STUDIES 56–73

The Water Histories of Hungary's Major Rivers

Environmental Debates around Antal Réthly and Emil Mosonyi

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Taking a biographical approach, two main characters of Hungarian water-environmental history are explored in this study. Before the global warming era, meteorologist Antal Réthly played a major role in the climatic controversy concerning the water regulation and afforestation of the Great Hungarian Plain arguing that these human activities could not change the climate. In turn, water engineer Emil Mosonyi strove to conceptualize and develop the utilization of Hungarian hydropower potentials and remained a supporter of large hydropower projects even after his emigration and return, when the construction of the Danube barrage system catalyzed the Hungarian environmental movement and the political transition in 1989. Their histories help understanding of the limited capacities of science in solving environmental controversies.

Key Words *Environmental History; Water Regulation; Afforestation; Climatic Controversy; Hungary*

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After the intense drought of 2022, and the increasing frequency of heatwaves due to global warming, Hungarian water management is slowly entering the spotlight again. In the recent past it has usually been extreme floods that have been given similar public attention. If we try examining a longer period, right back to the start of the water regulation projects in the Carpathian Basin,[1] about one and a half centuries ago, we can see that the question of rivers and water, together with other issues, such as agriculture, afforestation and electricity generation, has been in the focus of Hungarian environmental sciences and technology for a long time.[2]

This is not a feature unique of Hungary; the transformation of nature and the exploitation of water resources were means of modernization for governments all around the globe.[3] Consequently, the transformation of rivers, taming their runoff, utilizing their

[1] In the 19th century, the climate of Hungary was definitely cooler, but only a slightly wetter. See BIHARI, Zita – BABOLCSAI, György – BARTHOLY, Judit et al.: Climate. In: KOCSIS, Károly (ed.): *National Atlas of Hungary,* 2 : *Natural Environment.* Budapest 2018, pp. 62–64.

[2] SOMOGYI, Sándor (ed.): *A XIX. századi folyószabályozások és ármentesítések földrajzi és ökológiai hatásai.* Budapest 2000; JANKÓ, Ferenc: Az éghajlatváltozás kérdése a magyar tudományban. In: JANKÓ, Ferenc (ed.): *Éghajlat – tudomány – történetek : Beszélgetések a klímaváltozásról.* Budapest 2017, pp. 145–170.

[3] WORSTER, Donald: *Rivers of Empire : Water, Aridity, and the Growth of the American West*. New York 1985; BOELENS, Rutgerd – POST UITERWEER, Nynke C.: Hydraulic heroes: the ironies of utopian hydraulism and its politics of autonomy in the Guadalhorce Valley, Spain. *Journal of Historical Geography* 41, 2013, pp. 44–58;

irrigation and hydropower potentials served particular economic and political interests, while creating conflict with others.[4] Inarguably, rivers have also experienced fundamental changes alongside the nations, regions, societies, and ecosystems they supply, which may also be called water systems[5] or hydrosocial territories.[6]

Things are no different in Hungary, where the Danube and Tisza rivers play eminent roles in the country's environmental history. This study aims to give an overview of the debates surrounding these rivers. Their regulation and hydropower utilization have been at the heart of Hungarian social and economic modernization since the middle of the 19th century, and remain so to the present day.[7] The article uses the histories of two scientists, two "hydraulic heroes"[8] as cornerstones. Both men lived to an advanced age, with their lives and expertise almost spanning the entire period under examination, and were prominent figures in the making and defending of science in hydro-environmental controversies and beyond. Namely, meteorologist Antal Réthly (1879–1975) and hydraulic engineer Emil Mosonyi (1910–2009; Figure 1). The study's goal is to assess and compare their roles in Hungarian water-environmental history, but also to assess the achievements of science in general in the midst of two environmental controversies. These controversies were the hundred years of climate change debate concerning the Great Hungarian Plain (Alföld) from the 1860s to the 1960s, where Réthly played a major role, and the Gabčíkovo–Nagymaros barrage system, with Mosonyi's involvement in this spanning across the decades both before and after the political transition of Hungary in 1989. As we will see, their paths barely crossed, however Réthly was deeply committed to Hungarian water affairs, while Mosonyi started his career and emerged as a top scientist from the same arena before World War II. Emil Mosonyi also embodies the change within Hungarian water management, the shift of focus from the Tisza basin to the Danube during the first decades of the socialist period.

Nature Transformation and Early Debates in the 19th Century

Chief meteorologist Antal Réthly was born in the same year as the catastrophic flood of the Tisza River in 1879, in the course of which the largest city on the southern plains, Szeged was destroyed. By that time, the channelization works along the river had been underway for decades; and were symbolically opened by count István Széchenyi in 1846,

HOMMES, Lena – BOELENS, Rutgerd: From natural flow to 'working river' : hydropower development, modernity and socio-territorial transformations in Lima's Rímac watershed. *Journal of Historical Geography* 62, 2018, pp. 85–95; DE OLIVEIRA, Nathalia C. C. – FLORENTIN, Carlos G.: Hydroelectric dams and the rise of environmentalism under dictatorship in Brazil and Paraguay (1950–1990) : The case of Itaipu. In: BRAIN, Stephen – PÁL, Viktor (eds.): *Environmentalism under Authoritarian Regimes Myth, Propaganda, Reality*. London – New York 2019, pp. 51–74.

