HISTORY OF HYDRAULIC ENGINEERING EDUCATION

In Commemoration of the Bicentenary of Training Hydraulic Engineers in Hungary

By

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Institutum Geometricum, a unit organized in 1782 within the University of Sciences seated in Buda, and resettled in 1784 to Pest, had been the first all over the world to graduate civil engineers, in particular, surveying and hydraulic engineers, and to issue certificates thereof.

Recapitulation of some particulars of the development of hydraulic engineering subjects will refer to the following dates:

1782—1850 Institutum Geometricum
1846—1856 Joseph Technical School
1850 Institutum merging with Technical School
1856—1934 Joseph Technical University (JME)
1878—1879 Independent Department of Hydraulic Engineering
1834—1948 Palatine Joseph Technical and Economical University (JMGE)
1942 Department of Hydraulic Engineering II
1948—1952 Technical University, Budapest (BME)
1952—1955 Technical University of Building (EME)
1955—1967 Technical University of Building and Transport Engineering (EKME)
1963 Department of Water Management
Department of Hydraulic Engineering
1967 Technical University, Budapest reunited
1971 Institute for Water Management and Hydraulic Engineering
1971 Section of Water Supply and Canalization
Hydraulic Laboratory.

Development of subjects Hydrology and Hydrometry fits that of the University, best seen by textbooks and notebooks1—10.

2 Rausch, F.: Compendium hydrotechnicum cum tabulis aeneis VI. — Pest, 1797.
From the late 18th to mid-19th century, hydrology had been focused on big watercourses. In the late 19th century, the program of lectures on "Agricultural Hydrology" by B. Gonda (Annals of JME, 1880/81) points to the recognition of the importance — beyond big watercourses — of small watercourses, brooks, hydrology-type sources, different-type still-waters (marshlands, moors, lakes), and finally of ground-water balance determining surface and subsurface hydrological and hydrogeological conditions. Ö. Bogdányi was the first to systematize the subject "Hydrology". Later S. Rohringer made hydraulic analyses to determine the process of surface water accumulation. An up-to-date, comprehensive treatment has been devoted to hydrology and hydrometry problems as well as on problems of sediment motion.

Gy. Szilágyi did pioneering work in applying probability calculus including mathematical statistics, and so did W. Lászlóffy, and also the mentioned lecturers on hydrology completed thereby their notebooks. Recently, J. Reimann examined the theory of probability from the aspect of hydrology. Of course, latest probability analysis underlies hydrology calculations.

Development of hydrometric gauging exercises as a means to acquire the subject matter of hydrology under natural conditions is internationally instructive. River gauging exercises on the Danube look back to 160 years, to 1842 as read in the recently published diary of Ganzó from the past century. Danube exercises had several sites (Vác, Óbuda, Nagyítény etc.), and since Professor Petzelt considered more instructive for the students to gauge smaller rivers so he led his pupils to the river Ipoly. Systematic gauging exercises

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* Self-intended, the language of instruction is Hungarian, and so is that of textbooks and notebooks, translated here to English for convenience, except the first few ones in Latin.
cises were made at Szob on the Danube since 1883, while the first university hydrometrical gauging station (to my knowledge) all over the world has been that at Nagymaros on the Danube where ground and premises were purchased by the Technical University in 1894.

Gauging exercises have been extended on small watercourses (brooks of Óbuda and Visegrád) assisted by notebooks. An important part of hydrology is hydrometeorology, another subject matter of important development. The already quoted program of B. Gonda (JME, 1880/81) dating from more than a century ago, includes several of such details, to be considered therefore the beginning of hydrometeorological education in this country. Since then, every lecturer on hydrology has been laying much stress on this discipline. Let it be mentioned that the Author delivered four courses in hydrometeorology — in academic years 1953/54, 1979, 1980 and 1981 — to students of the Eötvös Loránd University of Sciences. Again, the Author lectured on hydrology and meteorology problems of agricultural water management (in strict relation to agrometeorology) as an "optional mandatory subject" for students in geography at the Eötvös Loránd University of Sciences for about ten years in the last two decades. At present hydrology is a mandatory subject for certain students in geography.

Let us consider the development of some further accessory priming subjects related to hydrology.

