage projects had been embarked upon in the Great Hungarian Plain. By the end of the 19th century 5,4 million cadastral yokes (23,000 km^2) of land were reclaimed and in this way the waterlogged grass- and marshlands were turned into arable land. This enormous—and very expensive—growth of cropland required the most suitable form of land utilization. The increase of extensive grain crop production did not prove economical, as development of the arable area unfortunately coincided with the onrush of cheap overseas grain shipments to the European market. This misfortune was manifested in the late 19th-century Hungary by an agrarian crisis and resultant mass emigrations, which decimated the agricultural population by an annual loss of hundreds of thousands of persons. The only possible answer was the intensification of the agricultural production, by introduction of higher rank of cultures such as industrial crops, vegetables, fruits, vines, etc. which were still unaffected by the American competition. However, a prerequisite for the introduction of more intensive cultures was the accurate knowledge of the characteristics of the fertile soil. Hence, a nation-wide soil survey that might provide the necessary information was needed. Since the greater part of the land properties was owned by the feudal landlords, it was they who were faced by the compelling need for an economic change-over. That was the reason why their enlightened and progressive representatives did intervene at the Geological Institute, urging for agrogeological surveys.

In 1891 BÉLA INKEY was appointed to be the head of the Agrogeological Section of the Institute. Before setting to work at home, INKEY had made a long study tour abroad for getting acquainted with the Prussian and Saxon lowland surveys in Berlin, Leipzig, Heidelberg, and Strasbourg. Back in Hungary, he compiled a tentative pedological map of the vicinity of Pusztaszentlőrinc and organized the work of the Agrogeological Team by taking part himself in the survey operations.

The work was progressively joined by PÉTER TREITZ, HENRIK HORUSITZKY, VILMOS GÜLL, IMRE TIMKÓ, GÁBOR LÁSZLÓ, and AURÉL LIFFA. The areas they surveyed were the Little Hungarian Plain and the Danube—Tisza Interfluve part of the Great Hungarian Plain.

The first map was published in 1903. This was the map-sheet labeled "Magyarszölgyén és Párkánynána vidéke; 14. zóna XIX. rovat" (The Vicinity of Magyarszölgyén and Párkánynána; Zone 14, Sheet XIX) mapped between 1896 and 1899 by HENRIK HORUSITZKY, BÉLA INKEY and IMRE TIMKÓ. It was compiled by the reduction of 1:25 000-scale survey sheets to 1:75 000 scale.

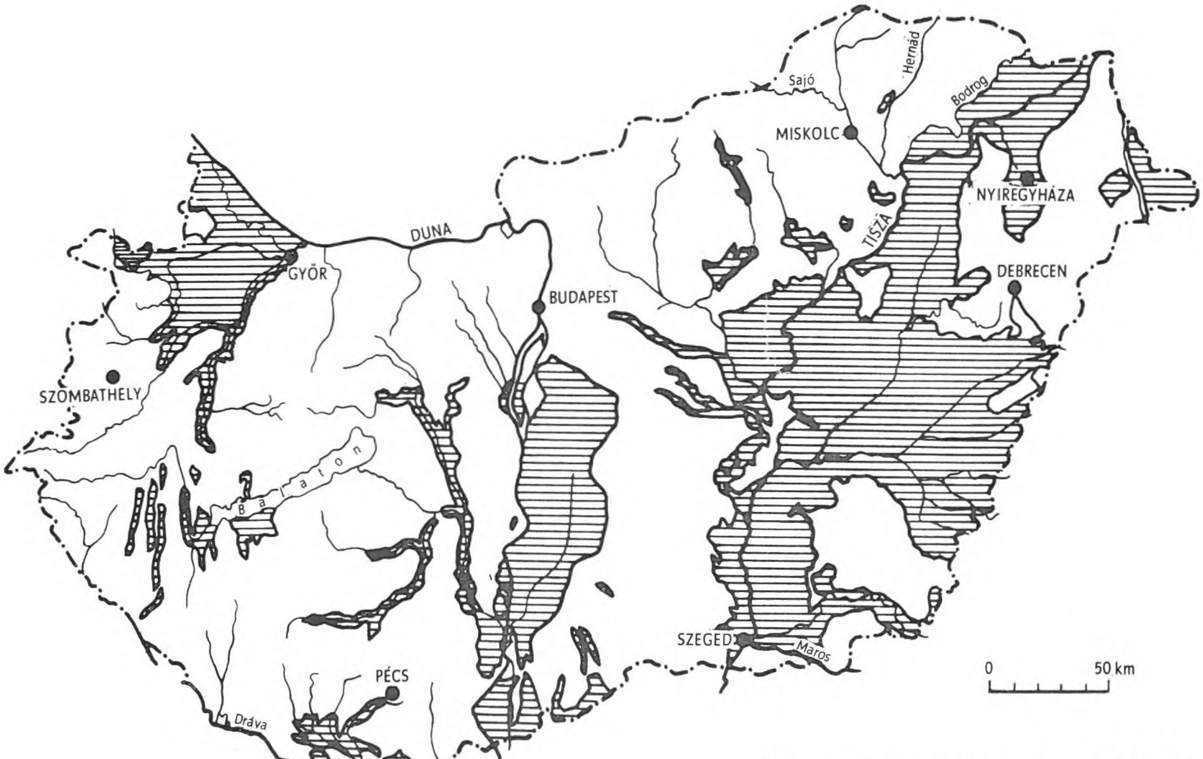

Fig. 2. Flood-controlled regions of Hungary

On the map the different topsoil types were shown by colour signs and letter symbols, the quality of the subsoils by ruling. This was the first attempt at preparing a two-level map of the densely stratified surface zone of the plains. This tentative map was later renewed in countless forms without leading, however, to a satisfactory result. Special signs were used to depict the *1.* marshlands, *2.* the waterlogged areas, *3.* the iron-bearing (ferruginous) soil types, *4.* the soda soil types, *5.* the localities of fossil finds, *6.* the hot springs, *7.* the outcrops of lignite, *8.* the points of deep drilling.

The thickness of the soils and the $CaCO_3$ content of the top- and subsoils were indicated by numerical signs. On the margin of the map-sheet a few ideal profiles of typical soil layers down to 2 m depth were represented. At the bottom of the map-sheet a geological profile — with a symbol and colour legend — was given. The geological explanations for the map-sheet were written by HENRIK HORUSITZKY and published in 3 languages (Hungarian, German, French).

The second sheet, "Szeged és Kistelek vidéke; 20. zóna, XXII. rovat" (The Region of Szeged and Kistelek; Zone 20, Sheet; XXII; 1:75 000) of the same map, compiled by PÉTER TREITZ was published in the same year. The cartographic formal arrangement of the map-sheet was the same as in the former case. However, the legend was substantially different. A colour legend was used for the distinction of geological formations of different age; and hachure and symbols were used for the different qualitative characteristics. On the margin, the typical soil profiles of the uppermost 2 meters and the small-scale geological profile, can be found here too.

The two map-sheets readily show that there were significant differences in both the methods of map preparation and the concepts of the authors. Agrogeological mapping had no traditions, therefore the contradictions of these first tentatives were the unavoidable faults of a new initiative. The lithologically-oriented geological mapping of the Prussian model came to a deadlock even in its native Prussia. This happened as the Prussian surveyors had adopted methods developed under different conditions in different areas and because they had clung to them for reasons of uniformity, and the traditional Prussian pedantry.

The Hungarian pioneers sought issue in various ways, which naturally resulted in personal disaggreements and regrettable changes in the leading posts. Thus, BÉLA INKEY—disapproving the policy of the Institute's leadership—resigned his post as head of the Agrogeological Section (1897).

In 1905 the Geological Institute delegated a committee for the uniformization of the agrogeological maps. On the suggestion of the committee, the map of Érsekújvár (now: Nové Zámky, Czechoslovakia) and of Komárom, Northwestern Hungary (Zone 14, Sheet

XXVIII), scale 1:75 000, was published in 1907 by I. TIMKÓ and H. HORUSITZKY. The controversy, however, did continue, and gave rise to a new revision of the mapping principles and to a movement for finding a forum which, on the basis of experience, might make convincing decisions on matters of principle. Such a forum could be an international conference. The idea was welcome by LAJOS LÓCZY SR., the new and very active director of the Institute, who managed to convene the meeting within an amazingly short time.

3. The First International Conference on Agrogeology

Before discussing the agenda and the results of the Conference, the author should like to give a brief cross-section of the development abroad in the research branch embodied under agrogeology.

At that time both, geology and the new-born soil science, were undergoing the swiftest development in Great Britain, France, and Germany. Although Great Britain had no vast agricultural areas, the improvement and control of production and transports, as well as, the construction of irrigation and communication facilities in her colonies raised many problems. The colonial geoscientists, graduating from the British geological school, which was paramount in the domain of classical geology and paleontology, were not only concerned with the exploration and development of mineral resources, but they were faced by the problems of the use of agricultural land, as well. In France, the Napoleonic era brought about an unprecedented development of mapping. The officers of Napoleon's army conducted surveys throughout Europe producing magnificent maps. The recording of the land's characteristic qualities, in form of central registers for the assessment of taxes, directed attention toward agricultural soil-mapping orientation. Prussia was, as mentioned above, a pioneer in systematic geological mapping; the agricultural areas too were mapped according to the standard lithological nomenclature there.

In Russia a new trend of development was introduced. As a result of the conquest of Siberia at the turn of the 18^{th} and 19^{th} centuries there was a period of centralization and reorganization which affected vast areas. Besides surveying of the scenic landscapes of the mountain ranges, the Russian geologists were also entrusted with the mapping of the extensive lowlands—the primary domain of agriculture. These large-scale activities over a territory of continental size resulted in new discoveries in the domain of soil genesis.

FERDINAND RICHTHOFEN's monograph on the relationship between climate and landscape appeared in 1886. On his study tours of China, this prominent traveler made observations of continental scope. His results showed are markable agreement with the observations of the Russian geologists. Having studied extensive areas, V. V. DOKUCHAEV, N. SIBIRTZEV, and K. D. GLINKA came to the conclusion that the process of humification transforms the surface sediments and produces such soil types in which the original properties of the motherrock are outmatched by the climate-induced characteristics. Consequently, to prepare the agrogeological map of an area would anticipate the assessment of the climazonal conditions of a larger area and also the determination of their soil-forming influence. The soil types determined this way would have to be surveyed and represented on large-scale maps.

A similar approach was developed in the United States of America, too. The economic conquest of the vast open spaces of the Great Mississippian Plains had been completed, and their large-scale economic development was commenced. The "Wild West" was being turned into an area of culture (California).

The fame of the Russian and American achievements reached Hungary, and sharpened the controversy between the adherents of the lithological and of the climazonal approaches. A controversy, which had originated in the late 19^{th} century and had become strained in the beginning of the 20^{th} century, after PÉTER TREITZ's study tours of Russia in 1907 and 1908.

The disagreements were not limited to the principles of preparation and the legend of the agrogeological maps, but they concerned the order of succession and the scale of the surveys, too. The representatives of the lithological approach advocated the continuous preparation of large-scale part-maps with a step-by-step progress towards the coverage of larger areas. On the other hand, the climazonal approach was required to begin with small-scale mapping of large areas and then to proceed to the details.

It was after such preliminaries that the First International Agrogeological Conference was organized by the Institute in 1909. A great moment of the Conference was the entry of the Russian pedological school into Europe's hallowed halls of science.

The Conference was held in Budapest, from April 14 to 24, 1909, and was the scene of the delivery of excellent papers and of instructive discussions about the problems of soil genesis and classification and qualification of soils. Novel pedological methods were introduced along with geological ones; about the newer achievements in chemistry; and map scale problems. A few scientists (among them the Hungarian ELEK SIGMOND), gained here, that first bit, which would grow into an international reputation. As formulated in its resolutions, the Conference considered it to be desirable to carry out surveys for the maps of soil types throughout Europe and for the "*. . .schleunigste Herstellung von Übersichtskarten unter Berücksichtigung der zonalen Bodentypen*" (Comptes Rendus de la Première Conférence Internationale Agrogéologique). In the following years PÉTER TREITZ, the Hungarian representative to this approach, gained the leading role in the Hungarian agrogeology.

This meeting — important as it was for the development of soil science, and even though followed by regular meetings devoted to this subject — had, however, unwanted consequences by the abandoning of the fundamentals of the lowland and Quaternary geology. Although Péter Treitz still preserved on his maps the geological background, the chemical approach had already cast its shadow before, and L. Kreybig's maps would completely lose the connection with the parent rock — the source of the Quaternary sediments.

The Conference gave a new impetus to the geological mapping of the Hungarian plains. Scores of map producers set to work and mapped the greater part of the State territory for a comparatively short time. Péter Treitz was joined by Henrik Horusitzky, Imre Timkó, Gábor László, and Róbert Ballenegger. The First World War partly impeded the work, partly hastened it, urging for its soonest possible completion. Péter Treitz, who was one of the busiest surveyors, compiled in 1918 a small-scale (1:1 000 000) national map. It was published, in colour print, in 1927. The map was devoted to the representation of the soil regions rather than to agrogeology. The Hungarian soils were referred to, in four categories: I. Region of bleached forest soils (climate of coniferous forests); II. Region of brown forest soils (climate of beech forests); III. Region of black forest soils (climate of mixed deciduous forests); IV. Region of dark-brown agricultural soils (chernozem climate).

Within the climazonal soil regions several lithological and petrographic characteristics were represented on the map. Among them there were such as sand, wind-blown sand, loess, ferruginous gravel, calcareous gravel, marl, limestone, dolomite, sandstone, basalte, trachyte, volcanic tuff, ancient eruptive granite, crystalline schist, flood-deposited soil, peaty earth, meadow clay, soda soil.

Although prepared in due time, the map was published too late, due to postwar turbulences. By the time it appeared,scientific research had advanced much and required more than was provided by the map. Since soil science had become independent, it progressed at a quick pace, and production techniques required a much more detailed map than P. Treitz'. Thus the mapping did not achieve its real goal. Nevertheless, its scientific significance is great and the survey map-sheets have been and are used as a basis for geological and pedological mapping ever since.

4. The Balaton Monograph and the Beginnings of Quaternary Research in Hungary

Although the Great Plain mapping belonged to the sphere of Quaternary research, the study of the entire Quaternary system was started in Transdanubia.

The first major accomplishment in Hungarian Quaternary research is connected with the monograph on Lake Balaton. It belongs to the merits of LAJOS LÓCZY SR., the producer of the monograph. The fact is: he did not neglect the Quaternary either; even he performed, himself, an audacious pioneering into this still little known field of geology.

The time of Lake Balaton's formation ranged from the Latest Pleistocene to the Early Holocene, though a few portions of the lake had been formed in the earlier parts of the Pleistocene. Consequently, the Balaton's history is a Late Quaternary history. LÓCZY tried to clear this by drilling several boreholes into the lake's bottom. By studies, in the neighbourhood of the lake, he discerned pre-Balaton river valleys of north-south trend, and the common origin of the Early Pleistocene gravels occurring in a high structural position on the northern and eastern lakeshores and deep-faulted on the southern side of the lake. He found considerable oscillations in the Balaton's water level; peat deposits at 5 to 10 m depth below the lake bottom; and abrasion benches on the lakeshore. He studied the peat and chalk-loam layers of the young depressions around the lake.

From the point of view of Quaternary mapping, the careful and detailed surveying of the broader neighbourhood of the lake by contributors to the Balaton Monograph has been very important.

The series of 1:75 000-scale map-sheets, attached to the monograph is the first — magnificent — synthesis on the pre-Tertiary formations of the so-called Balaton Highland (the hill range along the northern shore of Lake Balaton), being, at the same time, an exemplary, well-documented treatise on the Pliocene, Pleistocene, and Holocene deposits too. The collected data about the stratigraphy and the fauna of the Pannonian deposits, published in separate volumes, are crucial for the understanding of the sediments of the Pannonian basin.

Special mention should be made of LÓCZY's loess studies. In the Balaton Monograph he gave detailed descriptions of the loess exposures around the lake and of the Transdanubian loess types. Beside the typical loess blankets, he recognized the stratified, redeposited, sand-and-gravel-banded "valley loesses" and the different types of sandy loesses. The Quaternary tectonic movements, too, found expression in his geological summary.

In the domain of the stratigraphic classification of the Quaternary both LAJOS LÓCZY SR. and his fellow-workers adopted the monoglacialist theory and divided the Quaternary into three parts: preglacial, glacial, and postglacial stages. The observations and papers about repeated glaciations in the Alps and Northern Europe reached the Hungarian workers, too. This provoked arduous discussions, chiefly among the paleontologists. Even though, the glaciations had not directly affected the territory of Hungary, so that no tangible evidence of their repetitions was available in this country. Indeed, the Hungarian finds of mammals and molluscs did not exhibit in their evolution any manifestation of what might be ascribed to repeated significant changes in climate. For a long time this fact was a drawback to Quaternary researches in Hungary — a puzzle which could not be solved until just recently. In recent years, however, the careful investigation of the fauna and flora of the Great Plain Quaternary has shown that in the Hungarian Basin the first two-thirds of the Quaternary had been characterized by a warm-to-temperate climate and that only the last one-third of it had been cold. In this last one-third, however, the climate remained cold till the end of the Quaternary and its occasional slight fluctuations did not cause any remarkable change in the vegetation. Thus it is understandable that neither the first and second glaciations, nor the warm phase between the third and forth glaciations — which had been recorded in Western Europe — could be traced in the evolution of the fauna of this country. Nevertheless, the most recent researches on the fossils of small mammals (by M. KRETZOI) managed to reveal the manifestations of repeated climatic changes here too.

II. GEOMORPHOLOGY AND BASIN RESEARCH: THE MAIN SOURCES OF KNOWLEDGE IN THE INTERWAR PERIOD

After World War I the Quaternary research developed in two lines. In the mountainous and hilly regions detailed geomorphological studies were embarked upon, in the basin areas the subsurface strata were gradually explored. Geomorphology was cultivated primarily by the departments of geography of the universities, basin research was undertaken partly by the Geological Institute, partly was conducted as a subsidiary to prospecting (for water, oil, and natural gas).