4 WHITE, Richard: *Organic Machine : The Remaking of the Columbia River*. New York 1995; EVENDEN, Matthew D.: *Fish versus power : An environmental history of the Fraser River*. Cambridge 2004; SUMMITT, April R.: *Contested Waters : An environmental history of the Colorado River*. Boulder 2013.

5 TVEDT, Terje: 'Water Systems', Environmental History and the Deconstruction of Nature. *Environment and History* 16, 2010, no. 2, pp. 143–166.

6 BOELENS, Rutgerd – HOOGESTEGER, Jaime – SWYNGEDOUW, Erik et al.: Hydrosocial territories: a political ecology perspective. *Water International* 41, 2016, no. 1, pp. 1–14.

7 PINKE, Zsolt: Modernization and decline: an eco-historical perspective on regulation of the Tisza Valley, Hungary. *Journal of Historical Geography* 45, 2014, pp. 92–105.

8 BOELENS, R. – POST UITERWEER, R. C.: Hydraulic heroes.

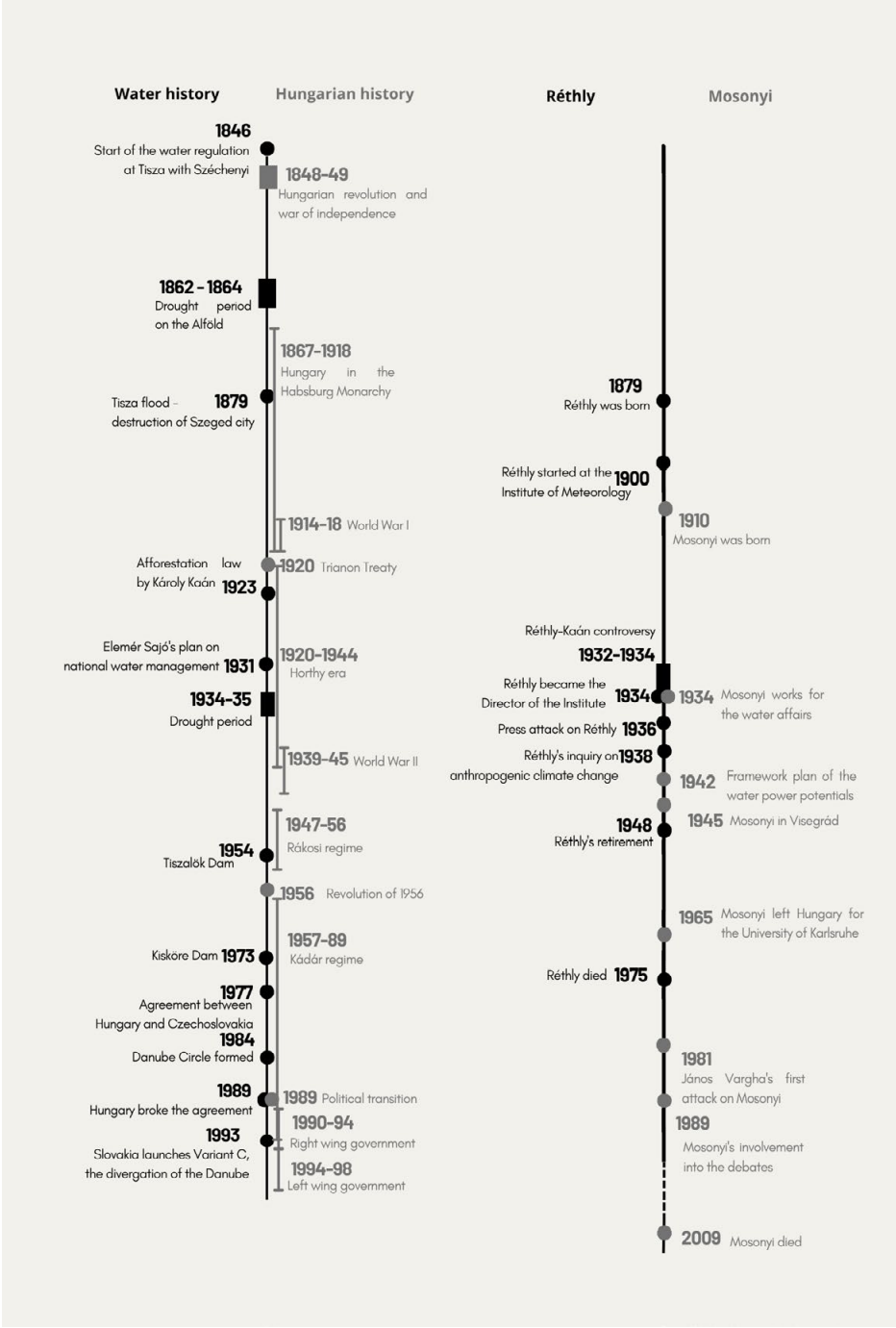

Figure 1: Timeline of the personal stories framed by the key historical events of water management and Hungary. Source: the authors.

who organized and directed the Tisza regulation project until his death in 1860.[9] Besides the construction of the Hungarian railway system, this project was a major part of the 19th century modernization of the country, which contributed to the creation of a modern, market-oriented agriculture and a country-wide landscape change, a "transformation of nature".