Education in hydrobiology dates back to the '20s when G. Entz, Jr. delivered this subject in two terms, according to the following sketchy program (JME, 1918/19): "Position of hydrobiology among disciplines, its history, devices, tools. Fundamentals of water ecology. Classification of waters from the aspect of biology. Plankton, benton etc. Systematic presentation of organisms of importance in hydrobiology, from protozoans to fishes." Later (JME 1930/31) the subject was extended: "Hydrobiology and fish breeding". But for a long time it was not lectured on as an independent subject but only as an important part of "Canalization and Water Supply" though ever growing in significance so that actually special exercises are spent on it.

Education in hydrogeology is strictly related to that in hydraulic engineering within the subject "Geology". The first lectures were delivered by F. Schafarzik, in academic years from 1891/92 to 1894/95, under the title: "Selected chapters of engineering geology (springs, wells, artesian wells)" (JME, 1891/92): "Springs, groundwater, ordinary and artesian wells, well-sinking. Artesian well boring. Normal boring with a hand borer, boring with gravity borer, rope boring, sludge boring, diamond borers." Since then, lectures by F. Schafarzik,


A. VENDL\textsuperscript{19} (1951/52), F. PAPP, J. MEISEL laid much stress on hydrology. F. SCHAFARZIK completed the subject matter with the examination of subsurface waters (groundwater, deep water) of Budapest; A. VENDL with the bitter waters of Buda, F. PAPP with problems and results of spring finding, Danube fugitive sources, research problems and results of karstic waters, and classification of sources. F. PAPP did pioneering, and at the same time rather efficient, work in realizing the \textit{Vas Imre Karstic Water Research Station} in Józsvaft, inaugurated by himself and the rector of this university on 7.11.1957, granting hydrology a score of new scientific research results by making observations with the participation of students in the pertaining \textit{Vas Imre karstic cavern} 1 km long, and in the “Lófő” siphon source. (Actually this research belongs to VITUKI but it has ever been managed by L. MAUCHA.) Education in geology and in hydrology has been integrated by geological study tours\textsuperscript{20}. Here it should be mentioned the introduction of education in engineering geology urged by F. PAPP\textsuperscript{21}. Education in hydrogeology was much influenced by engineering geology delivered by S. VITALIS at the \textit{Eötvös Loránd University of Sciences}. Actually the centre of education in hydrogeology is at the \textit{Technical University of Heavy Industry, Miskolc}\textsuperscript{22}.

Education in geology is paralleled by that in \textit{pedology}\textsuperscript{22–26} introduced by the group of pedology at the Department of Agricultural Chemical Technology, Faculty of Chemical Engineering, and its internationally renown head, E. SIGMOND. Pedology was delivered to civil engineering students in section C, hydraulic engineering in 1929/30 (E. SIGMOND, R. BALLENEGER). Becoming independent in 1942, the Department of Pedology headed by L. MADOS contributed to the science of pedology mainly by groundwater balance investigations. After the liberation the department was transferred to agricultural high schools and this subject was delivered either by non-university lecturers or by other departments of this University (Department of Mineralogy and Geology\textsuperscript{23,24}). Later this subject merged with subjects “agriculture”, then “agricultural water management” to become recently an independent subject partly in specialist engineering education, and partly, curious enough, in geodesy and surveying education\textsuperscript{25}. Pedologic effect of soil cultivating machinery is given a comprehensive analysis\textsuperscript{25} at the Department of Agricultural Machinery delivering post-graduate courses.

\textsuperscript{19} VENDL, A.: Geology I–II.\textsuperscript{*} Budapest, 1951–52, 1326 pp.
\textsuperscript{23} FEKETE, Z.: Pedology\textsuperscript{*}. Budapest. 1952. 410 pp.
Some chapters of hydrochemistry have been incorporated into the curriculum of Water Supply, Canalization. As early as in 1880–81, the program of lectures by B. Gonda refers to "... quality and temperature of irrigation water...". The 1906/07 program of lectures by I. Forbáth specially mentions "the water quality". After the liberation, the subject "Water chemistry" was delivered and developed by Sz. Papp. At present it is an important chapter in "Water Supply, Canalization" unfolded in a special exercise notebook. A special laboratory of hydrobiology and hydrochemistry was equipped for exercises and research in 1967.

Another subject belonging to fundamental sciences is hydraulics, hydromechanics comprising statics and dynamics. The education in hydraulics arose even before that in hydrology. Hydraulics was delivered already at e.g. the Nagyszombat University by J. Ivancics in 1752, and at the Mining Academy of Selmeck by M. Boda. Later, at the Institutum Geometricum, "Hydraulics" was an important chapter.

