



## **Karst hydrodynamics, estimation of renewable karst water reserves on Darcyan principles, resource utilization and management.**

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The fundamentals of karst science still rest with the great Thinkers of the 19th Century; "Surface studies of karst are hampered by the fact that surface features are controlled by underground water movement, without knowledge of which it is impossible to interpret the surface features properly." [1]. The reasons for lacking progress rest with the need of physical skills and psychological properties that the academics and traditional researchers normally do not possess.

Research into karst water utilisation for water supply came to head in the 1950s and 1960s, when the rapidly growing industrial city of Miskolc (North Hungary) faced extreme shortages in potable water. The proposed water supply from the alluvials of Bodrog River could not proceed, because the guarantee sought from Czechoslovakia to keep the catchment free of pollution had remained unanswered for six years. The reply arrived in waves of dead fish floating down the River with effluent waste from the experimental operation of a freshly constructed paper mill at the catchment.

In May 1966, the Author and his research group of cavers presented his findings to the technical elite of the time in a 3-day conference referred to Karst66. Fifty copies of the abbreviated versions of papers presented were suppressed for the reason of political sensitivity that surrounded the subject, and the Author was forced into exile in the same year.

The present paper is an updated and revised version of the material presented in 1966.

The paper deals with the hydrodynamics, hydraulic properties and hydrological mechanism of karst evolved in steeply dipping geological structures rising above the base

of erosion and penetrating to considerable depth.

Distinction is made between turbulent and laminar flows, and the Darcyan concept is applied to the flow in the limestone bulks, which exist between the underground flow passages, and the Author refers to it as "pore waters". The role of bulk karst is defined as the equivalent of long-term catchments and supply source of the well-known small groundwater basins of the surface.

In bulk developments the karst water level manifests the level of saturation of secondary interstices, which store the long term water reserve, while the main functions of flow passages are:-

collection of water from the interstitial storage, and storm water conduits.

For one typical karst unit of the Bükk Mountains the Pleistocene evolution of karst is reviewed, the hydraulic properties and water balance for the bulk developments have been estimated. It was found that under the given climatic conditions the rate of annual infiltration exceeds 40% of precipitation. Of the infiltrated volume about 20% is stored in the secondary interstices of the bulk limestone, in the zone of annual karst water level fluctuation. This volume of water supplies the long-term low yield of karst water outlets. The rest of infiltration passes through the karst as turbulent flow and floods.

The Darcyan storage of karst can be manipulated to release water in the low infiltration periods and recharge during the seasons of high infiltration. The intervention manipulates the karst water level, which in turn drastically minimises the karst floods, and provides significant yields in seasons of high water consumption and traditionally low karst water discharges. The process is referred to as "balanced extraction and storage in the natural karstic reservoirs".

The cost of implementation and maintenance is a small fraction of the cost of constructing surface reservoirs; losses to evaporation are practically Zero. The interstitial reservoirs are free of surface pollution. Quality maintenance and public security require low-level environment protection and security measures. The risks associated with high dam constructions are eliminated.

[1] International Union of Geological Sciences, Commission on Geological Sciences for Environmental Planning and US Global Change Research and Information Office, <http://www.gcrio.org/geo/karst.html>