The first wave of the Alföld climatic controversy took place in the mid-1860s, when three leading naturalists started to debate the possible reasons for and solutions to the devastating drought of 1863. János Hunfalvy, the first university geographer in Hungary, argued that the flawed regulation of the River Tisza was the reason for the drought and, instead, proposed afforestation on the plains to modify the climate and enhance rainfall. As a propagator of the ideas of John Perkins Marsh[10] expressed conservationist ideas to protect the Hungarian forests from the utilitarian management practices represented by his opponents, forestry engineer Adolf Divald and water engineer Adolf Érkövy. They not only claimed that forests should only be maintained in areas where the yield of timber is greater than the possible crop yield, they also attacked Hunfalvy's views on afforestation and river channelization. The three participants in the debate, whose papers were published in parallel by the Hungarian forestry journal (*Erdészeti Lapok*) and a major daily newspaper (*Pesti Napló*), failed to reach a compromise.[11] What is more, Hunfalvy also maintained his negative views of the regulation of the Tisza at the time of the flood catastrophe in Szeged.[12]

These debates had no effect on the continuation of the water regulation projects, but the destruction of Szeged alone did have a political impact on the future works. The regulation of the Tisza was in fact so incomplete and unsystematic that was an important criterion of the catastrophe impacting the city. The works were continued with stronger state involvement, when chief hydraulic engineer Jenő Kvassay took the lead, who labeled the regulation of the Tisza the "second Hungarian conquest".[13] Similarly, starting in the last decades of the 19th century, the water regulation of Alföld, and more broadly of all of Hungary became more complete with the regulation works of the Danube.

Meanwhile, there was hardly any shift in the views on climate change, while the question of ice ages was the focus of scholarly attention, in Hungary also. After its publication in 1896, the theory of Svante Arrhenius on carbon dioxide emission and human impact

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[9] KÁROLYI, Zsigmond: A magyar vízi munkálatok rövid története különös tekintettel a vizek szabályozására. In: IHRIG, Dénes (ed.): *A agyar vízszabályozás története*. Budapest 1973, pp. 21–147; DUNKA Sándor – FEJÉR, László – VÁGÁS, István: *A verítékes honfoglalás : A Tisza-szabályozás története*. Budapest 1996, pp. 61–77. Széchenyi's is celebrated as "the greatest Hungarian" as the father of Hungary's, not only the Alföld's, modernization today; his name is also linked to the Chain Bridge in Budapest and to the foundation of the Hungarian Academy of Sciences, among others.

[10] The works of Marsh also indicate that the question of afforestation and its effect on climate and especially on precipitation was an old issue in scientific as well as policy encounters. See e.g. STORCH, Hans von – STEHR, Nico: Anthropogenic climate change: A reason for concern since the 18th century and earlier. *Geografiska Annaler A*. 88, 2006, no. 2, pp. 107–113.

[11] E.g. ERDŐDI (DIVALD), Adolf: Nézetek az erdőnek a klimára való befolyásáról. *Erdészeti Lapok* 3, 1864, no. 1, pp. 15–31; DIVALD, Adolf: A természettudományok és az erdészet. *Erdészeti Lapok* 4, 1865, no. 1, pp. 1–22; ÉRKÖVY, Adolf: Az erdők, mint esőzési tényezők a sikföldön. *Erdészeti Lapok* 3, 1864, no. 12, pp. 385–400; HUNFALVY, János: Az erdők befolyásáról a klimára. *Erdészeti Lapok* 4, 1865, no. 2, pp. 39–48.

[12] HUNFALVY, János: *Az éghajlat változóságáról*. Proceedings of Magyar Orvosok és Természetvizsgálók XXII. Nagygyűlése, Debrecen 1882, p. 34.

[13] DUNKA, S. – FEJÉR, L. – VÁGÁS, I.: A verítékes honfoglalás, pp. 118–121.

on the climate was firstly referenced at the beginning of the new century by leading Hungarian meteorologists and geographers based on a Polish climatologist's work, mainly with regard to the climate of the geological past and ice ages.[14] Arrhenius' fresh ideas on climate change were also published in Hungarian in 1907, which was followed by his book in 1922.[15] However, these early references to his works barely changed the mainstream views, i.e. the belief that the climate does not change within the human timescale, which became explicitly apparent during the climate debates on the Alföld.[16]

The debate on the climatic effect of water regulation and afforestation only flared up after the end of World War I, when the postwar penalty of Hungary, the Trianon Treaty, dismembered the country. Hungary not only lost two-thirds of its territory, but its major forests also fell within the successor countries, mainly (Czecho-) Slovakia and Romania. These circumstances naturally turned the attention of science and politics towards the Great Hungarian Plain, and many sought the opportunities in the development of the Alföld as a basis for postwar Hungary's future progress.[17]

The regulation works also continued in the interwar period, while many believed their mission pathetic under the second Hungarian conquest. The drainage of the region between the Tisza and the Danube rivers was pushed forward after the years of World War I with the construction of a main channel in the Danube valley and the drainage of swamps, however the construction of irrigation infrastructure was delayed. Here, hydraulic engineer Sándor Rohringer was the leader of the project, commissioner of the Ministry of Agriculture, and professor at the Budapest University of Technology at the same time.[18] In this region, the plans for a Danube–Tisza channel provided the basis for further discussions among scientists and politicians about where and how to plan and construct a new water route between the two major rivers to develop intrastate shipping trade.[19]

A leading forest engineer and forest politician in the 1920s, Károly Kaán also saw the potential for afforestation on the Alföld. He claimed that deforestation and water regulation had a negative effect on the climate of the plain and attempted to convince the professional elite and the public that afforestation could address the problems.[20] He went on to propose and launch the "Alföld" afforestation law in 1923, which was also justified with a climatic argument, i.e. planting trees in order to promote climatic amendment, and heated up the climatic debate. Scientists analyzed the effects of aridification,[21] foresters

[14] RÓNA, Zsigmond: No. 67. *Természettudományi Közlöny* 35, 1903, no. 406, p. 420; FODOR, Ferenc: A geológiai korszakok klímája. *Természettudományi Közlöny* 37, 1905, no. 433, pp. 577–578; CHOLNOKY, Jenő: A jégkorszakokról. *Földrajzi Közlmények* 33, 1905, no. 7, p. 269; PRINZ, Gyula: A klíma története. *Természettudományi Közlöny* 37, 1905, no. 80 (suppl.), pp. 164–165.