It is worth mentioning that Á. Jédlík, applying for teachership about 1830, composed a notebook on Hydraulics preserved as manuscript. First comprehensive treatment of hydraulics was due to I. Horváth, academician, who at his untimely death passed down all his wealth to the University to open yearly alternating competitions in mechanics and in hydraulics for university students to be rewarded from the interests. After him, hydrodynamics was for a short time delivered by K. Szily, Sr. (1833,84), followed by D. Bánki under the denomination "Practical Hydraulics" as part of "Hydraulic Machines" and further developed as "Hydraulic Engineering" by Ö. Bogdányi. Subsequently it gets to departments delivering marginal sciences such as Department of Hydraulic Machines (D. Bánki after 1899) where hydraulics and aerodynamics had been lectured on by K. Fényes and M. Treer, respectively; Department of Fluid Mechanics as well as to the actual University of Wood Industry and Forestry and its legal predecessor. Direct

27 Jédlík, Á.: Hidraulica. Remains in manuscript, Pozsony, early 1830s.
education in hydraulics of civil engineers, and later, of specialized hydraulic engineers relied on textbooks and notebooks\(^6\). \(^{10} \) Practical work in hydraulics was offered by non-mandatory, optional “Exercises in Hydromechanics” offered by the Author in the ’60s\(^6\)–\(^{47} \). Education in hydraulics has been considered to be much facilitated by a laboratory for hydraulics. The review “Társalkodó” was the first to suggest establishment of a laboratory of hydraulics in 1843 (probably due to Prof. J. Petzelt). Though, the first hydraulic laboratory was established by the Department of Hydraulic Machines (D. Bánki, 1909), rather than by that of Hydraulic Engineering; the first laboratory of the Department of Hydraulic Engineering was established by S. Rohringer in 1926, featuring a glass canal, mainly for the examination of hydraulic engineering structures. In 1941, the Department of Fluid Mechanics set the first wind tunnel of the aerodynamic laboratory, affine to the hydraulic laboratory, going, and it was J. Szily who in 1941 developed the hydraulic laboratory of the Department of Hydraulic Engineering II, primarily for river regulation, at last, in 1953, E. Németh established an open-air hydraulic laboratory in Nagymaros for irrigation and water purification research. This laboratory ranks internationally high among those of technical high schools and universities, with its discharge of about 500 litres/sec. Last but not least, in 1971, date of organization of the Institute of Water Management and Hydraulic Engineering, laboratories of the two “water” departments united to an independent Hydraulic Laboratory. (By the way, the staff of the two hydraulic departments made the first sketches, under the guidance of the Author and Gy. Kovács, of the Hydraulic Laboratory of VITUKI, founded in 1955 and operating since then.)

Knowledge matters of agriculture and forestry\(^58\)–\(^{57} \) have to be mentioned as auxiliary sciences of water management. At its foundation, the Institutum comprised the department organized in 1777 of L. Mitterpacher, who authored a very high-niveau textbook\(^48 \) published in seven editions. Already at the JME, L. Zólyomi-Wágner developed this subject to a high perfection. J. Kvasay was concerned in his book\(^10 \) with the forwarding of civil engineering

\(^{48} \) Mitterpacher, L.: Elementa Rusticae in usum Academiarum Regni Hungariae. – Pest (previously Buda) 1779 – 1794, last edition 1816.
education. In the '20s, an agricultural encyclopedia was delivered by R. KÁROLY. Thereafter for some time, chapters of these sciences were comprised in the subject Hydraulic Engineering II. For some years after the liberation, "Agriculture" was an independent subject, to be partly embraced by agricultural water management. It remained an independent subject of specialized engineering education, and curiously, an independent subject is "Forestry and Agriculture" for students in geodesy.

Let us have a look now at the development of the principal hydraulic engineering subjects, beginning with "Agricultural Water Management" (water regulation and utilization in agriculture), a subject also delivered at universities and high schools of agriculture and the University of Horticulture.