The two different kinds of work were carried on independently, and it was not until much later that the usefulness, of the correlation of the two methods, the prerequisite for the solution of Quaternary chronology in Hungary, was recognized.

After the Paris Peace Treaty the Great Plain shared more than the half of the country's 93,000 km^2 territory and the rest was occupied, for the most part, by the gentle hilly landscape of Transdanubia and by the Little Hungarian Plain. Hardly 8–9 per cent of the State's territory was occupied by what could be considered as mountainous territory. It would have been logical to focus geological investigations on the exploration of the surface and depths of the plains rather than concentrate efforts on prospecting for mineral deposits in the mountains.

However, this was not the case, at least not at the beginning. On the contrary, a forced prospecting for new coal-fields, oil, and native salt was conducted in what remained of the mountainous areas. In the Great Plain, "boring" as it was considered, only timid tentatives were made, even though there were a few stout pioneers of Great Plain research and though the government sought to encourage development by resettling pertinent schools in Great Plain cities (Szeged, Debrecen) or by founding new ones there.

Geomorphology is the science of rough landscapes. Between the two wars the geographers searched for terraces in Hungary; recorded the phenomena of erosion and deflation; described valley forms and types. Alone, the students of the blown-sand features were concerned with the Great Plain surface. The investigators of loesses too, took their examples from the mountainous regions and the Transdanubian Hills. No wonder. With M. WILLIAM DAVIS' work in 1899, modern geomorphology caused an explosion in the geographical sciences, but settled the problems of the exogenic phenomena of Earth's surface. It is understandable that the Hungarian geoscientists also sought to settle the up-to-date problems of this country's geomorphology. Most of these problems could be investigated in the mountainous areas, rather than in the large plains.

Nevertheless, the Hungarian workers did not restrict their activities to the fruitful mountainous subjects. JENŐ CHOLNOKY, the first and most impressive student of the geomorphology of Hungary, the author of the first terrace theory in Hungary, the writer of brilliant works about erosion and deflation, and the internationally reputed contributor to the understanding of river mechanism — wrote a fundamental treatise on Great Plain morphology, too. Considering the scarcity of data then available, this work deserves the greatest appreciation.

However, the subsoil of a vast plain cannot be explored by surficial observations. To learn about the origin and the structure of the Great Hungarian Plain something more than mere hypotheses was required, deep drilling was needed. Possibilities for this have been provided by artesian water developments and by oil- and gas-prospecting—the most viable means for the understanding of subsurface geology.

The ground-waters of the Great Plain are bad. Waters abundant in soda and bitter salt occur in most of the dug wells. Good drinking water is scarce, being liable to pollution from the surface, for the depth of the ground-water table below the permeable wind-blown sand surface layer does not exceed 1 to 2 m in the majority of the cases. As the Great Plain was populated, water had to be procured. To supply the population of the extensive areas with river water has been unfeasible. The only solution to the problem has been provided by drilling for and tapping of subsurface aquifers.

The first outstanding achievement — which was honoured by the admiration of the international public — was the drilling between 1868 and 1877 of a deep artesian well (970 m) in the City Park (Városliget) of Budapest by VILMOS ZSIGMONDY. This well has yielded thermal water ever since. However, the problem of the Great Plain water supply was solved by less deep — 200 to 300 m — wells sunk into the Quaternary. They have yielded a slightly tepid water of low salt content. In lucky cases their hydrostatic level rose above the surface, despite the comparatively small depth of the aquifer tapped. Thus, the wells could be operated without the use of pumps.

After the positive results of the first wells drilled in the last decades of the 19^{th} century, artesian wells were sunk by the hundreds throughout the Great Plain, and the number of wells with good drinking water totalled nearly one thousand by the end of the century. The first legal regulation, concerning the artesian wells, was issued in 1885.

Artesian well drilling has shed light on the lithological conditions of the near-surface strata of the Great Plain. The lithologic logs were carefully sampled by the first welldrillers (particularly so by VILMOS ZSIGMONDY and his son BÉLA); later they were deposited at the Institute. Thus the lithological and paleontological examination of the strata has become possible. In 1913 a decree, stipulating the procedure and content of hydrogeological information for the Geological Institute, was issued.

Relying, for the most part, on artesian informations, GYULA HALAVÁTS published in 1896 his comprehensive work on the Hungarian artesian wells and on the geology of the Danube—Tisza Interfluve portion of the Great Plain. In 1929 HENRIK HORUSITZKY published a synthesis on the geology of the western Little Plain, again on the basis of artesian data. The thickness of the Quaternary — underlain in the Little Plain by the Upper Pliocene, the Levantine, in the Danube—Tisza Interfluve by the Upper Pannonian — was shown, in both the aforementioned works, to range from 150 to 200 m. However, these works marked just the beginning. They were succeeded by two big monographs — the first pre-hydrocarbon syntheses on the surface geology and structure of the two Hungarian Plains. In addition, the Institute's geologists called attention to the colossal

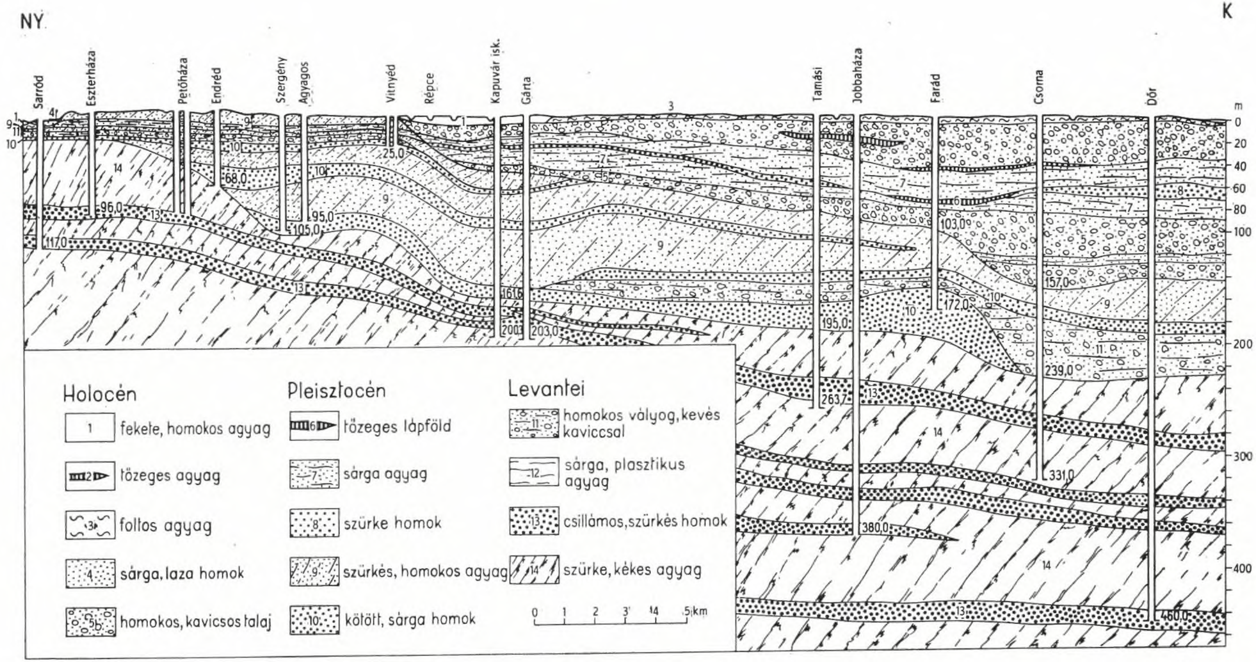

Fig. 3. Artesian wells in the county of Sopron, by H. HORUSITZKY, 1929. (Cross section of the Quaternary and Late Pliocene deposits of the Little Plain).

wastes of artesian water – to the great number of freely flowing wells, whose output was unexploited. Solicited by the Institute, the government issued in 1933 a decree, according to which any subsequent artesian drilling was to be authorized on the basis of the Institute's expert opinion. The number of expert opinions initially attained several hundreds a year, and later amounted to thousands per year.

In 1938 a big monograph, on the Little Plain, was published by ELEMÉR SZÁDECZKY-KARDOSS in Sopron. In 1944, the Institute-edited monograph "Tiszántúl" (The Trans-Tisza Region) of J. SÜMEGHY appeared, which also gave an outline of the tectonic setting of the entire Great Plain and a sketch of the post-Pannonian history of this large depression.

E. SZÁDECZKY-KARDOSS' work was not limited to the morphology and geohistory of the Little Plain. Combining the fashionable terrace-morphological results with novel methods of materials-testing, the author deduced important paleogeographical conclusions on the Late Pliocene and Quaternary evolution of the river system, and finally, he called attention to the periglacial phenomena of the gravel terraces. The monograph has greatly influenced the development of Quaternary geology and geography in Hungary, though the positive results of this influence were delayed by the vicissitudes of the Second World War.

In his "Tiszántúl", JÓZSEF SÜMEGHY listed the Quaternary sediments of the Great Plain and its borderland and discussed the origin of the Upper Pannonian surface and its subsequent deformations in Levantine and Quaternary times. This monograph – which had been preceded by SÜMEGHY's sensational essay on the geothermal gradient and the basement structure of the Great Plain – showed the Great Plain structure to be fault-controlled; diametrically opposing FERENC PÁVAI-VAJNA's theory of fold-controlled Great Plain tectonics, based on the results of hydrocarbon-prospecting.

SÜMEGHY's "Tiszántúl" was supplemented by a 1 : 200 000-scale map of the Holocene and Upper Pleistocene formations of the Trans-Tisza Region. However, on the map, the question of stratigraphic subdivision was left open in many places. JÓZSEF SÜMEGHY also carried out a detailed, 1 : 25 000, mapping in several parts of the Trans-Tisza Region and explored the area by a dense drilling grid.

The results of artesian drilling were assembled and summarized by RÓBERT E. SCHMIDT. His data were published in the explanatory fascicles attached to L. KREYBIG's 1 : 25 000-scale soil maps.

Artesian drilling unveiled the secrets of the last half to one million years of Great Plain history — of the fluviatile accumulations, formed after the emergence of the Pannonian lake bottom. However, no reliable information was still available about the thickness of the Pliocene foot-wall of the Quaternary, or about the composition of the basement of the basin. These questions have been and are still being answered by hydrocarbon prospecting and the accessory geophysical measurements. Although these do not belong to the subject of the present paper. I should like to mention, for the sake of date references, that in 1911 ROLAND EÖTVÖS performed gravimetric measurements in the vicinities of Bugyi and Kecskemét; that in the same year LAJOS LÓCZY SR. was on a tour for studying oil-prospecting in the Rumanian Plains; and that the first Great Plain deep boreholes were drilled in the Hortobágy between 1918 and 1924, to be then followed by other ones at Karcag, Hajdúszoboszló, Debrecen, and Tiszaörs.

In 1926, after having toured and studied the Hungarian landscapes on special congressional excursions, the Bodenkartierungskommission of the Internationaler Bodenkundlicher Kongress held its session in Hungary (August-September) and made its proposals on further collaboration. In the summer of 1929 another international meeting took again place in Hungary — that of the II[nd] Commission of the International Pedological Society. However, the opinions, concerning the new trends of soil science, both in Hungary and abroad, were very dissonant. For this reason, the specialists of the Geological Institute, with PÉTER TREITZ at their head, embarked upon practical projects. Among them: the mapping of the soda-soiled areas and development of methods for their reclamation; mapping of marshlands and peat bogs with the development of watercontrol and amelioration projects; examination of the pedological effects of sprinkler irrigation; investigations of the soils of the vinegrowing districts.

In the 1930's, the development of the Great Plain research came into the focus of the Hungarian economic policy. It was not until these years that the country, which had been materially reduced in area and had become totally agricultural in character, first began to realize what had happened, and sought to develop a new economic orientation. By this time, the big boom—during which the population of Europe, famished as they were in the postwar years, purchased, at a good price, all the food they could lay hands on—had come to an end. By all means, a reform was needed which would shift the development from extensive production toward an intensive one; from the bread grains towards the fodder crops, vegetables, industrial crops, and fruits without any increase in the production costs per yield.

In the domain of production techniques, the introduction of irrigation was required first of all; for the climate of the Great Plain is dry, the natural precipitation being sufficient for the extensive grain crop production only. (Occasional draughts may jeopardize even this.) The second condition was the requirement of the uniform and strictly scheduled management of the major agricultural units. This was promoted by the irrigation itself, for the distribution of the irrigating water, both in time and space anticipated the scheduled and concerted running of major estates. The third condition is the mechanization, the fourth, the development and cheapening of the communication and transport facilities.

The central problem was the irrigation. The rest of the conditions were concentrated around it. The economy required putting large areas under irrigation—possibly such areas which would be poorly harnessed, if at all, by dry farming (soda soils). The choice fell upon the northern half of the Trans-Tisza Region. The plans were drafted as early as the mid-1920's, though the proper preparative work was commenced in the thirties.

As to the locations of the water-lifting stations and the storage dams, several alternatives were proposed. Developments were started in the vicinities of Tiszaszederkény, Tiszaluc, Tiszalök, Tiszafüred, and were extended to the central part of the Trans-Tisza Region — from the Nyírség to the Körös Riverine. Nearly three thousand boreholes were drilled, along more than 60 section lines, down to 10 to 30 m depths. Drilling was directed by JÓZSEF SÜMEGHY who then processed the results and presented them in his "Tiszántúl" and on the map annexed to it.

The exploration of the irrigation-bound areas of the Trans-Tisza Region was the biggest interwar geological project on the Hungarian plains. Properly speaking, it was the first example of regional engineering-geological projects in this country.

Also in the 1930's, after two hundred years of delay, the design of the Danube—Tisza Canal was completed. Planned for both navigation and irrigation, the canal was to facilitate cheap shipments of agricultural products. Its track was completely explored by 10 to 20-m-deep drilling. Drilling was directed and geologically controlled by JÓZSEF SÜMEGHY; the samples were processed by ISTVÁN MIHÁLTZ, Professor of the Szeged University. Thus the first general geological profile of the near-surface strata across the Danube—Tisza Interfluve was obtained.

The uniform implementation of the irrigation project and the proper utilization of the irrigating water would anticipate the detailed knowledge of the soils of the areas to be irrigated. Such soil maps were needed which might give the farmer a direct information about the means of fertile land use and cultivation.

III. THE FIRST AGROCHEMICAL MAPPING

In 1933 a new project of pedological surveys was embarked upon. It was developed by LAJOS KREYBIG who had joined the Institute's staff in 1930. Again, the proper surveying was preceded by long preparations, discussions, and the surveying of the test sheets. The following method was adopted: the calcium carbonate content of the soil — the factor most important for crop production — is expressed by map-colouring; in some instances, the $CaCO_3$ content of the subsoil is also represented; the behaviour of the soil with respect to the meteoric waters is indicated by ruling or dotting. The following categories have been distinguished:

According to chemical characteristics:

i. predominantly intermediary or slightly alkaline soils saturated with lime
ii. soils, predominantly acid, unsaturated with lime in the topsoil, but containing some calcium carbonate even in the near-surface portions of the subsoil
iii. predominantly acid, unsaturated soil with no calcium carbonate in the near-surface portion of the subsoil
iv. soda soils suitable for use as cropland
v. soda soil less suitable, if at all, for use as cropland
vi. soda soils unsuitable for use as cropland

According to physical characteristics:

i. readily pervious and water-retaining soils
ii. fairly pervious and more water-retaining soils
iii. poorly pervious, strongly water retaining soils, very liable to fracturing
iv. highly pervious and still readily water-retaining soils
v. extremely pervious, poorly water-retaining soils

The map area was explored by a closely spaced drilling grid of 0,6 to 1,4 (occasionally, 5–10 m) depth. The collected samples were analysed in the laboratory. The following data were determined: pH, $CaCO_3$, Na_2CO_3, C%, N%, P_2O_5, K_2O, the total amount of water-dissolved salts, hydrolytic acidity, exchange acidity, exchangeable alkali, humus content, capillary rise of water, air-dry soil moisture, highest water-absorbing capacity, and linear shrinkage.

The position of the ground-water table was also taken into consideration. It was recorded, as observed in the boreholes (wells), and water samples were taken and analysed. Out of the laboratory analyses the following general values were represented (by spatial units): humus content, phosphoric acid, potassium oxide, the thickness of the humified layer, and the depth of the ground-water table. The data, indicated by numbers were entered into the fields of the respective colour patches.

This method almost completely abandoned the representation of the geological conditions. All that, which was represented was confined to some physical characteristics of the sediments (permeability and water-retaining capacity). The nomenclature of soil geography was not used, either. The only substantial information provided by the map was to facilitate the production techniques. Nevertheless, for nearly 30 years, the map was the most widely used hand-tool of the students of the Great Plain surface. It was so, simply because no other map of such a large scale was available.

Under the direction of LAJOS KREYBIG the soil surveys were performed by ENDRE ENDRÉDY, GYULA EBÉNYI, KÁROLY SÍK, JÓZSEF BABARCZY, ENDRE WITKOWSZKY, FERENC HAN, GYÖRGY BUDAI, and LÁSZLÓ TEÖREÖK. The work was completed by 1944. Most of the Trans-Tisza map-sheets were published. The number of the published Great Plain map-sheets, scale 1:25 000, totalled 97. In the meantime, 10 tentative map-sheets, scale also 1:25 000, were published for the territories of Transdanubia and the Little Plain. 103 more Great Plain sheets and 143 more Transdanubian sheets were being prepared, but these could not be printed because of the vicissitudes of World War II.