[15] ARRHENIUS, Svante: Földünk és az égitestek mint az élőlények lakóhelyei. *Természettudományi Közlöny* 39, 1907, no. 460, pp. 665–679; ARRHENIUS, Svante: *A világok keletkezése*. Budapest 1922.

[16] JANKÓ, F.: Az éghajlatváltozás, pp. 155–160.

[17] JANKÓ, Ferenc – GYŐRI, Róbert: Az Alföld fejlődésével és természetátalakításával kapcsolatos viták a két világháború között. In: SÍKOS, Tamás – TINER, Tibor (eds.): *Tájak, régiók, települések térben és időben: tanulmánykötet Beluszky Pál 80. születésnapjára.* Budapest 2016, pp. 136–142.

[18] UJHÁZY, Noémi – BIRÓ, Marianna: The 'Cursed Channel' : utopian and dystopian imaginations of landscape transformation in twentieth-century Hungary. *Journal of Historical Geography* 61, 2018, pp. 4–5.

[19] JANKÓ, F. – GYŐRI, R. : Az Alföld, p. 138.

[20] JANKÓ, F.: Az éghajlatváltozás, p. 152.

[21] THAISZ, Lajos: Az alföldi gyepek fejlődéstörténete és azok minősítése gazdasági szempontból. *Erdészeti Lapok* 60, 1921, no. 3–4, pp. 33–55; TREITZ, Péter: A Nagy-Alföld erdősítése talajtani szempontból. *Erdészeti Lapok* 60, 1921, no. 17–18, 19–20, pp. 311–333, 346–380; TUZSON, János: *A magyar Alföld*. Budapest 1915.

began to promote afforestation for precipitation increase,[22] while the hydraulic engineers blamed for the drying of the plains through the water projects attempted to defend themselves by organizing lectures.[23] These engineers received help from meteorologists, geographers and even from some foresters,[24] and this was the point when Antal Réthly entered the debate.

Antal Réthly and the Climatic Controversy on the Alföld

Antal Réthly became a junior clerk at the Institute of Meteorology and Earth Magnetism in 1900, at the same time he began his studies at the University of Budapest (the predecessor of Eötvös Loránd University). Working for the department of climatic research, he was given regular lecturer assignments at the university and performed foreign service in Turkey. He became deputy director in 1933 and director of the Institute in 1935.[25]

From Réthly's viewpoint, there were three major events that highlight the major role he played in the debates in the interwar period and beyond. The first was his controversy with Károly Kaán, the originator of the Alföld-afforestation idea and, in fact, deputy state secretary for forestry until his retirement in 1925. Interestingly, Kaán shared many common views with the hydraulic engineers, envisioning a prosperous future for the Alföld. The common ground was Széchenyi and his Alföld modernization program to raise the people and the landscape out of backwardness, which encouraged both the foresters and the hydraulic engineers during their work, since the protection and promotion of forest coverage as well as encouraging water regulation have their roots in Széchenyi's ideas.[26] However, in the spirit of his legislation, Kaán suggested that forests may somehow modify the climate and promote more humid conditions, even on a larger scale. He similarly argued that water regulation works could contribute to aridification, especially in those areas where the regulation projects remained incomplete.[27]

Réthly's first contribution to the debate, a postscript to the abovementioned lectures held for the Hungarian association of engineers and architects, was published in a volume edited by the leader of the Hungarian water service, Elemér Sajó, in 1933. Using observational weather data, Réthly claimed that the climate of the Alföld has a changeable character, independent of the hydro-regulation works, varying between humid and

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[22] SÁVOLY, Ferenc: Az Alföld fásításától és öntözésétől a mezőgazdaság terén várható bioklimatikus értéknövelésről. *Erdészeti Lapok* 59, 1920, no. 17–18, pp. 387–408; KALLIVODA, Andor: Az Alföldfásítás kérdéséhez. *Erdészeti Lapok* 66, 1927, no. 5, pp. 214–221; BODOR, Gábor: Az Alföld fásítása. *Erdészeti Lapok* 68, 1929, no. 3, pp. 39–45; KALLIVODA, Andor: A lecsapolók meg az esőcsinálók. *Erdészeti Lapok* 71, 1932, no. 2, pp. 125–133.

[23] KENESSEY, Béla: Az Alföld állítólagos kiszárítása, elszikesítése és öntözésének kérdése. *Vízügyi Közlemények* 13, 1931, no. 2, pp. 3–27; POGONYI, György: A Magyar Mérnök- és Építész-Egylet vízépítési szakosztálya által megtartott előadások és hozzászólások rövid ismertetése. *A Magyar Mérnök- és Építész-Egylet Közlönye* 65, 1931, no. 31–34, pp. 228–231; KENESSEY, Béla: Az Alföld vízgazdálkodása. *Vízügyi Közlemények* 16, 1934, no. 2, pp. 314–333.