Traces of delivering agricultural water regulation (concerned with marsh drainage) appear as early as by the end of the 18th century, the trend being the same by the mid-19th century. A real development starts in the second half of the 19th century. The program of lectures by B. GONDA (JME, 1880/81) — that still would count as up-to-date, except for the lack of mathematical tools, computers, — in addition to the drainage of marshlands and lakes, features regulation of mountain streams and drainage. By the way, although streams are linear hence belong to the subject on watercourses, but if present at a high density, they cannot be detached from the concerned area, placing them with the agricultural water management of rather areal character. Within the subjects "Hydraulic Engineering" I and II, small watercourses have been dealt with, with reference to other problems of watercourse regulation.

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This scope has much been forwarded at the *University of Wood Industry and Forestry*, and its legal predecessor, in particular, regulation of mountain streams and binding of gullies. The term „*inland drainage*” is first encountered in the lecture program of S. *ROHRINGER*, and much of its development is due to notebooks *SALAMIN*. and where the idea of terrain regulation against soil erosion appears, but *SALAMIN* is the first to be concerned with protection against erosion in itself. (Let us mention that — according to the inaugural speech of rector G. *SZABÓ* — in the ’40s E. *KUND* at this Department had great merits in forwarding terracing.) Recently, an independent chapter *SALAMIN* has been spent on the relationship between water regulation and environmental engineering.

**Agricultural water utilization** is first encountered early in the 19th century. Subchapter “Construction of water utilization objects” discusses “Irrigation objects”. For a comprehensive discussion of irrigation let us refer again to the lecture program of B. *GONDA* (1880–81) embracing even “technical and sanitary problems of irrigation with sewage water”. Civil engineering education has been rather effective also in this field. Thereafter, irrigation is discussed within the subject “Hydraulic Engineering II”. Subsequent education lays much stress on irrigation but up-to-date theoretical foundations are due to A. *DOBOS*, A. *KOVÁCS-SEBESTYÉN* was the first to be concerned with fishpond management within the subject “Hydraulic Engineering II” according to his program in JME 1908/09 that belonged to it thereafter, and was further developed by E. *NÉMETI* who was a practicing engineer partly in fishpond management, and partly, at the Office of Irrigation.


The subject “Watercourses” is strictly related to that of navigation. Its first traces appear in the early period of the Institutum, but also *SCHNE-****
DÁR was concerned with it (e.g. JME 1860/61). Subsequently, it became part of subjects “Hydraulic Engineering I and II”6,58,67. The recent development of this subject is rather promising69.

Education in Watercourses has that in Hydraulic Engineering Structures as natural concomitant since the early beginnings1,3,66; then in lecture programs of B. GONDA, M. KLIM, A. KOVÁCH-SEBESTYÉN, J. WEISSMAHR, S. ROHRINGER.

This period is featured by the activity of Prof. Sz. ZIELINSZKY who introduced reinforced concrete structured hydraulic objects, first of all, water towers such as that on the Margaret island (Budapest), but he also designed sluices etc. It occurs as an independent subject in notebooks51-72, interestingly complemented73. Let us mention that the subject “Foundations” was long delivered in the frames of hydraulic engineering5,66, later within the subject “Hydraulic Engineering I”. After World War I, a notebook was written on “Foundations” for returning soldiers becoming students74.

After the redivisions in 1929/30, in the mid-'40s, students in hydraulic engineering attended lessons of J. JÁKY in soil mechanics, and with the establishment of the predecessor of the actual Department of Geotechnique (1942), the subject “Foundations” got detached from hydraulic engineering. Education in “Foundations” and its auxiliary subjects “Soil Mechanics” and “Earthworks” may be acquainted with from notebooks and textbooks5-76.

Education in water power utilization looks back to the mid-19th century5, in particular, its initial stage, the water mills, as an item in “construction for utilizing water power”. Besides of a book on water power published early in this century80, S. ROHRINGER was the first to indicate this subject in his program of lectures: “III. Utilization of water: . . . Low and high-pressure hydraulic power plants”. The same subject was lectured on by E. NÉMETH, and developed beyond its significance in this country by E. MOSONYI81.

Recently, the subject matter of “Water Power Utilization” has been discussed69 in conformity with Hungarian practice.

In connection with hydraulic engineering structures and water power utilization, the subject „Hydraulic Machines” generally lectured on by the

staff of the Department of Hydraulic Machines has to be mentioned. As early as between 1774 and 1792, Professor I. Horváth lectured on machines driven by water and air at the University of Sciences. Also the program of B. Gonda includes “Water-raising engines and their comparison”. Development of the subject and the department is due to D. Bánki. A. Dobos at the Department of Hydraulic Engineering I elaborated pump peculiarities in connection with plants incorporating them. Actual education of students in hydraulic engineering relies on two textbooks in this scope.