Each map-sheet was supplemented by a written explanatory fascicle. These had the following contents:

I. Instructions for the use of the map
II. Pedological implications of the climate
III. Significance of the recorded results
IV. Pertinent tables of ZSIGMOND's soil classification
V. Applied methods of laboratory analysis
VI. References cited

The explanatory fascicles to KREYBIG's maps have given information on the Great Plain artesian wells, too. In other words, they have also informed the reader about the porosity, the aquifers and water-yielding capacities of the Quaternary and Upper Pannonian deposits. In addition, they also called attention to the anomalies in the temperatures of subsurface waters and on the gas-saturated condition of the waters occuring in certain parts of the Great Plain. The hydrogeological chapters, including the tabulations of the artesian wells, were compiled by E. RÓBERT SCHMIDT.

The most significant interwar accomplishments, in the geological knowledge of the Great Plain surface, were J. SÜMEGHY's artificial exposures in the Trans-Tisza Region and L. KREYBIG's soil mapping.

Being practical (production techniques), KREYBIG's maps had none of the geological nomenclature in their legend. There was no indication of soil genesis and of the lithology of the subsoil. A reference to climazonal soil belts and -types was also missed. Most of the co-workers were chemists and the Institute's laboratory was being developed with a soilchemistry orientation. Thus the agrogeological mapping became an agrochemical one and with this map-series the agrogeology (for L. KREYBIG was head of the Agrogeological Section) went so far as to liquidate itself. The tentative cannot be blamed, as it sought to find approaches to a new science. It must be admitted, however, that under the auspices of pedological mapping the widening of the geological knowledge of the Great Plain was neglected.

Many Institute workers, who advocated the geological trend during lengthy discussions, were aware of this fact. And in 1939–1940 the promising lowland geological and hydrogeological investigations were started. EMIL SCHERF, ISTVÁN FERENCZY, LAJOS KOVÁCS, JÓZSEF SÜMEGHY, LAJOS LÓCZY JR., RÓBERT E. SCHMIDT, and LAJOS MARZSÓ took part in them. Unfortunately, this collective was soon broken up and the collected materials were dissipated by the war.

KREYBIG's mapping trend, the replacement of agrogeology by agrochemistry, led logically to the seceding of the Agrogeological Section from the Geological Institute. By the governmental decree No. 2050/1948, issued on September 5, 1948, the afore-mentioned Section was promoted to the rank of an independent Hungarian National Institute of Soil Science under the control of the Ministry of Agriculture (and reorganized later to the Institute of Agrochemistry and Pedology, Hungarian Academy of Sciences). At the same time, the Hungarian Geological Institute was put under the control of the Ministry of Industry.

IV. RECENT COMPLEX INVESTIGATIONS

In postwar Hungary a definite turn of the geologists' interest toward the plains, especially towards the Great Hungarian Plain, occurred in 1950. The systematic continuation of Quaternary research can be counted from that date, for the relevant papers published between 1945 and 1950 (by J. KEREKES, E. R. SCHMIDT, S. JASKÓ, L. KREYBIG) still were the retarded publications of interwar results.

1. Great Plain Mapping

The implementation of the big Great Plain Irrigation Project was left for the postwar years. As the economic conditions became normalized, the transformation of Great Plain agriculture and the respective scientific and technological measures were again encouraged. Industrialization also urged for the more detailed understanding of Great Plain geology. The spatial extension of industrial developments and the need for the industrial employment of a half of the country's population required the inclusion of the Great Plain in the industrialization programme. Therefore, not only new industrial plants had to be erected, but also the power networks, the communications, and the transportation and communal facilities had to be improved.

The need for building raw materials also required a better and more purposeful exploration of the near-surface strata of the Great Plain. In fact, the Great Plain lacks the most conventional building materials such as solid rocks, gravels, and coarse sands. However, the newly developed technological processes have adapted even the fine-grained sands to the purposes of the building industry, particularly so, for road construction.

The reorganization and improvement of Great Plain economics offered possibilities for bringing the industrial projects into harmony with the agricultural background. Such an economic policy required the extension of the geological investigations to the spheres of engineering- and hydrogeology.

In 1950 the Hungarian Geological Institute launched the project of the 1 : 25 000-scale geological surveying of the plains — the third of this kind since the Institute's founding.

Disregarding INKEY's abortive initiative, TREITZ's was the first nation-wide lowland mapping, KREYBIG's the second.

The mapping was preceded by short methodological and practical preparations. The principal aim was to determine and map the lithological and facial conditions, the physical characteristics, and the granulometric compositions of the lowland sediments. This is reflected by the legend in which 29 Holocene and 20 Pleistocene formations have been listed.

Holocene formations: 1. peaty earth, *2.* peat, *3.* boggy clay, *4.* meadow clay, *5.* flood-deposited clay, *6.* flood-deposited silt, *7.* flood-deposited sand, *7a.* flood-deposited sand with granule, *7b.* humified, calcareous, flood-deposited sand, *8.* fluviatile sand, *9.* sand with granule and pure granule, *10.* gravel, *10b.* fluviatile gravel covered by Holocene brown earth, *11.* fixed sand, *12.* blanket sand, *13.* wind-blown sand, *14.* sand with chalk-loam, *15.* chalk-loam, *16.* loessic chalk-loam, *17.* meadow limestone, *17a.* freshwater limestone, *18* alkalized loessic sediment, *19.* loessic sediment, *20.* sandy loess, *21.* loessic sand, *22.* gravelly loess, *22a.* brown earth affected by sheet-wash, *23.* brown earth, *24.* marsh, water body

Pleistocene formations: 25. fluviatile sand, *26.* sand with granule, *27.* gravelly sand, sandy gravel, *28* gravel, *29.* Early Pleistocene gravel, *29a.* dolomite gravel, *30.* wind-blown sand, *30a.* fixed sand, *31.* loessic sand, *32.* loess, *32a.* western loess, *33.* Alföld loess, *34.* infusion loess, *35a.* clayey loess, *36.* clay, *37.* Ist class red clay, *38.* IInd class red clay, *39.* IIIrd class red clay, *40.* IVth class red clay, *41.* variegated clay.

The Great Plain mapping of 1950–1954 was closely connected with the name of JÓZSEF SÜMEGHY. Entrusted by SÁNDOR VITÁLIS, then director of the Hungarian Geological Institute, he was the designer, preparator, organizer, and executor of the project. It was he who summarized the survey results, conclusions, and who harmonized the map-sheets. Professor ISTVÁN MIHÁLTZ collaborated by directing a separate mapping team; Prof. BÉLA BULLA and Prof. ANDOR KÉZ collaborated as experts.

The survey was rapidly performed. Composed of 29 members, the mapping team in the summer of 1950 completed the surveying of 69 map-sheets of 1 : 25 000 scale over a total of 18 000 km^2 area. In 1951 — 78 map-sheet areas were surveyed, in 1952 — 91 maps, over a total of 24 206 km^2. In the meantime the number of the contributors had grown to 60. The rush was justified by the events of 1953. The National Geological Authority expressed its misgivings about the Great Plain mapping project; found it too expensive; and slowed down its progress by entrusting the mapping teams with other tasks. Thus the project failed to be duly completed. The work for the remaining map-sheets was delayed till 1956. J. SÜMEGHY could not complete the final summing up of the results, as he died in the December of 1955.

SÜMEGHY's mapping gave a review of the surface geology of the Great and Little Hungarian Plains; drew the formation boundaries by dinstinguishing fluviatile, eolian, and palustrine sediments; showed the occurrences of the different types of slope-deposited clays in the borderlands, and the areas of accumulation, the different types of eolian mantles and the types of wind-blown sand and loess in the lowlands. In many instances, they identified the foot-wall of the surface formations with their varied lithology down to 5 to 10 m depth. The attempts at representing — in case of a frequent alternation of sediments — the foot-wall of the uppermost strata, i.e. at distinguishing two superimposed layers respectively by colour and ruling, proved unsuccessful.

To explore the regional geological patterns and the processes of the filling-up of the Great Plain, as well as, to study the latest movements, the mapping teams drilled hosts of boreholes along several section lines. These penetrated down to 10 to 30 m depth. Their sample material was processed in the laboratory. The section across the Danube—Tisza Interfluve has been the most significant. The northern (SÜMEGHY's) section, running along the Szekszárd—Tószeg line, was processed by GÁBOR KOPEK; the southern one, along the Baja—Szentes line, by ISTVÁN MIHÁLTZ.

The interpretation of the two profiles raised two questions about the geological structure of the Danube-Tisza Interfluve: Was this ridge an active alluvial fan during much of the Pleistocene (as suggested by J. SÜMEGHY), or was its alluvial fan stage limited to the very beginning of the Pleistocene and followed by an over-all eolian accumulation during the rest of Pleistocene time (as believed by I. MIHÁLTZ)?

Geohistoric problems were also raised in the Trans-Tisza Region. There the opinions diverged in connection with the origin and the development of the sand-covered area of the Nyírség. Before the mapping, the Nyírség's sand hill landscape was held for the result of Holocene accumulation of eolian sediments on an Upper Pleistocene loess plateau (J. CHOLNOKY). However, the mapping results did not warrant the presence of a contiguous loess plateau, nor did the subsequent geomorphological research do so (Z. BORSY).

On the basis of the mapping, two types of Great Plain loesses can be distinguished. One is the loess of the alluvial fans which is in some places more sandy, and in others more loamy than, again in others just the same as the typical loess. The second is the loess of the wet-surfaced low-seated areas which is also called paludal loess or waterlogged loess and which has recently been given the name "infusion loess" by the Hungarian scientists. It commonly shows a higher percentage of the loam size fraction than the typical loess and is finely stratified. Its fauna includes both land- and water-dwelling gastropods. Under typical loess the 20- to 40-m-thick loess mantle of the mountain slopes and of the Transdanubian Hills is understood. The thickness of the Great Plain loesses, whether loamy or waterlogged, rarely exceed 2 to 4 m. The chemical and mineralogical analyses of the two loess types do not exhibit such differences as might allow us to distinguish them even lithologically or which would suggest different source areas.

The lowland mapping of 1950–1955 included both the observation of the ground-water table and the qualitative determination of the ground-water. To this end, beside observations in the few artificial ground-water exposures, a complete well register was established. Every well was mapped and entered into the register. In all of them the bottom hole depth, the water level and the water temperature were recorded; some of them were also water-sampled for chemical analysis.

Between 1950 and 1956 the surveyors registered and mapped 1,030 042 dug-wells and 15 965 artesian wells over an area of 80 900 km^2. After that, additional records were made, chiefly in the territory of Greater Budapest and its vicinity. By 1960 166 131 more dug-wells were recorded and mapped. Ground-water mapping and the survey of the dug-wells was completed for the country's lowland areas, but contiguous ground-water table maps were prepared for the Little and Great Plains only. In the hilly regions the wells are scarce and, because of changes in the relief, the tracing of the position of the ground-water table is much more difficult than it is in the Great Plain.

The ground-water records permitted the delineation of the Great Plain areas of the elevated ground-water table, where there is danger from inland water upsurge. The designers of engineering and housing projects have to reckon with the presence of ground-water even at the smallest depth. Out of the Great Plain's present-day Hungarian territory (45 000 km^2) 6000 km^2 have been found to be characterized by a less than 2 m average depth in the ground-water table. In these areas, as a result of seasonal changes, the depth of the ground-water table may be reduced temporarily to less than 1 m. Surprisingly enough, an extremely elevated ground-water table was found mostly in the areas of high sand hills rather than in the deepest parts. This peculiarity of the Danube-Tisza Interfluve cannot be accounted for by the near-surface geology. The phenomenon appears to be due to the particular tectonic setting, to the pressure conditions (anomalies) existing in the deeper aquifers.

The exploration of the deeper strata has revealed the major laws of subsurface water migration, the subsurface "watersheds", and the geologically controlled directions of groundwater movement. It has also uncovered, that even in the readily permeable sand-covered areas, the position of the ground-water table is controlled, beside the permeability of the surface and subsurface strata, by the pressure conditions existing in the deeper strata. In other words, the depth position of the ground-water table does not only depend on the rate of infiltration from the surface, or on the rate of lateral filtration, but is also influenced by the upward movement of waters deriving from aquifers underneath. This influence affects, of course, the vertical oscillations of the ground-water table, too.

The examination of the salts dissolved in the ground-water has yielded important results. The first conclusion is that in the plains the water of the uppermost water-bearing layer contains many different salts. The salinity of the Great Plain ground-waters usually averages about 1000 to 2000 p.p.m. Waters with less than 500 p.p.m. of salt are rare. Solutions containing 3000 to 5000 p.p.m. of salt are more frequent, and even, there are places where the weight of total salt dissolved attains 10 to 15 g per liter, or exceptionally even the multiple of this figure (e.g. 58,5 g at Jászkarajenő).

The chemical character of the ground-water in the plains is very diversified. Waters of favourable composition can be tapped in the immediate neighbourhood of rivers and in a few sand areas only. The ground-water of the clay- or loess-covered areas is either of sodium-hydrogen-carbonate type (soda) or of bitter salt type (sodium sulphate, magnesium sulphate). Very often, the water contains hosts of different salts and though its concentration is very high, the water does not show any definite character.

As found during the investigations, the abundance and the variety of salts, marked as they are in the water of the uppermost water-bearing layer—the so-called "ground-water"—will disappear when the deeper aquifers are examined (even, if it would not be deeper than 20 to 50 m). At this depth and farther down to 600–1500 m, the salinity rarely attains the figure of 1000 p.p.m., being usually about 500 to 1000 p.p.m. The character of the water is more uniform here.

The results of the Great Plain mapping of 1950–1955 were assembled on 1 : 200 000-scale manuscript map-sheets, but the sheets failed to be harmonized and completed. A single schematical digest was only afforded and incorporated into the geological map of 1 : 300 000 scale, published by the Institute in 1956.

After the above campaign the Great Plain mapping was interrupted for a few years at the Hungarian Geological Institute, though an attempt was made at experimenting in the methods of a detailed survey of a comparatively greater depth range (Újkígyós). Nota bene, the planners and executors of the 1950–1955 project were aware of the fact that the first, rapid, small-scale survey would have to be followed by a more detailed, more thorough and deeper-ranged mapping programme which would use a greater variety of exploration and materials-testing facilities.

And before this had been made possible, the evidence of surface mapping was supplemented by the data of water- and hydrogen prospecting.

2. *Newer Results in Great Plain Researche: Contributions by Artesian Water Development and Hydrocarbon Prospecting*

The information about the thickness and development of the Quaternary has been enriched by artesian drilling and water prospecting. After the register of the ground-water wells the Hungarian Geological Institute compiled a similar register for the artesian wells. On this evidence, the Institute's Hydrogeological Section compiled the *Hydrogeological Atlas of Hungary*. The Atlas, an imposing work, and the accessory texts, illustrations, and tabulations were published in 1961. In the Atlas the thickness of the Quaternary; the porosity and water-yielding capacity of the strata by depth categories; the Great Plain's buried Quaternary fluviatile alluvial fans, etc. have been represented in form of 1 : 1,000 000-scale maps.

The artesian wells have been the subject of additional compilations. In 1963 the National Hydrological Authority published in two volumes the list and the statistical data of the bore-wells, as compiled by the geologists of the National Water Prospecting and Drilling Enterprise (JÁNOS URBANCSEK). In these there is detailed information (by communities) on the water-yielding capacity and the depth position of the Quaternary and Upper Pannonian strata as well as countless recapitulative tabulations and graphs about the hydrogeological conditions of single counties. The artesian wells have, for the most part, intersected and tapped Quaternary sediments. Thus valuable information has been gained on the depths of the Quaternary basin portions, on the porosity of the Quaternary beds and on their temperature and pressure conditions.

On the basis of the data of the artesian wells, JÁNOS URBANCSEK plotted several small-scale profiles illustrating the stages of accumulation in the various local depressions. Accordingly, early in the Pleistocene, coarse-grained sediments (gravels, coarse sands) in general, were deposited. Consequently, the slope gradient of the rivers and the rate of subsidence were the greatest at that time. The Middle Pleistocene was characterized by the deposition of finer-grained sediments. This was the period of an over-all slow subsidence and of a low-rate accumulation throughout the territory of what is now the Great Plain. In the last one-third of Pleistocene time the sediments again became coarser and an accumulation of air-borne sands was going on, over extensive areas.

Using artesian date, the Institute's staff also plotted a number of small-scale geological and hydrogeological profiles. On the basis of these works some comprehensive maps were prepared on the thickness of the Quaternary deposits. Since very few of the artesian boreholes have been processed lithologically and paleontologically and since none of them has furnished any reliable stratigraphic information, these maps can be substantiated merely by indirect evidence such as well logs, water pressure data, hydrochemical data, and geophysical measurements.