[24] VÁGI, István: *A meteorológia és éghajlattan elemei*. Sopron 1929, p. 9; MAGYAR, Pál: Néhány alföldfásítási cikkhez. *Erdészeti Lapok* 71, 1932, no. 5, pp. 448–461.

[25] ZÁCH, Antal: Dr. Réthly Antal életútja. In: FELMÉRY, László – ZÁCH Antal (eds.): *Réthly Antal emlékkönyv*. Budapest 1975, pp. 5–15.

[26] KAÁN, Károly: Gróf Széchenyi István és a Nagy Magyar Alföld. *Budapesti Szemle* 200, 1925, no. 578–580, pp. 347–386.

[27] Idem: *A magyar Alföld : Gazdaságpolitikai tanulmány*. Budapest 1927, pp. 104–105, 141–142.

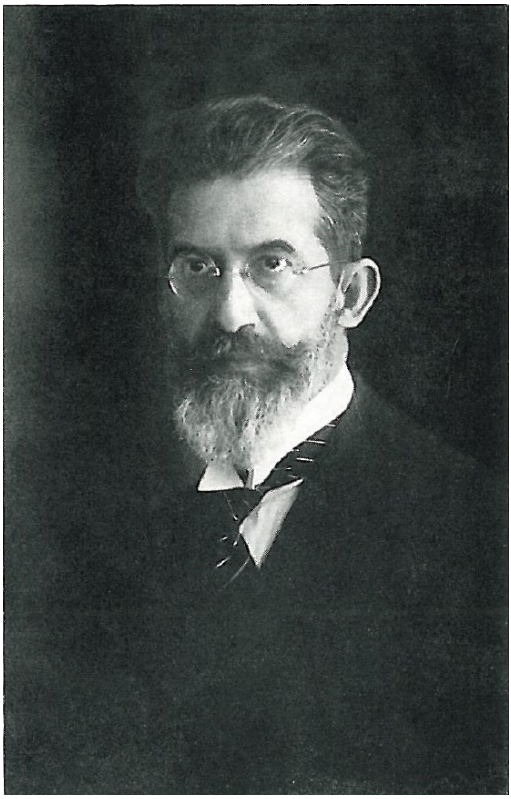

Figure 2: Antal Réthly, the director of the Hungarian National Meteorological Institute in 1935 Source: ZÁCH: Dr. Réthly, p. 10.

arid years. He wanted to support the arguments of Sajó and his colleagues against the widely popular, but, according to him, unscientific charge that the regulation projects had dried out the Alföld area, and that afforestation could help with it.[28]

Kaán replied sharply. He took Réthly's paper as a personal attack against him and attempted to present Réthly as an incompetent in issues of microclimate. Réthly however, after rejecting the hurtful accusations, realized that Kaán had somehow misunderstood the microclimatic effect of trees, as if these could be aggregated to a macroclimatic influence. Thus, he attempted to close the debate on a conciliatory note and emphasized the common grounds they had. Kaán, in turn, grudgingly accepted the peace bond, and maintained his resentful position in his last work on the Alföld.[29]

[28] RÉTHLY, Antal: Az Alföld csapadékviszonyai. In: SAJÓ, Elemér – TRUMMER, Árpád (eds.): *Újabb tanulmányok az öntözésről*. Budapest 1933, pp. 148–177.

[29] KAÁN, Károly: Az Alföld csapadékviszonyai és az alföldi erdőtelepítések és fásítások. *Vízügyi Közlemények* 15, 1933, no. 2, pp. 46–58; RÉTHLY, Antal: Az Alföld csapadékviszonyai és a fásítás mikroklimatológiai indoklása. *Vízügyi Közlemények* 16, 1934, no. 1, pp. 65–81; KAÁN, Károly: *Alföldi kérdések*. Budapest 1939, p. 347.

For Réthly, the Kaán-controversy was not the end. As the public discourse around the regulation works intensified with the period of drought in 1934–1935, he was attacked by journalist and popular writer László Szalay in a newspaper article entitled *The director of the Hungarian meteorological institute does not know the rainfall patterns of the Alföld…* in January 1936. The matter, the second of the events affecting Réthly, immediately reached the highest political circles of Hungary, i.e. the Minister for Agriculture and even Regent Miklós Horthy. Réthly was urged to react promptly and got his colleagues to work over the weekend to draw up a report for the political leaders. This report became the basis of his later lecture in February and a further publication, where he proved again that human activity, namely water regulation, cannot induce one-way climate change.[30] As Réthly later recalled, he was proud of how successfully he repelled the media attack and of the debates with higher authorities like Kaán and others, where even the Governor shared the views of his opponents.[31]

The third event concerning Réthly goes beyond his role in the interwar period as the defender of the position that human activities cannot induce climatic change. Archive documents revealed that Réthly, chairing the Sub-Commission for the Study of the Influence of Human Activities on the Climate (within the Commission of Agricultural Meteorology in the International Meteorological Organization), sent letters to the commission members in 1938 asking whether they knew of any research, any publications on the question of human influence on the climate. His motivation may be self-justification or not, however this does show that he was concerned with the issue. According to the archive data, there was only one relevant response, which came from the director of the British Meteorological Office, Nelson K. Johnson, who provided a reference list of two papers by Guy Stewart Callendar, a promoter of the Arrhenius theory in the late interwar period. Réthly, thus encountered the new idea of anthropogenic climate change, however, he never referenced it in his writings.[32]

In his last decades after retirement, Réthly was only able to obtain the doctoral degree of the Hungarian Academy of Sciences three years before his death; as he was set aside in the 1950s by the state socialist academic accreditation committee for political reasons. Even so, Réthly still did not lose his motivation for research and spent much of his time collecting and publishing an inventory of Hungarian historic climatic extremes to prove that there is no trend in extremities, i.e. no one-way climate change.[33] However, his younger colleagues were among the first in Hungary who reported and referenced the new anthropogenic climate change theory half a century after its publication by Arrhenius and gave it its first Hungarian mentions.[34]

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30 Central Archive of the Hungarian Meteorological Service, Documents of the National Meteorological and Geophysical Institute, inv. no. 8 d., sign. 454/1936; RÉTHLY, Antal: Megváltoztatta-e éghajlatunkat az ármentesítés? *Vízügyi Közlemények* 18, 1936, no. 1, pp. 134–165.