As to the development of Water Supply — Canalization, the third main subject, one of the first notebooks contained relevant items such as “Constructions for water utilization. (Rainwater tanks, . . . drainage of sewage from streets and homes, canals for floating manure . . .)”. Let us refer to the sewage disposal by irrigation in the program of B. Gonda. The 1900/01 program of I. Pfeiffer in the subject “Water Technology” (Composition of natural waters. Water use in industry. Examination of boiler feed waters. Chemical and mechanical water purification. Preheaters. Desilters. Surface condensers. Water purification equipment. Checking of water purification plants. Valuation of drinking water. Sewage purification) suggests this subject to be the predecessor of the actual subject “Industrial Water Supply and Sewage Purification”. The de facto beginning of lecturing on Water Supply—Canalization as an independent subject may be put to early in this century. For years, I. Forbáth lectured on “Urban Water Supply” and “Urban Canalization”, subjects in the scope of “Hydraulic Engineering II” since the organization of an independent Department of Hydraulic Engineering (M. Klimm, A. Kovács-Sebestyén, J. Weissmahr and S. Rohlinger). Recent conditions are reflected in textbooks. The subject boomed with the organization of the independent Section of Water Supply and Canalization (1971).

I. Dégen was the first to deliver unified bases of water management including water resources management.

Impartment of the subject matter of water rights starts with the multifaceted “Agricultural Hydrology” (1880/81. III. Legal aspects). Later it is

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delivered as an independent subject by Prof. K. Csiky (1890/91): “The Law on Water Rights, By-Law on Boat Mills” and by A. Kovács-Sebestyén under the heading “Water Rights and Water Service” (e.g. in 1918/19). This problematic has recently been discussed.

Latest curricula stress computer methods.

Last but not least, let us consider some accessory education problems.

After the specialization introduced in 1929/30, the civil engineering students in hydraulic engineering, so-called section C, elaborated a subject independently, as an attempt of scientific elaboration, in the framework of „Hydraulic Engineering Seminary” a subject to be considered the beginnings of the work in the Scientific Students’ Circle, with a view on the mentioned I. Horváth award (integrated by the Test Report of students’ independent hydraulic tests directed by J. Szily).

A special problem has been to impart hydraulic engineering knowledge to other than hydraulic engineering students. To this aim, independent subject matters have been developed and notebooks written for each of the other three specializations: for geodesists; for structural engineers; and for road and railway engineers.

The design work, of outstanding importance at this University, is helped by Aids, Guides, Directives such as: in agricultural water management; in computer techniques; in agricultural hydraulic engineering; in road and railway engineering.

References:

water supply and canalization\textsuperscript{106}; in watercourses,\textsuperscript{107,108} for structural engineers\textsuperscript{109}; for road and railway engineers\textsuperscript{110,111}. At last, the important development in subjects "Construction", "Building Mechanization" and "Site Management" with the establishment of the Department of Building Management and Organization (1951) must not be left unmentioned\textsuperscript{112,113,114}.

Summary

Hydraulic engineering education looks back to 200 years in Hungary. delivered first at the University of Sciences transferred by that time from Nagyszombat to Buda. Its home, the "Institutum" soon became independent and promoted to a higher educational institution, to be degraded to an industrial secondary school with adverse political events. Increasing importance of river regulation and similar works in this country forwarded its upswing and promotion to the rank of a university. Its subjects delivered by professors of renown multiplied — some of them belonging now to other universities — just as its departments. The relevant textbooks and notebooks are continuously updated.

References

1. Annals of the Technical University, Budapest (BME) and of the Joseph Technical University (JME)*.
2. Fodor, F.: Institutum Geometricum. Engineering Institute at the Faculty of Arts of the University of Sciences. 1782 to 1850\textsuperscript{a}. Tankönyvkiadó. Budapest, 1955. 192 pp. + XII Annexes.

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\textsuperscript{109} Hámvas, F.: Hydraulic Engineering Structures. (Design Aid)*. Budapest, in press.
\textsuperscript{114} Maurer, Gy.: Peculiarities of Organizing Hydraulic Constructions*. Budapest, 1954. 152 pp.

\textsuperscript{*} In Hungarian