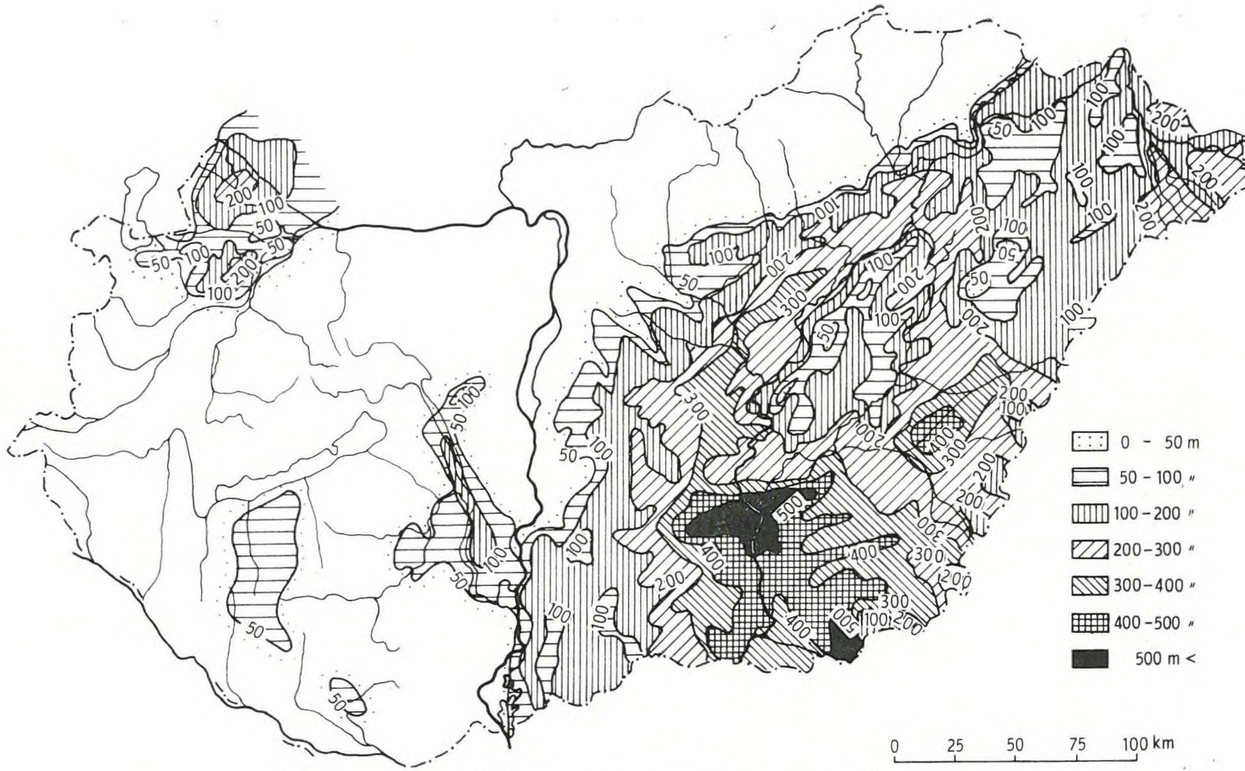

Fig. 4. Thickness of the Quaternary deposits. Plotted by A. Rónai, 1963

3. The Lowland Sheets of the National Geological Map, Scale 1: 200 000

SÜMEGHY's 1: 25 000-scale survey results were re-plotted on manuscript map-sheets of 1 : 200 000 scale. During this work several shortcomings were realized. First of all, that the artificial exposures (drilling and trenching) were insufficient and unevenly distributed; in other words, they were not enough for giving a cross-section of subsurface geology. An even more significant fault was that very few samples had been analysed in the laboratory and that a multitude of unsettled problems and contradictions had resulted from the great number of surveyors involved, and from their inadequate skill in megaloscopic observations. For this reason, the 1: 200 000-scale map could not be edited, unless the territory was reambulated and unless additional data were assembled and analyses performed.

The reambulation imposed some new tasks. With the reconstruction of the ravages of World War II and with the new engineering and housing developments, countless arficial exposures and soil-mechanical tests and analyses were produced in the postwar years. The need for assembling and mapping these data became urgent. The ground-water data could be supplemented with the results of engineering and housing developments; the chemical analyses of the ground-waters with data from the files of the Institute of Public Health, the Research Institute of Water Resources and the Hungarian State Railways. Such an extensive data-collecting required data-processing in archives.

The Institute's Lowland Research Section has ordered and processed the data by 1: 100 000-scale map-sheet areas, thus laying the foundations of an archives of lowland geology.

In 1958, parallel with data-collecting, a systematic reambulation by 1: 100 000 sheets was begun and the publication plan of the different map-sheet versions of the same scale was developed. Four map-sheet versions have been proposed:

i. Surface Geology
ii. Engineering Geology on the Basis of Shallow Drilling
iii. Average Depth of the Ground-Water Table
iv. Dissolved Salts of the Ground-Water (Ground-Water Chemistry)

The first test sheets were prepared for the region of Eger—Füzesabony in 1958–1959.

A turning point in — and of great help for — the new mapping and reambulation was the fact that in 1956 in Prague the representatives of the Soviet Union and of several European socialist countries signed an agreement concerning the publication of 1: 200 000-scale national geological maps, to be prepared on the basis of uniform principles and methods. The 100 000-scale maps which had been prepared at the Institute's Lowland Research Section were assumed to be utilizable as manuscript base-maps for the 1: 200 000 project. Therefore, the serial preparation of 1: 100 000-scale manuscript sheets and their replotting into publication-bound 1: 200 000-scale sheets were included in the Institute's working programme. The principles of the preparation of the 100 000-scale sheets were roughly the same as those adopted by the Prague Agreement. As for divergencies, they were either subsequently eliminated, or they were then discussed at the International Map Publication Conference, Warsaw 1960, and included in the International Instructions issued by that meeting. The four versions proposed for the 1: 100 000-scale maps were adopted for the new map too. In addition to them, a fifth version was also included in the project. Nota bene, as agreed on internationally, a map version was to be devoted to economic geology; a map which would show the mineral deposits and the sites of extraction.

According to the International Instructions, the 1: 200 000-scale map-sheets had to be supplemented by detailed and comprehensive explanatory fascicles of rather clearly outlined contents.

The explanatory fascicles being drafted in Hungary, comprise a much more detailed and matterful information than those published in the neighbouring countries, on the same international project.

For the preparation of the lowland maps and their explanations, all the earlier geological and pedological maps, all the pertinent geographical descriptions, the available hydrographic and hydrogeological data and the deep drilling and geophysical results have been made use of. Although because of differences in the density and distribution of the collected data, the various fascicles may be of different value, they replace the missing regional geological syntheses at the present-day level of knowledge.

By 1969 the preparation of the five-version lowland map-sheets and of their explanatories has been almost completely finished. Apart from the small-scale national geological maps (there are only 3 of them so far), this series is the first published map-collection representing the geological conditions of the plains.

4. Initiatives for Complex Research in Collaboration with Other Organizations

In the last decades the geological surveys of several European countries have embarked upon projects for the exploration of the major Quaternary basins for their full depth range. (In neighbouring

Czechoslovakia investigations of this kind were carried out in the region of the Ostrava Gate; in Poland, after the exploration of several regions, the Quaternary basin near Ferdynandów is now being explored by core-drilling; in Rumania the Quaternary sequences of Muntenia and Oltenia were explored for the solution of hydrogeological problems.)

The Hungarian Geological Institute launched in 1964 the project for the geological exploration of the Great Hungarian Plain from the surface down to the pre-Tertiary basement.

To ensure success, the Institute invited the National Trust of the Oil-and-Gas Industry and the Roland Eötvös Geophysical Institute to collaborate in the project. The first achievement was the deep borehole of Jászladány which traversed the entire Pleistocene (432 m) of the Hungarian Basin, then the Upper Pleistocene clay sequence (303 m) and stopped in the Upper Pannonian at 950 m depth. Its drillcore, rich in fossil fauna and flora, gave the first key to the tectonic and climatic history of the Hungarian Pleistocene.

Accordingly, the deposition of the Upper Pliocene lake sediments was followed by a transitional stage of warm-to-temperate climate characterized by an alternation of fluviatile and lacustrine accumulations. The sediments, of this stage, exhibit three phases of subsidence. Within the Pleistocene s. str. 7 major phases of subsidence are shown by the sedimentary cycles. These seven steps of subsidence roughly correspond to the terrace levels occurring in the mountainous areas. The first two subsidences and accumulations occupy half of the Pleistocene taken in the strict sense; in the second half five minor subsidences can be distinguished, the third of which can be split up into three secondary phases. Both the subsidences and the accumulations are readily reflected by the rhythmical coarsening and reduction of the grain size of the sediments; but the mineralogical composition of the sands also reflects the changes of the source areas. In fact, the subsidences were accompained by a simultaneous uplift, both relative and absolute, of the surrounding mountain frame, but this movement was rather differentiated in the various mountain portions.

The above key drilling yielded a rich evidence for the Pleistocene climate of the Hungarian Basin, too. Beside a mammal, gastropod, and ostracod fauna, hosts of pollen grains could be continuously extracted. On the basis of these, the climate of the Quaternary can be reconstructed. In what is now the Hungarian Basin, the first one-third of Pleistocene time was warm to temperate. The temperature was only slightly more temperate than the Late Pliocene climate. Warm-humid and warm-arid phases alternated with temperate ones. These conditions continued in Early Pleistocene time. During the middle of the Pleistocene the temperature climate gained predominance, though it was interrupted by a few warm phases and a cool one at the end. Arid and humid phases often alternated with one another. The third part of the Pleistocene was distinctly cold, with insignificant temperate phases, and repeated changes of arid and humid periods.

Beside general stratigraphic results, the detailed Great Plain research yielded plenty of practical results. The results of the first tentative 1 : 100 000-scale map-sheet (Szolnok), assembled into an atlas, have already been published by the Institute. The processed data of the near-surface sections of the boreholes and wells were used for the preparation of many different map versions devoted primarily to engineering geology, agrogeology and hydrogeology.

The drilling grid of the 1520 km^2 area of the map-sheet comprised 386 full-hole-drilled boreholes of 10 m depth as well as numerous continuously core-drilled holes of different depths: 20 m (8 holes), 100 m (10 holes), 300 m (3 holes), and 500 m (one hole). All of them were core-drilled for their whole depth range. The editors have also used the shallow geoelectric logs produced by the staff of the Roland Eötvös Geophysical Institute. On the basis of all information available the following map versions have been prepared for the Szolnok map-sheet area:

1. Location Map (showing the locations of the shallow and medium-deep boreholes)
2. Surface Geology
3. Engineering Geology of Shallow Boreholes. Lithological Logs
4. $CaCO_3$ Content in the Topsoil at 0,5 m, 1,0 m, and 1,5 m Depths
5. Permeability of the Surface at 0,5 m, 1,0 m, and 1,5 m Depths
6. Geology at 2 m Depth below the Surface
7. Geology at 5 m Depth below the Surface
8. Depth of Ground-Water Entries in Boreholes
9. Hydrostatic Level of the Ground-Water Table
10. Position of the Ground-Water Table above Sea Level
11. Level Rise of the Ground-Water in Boreholes (as provoked by the pressure applied to it)
12. Chemical Character of the Dissolved Salts of the Ground-Water
13. Depth of the Best Aquifer within the Upper-most 500 m

The thickness of the deeper strata, their paleogeographical history and geotectonic setting have been illustrated on additional map versions. Based, for the most part, on the drilling results of the National Trust of the Oil-and-Gas Industry and on geophysical measurements by the staff of the Roland Eötvös Geophysical Institute, these maps were partly prepared by workers of this last-mentioned institute.

In the Szolnok map-sheet area 61 deep boreholes of the Oil-and-Gas Trust, the seismic exploration grids of the Trust and the Geophysical Institute as well as the well-logs of additional 68 deep artesian boreholes have been used for the preparation of additional maps. The resultant subsurface-geological maps are the following:

14. Thickness of the Quaternary (MÁFI)*
15. Thickness of the Upper Pliocene (MÁFI)
16. Contour Map of the pre-Austrian Basement (ELGI)**
17. Tectonic Map of the pre-Upper Cretaceous Basement (MÁFI)
18. Contour Map of the pre-Neogene Basement
19. Tectonic Map of the pre-Neogene Basement (MÁFI)
20. Contour Map of the pre-Pannonian Basement (ELGI)
21. Contour Map of the Lower-Upper Pannonian Boundary (ELGI)

The first tentative does not provide a complete cross-section of the maps which can be prepared on the basis of the available data. In fact, these may be used for additional illustrations or maps devoted to near-surface geology and hydrogeology. The lithological and tectonic studies concerning the pre-Tertiary basement are not yet finished.

The following initiative is particularly worth mentioning. The Hungarian experts in hydrogeology have, for a long time, felt the need for drilling special wells devoted to systematic observations of changes in the dynamics of subsurface waters—wells which might provide data for the estimation of the subsurface water recharge and the exploitable water reserves. In such wells, the pressure conditions existing in the aquifers of different depth would be measured and their natural changes would be recorded.

Such wells can be developed only from boreholes with an accurately known lithologic column. However, before setting to well-completion, the executor of the project should carry out analyses in such detail as would ensure the correlation of strata in wells drilled in different areas.

Some of the boreholes of the Complex Great Plain Research Project have been completed to such "artesian check-wells". At present 14 check-wells are being operated in the Great Plain by the Institute.

Beside basin research, the Institute also started the Quaternary exploration of the mountainous regions, primarily for engineering-geological purposes. In 1968 engineering-geological mapping at 1 : 10 000 scale was commenced in the region of Lake Balaton. The project is just being developed at full scale with the collaboration of the Enterprise for Geodesy and Soil Mechanics and of the Geographical Research Institute of the Hungarian Academy of Sciences. This last-mentioned institute, backed by the university chairs of geography,

* Abbreviation of *M*agyar *Á*llami *F*öldtani *I*ntézet (Hungarian Geological Institute)

** Abbreviation of *E*ötvös *L*óránd *G*eofizikai *I*ntézet (Roland Eötvös Geophysical Institute)

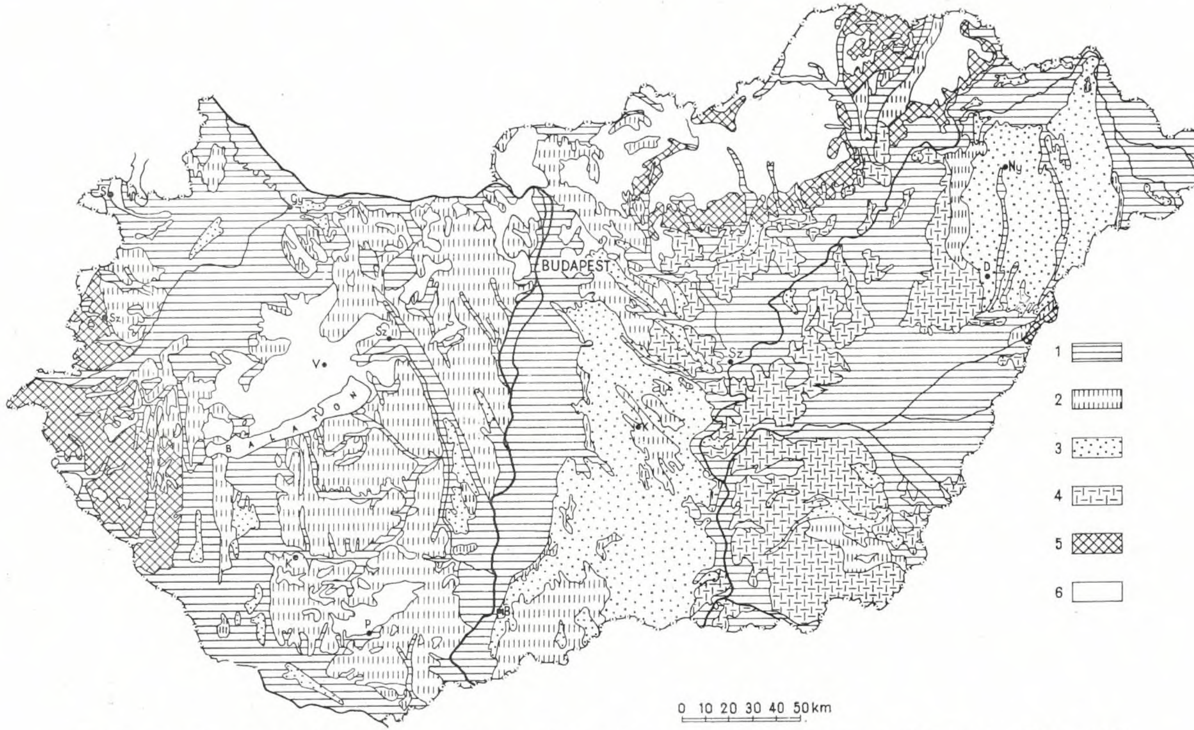

Fig. 5. Small-scale geological map-scheme of the Quaternary of Hungary, plotted by A. Rónai, 1964.
1. Fluviatile deposits, *2.* loess, *3.* wind-blown sand, *4.* loamy loess, *5.* slope-deposited clay, *6.* pre-Quaternary deposits

has been carrying on the geomorphological investigations since 1952. Since the early 1960's the mountain research teams of the Hungarian Geological Institute have paid an ever increasing attention to the observation of the Quaternary deposits and to the latest stages of the geological history, and young specialist have been gaining skill. Thus we are getting closer to our goal — an up-to-date monograph on the Quaternary of Hungary, including chapters on lithology, paleogeography, geomorphology, and geotectonics. The practical aspects of this new branch of research are engineering geology, hydrogeology, and pedology (or agrogeology in its modern sense) in which considerable result are expected.

The efforts for better understanding of the Quaternary, both in this country and abroad, are actively shared by the archeologists. In Hungary the most important results were obtained in the exploration of caves. In 1934 our Institute published a comprehensive work on the archeological finds from caves and excavations and on the Hungarian sites of Quaternary cultures (O. KADIĆ). The Institute's geologists (M. KRETZOI, L. MOLDVAY) have collaborated with the archeologists by exploring the geological background of newly excavated sites.

The small-scale national mapping projects and the detailed Quaternary researches enabled us to prepare the country's small-scale Quaternary geological map. Our Institute has supplied pertinent information for the international geological and Quaternary map-editing committees.

5. International Cooperation in Quaternary Research and Mapping

Our Institute has not neglected the possibilities offered by international connections for Quaternary research, lowland geology and agrogeology. After the first pioneering initiative made in 1909 in Budapest, the Hungarian geologists took part in the subsequent international meetings on agrogeology and pedology and actively contributed to the work of their committees.

The Hungarian geologists soon joined the activities of the International Association for Quaternary Research (INQUA) organized in Copenhagen, in 1928. At the congress held in Vienna in 1936, our country was represented by a large delegation. And their activities at the congress were so highly recognized that Hungary was entrusted with the organization of the congressional session of 1940. Above all, this is to be thanked to EMIL SCHERF, who was the first to attempt to subdivide the Hungarian Pleistocene deposits by taking into consideration the repeated glaciations. Because of the intervention of the war, the envisaged Hungarian congressional session could not be held either in 1940 or in 1948. It was not until 1960 that our Institute could again join the efforts of the INQUA. Since this date, however, it has sent its representatives to all of the congresses held at fouryear intervals and the members on its staff have been busy participating in the Association's commissions: Commission on Stratigraphy, Map Editing Committee, Commission on Neotectonics.