31 Central Archive of the Hungarian Meteorological Service, Documents of Antal Réthly, Radio interview about my life, manuscript, 1963, inv. no. 8a/3; Ibidem: Letter to [László Aujeszky] "My dear friend Laci…", manuscript, July 17. 1974. inv. no. 8a/3.

32 Ibidem, Documents of the National Meteorological and Geophysical Institute, inv. no. 10. d., sign. 562/1938.

33 RÉTHLY, Antal: *Időjárási események és elemi csapások Magyarországon 1700-ig*. Budapest 1962; JANKÓ, Ferenc: Éghajlatingadozás és éghajlatváltozás: adalékok Réthly Antal hagyatékából. *Légkör* 61, 2016, pp. 83–84.

34 E.g. BERKES, Zoltán: *Éghajlatváltozás – éghajlatingadozás?* Budapest 1953; For further details see JANKÓ, F.: Az éghajlatváltozás, pp. 160–162.

Emil Mosonyi and the Dams in Hungary

While Antal Réthly and his contemporaries debated the questions of forests, water and climate, Emil Mosonyi, born in 1910, had just began his career at his alma mater, the University of Technology, where he graduated in 1934 under the professorship of Sándor Rohringer. Simultaneously, he began his service at the Ministry of Agriculture's department for water engineering, only leaving the university when he joined the Irrigation Office.[35] Promoted by Elemér Sajó, irrigation became an important subject area in the second half of the 1930s, and was certainly not independent of the abovementioned drought and climate debates.[36] In other words, the water issues of the Alföld and the Tisza River were always more important than those of the Danube.[37]

The young engineer, Emil Mosonyi was given important tasks, both in practice as well as in long term planning: he took part in the design of the first significant dams on the Körös River (Békésszentandrás, 1943) and Tisza (Tiszalök, realized only in 1959). Meanwhile, hydropower planning became independent from irrigation planning due to its elevated importance in wartime national policy and Mosonyi became the leader of the Hydropower Office in 1942. With the temporary return of pre-WWI Hungarian areas in 1938–1940, the irrigation of the Alföld obtained new aspects; the water supply for the plains could be imagined with stored water in the mountains. Here, Mosonyi had promising plans.[38] In addition, in 1942 he investigated and proposed a framework plan for exploiting Hungarian hydropower potential. In the context of the aforementioned irrigation factors, the Tisza River was given priority, and the implementation plans were drawn up, while the Danube remained mostly in the theoretical stage.[39] At the end of World War II, when Hungary was occupied by Nazi Germany and the Soviet Army was approaching Budapest, Emil Mosonyi took his family to safety in Visegrád, a nearby village on the Danube Bend. As Mosonyi recalled, the choice of Visegrád as a refuge was no coincidence, he wanted to study the possible site of a future dam there.[40]

This event shows, however, that his attention was increasingly focused on the Danube at that time,[41] since the Danube embodied 70 % of Hungarian waterpower potential.[42] Alongside his stressful work at the Tiszalök barrage, where the state security depart-

[35] ÁRPÁSI, Zoltán: *Mosonyi Emil a vízépítés professzora*. Budapest 2006, pp. 40–44.

[36] SAJÓ, Elemér: Emlékirat vizeink fokozottabb kihasználása és újabb vízügyi politikánk megállapítása tárgyában. Vízügyi Közlemények 13, 1931, no. 1, pp. 55–66; LAMPL, Hugó – MOSONYI, Emil: Vízépítési munkálataink fejlődése. *Vízügyi Közlemények* 36, 1954, no. 4, pp. 379–380; MOSONYI, Emil: Vásárhelyi Pál emléke. *Az MTA Műszaki Tudományok Osztályának Közleményei* 18, 1956, no. 1–4, pp. 245–246.

[37] ÁRPÁSI, Z.: Mosonyi, pp. 53–54.

[38] Ibidem, pp. 46–55; MOSONYI, Emil: A visóvölgyi víztározó medence. *A Magyar Mérnök- és Építész Egylet Közlönye* 78, 1944, no. 9, pp. 113–122.

[39] MOSONYI, Emil: Magyarország elméleti vízerőkészlete. *Magyar Technika* 1, 1946, no. 5, pp. 165–170; Idem: Vízerőművek létesítésének kérdése az országos villamosítás keretében : Hazai vízerőművek kiépítése. *Magyar Technika* 2, 1947, no. 1–8, pp. 59–70; Idem: Magyarország vízerői. *Vízügyi Közelmények* 30, 1948, no. 2, pp. 160–187. Although this study was published after the war, it corresponds with the research in the first half of the 1940s Mosonyi mentioned in his interview. Hence, exact plans for the Nagymaros dam were not yet revealed.

