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Development of principles related to subsurface water prospecting in Hungary

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Some hundred years ago water requirements were covered also in Hungary, like in any other country, from groundwater resources.

Prospecting for subsurface waters in deeper lying formations began with the activity of V. ZSIGMONDY. He was an engineer and as such was probably more interested in the technical challenge of deep well drilling as in water production proper. Yet being a real researcher he showed interest for everything connected with his work, observing the penetrated strata, carefully collecting samples, extracting and examining the fossils found in the rock samples, thus performing also some kind of geological work and calling the attention of geologists to his historical geological findings. Despite the endeavours of V. ZSIGMONDY, artesian well drilling remained for a few decades a mere technical task, resulting in many dry holes.

The examination of the formations, penetrated by drillings, began at the turn of the century only with the work of the geologist GY. HALAVÁTS, inciating the development of Hungarian hydrogeology. In addition to the artesian waters, attention is given also to the karstic waters especially there, where high amount of water is needed, but no surface streams are available. The study of karstic waters begun by some miners, but soon it was taken over by geologists. The prevention of waterflooding of the mines requested a profound knowledge of stratigraphical and tectonical conditions. With respect to water production the geologist had to be consulted before locating wells or water works to lift karstic water. Control of artesian wells, steadily growing in number, became the task of the Hungarian Geological Institute. The importance of technology was superseded by science and geology, leading to the formation of a new branche of geoscience, i.e.: hydrogeology.

The geologists paid an ever growing attention to karstic water and artesian water problems and totally neglected the problems of groundwaters. Probably the reason for this phenomenon was the fact, that groundwaters are mainly important in the big plains, which are the least interesting for the geologists, because the big basins are usually covered by vast expanses of the most recent sediments without any outcrops of older formations and without any mineral deposits.

The goundwater remained therefore a problem for the civil engineer. The importance of the groundwater and groundwater flow was first recognized in Hungary by some civil engineers working on the regulation of the Tisza river to prevent devastating floods. P. VÁSÁRHELYI, in charge of the works, and his

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associates recognized, that at flood time also the level of the groundwater, i.e.: the water-table will also rise and if reaching the surface behind the dams it may cause great damage to the protecting system. Some observation wells were established and existing wells were utilized as observation wells. When the dam system was completed the observation service became forgotten. The service was started again considerably later due to an argument about alkaline formation in the soil through which agrogeologists working on the Great-Plain, and civil engineers working on river regulation and draining the swamps confronted each other. The construction of observation wells was started by Professor ROHRINGER (Technical University, Budapest) in the Danube–Tisza Midlands to observe the fluctuation of the groundwater table. Later it was taken over by the *Hydrographical Institute* under the supervision of the Ministry of Agriculture followed by VITUKI, both of them being engineering institutions, completing the wells, carrying out observations, collecting, interpreting and storing data with technical exactness.

The only contribution of geology was in this period the examination of hydrogeological conditions in the area of Budapest, compiled by H. HORUSITZKY. The study was a mere descriptive one, without any investigation of the origin of groundwater, of its flow beneath the surface, of the reasons causing fluctuations of the groundwater-table, and of the special problems of groundwater chemistry.

At the same time the Hungarian Geological Institute showed more interest towards the artesian wells and E. R. SCHMIDT compiled a register of artesian wells, parallel to the agrogeological mapping of the Great Plain in the thirties. Till now both: the geological and engineering activities involved data-collecting only.

Meanwhile a third party: the forestry appeared also in the investigation of groundwater behaviour. E. L. IJJÁSZ, while investigating the effect of forests on the position of groundwater in 1938 started the scientific examination and explanation of groundwater fluctuation.

This work was continued by Dr. J. BOGÁRDI, a civil engineer, carrying out deductive studies about groundwater motion by interpreting the data obtained from the Hydrographical Institute. At the same time J. SÜMEGHY (Hungarian Geological Institute) iniciated the accurate mapping of all water resources in the country. Country-wide some 1.2 million wells were accurately recorded (type, depth, water level, yield, etc.). The conclusions of the geologists were quite contradictory to those of the engineers, with respect to the origin of groundwater, to the reasons of water-table fuctuations, to the changes of chemical properties, etc. provoking a vivid argumentation over some years to come promoting a better acquaintance with the groundwater neglected for so long. The groundwater now occupies a prominent place in the hydrological literature.

By the concentration of all hydrological tasks country-wide in one organization, i.e.: in the *Hungarian Hydrological Authority* (OVH) the engineers took over the supervision of Hungarian water resources. The engineers requested precise numerical data about subsurface water resources (including groundwater), about the supply of water reserves, about consumption, etc., to establish a country-wide balance of water resources. The Geological Institute was not able to satisfy these requirements, therefore the Hydrological Authority wanted to take over water prospecting and it was decided that any consulting about the exploitation of subsurface water resources became under its authority.

Now the scientific examination of groundwater resources is supplemented by technical examinations, applying the laws of physics and mechanics, and observing subsurface hydrodynamics. Hydrology was further developed by the application of reservoir engineering knowledge built up in the oil fields, applying the results of subsurface geophysics, rendering highly valuable data not only for hydrocarbon exploitation, but also for water production and reserve estimation.

Thus water prospecting became also a branche of engineering sciences. In addition to hydrogeology the term geohydrology was introduced laying more emphasis upon hydrology, i.e. upon its engineering aspects. Also the content of the *Hydrological Bulletin* was correspondingly changed. The bulk of the several thousand strong membership of the Hydrological Society consists of engineers and an overwhelming part of the publications are engineering papers.

All of the above disciplines were united especially in hydrocarbon prospecting: utilizing geology, geophysics, physics, physical-chemistry, chemistry and mathematics as well as drilling technology to investigate the behaviour of formation fluids present in the rock formations in different physical state, observing their composition, effects and flow conditions, investigating their origin and accumulation. In this respect geology commands again an increased importance.

Up-to-date subsurface water prospecting similarly to hydrocarbon prospecting, became a complex operation based upon the methods, procedures and principles of the above mentioned disciplines. It was also recognized that groundwaters, formation waters, subsurface and juvenile waters, karstic waters, thermal waters, mineral waters can not be studied individually, being in close interrelation with each other, forming uniform hydrodynamic units as part of the big circulation system beneath the surface in addition to that above the surface of our planet.