All that which was displayed in connection with the First International Agrogeological Conference has obliged the Hungarian Geological Institute to combine its own forces with all national and international efforts for the cause of further progress in the domain of Quaternary and lowland research. From the very beginning, this branch of geological research has been forged into a unity of action. This tradition was manifested by the fact that in 1950 the Institute invited specialists from several other Hungarian institutions to join in its efforts for the implementation of the Great Plain Mapping Project. It was the result of this development that at the international discussions on the methods of preparation of the 1: 200 000-scale geological maps in 1956 and 1960 the Institute raised special requirements with regard to Quaternary mapping and managed to substantiate its own proposals by the maps it exhibited there. Another aspect of the same development was that the Geological Institute housed INQUA's Editing Committee for the International Map of the Quaternary on its session of 1964, where an agreement was reached concerning the principles for preparation of the maps of Western and Eastern Europe.

The Institute's staff made similar efforts for collaborating with the Nation's geological and related institutions and societies, for contributing to the activities of the sessional meetings of commissions and committees of the International Union of Geological Sciences; the Carpatho-Balkan Geological Association, etc. and paying particular regard to the subjects of lowland research and Quaternary geology and its special branches (hydrogeology and engineering geology).

On the Centenary of the Institute's founding and the 60^{th} anniversary of the First International Agrogeological Congress we can state, that in the domain of Quaternary research and lowland mapping the Hungarian Geological Institute is — both nationally and internationally — conciously continuing our predecessors' brilliant initiatives.

HISTORY OF THE GEOLOGICAL INSTITUTE'S LIBRARY

by

I. KAPLAY-SCHEY, DR. PH.,

Head of the Library of the Hungarian Geological Institute

At present, the Library of the Hungarian Geological Institute amounts to 140 000 volumes. In 1869 all of the Institute's books could be stored in an old case in a corridor of the National Museum.

Tracing the Library's past, we should recall ancient times.

It was at the beginning of the eighteenth century, that the idea of a public library started in Europe. It was one century later, that the first initiative was undertaken in Hungary: the National Museum's library had been founded. At the same time the first special libraries open for the public came into being. (In the second quarter of the nineteenth century, in the thirties, political and cultural reform movements flourished in our country.)

These favourable circumstances stimulated a remarkable progress in the field of publication and library culture. The foundation of the libraries of the Hungarian Academy of Sciences and of the Society of Natural Sciences promoted the evolution and popularization of natural sciences in Hungary.

The country's first special scientific library was that of the Mining Academy at Selmecbánya. Mining and earth sciences were practically inseparable from each other in those times; books on geology were primarily collected by colleges, teaching the science of mining. It is here that the predecessors of the present day geological libraries are to be found.

In the stock of the Selmecbánya Mining academy's library, geology was remarkably well represented. From the middle of the nineteenth century on, geological publishing activity rapidly increased. No wonder; the problems concerning the exploration and the better knowledge of the Earth could not be left out of consideration by men aiming at the economic development of the country. The Geological

Society and later the Geological Institute were created also, to meet such requirements.

The Geological Society, founded in 1848, processed a library of its own. Its Statutes prescribed the constant enlargement of the Library by purchasing and, in fact, from the very beginning the development of the Library was attended to with a particular care. Its foundations were primarily laid by private grants. An important opportunity was created by starting the Society's own geological journal, entitled "Földtani Közlöny", which provided a possibility of regular exchange with libraries abroad. In 1875, the Society's library was deposited in the Institute's Library. It still remained for a time, the Society's property, but somewhat later all rights were taken over by the Institute. As a compensation, the Society's members received gratis, the Institute's publications. This use persisted for almost half a century.

The 1869 Statutes of the newly founded Institute included library regulations. Financial facilities were provided by a regular budget allowance. According to the Statutes, the Institute's director was charged with the purchase of books, the sums disposable being determined by the Ministry. Bills were to be presented to the Minister. One of the chief geologists was charged with the inspection of the Library's order and inventory. The very fact, that the Library was assigned under the direct management and supervision of the director, and of the geologist second in rank, stressed its prominent importance.

The stock of the Library. The Library's initial stock is known from a Memorandum, which was presented by Director J. BÖCKH to the Ministry on October 21, 1891, requesting a definite location for the Institute. It is worth being quoted word by word: "*If one calls to mind the winter of 1868/69, when the Department of Geology was accomodated in a narrow anteroom, and all its books were stored in a small, worn-out case borrowed from the National Museum, and if one saw the Royal Hungarian Geological Institute in 1870, when it could be placed, with all its collections filling eight cases in four groundfloor rooms rented in the house Arany János Street 10, and compares this situation with the present-day one, with its very valuable and instructive collections, a special library comprising 10 000 items, a Map Depository of 4 000 items, these two alone representing an inventory value of 74 300 Fts, of which only a minor part has been purchased, the majority consists either of scientific products of the Institute, or has been acquired by exchange or donated by persons* *sympathizing with the Institute's activity, I say, if one considers all these, let him judge himself, how did that sapling develop, which was planted by* I. GOROVE *in 1868 . . .*"

During the repeated displacements which ensued from the Institute's foundation, considerable difficulties arose from the inevitable transportations and re-depositions of the Library.

Director J. BÖCKH reported in the same Memorandum that, calculating the average increase of nine years, the annual space requirement of the Library amounted to 75–80 square metres; this amounted to 750–800 square metres in the first ten years.

This means, that whenever the Institute moved into new headquarters, all the rooms were always at once completely filled up by the collections and there was no space left for further development. Beside this, the overwhelming majority of these rooms were completely dark, thus rather inconvenient for the given purpose. It was urgent to find a definitive solution. This problem was settled only in 1900, when the building of the Geological Institute was built up and the books were stored in appropriate rooms, specially designed for the Library.

The Library's stock increased at first principally by donations, purchase and exchange. From 1875 it received considerable aid from the Geological Society of Hungary founded in 1848. (As it was already mentioned above, the Society's library of great value was then transferred to the Institute.) According to the deed of gift, as a compensation for the books received the Institute furnished at first 200, later 400 exemplars of its issues for the Society's members. When the books of the Society were taken over, the Institute's Library included about 600–700 volumes. It received further additions from the Society, newly received books being constantly transferred.

The Library is very much obliged to a number of individual donors who during several decades contributed largely to its growth. *The Library's greatest contributor was* A. SEMSEY, who had inestimable merits in connection with the Institute's foundation as well. He not only presented valuable books and an entire series of periodicals to the Library, but also took care of filling up lacks, completing incomplete series. Till the end of his life, he was always ready to aid the Library.

During the past century, several other donors also contributed to the growth of the Library's stock. In some cases, the private libraries of deceased geologists were incorporated, enriching the Library with new colours, according to the proprietors' personal special interests.

(The names of V. ZSIGMONDY, L. LÓCZY SR., T. PÁVAI-VAJNA, J. SÜMEGHY should be mentioned in this connection.)

The Library *collected*, from the very beginning, chiefly geological publications. Beside the fundamental topics including geology, paleontology, mineralogy and petrography, books of numerous auxiliary disciplines have been collected as well. This range of collecting and the methods of increasing have not changed. Growth was so rapid, that storing represented a serious problem again, between the two World Wars.

The situation was but temporarily improved by getting rid of the books concerning the subject of the Department of Pedology as this receded from the Institute in 1949, and by the separation of the Map Depository from the Library.

The foundation ordered the stock and applied surprisingly modern methods, arranging the publications according to the numerous currents, separating the independent issues from the periodicals. It was very early, when an *information* and *reviewing service* was founded, presenting the new acquisitions to the readers, on shelves of the reading-room, practically according to the up-to-date "open access system".

The ancient books of *science-historical value*, which were recently separated from the other parts of the stock, represent a very interesting collection.

Some of these describe collections of minerals and fossils, while other deal with zoology and botany, i.e. with disciplines related to geology.

Beginning with the seventeenth century, numerous travel books contain geological and paleontological observations. These are the most valuable books of our collection from the point of view of the history of Hungary's geological exploration. The collection contains also a number of ancient books on mining. A particular value of these ancient books consists in their illustrations, these being the precursors of modern, multi-coloured illustrations based on black-and-white and coloured photography. The progress of illustration technique can be well traced: from xylography through chalcography to lithography. The hand-painted multicoloured figures are of significant artistic and aesthetic value.

It would be beyond the scope of the present communication to deal with the individual works in detail. Only a few examples should be mentioned. The oldest volume is "*De omni rerum fossilium genere, gemmis, lapidibus, metallis*", by C. GESSNER, Tigurum (Zürich) 1565.

(In those times fossils were considered as "lusus naturae", and their real origin was not investigated.)

Another book: "*Herbarium diluvianum*" (Zürich 1709) deals with lithified plants. Its author being one of the chief representatives of the diluvial theory: J. J. SCHEUCHZER, he described the fossil plants as proofs of the Flood reported in the Bible.

Another bibliographical rarity is the ill famed "*Lithographiae Wirceburgensis*" 1726, by HUEBER, a disciple of BERINGER.

Numerous ancient books are related with Hungary. In the second half of the eighteenth century geology was closely interwoven with mining both in Hungary and abroad. A. G. WERNER was a miner himself and so was I. BORN. The latter travelled widely in the mining districts of the Carpathian Basin and published his observations in the form of 23 letters, entitled "*Briefe über mineralogische Gegenstände auf einer Reise*", Frankfurt-Leipzig, 1774. One of the first mineralogical-geological description of the Carpathian Basin was given by J. FICHTEL: "*Mineralogische Bemerkungen von den Karpathen*", 1791, Wien.

The official language being Latin in those times, Hungarian-language scientific works were very rare. One of the first such attempts was S. ZAY's "*Magyar mineralogia*" (Hungarian Mineralogy), 1791, Komárom, containing also Hungarian scientific terms.

Several foreign scientists published summarizing descriptions of the geology and mineral resources of Hungary. The most prominent of this kind is the work of an English traveller, R. TOWNSON, entitled "*Travels in Hungary*", London 1757. This work is of special importance because it contains *the first coloured geological map of Hungary*.

Another traveller, whose work contributed to Hungary's geological knowledge with data of fundamental importance, was F. S. BEUDANT. His work "*Voyage minéralogique et géologique en Hongrie*" Paris 1822, was the first to furnish a geological description of the major part of the country.

Publication exchange. A very important moment was the *establishment of a broadly extended exchange network excelling among Hungary's special libraries.* The financial means for book purchases assured by the foundation were very modest for a long time and could not warrant a considerable increase of the stock.

The publication of the Institute's own first issues was immediately followed by the beginning of an exchange activity. According to contemporary records, 49 books were received in exchange in 1879.

This activity was enlarged in 1875 when not only the books, but also many already established exhange relations were taken over from the Geological Society.

A growing exchange played also another important role in the Institute's life, assuring the exchange of ideas and views with similar institutions, thus constituting the very base of fruitful scientific interrelations. We are in possession of some original letters dating from 1921, when the *Comité Géologique de Russie* in Petrograd addressed a letter to the Library of the Royal Hungarian Geological Institute. In this, the new Directory emphasized that "*. . .the events of the past can not disrupt the intellectual connections of scientific organizations . . .*" and proposes the Hungarian colleagues "*. . .to restore the previously existed communications aiming at the geological exploration of the earth's surface*". "*The events of the past years*" — it reads — "*may not produce an insurmountable barrier to the recognition of the truth . . .*" The Geological Institute of the Soviet Union proposes in this letter to restore the previous publication exchange, declaring itself ready to send all the publications which could be published in spite of the unfavourable circumstances, and which could not be mailed so far. They are deeply convinced that the Hungarian Geological Institute will do the same as soon as possible.

Chief geologist Dr. Gy. Halavàts, the acting librarian, was overjoyed by the reestablishment of the connections, the reorganization of the *Comité* after World War I, and the reassumption of its regular work. He was ready, and with pleasure, to receive the always very valuable "Bulletin" and to promote the renovation of the broken interrelations.

This correct scientific spirit succeeded in maintaining the exchange, an almost unique fact, in these times, for Hungary's libraries.

Beside its bearing upon the conservation of the scientific mentality, series of publications thus received in exchange represent an almost unique value, because they could not have been purchased directly.

Nowadays, another important task is fulfilled by the Library's exchange activity, i.e. that of promoting the progress of science in the developing countries.

Ten years after the Institute's foundation the Library had already one hundred exchange partners. Thirty years later the number was increased to almost 200. *Now, at the end of the first century, it is 752.*

Accordingly, the number of the publications received in exchange grew from 214 volumes in 1900, to 300 just before World War I. Both World Wars meant a considerable breakdown; interrupted exchange relations had to be reconstituted. In fact, after 1945 exchange activity boomed as never before: in 1958, already 1148 volumes of periodicals were received in exchange; and in this year 1733. The Institute has established exchange relations with 80 foreign countries.

During the past years new exchange partners were sought, not at random, but preferentially among the Mediterranean and developing countries.

Librarians of the Institute. The names of those librarians, whose diligence and enthusiasm has founded, preserved and developed the Library of the Geological Institute, are found in the archives only. These old notes throw light upon the efforts of a modest social class consisting of minor officials and clerks, of whom nothing would be known except for the commonplace situation that they were constantly underpaid by the State to the measure that they were forced to beg advanced pay, financial aids and increase of salary, if they had not found a better chance in the Institute's Library.

During several decades a senior geologist was appointed to supervise the Library, and to manage and direct its development.

The first nominated librarian of the Institute was R. FARKASS in the seventies-eighties of the last century, who also headed the Institute's office. A fact characteristic of his enthusiasm is, that he undertook, at his own initiatives to compile a chronicle of the Institute's first decade including its organization and activity: on the occasion of the tenth anniversary of its foundation. When he asked financial support for printing his work, he was plainly refused and even rebuked by pointing out that he had not been charged to do this work, so it was to be considered as a manuscript of purely private character, and as such, it could not be printed at the Institute's expense. As a matter of fact, it nevertheless was printed two years later and represents one of the most valuable documents of the Institute's history. He reported that *the Library's stock in 1879 included 1600 volumes.* These consisted of geological and paleontological books and periodicals written in many languages. Moreover, the Library already disposed of considerable printed material on zoology, botany, mineralogy and petrography. While acting as a librarian, R. FARKASS undertook the first revision of the Library, composing the list of the books lost during the first thirteen years.

The first means of orientation in the newly founded Library was the title list, a forerunner of the present-day catalogues. The first one registered only 770 items. The rapid growth of the Library is reflected by the fact that after the first ten years the stock was rearranged and a new title list was prepared. Owing to the insistance of R. FARKASS, also, this one was printed in 1884.

Another prominent librarian: J. BRUCK followed his predecessor's footsteps preparing a "Supplementary Title List" consisting of five volumes, reflecting the further rapid growth of the Library.

A difficult phase in the history of the Institute and of the Library was the period of the frequent transportations. The Library had to move seven times before it found its definite home in the new building of the Geological Institute constructed according to the architectural designs by Ö. LECHNER.

It can not be undertaken to enumerate in the style of true chronicles all the workers of the Library. Let us select a few of them, who promoted essentially the Library's development or who brought new colours to its activity.

Chief geologist GY. HALAVÁTS, chief mine councillor was, among all the geologists of the Institute the most closely connected with the Library. As a junior geologist, he joined the Library's work, copying the base inventary. He was always ready to give assistance to the Library, if it was necessary. The successor of R. FARKASS was introduced to his job by GY. HALAVÁTS. He was the first geologist to be charged with the supervision of the Library and of the Map Depository. He took care of the Library and of its development for more than a decade, paying particular attention to establishing new exchange relations.

P. TELKES, librarian, died in World War I. The Library was left without a competent manager and had to face a rather difficult situation which threatened it with complete chaos. In 1915 the Director, L. LÓCZY SR., asked again GY. HALAVÁTS to rescue the Library. Thus he devoted the major part of his time to the Library, consuming with prodigious patience the accumulated backlog. He went on with his precious and most useful work till the end of his life in 1925.

After the death of HALAVÁTS, Director F. NOPCSA invited K. LAMBRECHT, the world famous specialist in paleoornithology, to head the Library. He was a particularly prominent leader. His activity brought fresh air into the Library, which became not only one of the major intellectual centres within the Institute, but also a public forum of Hungarian and foreign specialists, where relying upon the most up-to-date literature, scientific problems were discussed. He created a "living information service": being familiar with the particular interests of each geologist, he promptly informed them of the relevant news. Making use of his broad international connections, he established numerous new exchange relations. He filled the existing lacks in the periodicals and other publications. His activity opened new vistas to the Library. And beside all these merits, he was a world-famous representative of the new, biological concepts in paleontology; and created, owing to his incredible working capacity, the high-standard popular scientific literature in Hungary, thus providing an important factor for the education of the youth and of the large public in general.

The flourishing Library was badly hit by World War II. That which was collected, registered and stored in the Library, preserved from the dangers of the devastating World War II, hidden in, and recollected from air raid shelters and remote country castles, restored and renewed, was to be changed into an up-to-date library by the present generation of librarians.

The exchange relations established before, were to be revived *after World War II* and new partners were to be won. It was necessary to take into consideration the achievements and requirements of an up-to-date library of science, to restore order and discipline, to create favourable conditions for peaceful work, and to draw up new plans.

The small, but enthusiastic *group of librarians* employees took undergraduate and graduate courses in order to become qualified librarians. They studied the trends of evolution in Hungarian and foreign libraries, aiming at an immediate utilization of all experiences at the Institute's Library. One of the principal tasks of the Institute's first Five Year Plan was to settle the urgent problems of the *Library* counting already more than 100 000 volumes, which were temporarily stored in overfilled rooms.