[40] ÁRPÁSI, Z.: Mosonyi, p. 62.

[41] Ibidem, p. 66.

[42] MOSONYI, Emil: Vízerő-gazdálkodásunk időszerű feladatai. *Az MTA Műszaki Tudományok Osztályának Közleményei* 1, 1951, no. 1, pp. 518–519, Idem: A dunai vízerőhasznosítás hidrológiája. *Az MTA Műszaki Tudományok Osztályának Közleményei* 2, 1952, no. 4, p. 489.

Figure 3: Emil Mosonyi, around 1935–1940. Source: http://dunamuzeum.hu/1956/vizugy/v_04.html.

ment investigated him for sabotage, he also outlined his first plans for the location and sequence of dams on the Danube. In his first review study, he interestingly excluded the possibility of using so-called bypass channels for hydroelectric power plants on the Hungarian rivers.[43] However, in his second review this was not the case; he saw multiple variations as potential modes of implementation.[44] Mosonyi's ideas received support in academic circles, with his paper being presented at a hydrological conference at the Hungarian Academy of Sciences in 1951, where the issues of water utilization along the Tisza and the Danube rivers were discussed.[45] Mosonyi, in fact, envisioned a highly controlled system of water utilization in Hungary as comprehensive, coherent infrastructure serving the joint goals of water supply, irrigation, electricity generation, industry and recreation,

43 Idem: Vízerő-gazdálkodásunk, pp. 522, 527.

44 Idem: A dunai vízerőhasznosítás, p. 493.

45 It was an important question there, similarly to the climatic issue, whether river channelization negatively influences the ground water levels along the rivers. The majority argued, among them László Aujeszky, a colleague of Antal Réthly, that no is the answer. This event also virtually combines the two main protagonists of this study.

which was pioneering in its day.[46] This fit well into the Hungarian version of the Great Stalin Plan for the Transformation of Nature together with massive growth in mining and heavy industry, intensive agriculture and afforestation.[47]

Meanwhile, in 1954, Mosonyi became department leader at the University of Technology, however, due to his involvement in the revolutionary activity at the university in 1956, he had to step down in the following year. While he was partly able to maintain his positions in water affairs, he was not given the management position at the newly established Danube waterpower planning office. Aside from this, his relationship with his leaders increasingly deteriorated. Hence, following an invitation from the University of Karlsruhe, he managed to leave Hungary in 1965. In doing this, he also essentially dropped out of the hydropower planning dialogue in the country for decades, and, in turn, became a prominent hydraulic engineer employed worldwide.[48]

The case of the Gabcikovo–Nagymaros Barrage System

Following 1956, and more so after Mosonyi's emigration, the planning of hydropower utilization on the Danube continued. After the theoretical planning work, here, Mosonyi wrote his last short article in 1961 proposing more attention on peak energy production and on remarkable investment savings,[49] practical and technical preparations came into the foreground, now in unison with Czechoslovakian engineers and scientists.[50] Numerous conceptual versions were planned jointly in the second half of the 1950s; then the final version was formulated with decisions being made in 1963 and 1969. The Gabčíkovo-Nagymaros Barrage System (further GNBS) was the result put on the planning table, as the most cost-efficient and energy-productive version, with a reservoir near Dunakiliti feeding water into a race canal (side or by-pass canal) with a power plant at Gabčíkovo (in Hungarian: Bős). As part of the system, a further barrage was planned downstream at Nagymaros, on the Danube Bend, with another hydropower station enabling peak hour electricity production at Gabčíkovo. After further preparations for the joint investment, Hungary and Czechoslovakia signed an intergovernmental agreement in 1977.[51]

This story seems quite straightforward, however retrospective analyses, written by later opponents of the project, highlight a controversial and constantly changing context. Like the critics in the field of energy production, some argued in the 1950s that a thermal power plant would be cheaper.[52] But this was in the era of cheap coal, later, after the oil crisis, with a step back to a stronger communist leadership following an

46 MOSONYI, Emil: Országos Vízgazdálkodási Keretterv. *Az MTA Műszaki Tudományok Osztályának Közleményei* 14, 1954, no. 4, pp. 393–416; ÁRPÁSI, Z.: Mosonyi, pp. 68–71.

47 BRAIN, Stephen: The Great Stalin Plan for the Transformation of Nature. *Environmental History* 15, 2010, no. 10, pp. 670–700; PÁL, Viktor: *Technology and the Environment in State-Socialist Hungary : An Economic History*. London 2017, pp. 69–75.

48 ÁRPÁSI, Z.: Mosonyi, pp. 117–122, 187–233.

49 MOSONYI, Emil: Új elgondolások vízerőink kihasználásában. *Hidrológiai Tájékoztató* 1, 1961, no. 1, pp. 17–18.

50 ILLEI, Vilmos: A magyar Dunaszakasz vízlépcsőzése. *Vízügyi Közlemények* 57, 1975, no. 1, pp. 95–102.

51 BREINICH, Miklós – NAGY, László – SZÁNTÓ, Miklós: A dunai vízlépcsőrendszer koncepciójának kialakulása. *Vízügyi közlemények* 65, 1983, no. 4, pp. 483–501; PÁL, V.: Technology, pp. 221–225. Certainly, the Prague Spring also caused delays.

