p-Laplacian — history, mathematical models from hydrology and natural gas extraction, experiments

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In the first part of this talk we will discuss evolution of mathematical models of turbulent flow in porous media. The approach will be purely phenomenological and not from the Navier-Stokes equations. The governing equation will follow from the continuity equation and an empirical constitutive law (nonlinear generalization of the Darcy law). As the nonlinear generalization of Darcy law, we use the power law discovered by Smreker and verified by laboratory experiments by Kroeber, Forchheimer, Izbash and Missbach in 1880's - 1930's. We will focus on pioneering work on the development of these mathematical models due to Dupuit, Forchheimer, Zhukovskii, Christianovitch, Leibenson and Barenblatt in 1880's - 1950's. This historical review was a joint work with J. Benedikt, L. Kotrla and P. Takac. In the second part of this talk, we will discuss some very recent experiments done by D. Vesely and Z. Vesely on real porous media used in civil engineering.