The storing magazine of the *Library*, which had been designed by architect Ö. LECHNER, situated in the central axis of the Institute's first floor, has been divided into two levels by an iron scaffolding. Utilizing all wall surfaces, a system of movable iron shelves has been constructed, leaving free interspace for the necessary "corridors" only. Only the original, "Hungarian-style" columns are spared, respecting the building's architectural monumental character. Neon lighting has been introduced.

During the second Five Year Plan, also, the ancient *reading room* was modernized. Instead of the old, long and uncomfortable common reading-table, now, there are small reading tables for two persons each. Next to the entry there is a lending desk, in which the borrower's cards are located. Along the walls are arranged the cases of the reference library, for use according to the open access system. Here at the readers' disposal are the most important manuals, dictionaries, encyclopedias, abstracting journals, bibliographies, and all the Institute's own publications from its foundation to the present day. Moreover, there is a microfilm reading apparatus for free use. The furniture is modern-lined and of light colour, providing an agreable environment for the scientists reading in the awe-inspiring silence of the room.

The former library room has been transformed into a *catalogue room*, furnished with catalogue cases and a built-in glass-case in which the most recently arrived publications are exhibited. *The creation of detailed, up-to-date catalogues was a very important step*. (The former obsolete "title lists" and "supplementary title lists" were substituted by these.) At first, hand-written catalogue cards were made, which did not contain exactly all the necessary bibliographical data and did not correspond to the international standards.

The completion of the titles and the preparation of catalogues according to the up-to-date international standards was started after World War II. (New acquirements were already correctly catalogized, the revision and modernization of the old cards, however, is a long term work. In order to facilitate handling, old and new catalogues have been united by means of photographic uniformization.)

There are two fundamental catalogues at present; one of the independent works (books) in alphabetical order of the authors, and another of the periodicals. There was no thematic catalogue in the Library before World War II. This is being made now according to the *Universal Decimal Classification system*. It will gradually be completed for the entire stock. As an aid to the reader's easier orientation an alphabetical subject index is being made. To the catalogue of the periodicals, a geographical catalogue, following the alphabetical order of the countries, has been added. Another catalogue contains the references concerning the scientific subjects of first importance for the research going on in the Institute. Finally, for both the independent issues and the periodicals a storing-order or official catalogue is being made. In this catalogue all particular details about a given periodical are carefully recorded [year, volume and issue (number) indications, title changes, missing issues, respective correspondance, etc.]. Current periodicals are being registered according to the so-called *cardex system*.

Aiming at regular literature information, recently arrived publications are exposed two days every week in the reading room, so the staff scientists can skim the new acquirements, noting the items of particular interest.

The Library's bibliographical services will be further developed in the future. The recently started "*Könyvtári tájékoztató*" series is the first attempt. During the past few years, bibliographics have been made and new literature has been reviewed concerning given regions and geological epochs. Finally, a title list of the papers published in the Institute's own issues is continuously prepared.

A special service offered by the Library is the so-called "*inter-library lending*". Special literature requested, not to be found in the Library, may be acquired — or borrowed — from other libraries in Hungary and abroad, in form of printed matter or microfilm.

The sum disposable for purchasing publications — with the exception of exchange and donations — is determined by the financial budget. In the last century, it was the Director's privilege, to order publication purchases. Nowadays, it is a common duty of all staff members to propose papers to be acquired. New editor's catalogues, price lists and other informations are constantly at their disposal; every scientist has the right to express his desire concerning the acquisition of special literature. A "Library Committee", composed of several scientists appointed to aid the Library's work, makes a selection of the requests, forwarding a joint proposal to the Director, whom the right of decision has been reserved to.

The Library of the Geological Institute, being a national and public library specializing in geology, lends books and periodicals to external members too. *Lending* was controlled from the very beginning by exact prescriptions, the first regulation dating back to 1883. It has not been changed very much, except for time scheduling. (Originally, the Library was closed during two months in the summer, and it was open on some days of the week only and even on these days for a few hours only. For the time being, the Library is open on all work-days, from 9 a.m. to 4 p.m. without any summer holidays.)

Tracing back the Library's history, very scarce evidence has been found as to the *development of the membership*. Reports and other records register the increase of stock and exchange, but do not mention the number of items lent. There is a single note from 1911, in a report by Director L. Lóczy Sr., that "from October 1911 to December 31, 18 persons made use of the Library on 22 occasions". This is to be compared with the actual situation, when *in a year*

6000 touch 150 000 volumes; of these 1800 persons borrow 6000 items. (It is worth being mentioned, in addition, that the books most frequently used by the specialists are kept always at hand in their working rooms.)

The Institute's Library stands outside the network of the National Library Organization, but it is in close connection with the biggest and greatest libraries of the country. New acquirements are regularly reported for being included in the Central Title List of the National Library. For several years abstracts were prepared from a few selected journals for the National Technical Library. Annual exchange growth, being of national importance, is regularly reported to the top library authorities.

The Library's annual reports deal with four topics: *1)* acquirements; *2)* processing; *3)* bibliography; *4)* reading and lending services. An additional duty of the Library's officials is to take care of the Institute's own Publication Depository, containing about 100 000 volumes. The activities outlined above are being performed by a staff consisting of four professional librarians, one contractual librarian and one store-keeper.

All these intend to carry on their work with unchanged enthusiasm and sense of duty, relying upon the traditions of the past one hundred years, working for the future.

THE MUSEUM OF THE HUNGARIAN GEOLOGICAL INSTITUTE

by

A. TASNÁDI KUBACSKA, DR. PH., DR. SC.,

Head of the Museum, Hungarian Geological Institute

During the one hundred years from the birth of the Hungarian Geological Institute on, the Institute is the greatest home of scientific geological research in Hungary.

Director J. FÜLÖP, lecturing on the actual organization tasks in the earth sciences at a session of the Hungarian Academy of Sciences in 1967, said: "*The paramount duty of the Institute is the preparation and publication of the small-scale and detailed geological map series of Hungary, the all-round and thorough exploration of the mountains and basins containing exploitable mineral resources, and the publication of the results of all these investigations.*"

This enormous research work is substantially supported by the various sections of the Department of Documentation. Of these, the Institute's *Museum* ranks among the first; it was called into being simultaneously with the foundation of the Institute.

The one hundred years have not passed without considerable effect upon the Museum. Its duties were primarily outlined by the Institute's deed of foundation; later, however, its scope was sometimes widened, sometimes restricted, in response to the ever-changing requirements. Finally, all its collections were completely reorganized and renewed, and in 1966 new, up-to-date rules of organization were drawn up.

The past hundred years brought no essential changes in the life of the Museum, so that it seems to be convenient and actual, to review, for this comprehensive chronicle, represented in the present volume, the history, the present state and organization, showing the probable further development of all the collections comprising the entire second floor of the Institute.

It was on June 18, 1869, at Schönbrunn, that the proposition forwarded by I. GOROVE, Minister of Agriculture, Industry and Commerce, dated June 11, 1869, concerning "the organization of a Hungarian Geological Institute according to the project presented", obtained royal approval, and the Minister was summoned "to forward a proposal as to the nomination of the Director of the aforesaid Institute".*

I. GOROVE, in point two of his proposition charged the planned Institute with the task of determining the minerals and fossils to be collected in the course of the geological investigations and to deposit them in systematic collections. I.e., the creation and management of the geological collections were assigned as one of the principal tasks of the Institute.

The same topic was dealt with a new when the Minister proposed to King FRANCIS JOSEPH I. to appoint M. HANTKEN as the first Director of the Institute. Among other advantageous features of HANTKEN's personage, he emphasized his being versed in the creation and organization of collections and in the popularization of geological knowledge by means of exhibiting collections.*

The tasks of the Museum are outlined in definitive form, under several points, in the royal deed of foundation, the preparation of which was assisted by the already appointed Director, M. HANTKEN. Determining the Institute's aim and scope, it reads under point *(c)*: "The establishment of petrographic and paleontological collections, representing the formations which take part in the geological composition of the territory of the Hungarian State, and characterizing the paleontological features of these." And point *(e)* assigns expressly as one of the Institute's duties, "to spread geological knowledge by lectures on geology and paleontology."

Moreover, the deed of foundation "gives to the disposal of the director a sum of money, determined by the Minister for the starting of excavations, which are required for the exploration of the geological setting and for the collecting of geological objects." The chief geologists were charged to take the necessary measures "to organize, to establish and to keep open for the general public geological and paleontological collections."

The part of this document, dated 1869, which contains the prescriptions concerning *the establishment and organization of collections*, is worth being entirely quoted here, as it contains extraordinarily clear and circumspective regulations which surpassed by far the average mentality of those times, and determined for almost a century the

* According to original documents preserved in the National Archive.

activity of the Museum; they are worth being transmitted to posterity.

It reads word by word:

"The petrographic and paleontological collections to be established by the Institute should be made, such as, to represent in as detailed a manner as possible the territory of the Hungarian State, as well as the geological setting of its particular mountains. There are three types of collections:

(*a*) general paleontological,

(*b*) regional petrographic,

(*c*) regional paleontological ones.

The *general paleontological collection* serves as an aid for the scientific study of the paleontological objects collected during the surveys, and acquired by exchange or purchase.

The specimens of the collection are ordered according to the zoological and botanical system, and so, that the genera are arranged in stratigraphical order, according to the formations in which they occur. The general paleontological collection is guarded in the working rooms of the Institute.

The *regional petrographic collection* comprises the rock types building up the geological setting of the territory of the Hungarian State. These are ordered according to the system of regional geology, so that the rock types building up the different mountains and regions are arranged according to their geological age.

To the petrographical collections geological cross sections are to be added, illustrating the position and setting of the rocks.

The *regional paleontological collection* contains fossils occuring in the formations of the territory of the Hungarian State. For the arrangement of the geological objects, the same system is applied, as for the regional petrographic collection. Geological cross sections are to be added to this collection as well, demonstrating the distribution of fossils in the respective formations and their layers. The regional collections are to be exhibited in a site convenient for being visited by the public. In order to register the collections, acquisition and inventory protocols are made. In the acquisition protocol, the collected objects are entered according to the numerous currents, in the succession of their acquisition; the way of their being acquired is noted, i.e. purchase, exchange, gift; eventually remarks may be added. Inventory protocols are subdivided into four types: the protocols of (*1*) the regional paleontological, (*2*) the regional petrographic, (*3*) the regional paleontological collections and (*4*) the protocol of duplicates.

In order to avoid the accumulation of still not ordered materials, the objects collected during the surveys are to be registered and placed into one of the aforementioned collections, after their having been investigated, while other acquired objects—without delay, after their arrival. Objects which are not suitable for the collections are to be excluded immediately.

In order to enrich and to enlarge the collections, collecting and excavation works are to be carried out at the famous fossil-bearing localities of the country, in the measure of the financial possibilities provided."

Unfortunately, it was only twenty years after Hungary's unsuccessful War of Liberation, that these up-to-date foundation regulations were drawn up. The general lack of money prevented the Director — although he was a scientist renowned all over Europe — and the appointed distinguished experts (B. WINKLER, J. BÖCKH, K. HOFMANN and A. KOCH) from promoting the realization of the Museum's aims.

After 13 years of acting as the Director, M. HANTKEN left the Institute. During this relatively long period, he could not organize the Institute, in spite of doing his best, in a proper, or at least in a tolerable manner. This affected negatively also the establishment of the Museum.

No year passed without a petition being made concerning the budget, pointing out more and more the intolerable situation. Twenty two years after the foundation, in 1891, J. BÖCKH, the Institute's second director, wrote to the Minister:

(1) In 1870 the Institute was accomodated in four rooms on the ground-floor of the house at Arany János Street 20, together with its collections which were put into eight cases.

(2) From 1868 to 1887, the Institute was located in various uninteresting houses. In consequence "the incessant migrations, together with the increasing collections is acknowledged to be very disturbing and damaging. The accomodation of the Institute in tenement houses which have been built for quite other purposes, to meet very different requirements, could never be judged as appropriate."

"In the rented flats", BÖCKH goes on, "the collections were arranged in four (in fact, rather small) rooms. The materials, arranged systematically in the rooms which were at our disposal for the collections, were always seen, being quietly contemplated by Hungarian and foreign scientists. The words of appreciation heard from widely different circles encouraged the Institute to carry on its respective work, although all Hungarian and foreign visitors unanimously pronounced disapproving words about the rooms which served as the site of the collections."

The tight and inconvenient accomodation of the collections induced the Director and the Institute's staff to be crowded together in a surface of approximately 370 square metres, in order to assure a space of 500 square metres for the collections. BÖCKH emphasized, that he had already reported: "these branches are growing relatively rapidly, compared to the general development of the Institute: i.e. the Library, including the Map Depository, and above all our collections."

(3) In 1887, the Institute moved to the new building in the Ministry of Agriculture. Here a surface of 1400 square metres was reserved for the Institute — in principle — but when everything had been transferred, it obtained only 512 square metres for the collections, i.e. only 12 square metres more, than the space which had been disposable under the former primitive conditions. One part of the materials were put into the cellar, carefully packed in cases.

This is a frank letter, presenting the bad situation without trying to gloss it over. Böckh noted on the cover of the file, that it was handed over by him personally to M. Fejér, State Secretary of Agriculture on October 23, 1891.

Reading these data, the question arises, what was the production of the Institute until 1891, what the activity that resulted in such an increase in the Library and the collections. The answer to this question is an integral part of the chronicle of the collections, providing the proper background of it.

Now, till the completion of the map sheets surveyed to 1890 inclusively, 1416, 52 square miles of Hungary's territory have been geologically mapped at a large scale. Further 207,72 square kilometres of mine geological survey begun in 1883 (the mine district of Selmecbánya, Körmöcbánya, Nagybánya, etc.) and 12 371 square kilometres of the Székelyföld area in Transylvania are to be added. From this large territory complete materials were sampled for the exhibitions, care was taken of acquiring comparative materials both from Hungary and from abroad, and a systematical selection of objects important for mining and applied geology was made.

The particular attention paid to the enlargement of the comparative collections is aptly illustrated by the fact that A. Semsey, the maecenas and honorary director of the Institute, spent 15 000 franks to buy from the heirs of the French Professor M. Coquand one of the biggest and most important paleontological collections of France in those times. This collection consisted of about 30 000 specimens of more than 10 000 fossil species.

The final conclusion drawn by Director J. Böckh in his petition is that, "the convenient accomodation of the Institute is scarcely conceivable in any other way, no matter how simple it should be, an appropriate, well-lighted building, which *can be from time to time enlarged*, being unlimited in any respect regarding needed space." (Document in the collection concerning the Institute's history.)

This was the situation in the first quarter of the Institute's first century. Its prominent experts had already mapped almost one quarter of the country comprising the entire Carpathian Basin, when conditions began to improve. A new Minister appeared on the scene, and being aware of the precarious situation, succeeded in getting a bill through Parliament granting an enormous sum for the construction of an appropriate building. The piece of ground was a donation from the capital, and A. SEMSEY added 50 000 golden forints for construction and organization purposes.

In 1899, J. BÖCKH opened the gate of the Institute's own building, in which the museum comprised the whole second floor. It turned out that the material which had been packed into cases and stored in magazines, cellars and working rooms, now, accurately prepared and arranged, at once filled the many rooms of, indeed, imposing dimensions. SEMSEY was purchasing, during quite a number of years, the excellent exhibition materials of the world famous localities of Holzmaden, Solnhofen, the Bad Lands and others. Quite a series of Mesozoic vertebrate fossils were brought to Budapest from the preparing workshop of B. HAUFF: wonderful specimens of *Ichthyosaurus*, *Teleosaurus bolensis*, *Mystriosaurus*, *Pelagosaurus*, some of them several metres long; a complete *Rhamphorhynchus* skeleton from Solnhofen, fishes, *Homaeosaurus* and many others.

J. BÖCKH, deceased on May 10, 1909, and a month later (June 18, 1909) the Institute's new director, L. LÓCZY SR. issued the "*Guide*" to the museum of the Institute in two versions; the Hungarian language one consisting of 316 pages, the German language one — of 347.* Leaving out the mentioning of several smaller papers, this was the first work, that dealt with the description of the Institute's building, publications, history, staff, equipment and laboratories, devoting 289 pages to the careful and scientific description of the museum. At that time, it was made up of 10 very spacious intercommunicating rooms — a total surface of 1470 square metres — which provided the possibility of doing a complete round-tour among the cases exhibiting the systematically arranged collections.

The "*Guide*" is not a dry enumeration of scientific objects and facts. It was the first volume of the popularising issues planned by the Directory, and its style corresponded to this aim. An unusually big number (167) of characteristic, interesting and well-printed illustrations were included. In connection with some bigger, more important mineral, rock or fossil specimens not only a popular, but correct

* Führer durch das Museum der kön. Ungarischen Geologischen Reichsanstalt. Bp. 1910, pp. 1–347.

description was given, including the mode of occurrence and preparation, but also commentaries published in Hungarian and foreign papers, where on one or two pages the scientific conclusions could be drawn.

The author of this chapter remembers well that as a child he read and re-read the "*Guide*" till it became ragpaper; but now, as he looked for another exemplar in order to use it for the writing of the present chronicle, it turned out that the Institute is in possession of two copies only.

Let us quote a description, a well-known one for every geologist (not only in Hungary).

"*In the corridor of the museum, to the right, a big sandstone layer, supported by a low scaffolding, catches one's eye.*

Regarding it attentively, it is conspicuous that its surface is full of smaller and larger imprints, which may be interpreted as footprints of animals — mammals such as rhinoceros, deer, — and birds. This rarity was found near Ipolytarnóc, Nógrád, in 1900, and preserved from destruction by Chief Geologist I. SZONTAGH *von Igló, accompanied by* DR. H. BÖCKH *von Nagysúr, professor at the Selmecbánya Mining Academy. The significance of this sandstone bed, full of footprints, is stressed by the fact that it occurred in the immediate vicinity of the famous lithified pine trunk, described in the literature under the name* Pinus tarnócensis. *Moreover, Professor* A. KOCH *found near these, several hundreds of fossil shark teeth. This renowned locality at Ipolytarnóc is situated to the east of the village in a ditch called Borókás. Examining the steep gully from its bottom to the top, the following geological cross section can be observed. At the base, one finds loose sandstone, containing shark teeth. This is overlain by 2—3 m thick beds of coarse-grained quartz conglomerate, overlain on its turn by sandstones of dark-brown colour, which are rigid, of splintery fracture, and can be split into sheets of varying thickness. It was on the surface of this sandstone, that the footprints, which are now lying before us, where found by the local foresters. Towards the hanging-wall of the footprint-bearing sandstone one can see carbonized plant remnants, and all these are overlain by a mighty cover of trachyte tuff, which turned out — according to the investigations made by Prof.* KOCH *— to be biotitic andesite tuff. At the contact of the footprint-bearing sandstone and the tuff, lies that 25 m long pine trunk, which has become renowned all over the world. It appears from the succession of beds sketched above, that the Tarnóc sandstone is a near-shore deposit of the Lower Mediterranean sea, which by the caprice of Fate preserved some rests and vestiges* *of sharks, reptiles and mammals. The fine preservation of the bird and mammal footprints is due to the circumstance, that the Miocene sea-shore was abruptly covered by volcanic ash of the nearby volcanoes.*

If we note, that these events occurred before the Diluvium, approximately in that time, when the coal seams of Salgótarján were deposited in a bay of the Lower Mediterranean sea, we are clear about the many hundred thousand years' past of these footprints."

This is, in fact, a brief essay, a faultless summary of the relevant knowledge of those times. It records the historical facts, the description of the succession of beds, the position of the footprint-bearing sandstone, and the fact that the *Pinus tarnócensis* occurs at the sandstone/tuff contact. "It appears from the succession of beds sketched above, that the Tarnóc sandstone is a near-shore deposit." This was confirmed by the petrographic investigations performed by M. HERRMANN at the National Museum in the recent past, and the same conclusion was drawn by Prof. E. VADÁSZ as well. Even the age datation (Lower Mediterranean) is correct.

Mammoth skulls and a mammoth skeleton were also included among the exhibited objects. The text provides information on the circumstances of their occurrence, devotes an entire page to the mammoth finds in Siberia, to the role played by CUVIER and BLUMENBACH, and to the stuffed mammoth of the St. Petersburg Academy. In connection with the skeleton of the cave bear, information is given about the skeletal parts of Pleistocene vertebrates found in Hungary and abroad; moreover, the history of the excavations and the old diluvial flood theory are discussed in a fascinating style. *Placochelys*, *Brachydiastematherium*, the *Mesocetus* skeleton, the *Heterodelphis* remnants and F. NOPCSA's famous *Dinosaurus* finds from Transylvania are treated in the same manner.

Hundreds of beautiful vertebrate finds are dealt with by the "*Guide*". This description of the collection of Hungary's fossil vertebrates is, as a matter of fact, the first accurate review of this important animal group. Even since then, no comparable paleontological description has been made of these precious materials collected in the Carpathian Basin and deposited in the Institute's collection. Moreover, and at the same time, it may be considered as the first attempt to write a popular book on this subject. This requirement was met much later in the twenties by K. LAMBRECHT's independent work entitled "*Az ősember elődjei*" (The Forebears of Primeval Man).

At the end of the chapter, the asterisk is followed by two additional pages. On these, the reader is summoned to explore, to preserve, to impregnate and to prepare eventual finds and to classify them for the experts at the Geological Institute and the National Museum. It is even nowadays a quite up-to-date text, a clever and foreseeing sollicitation.

The next chapter is an interesting attempt in the grouping of Hungary's mountainous, hilly and plain regions, written by L. LÓCZY SR., Professor of Geography at the Budapest University, Chairman of the Hungarian Geographic Society, Director of the Institute. Since, the collections were still arranged according to the old, provisional system, he wanted to provide an aid for the better orientation of the museum's visitors.

The greatest part of the collection exhibited, in several rooms, the enormous material of invertebrate fossils of the Carpathian Basin, according to a partly natural, and partly artifical regional arrangement. Another room contained paleobotanical objects. In glass cases standing along the walls of all the rooms were to be seen the more than 20 000 rock specimens of Hungary's stratigraphic and petrographic collection. Most of them were regular, brick-shaped pieces, and all were documentary samples: to collect and to deposit such was a duty of all geologists like in all other institutions engaged in geological survey.

It is a pity, however, that later it was very difficult, sometimes even impossible, to determine on the map, or by the descriptions, the exact location where they had been sampled. There were not indicated any geodetic points, isohypses, or any other data which could have provided a possibility to sample the same occurrence again, except when the given rock type or bed was of larger extension and of only slightly varying composition. In most cases the geologists fixed the site of occurrence only by noting the name of the mountain, village, or route.

Of special interest was the Institute's *collection concerning mine geology*. It comprised objects of ore mining, coal mining, oil exploration, and salt mining, arranged according to the mining districts. The style of description was the same as mentioned above. The "*Guide*" devoted several pages to the history of ore mining in Hungary. The reader obtains instruction about the nature, origin, exploitation and mining possibilities of ores. The descriptions are illustrated by maps of the mines and by photographs of minerals. Notes on accessory minerals, paragenesis, exploitation rates etc. have been added.

At the end of the volume the comparative collections containing materials from foreign countries are described.

As a conclusion, it may be stated that the "*Guide*" is a very useful and precious document, providing an overall picture of the first forty years of the Institute's development. It testifies to the very considerable results attained by the vigorous effort of M. HANTKEN and J. BÖCKH and by the admirable work of the first geologist staff. The scientific material collected by them ranks among the first in the world; the preservation, arrangement, scientific level and popularizing effect stand up to any contemporaneous or present day criticism.

Putting aside the "*Guide*", one begins to consider the further possibilities. The building is already filled up with excellent materials. But — what now? Is there any possibility of development? No, there is none. And it was the same with the Library and the Laboratories, ten years after the spacious building had been constructed.

J. BÖCKH signalled already in 1891, that such a building was to be constructed, which could be enlargened from time to time. Let us see what happened hereafter.

On March 21, 1911, J. BÖCKH's successor, Director L. LÓCZY SR., asked the Minister of Agriculture, to buy for the Institute the adjacent piece of ground, where "the construction of a Geophysical Institute, including rooms for the observation of earthquakes", could be started. It is a characteristic historical fact, that already at the very beginning he intended to settle the problem of geophysical exploration within the Institute, incorporating geophysics into the organization of the Institute.

The petition was renewed on February 15, 1912, and laid before the Minister on March 1, 1912. The authorities, however, paid no attention to it.

Loosing his patience, in June 1913, LÓCZY prepared another petition, exposing in detail the precarious situation brought about by the always more and more rapidly increasing geological exploration activities. The point was to purchase a piece of ground of 1300 square fathoms owned by the capital. LÓCZY outlined an admirable project. The new building would provide a home for the "practical museum" and the laboratories. The former would have contained all the samples collected during the survey all over the country; the latter would have included all chemical laboratories, the workshop for rock sample cutting and thin section preparation, the instruments of rock mechanics, the printing shop, the devices for ore, coal, clay and gas testing, and all workshops. According to this project, 1400 square metres would have been set free in the old (actual) building. In this would have remained the enlarged Library, the museum's collections concerning mining, oil exploration, economic geology (stone, ceramical, cement-, ocre-, fertilizer-industry) and the entire collection of rocks and minerals. Here would have been accommodated the Hydrological Service, the Map Depository, and a lecture hall.

According to LÓCZY's project, a sum totalling to 910 000 crowns would have been needed for the construction of the new building, including the purchase of the respective piece of ground and its fencing in. Having received no answer, on November 24, 1913 he urged the affair, being afraid of speculations concerning the piece of ground.

The answer did arrive in 1921 (!), declaring that "if the circumstances improve, and an appropriate financial fund will be available, we desire the realization of the project."

In the meantime, however, a great many things happened. The piece of ground had been lost by speculation indeed, and then World War I. broke out, sweeping aside all projects. The geologists were called up for military service, and the Institute's life was very much calmed down in comparison to its vigorous pre-war activity. A proper heating of the too spacious rooms of the museum became impossible. The ordering of materials ceased and the public exhibition was closed, and remained so, for several years after the end of the war, because the peace did not remove at once the difficulties caused by the war.

During the twenties and thirties the unordered materials went on increasing; moreover, in the middle of several rooms new skeletons were mounted; newly established collections and exhibition sections contributed to the tumult of the overfilled museum.

Quaternary research, including the paleoanthropological excavations of an ever increasing extent, was booming all over Europe, producing innumerable various objects. On the other hand, however, the documentation of the recently started prospecting and mining activities concerning important mineral resources such as bauxite, ores of non-ferrous metals, bentonite, kaolin etc. was neglected; a curious fact, difficult to explain. In 1945, the collection of Hungary's mineral resources contained but 2-3 scores of ore and rock samples. After World War I., collecting activities were performed rather at random, and so were the explorations themselves, with continuous changes of the regions to be explored. It did not improve the situation, that the Institute asked other institutions to join in the scientific examination of the materials. As a consequence of this, objects collected on behalf and at the costs of the Institute, after having been examined, often were not returned to the Institute's museum.

It may be said that during the period between the two World Wars the principal stock of the museum's mineralogical, petrographic and paleontological collections consisted mainly of the materials collected before 1920 in the Carpathian Basin. Arrangement and methods of exhibition were also unchanged, with the exception of the few already mentioned new skeletons and collection sections.

Another fault of the collection management consisted in the fact, that sometimes important parts of the collection were accumulated in the working rooms of specialists, e.g. entire fossil groups as vertebrates, echinoides, unicellular animals, or the complete paleontological evidence of certain localities. They were not handled according to a uniform plan, and it happened more than once, that they were incorporated into the museum's collection only after the death of the given specialist, when the room was taken over by another research worker. In such cases it was obviously too late to supply the detected lacks, errors, inadequate data of age and occurrence. It also happened, that the specialist gave only numbers for the objects and consequently with his death the respective collection lost its value completely. There was no uniform concept of handling the materials and no discipline that would have been obligatory for everybody. Of course, this had its natural causes. Each specialist preferred to have the materials with him, till his work was published. Being given the fact, that publication procedures were rather protracted in consequence of the unfavourable circumstances, so was the restitution of the materials to the museum, and the accumulation of unpublished manuscripts involved the accumulation of materials as well.

The overfilled museum did not attract visitors. Entire rooms were filled with half-a-century old, obsolete objects, of no interest any more. E.g. a room was full of hundreds of visually absolutely identical clay samples together with the respective *Seger-cones*. In another room there were two thousand, cubic-shaped samples of rocks of industrial importance, most of them from localities abroad, but lacking exact data and explanations. This collection was extremely expensive. Its specimens were collected and polished during several decades, but their proper place would not have been at the Institute's Museum, specializing above all in the regional geology of Hungary, but rather at one of the Technical Universities.

It was a sense of wrongly understood duty that prevented the competent authorities from getting rid of this most obviously obsolete inheritance.

The same applies to the skeletons. These were, in the majority, not complete excavated ones, but were artificially "composed" bones found in the course of the excavations in caves. In the past century, when these were made, this procedure was not objected to from the purely scientifical point of view, since the concept of popularization and instruction prevailed. Even that point was considered negligible, that the separate bones mounted on an iron scaffolding resulted in absurd gigantic monsters. This was a general use all over the world in those times; but they required relatively too big a space in the documentary collection of a scientific research institute.

* * *

The idea of the museum's reorganization was at first raised in 1918–19, when the management of the Institute and its museum was taken over by young, progressive-minded, prominent experts. They intended to establish a national stock collection, by uniting the selected objects to be found in the collections of the Hungarian Geological Institute and the National Museum; to found a top-standard paleontological research institute, and to exhibit an "instructive" collection. The idea was developed in detail by several scientist (L. Soós, K. Lambrecht, G. Fejérváry): they started the relection and compilation of the objects.

The intervening political changes, the collapses of the Károlyi Government and the Soviet Republic, respectively, put an abrupt end to these endeavours. Besides, it was an innate fault of the project, that the uniting committee did not accept complete faunas, but selected the best specimens of both museums, in accordance with the predominating concepts of those times.

An important step was made after 1945, when director T. Szalai ceded the enormous paleoanthropological collection to the National Museum, remarking, that it does not correspond to the genuine field of research being performed by the Institute. The collection in question, was already asked for by the National Museum, more exactly, by the Ministry of Culture, in 1937, to be transferred to the Archeological Department of the National Museum. At that time, this was declined by director L. Lóczy Jr., in line with the superior authorities. T. Szalai, changing the former decision, did so with the intention of assuring a more convenient site for a more competent national institution.

Further measures followed. The radical reorganization of the Institute's collections was begun. Former director L. Majzon, and the actual director J. Fülöp made an agreement with the National Museum, according to which, the Institute will not organize public, popularizing exhibitions; ceding the objects which serve for this purpose to the National Museum (vertebrate skeletons, the Holzmaden and Solnhofen reptiles brought by A. SEMSEY, a major part of the Quaternary big mammals, the foreign-locality specimens of the petrographic collection, etc.) The collection of the cubic industrial rock samples was transferred to the Mineralo-Petrological Department of the Technical University.

To the order of the Institute's directory a new regulation for the Museum Section was prepared and accepted in 1966, which is in force at present. It reads: "*The Geological Collection (Museum Section) of the Hungarian Geological Institute collects and preserves the documentary objects of the national geological survey together with other collections and scientific documentary materials acquired by donation and purchase. It is in possession of special collections for comparison. Its scope of collecting activity includes Hungary's entire territory.*"

According to the regulations, the Museum Section "includes several groups such as those of the stratigraphic, vertebrate, paleobotanic, and type specimen collections, subsections of the mineralogical, petrographic and mineral resources collections, and a surveying sample collection."

Nowadays, the museum's work begins in the field. Collecting is done en masse. This facilitates the distinction of faunas, the delimitation of stages and zones, by statistical data processing. Every year hundreds of thousands of samples are registered, hundreds of thousands of fossils are examined by specialists: pollen and spore grains, foraminifers, Pliocene-Pleistocene small vertebrates, borehole samples. Are these objects of serial investigations of no value for the museum ? Not at all. The drilling costs millions of Fts, and the specialists' work is payed for as well. As a result, aboundant materials are incorporated into the Museum's collections. This, on the other hand, involves increasing problems of storing and handling. New acquirements must be prepared, registered, and labelled. The exact locality is marked on a map by means of a letter-and-number code, and is printed. Such finds become objects of high documentary value.

The regulation prescribes the systematical study of key sections. On these, collecting is performed by the Institute's experts, including the Museum's staff. All materials collected are transported to the Institute to provide a possibility for statistical evaluation. The majority is worth being preserved and registered on files as to their systematics stratigraphic and geographic position.

This reorganization requires the quiet and regular collaboration of all sections and members of the Institute. Not only new materials are to be managed correctly; it is an equally important task to select from the old ones the objects worth being stored in the museum.

Storing facilities must be continously enlarged, new cases must be set up. Requirements are high. Only one single fact should be mentioned. At the end of 1967, the museum possessed 370 uniform, double-door oak cases, i.e. more than 14,000 interchangeable drawers running on iron rails.

The Museum's well-arranged geological documentary collections of national character promote very much the efficient research. It was to this aim that the reorganization was ordered by director J. FÜLÖP. Public exhibitions were liquidated, popularization of science and instruction of the general public being the duties of the National Museum and — in the country — of the municipal ones. Accordingly, exhibition materials of such a nature were ceded to these.

The space thus gained provided a possibility to create several fundamental collections of high documentary value. E.g. at present, the collection of mine geology and mineral resources is stored in 30 big cases, while before the reorganization only a few scores of such objects were to be found scattered in various parts of the collections.

Advances are to be continued in this direction and in this spirit. The ever-increasing requirements of exploration and research can be met successfully only if assisted by a high-standard work in the museum.

LABORATORIES OF THE HUNGARIAN GEOLOGICAL INSTITUTE

by

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The establishment of the Institute's laboratories, their further development, the organization of large-scale material testing has always been in complete accord with the continuous progress of the Institute's activities and its more and more complicated tasks.

In response to needs imposed by the rapid progress of Hungarian geology,

a chemical laboratory

was organized in the Institute. The creation of a solid basis for the chemical analytical work, indispensable for a better knowledge of the composition of Hungary's mineral resources, rocks and waters, took place 14–15 years after the foundation of the Institute, in 1883. In looking over the list of the employees of that period, we already find a chemist among them.

It was Sándor Kalecsinszky, the first chemist of the Institute, who rapidly established his reputation with his great ability and high standard professional work. After some fruitful decades of activity, he became a corresponding member of the Hungarian Academy of Sciences, then he received the honorary doctor award, from the University of Kolozsvár. Shortage of appointments and machinery, in the first year, forced him to perform the analyses in the laboratories of Professor Wartha and Professor Than.

The young chemist was sent abroad on a study-tour at the beginning of 1884. His half-a-year stay in Heidelberg under the auspices of Professor Bunsen contributed greatly to his proficiency as a chemist. In the autumn of the same year in the Museum Street apartment house, which was rented by the Institute, he succeeded in creating the necessary working conditions, even under meagre circumstances where the analytical work could be done. Three years later having the possibility to work in the building of the Ministry of Agriculture, the Institute could provide better circumstances for laboratory work; here the chemist already had some aid from a newly employed laboratory assistant. In the next year, the qualifying analyses of the facing stone applied on the building of the Houses of Parliament were performed in the Institute's laboratory.

Beside increasing its work capacity in the subsequent years, the Institute could afford to enlarge the scale of analyses as well. KALECSINSZKY was the first to introduce a new method for determining the specific gravity of solid substances. The device constructed by him was named "*volumenometer*", capable of determining "specific gravity of water soluble, porous substances or of those which are lighter than water". Meanwhile, he started two series of analyses which led him to the writing of two monographs of great importance dealing with the testing of the resistance to heat of Hungarian clays and coal-analyses respectively.

The purchase and application of the newly constructed and extraordinary *Berthelot—Mahler calorimeter* which was rarely to be found in Hungary, brought about a decisive progress in coal-chemistry in 1894. It is well to note, that in the relevant reports of the laboratory concerning the new acquirements, the name of ANDOR SEMSEY occurs very frequently as the purchaser of the Institute's holdings. Coal samples from Hungary investigated in the Institute were presented at the World Exhibition in Budapest, organized for the 1000th anniversary, of settling in Hungary, in 1896.

The present home of the Institute was built in 1899. KALECSINSZKY also took part in designing the work; and the present sites of the laboratories were chosen by him. Hood-chimneys, water and channel conduit runs were made on the basis of his designs from the beginning of 1900 analytical work was continued on a larger scale in his final working place. Shortly afterwards another name appears on the list of chemists: K. EMSZT. The number of chemists employed in the Institute increased first to 3, then 4 in the later periods.

After the death of KALECSINSZKY, K. EMSZT took over the responsibilities as head of the laboratory in 1911. During a period of some 25 years under his guidance, the laboratory's top productions were the exhaustive studies on mineral and medicinal waters of Hungary and the silicate rock analyses of high accuracy, which were internationally renowned. The high importance of the detailed mineral water analyses may be characterized by the fact, that the laboratory of the Institute possessed a *Weszelszky-radioactivity-meter* apparatus as early as in 1912; freezing-point depression and conductivity were also measured at the same time.

As mentioned above, remarkable results were achieved in the analysis of silicate rocks by the application of methods aiming at high accuracy. Some rock analyses carried out in 1912 concern already 15 components, including Ba and Sr. The reliability of these rock analyses is effectively demonstrated by being recorded and often quoted in foreign handbooks.

In the last two decades the chemico-physical testing of medical muds were introduced, beside the mineral- and medicinal water analyses of high accuracy. All the most important medical mud-types of Hungary were analysed and qualified.

In the domain of the chemical laboratory work from the beginning of the 30-ies the following analytical tasks were completed:

- high standard analyses of silicate, carbonate, oxide rocks and minerals,
- chemical investigation of mineral- and other natural waters,
- chemical analyses of ore samples,
- studies in coal-chemistry; determination of main components, calorimetric value, ash- and moisture-contents,
- oil investigations.

As a consequence to the progress in the mining industry and the birth of special industrial laboratories, it was no longer, in the later periods, necessary to perform oil investigations, qualifying coal analyses and ore-testing.

At the same time, new, up-to-date analytical techniques were applied at the laboratory, to face different tasks and aiming at a possibly all-round characterization of Hungary's geological formations and mineral resources.

These methods provided the possibility for increasing the number of the analyses; maintaining or even improving their accuracy.

Introduction of *spectrography* at the laboratory in 1938 was an important initiative stimulating Hungarian geochemical studies.

In 1950, as a consequence of new knowledge about the structure and properties of clay minerals, clay-mineral studies became paramount in the field of geology. The immediate need for getting a general view about both the chemical and the mineral composition of the numerous clay-mineral occurrences in Hungary resulted in the introduction of *differential thermoanalysis*. The method was applied later on in the determination of the mineral composdtion not only of clay rocks, but also that of silicate, carbonate ai noxide rocks as well.

In the 50-ies several efforts were made, in order to meet the rapidly increasing requirements, to perform a greater number of analyses with the same accuracy and practically the same personnel. The further development of chemical analytical methods stemmed from the conclusions drawn from analyses made by many scientific researchers and laboratories abroad. *New analytical methods* were introduced; instrumental and volumetric analyses played a more prominent part than earlier. Some of the constituents were determined by means of a *spectro-photometer* combined with a *flame-photometer*, respectively. *Ion-exchange* procedure is frequently applied when aiming at benefication or separation. *Complexometric* determinations are used in water analysis together with flame-photometric methods.

The accuracy and reproductibility of the methods used in silicate rock analysis has been currently a lively subject among chemists and geologists all over the world. Several series of analyses were started, in order, to ascertain the reliability of *silicate rock analyses*. A paper was published by FAIRBAIRN *et al.* in 1951 about the results of a series of analyses on standard granite and diabase samples. GROSSMAN reported in 1966 about the second international series of analyses, initiated by the Geological Institute in Berlin, including, for the time being, only four types of samples. Our laboratory also took part in these investigations. A standard granite sample was prepared in the laboratory; for methodological purposes 16 analyses were carried out and evaluated on the material of this sample.

During the last five years, the chemical laboratory has developed into a *Section of Geochemistry*. It not only provides the necessary analytical data, but has started its own special geochemical processing and evaluation. Multiple duties, requirements of more intense labour resulted in the necessity of subdividing the laboratory according to several particular tasks. The Geochemical Section is divided into the following groups:

- *geochemical research group*, consisting of graduates in geology,
- *analytical laboratory group*, working on with the traditional methods of the original chemical laboratory,
- *instrumental analytical group*, performing spectrophotometric, flame-photometric, etc. analyses,
- *spectroanalytical group*,
- *geomicrobiological group*, studying at the present time the geochemical role of microorganisms with the help of model experiments.

* * *

The agrogeological—soil chemical laboratory of the Institute was brought into being shortly after the birth of the chemical laboratory. Its organization and outfitting began in 1892. There was only one laboratory assistent at work until 1901, then in 1902 K. EMSZT was charged with fostering the evolution of the soil-chemical laboratory. He should be remembered here, as a man who never ceased to develop working methods and who made pioneer efforts in the chemical classification of different soil-types on the basis of their chemical and physical characteristics.

PETER TREITZ was among the first to initiate the *First International Agrogeological Conference* held in Budapest in 1909. On this occasion, the agrogeological maps of the Institute were presented and international interest was soon focussed on this new, relatively young branch of earth sciences.

Successes achieved in the field of agrogeology and the urgent needs of agriculture resulted in broadening the capacity of agrogeological work.

The fortunate collaboration of TREITZ with such firstrate experts as ROBERT BALLENEGGER, BÉLA HORVÁTH, IMRE TIMKÓ and IMRE MAROS marked a considerable progress in soil-mapping and in the work of the agrogeological laboratory. In 1915, BALLENEGGER published the results furnished by the mechanical investigation of Hungary's soil-types.

It was in 1919, during the time of the Hungarian Soviet Republic, when the agrogeological laboratory had to move new offices giving birth to a Section of the Agricultural Botanical Station and it was developped as such, thereafter.

A national agrogeological conference convened at the Institute in 1924. It was declared in the resolutions to establish a new pedological laboratory in order to promote agrogeological mapping. A programme of prolonged soil-investigations and soil-qualifications was promptly started in 1926 by 5–6 experts (chemists and agronomists) headed by EMSZT.

A soil-biological group was organized in 1930 under the leadership of LAJOS KREYBIG who, 4 years later, took over the managing responsibilities of the united soil chemical—soil biological laboratory. From this time on, pedological mapping was carried out not by graduated geologists, but mainly by agronomists of the pedological laboratory. From the geological point of view, these soil-maps lacked the geological data which played an important part on the earlier types of maps constructed by TREITZ and TIMKÓ.

The deviation of pedological mapping from geology and the considerable development in the activities of the laboratory and also from the bearings of this work on agriculture, the laboratory was separated from the Institute in 1948 and has been developed into an independent Agrochemical Research Institute under the direction of the Hungarian Academy of Sciences.

* * *

The practical need for a chemical laboratory was succeeded considerably later by the recognition of the necessity for

a mineral-petrographical laboratory.

This can be explained by the fact, that the reliable quantitative analysis of rocks and minerals required the experience and knowledge of a chemist, while the mineral-petrographic investigations were included in the duties of a geologist, having been performed by the latter. This task, in addition to their other duties, was solved by them individually for a long time. Later on, their work was promoted considerably when some of the less complicated petrographic analyses, however in small quantities and not regularly, were carried out in the chemical laboratory.

The foundation of the *boreholes sample-testing laboratory* is connected with the name of H. BÖCKH, Director of the Institute, in 1929. With the exception of chemical analyses, all the material testing requiring a laboratory equipment, could be carried out here, including paleontological and coal-petrographic investigations, as well. Beside the core material testing, the laboratory was able to perform the examination of the samples collected during the geological surveys. Of the petrographic analyses, the laboratory carried out serial determinations of sand and carbonate percentage. In 1935, L. LÓCZY reorganized the laboratory, but followed no important change in its scope of activities. In 1939, mineral-petrographical investigations, together with other duties, were performed by a single staff scientist, K. KULCSÁR.

The *soil-mechanical-pedological laboratory* was established in 1947 and served as the material testing basis for the Section of Engineering Geology founded at that time. The newly organized laboratory gradually took over, till 1949, the tasks of the borehole sample-testing laboratory. A great number of determinations were made concerning grain-weight, together with soil-mechanical investigations.

The idea of a *Petrological Section* appears in 1950. It is soon at work in the processing of samples collected during the surveys. The newly established *Sediment-petrological Laboratory* of the Institute formed a solid basis for the testing of samples collected during the special geological mapping in the plain regions. All the equipment and also the members of the staff belonging to the former soil-mechanical-pedological laboratory were transferred to the Agrochemical Research Institute. While in 1950, the staff of the sedimentological laboratory consisted of two scientists and a laboratory assistant, the next year brought the total to six. Two of them were sent to the Mineralogical Department of the University in Szeged to be instructed in the job of laboratory assistant. The investigations of samples (approximately 10 000 in number in greater part of Pleistocene age) including determinations of the specific weight, volumetric weight, grainsize distribution and carbonate and micromineralogical investigations were completed in 1951–1952. At the same time, methodological experiments carried out in order to introduce the palynological macerations.

The concentration of the different laboratories resulted in the birth of the "*Material Processing Department*", in 1953. This included the sediment-petrological laboratory and the Petrological section — both classed as groups. In addition, a workshop was formed and operated within the scope of the petrological group with the task of preparing thin sections. Undoubtedly, the highest point in the history of the laboratory between 1954–57 was the complex investigation of the Liassic coal-bearing sequence of the Komló district.

By 1957–58, a new, important field of material testing was organized as an independent section, i.e. the Paleontological Section. Since that time, the work of the Mineral-petrological Section has formed an integral part of the complex and systematical research work combined with geological mapping according to geological regions. Serial investigations providing exact determinations of rocks, and descriptive, genetic mineralogical-petrological studies of particular sequences are made in the Section, within the scope of monographic studies of geological regions.

Organizational divisions of the Section has been unchanged since 1963. The Mineral-petrological Section, being a part of the Material Testing Department is subdivided into five working groups performing tasks as: *(1)* experts in mineralogy and petrography; *(2)* group of instrumental analysis; *(3)* coal-petrographic group; *(4)* a workshop making thin sections; *(5)* the organization of a rock-mechanical laboratory is under way.

Paleontological research has been carried out from the very first instant. Paleontological studies were closely associated to the stratigraphic classification of the geological formations in Hungary, one of the major duties was to preserve the stratigraphic paleontological evidence of documentary value. Although, the necessity for separate organization unit of

paleontological laboratory

was brought into being in the 1930-ies only, when dire needs of investigations brooked no delay. Up to that time, collecting, studying and evaluation of fossils of crucial importance in stratigraphy were executed by the surveying geologists themselves. To a smaller extent the gradual increase of the stratigraphic and paleontological collections of the Institute was obtained by individual collectors and by hoarding. It is of interest to note, that, in addition to the collecting and the investigation of macrofossils, attention was paid to microfossils already at a surprisingly early date. The Annual Report of the Institute from 1887 presents a *Bacillaria* collection owned by J. PANTOCSEK and G. ZECHENTES.

A great number of the Institute's publications include a series of remarkable stratigraphic and paleontological monographs, descriptive studies dealing with the paleontological collections of the Institute. Sometimes outside collaborators joined in this work. A paleophysiological monograph by F. NOPCSA and a study entitled "Paleobiological investigations in Hungary" by A. TASNÁDI KUBACSKA contain biological contributions valid even at the present stage of paleobiological knowledge.

In pursuit of the requirement simposed by the developing geological exploration of mineral resources by drilling, *a borehole sample testing laboratory* was organized in 1929. Thus, adequate conditions were created to perform special paleontological investigations requiring a more or less complicated laboratory equipment. According to L. MAJZON's report, published in the Annual Reports of the Institute, washing, selection and determination of fossil *Foraminifera, Radiolaria, Spongia, Echinoidea, Lamellibranchiata, Gastropoda, Os-*

tracoda and *Pisces* were performed here, aiming at a stratigraphic datation, mostly on a rapid determination level.

The Annual Report of the Institute in 1950 deals with the organization and activity of the Paleontological Section. Staff scientists E. Szörényi and M. Kretzoi were devoted to the study on macrofossils (echinoids and vertebrates) under the guidance of Gy. Vígh. The borehole sample testing laboratory carried on the investigations of *Foraminifera* and *Ostracoda*. In order to provide a proper basis for palynological work, the sediment-petrographic laboratory carried out methodological experiments, from 1951–52 on.

Since the years 1957–58, exploring by means of scientifically well-founded, systematic, planned geological mapping of the mineral resources possibilities of the country, the Institute's activity attained a new level. This large-scale scientific activity, surpassing all previous works, involved the rapid development of geological material testing and paleontological investigations, these being integral parts of the regional explorations performed.

The continual increase of paleontological tasks required the raising of the staff and equipment. For the sake of specific requirements of paleontological research work, the Paleontological Section has been grouped into three teams as follows:

a) A macropaleontological group consisting of 5 staff scientist, 4 technicians and a number of laboratory assistants. Their work is mostly devoted to the study of fossil *Lamellibranchiata* and *Gastropoda*.

b) A micropaleontological team consisting of 7 research workers, 5 technicians furnished with a laboratory for the preparation. They study small and larger *Foraminifera*, *Ostracoda* and *Coccolithophorida*.

c) A microphytopaleontological group: 5 scientific workers, 4 technicians and a preparing laboratory. This group is occupied mainly by *Diatoma* investigations and *spore-pollen* analyses, and by the study of *Silicoflagellata*, *Monodophyta*, *Dinoflagellata*, *Hystrichosphaerida*, etc. associated to the former.

69/984. Franklin Nyomda, Budapest. Felelős: Vértes Ferenc igazgató

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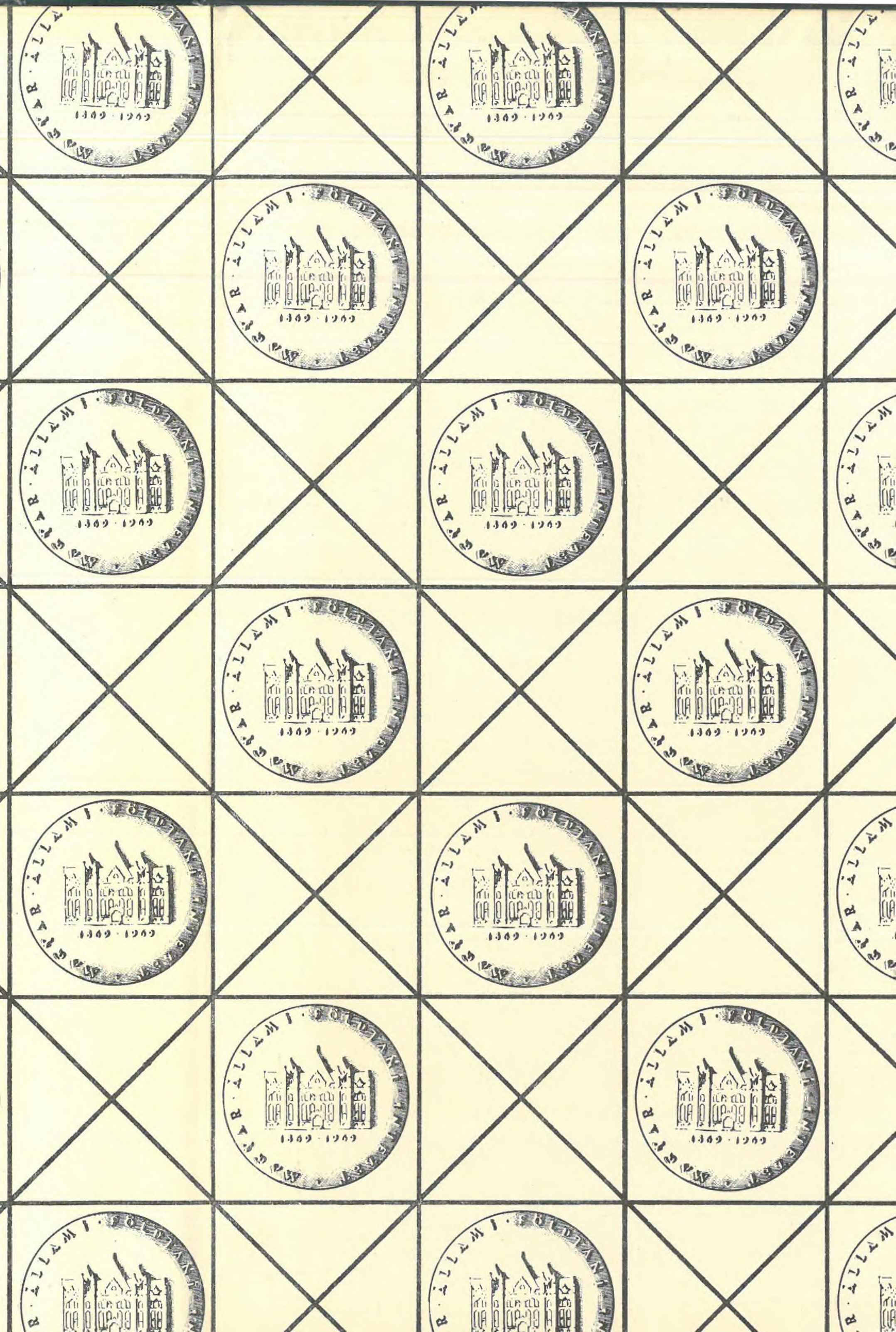
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