52 VARGHA, János: Egyre távolabb a jótól : Dokumentumok a Gabčikovo–Nagymarosi Vízlépcsőrendszer történetéből. *Valóság* 24, 1983, no. 1–12, pp. 61–63.

attempt at economic reform, the political and professional obstacles were removed from the project.[53]

The first news reporting the concept of the GNBS was released for the public in 1963–1965, and it was clear that the press, following party instructions, had framed the plan as a useful project, that it would enhance the beauty of landscape in the Danube Bend and promote economic progress and landscape development in the Szigetköz area. In the case of the latter, where a severe drop in groundwater level and landscape change were projected due to the race canal, negative warnings could only be read by reading between the lines.[54]

From 1974, after a hiatus of almost ten years, the press again started to report about the project, with a fundamentally positive tone, however more and more questions were raised.[55] In the case of Szigetköz, perhaps the first warning was written by Zoltán Alexay, a high school teacher and nature photographer, but without mentioning the GNBS.[56] The water industry kept its attention on technical questions, while other fields delivered some supporting articles.[57] After the start of the construction work, the first explicitly critical papers were published in a local history magazine in 1979, which raised important questions about the GNBS and projected, basically negative, environmental outcomes. As Alexay warned, the project endangers the wildlife, its habitats, hence the ecological conditions of the Szigetköz area.[58]

While some attempted to calm the fears.[59] The water industry maintained and even further developed its grandiose national plans for water and waterpower utilization.[60] Meanwhile, scientific bodies, roundtable discussions and local political committees started to investigate the environmental questions regarding the GNBS on the Danube Bend and in the Szigetköz area.[61]

On the national scale, the article of János Vargha represents a milestone in the history of opposition against the GNBS. The biologist Vargha, at that time a journalist for a popular science magazine, revealed that engineers had handled problems, i.e., the increasing and decreasing groundwater levels in the environment of hydropower plants, superficially

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53 FLEISCHER, Tamás: Jaws on the Danube: Water management, regime change and the movement against the middle Danube hydroelectric dam. *International Journal of Urban and Regional Research* 17, 1993, no. 3, pp. 431–432.

54 E.g. MÁRTON, Miklós: Erőművek a Dunán. *Népszabadság* 21, 1963, no. 301, pp. 16–17; CSERESZNYÁK, István: Szigetköz jövője : Vízvezeték a falvakban, öntözőrendszerek, kiírtják az erdőket. *Kisalföld* 9, 1964, no. 211, p. 1.

55 SZALAY, Antal: Napirenden a Szigetköz fejlesztése : Vízszint és talajvízszint, a vízlépcsőrendszer hatása, idegenforgalom. *Kisalföld* 33, 1977, no. 238, pp. 1, 3.

56 ALEXAY, Zoltán: A szigetközi vízivilág megmentéséért. A Szigetköz utolsó madárparadicsoma: Ritka madarak az ásványrárói szigetvilágban. *Búvár* 30, 1975, no. 12, pp. 553–556.

57 E.g. SOMOGYI, Sándor: A dunai transzkontinentális nemzetközi hajózóút megvalósításának feladatai hazánkban. *Földrajzi Értesítő* 25, 1975, no. 2–4, pp. 255–263.

58 ALEXAY, Zoltán: A Szigetköz élővilága. *Honismeret* 7, 1979, p. 23. See also the other articles in the volume.

59 KERTAI, Ede: A nagymarosi vízlépcső és a Dunakanyar. *Élet és Tudomány* 34, 1979, no. 19, pp. 594–596.

60 NAGY, László – DÁVID, László – DOBÓ, István et al.: A magyarországi vízgazdálkodási nagylétesítmények koncepciója. *Vízügyi Közlemények* 61, 1979, no. 1, pp. 7–16.

61 HORÁNSZKY, András – JAKUCS, Pál – LÁNG, Edit – SIMON, Tibor: A Gabcsikovo–Nagymarosi és a Tisza II. vízlépcsőrendszerek ökológiai problémái. *Az MTA Biológiai Tudományok Osztályának Közleményei* 22, 1979, no. 3–4, pp. 407–414; Here, the Water Planning Company entrusted the Department of Plant Systematics and Ecology at Budapest ELTE University to study the environmental impacts of the GNPB in the Szigetköz area; BENKŐ, Tibor: A vízlépcső-rendszer környezeti hatásai. *Népfront* 25, 1980, no. 3, pp. 11–14.

and with overconfidence. He also argued that the project is uneconomical and uncompetitive (and the benefits are relatively low), obsolete (since it ignored the environmental issues), and too dangerous (the reservoirs increase the risk of flooding and threaten the water supply of Budapest). Hence, Vargha vehemently attacked the water policies of the socialist regime, particularly Emil Mosonyi, as "the father" of water utilization. Related to this, in a later article he called the project a "Dunasaur" combining the words Danube and dinosaur.[62]

Vargha's paper was echoed in the media. Consequently, the Hungarian Academy of Sciences also investigated the project and declared the need for it to be shut down in 1983, and again in 1985, and several other scientific bodies issued their opinions on the GNBS. Increasing numbers of critical articles were published,[63] but the situation of the project itself also worsened as costs rose and political debate increased on both sides of the border.[64] The opponents to the GNBS formed a civil organization in 1984 called the Danube Circle, and the public dispute around the project grew.[65] They also organized a conference in 1988; with the counterarguments to the project reaching their full complexity.[66]

However, face-to-face debates did not take place, neither orally, nor written; both parties used only their own channels. As the press turned against the barrage, only the hydrological journals remained for the engineers to express their arguments and claims; they started a column in the *Hidrológiai Közlöny* (Hydrological Journal) to publish the articles that were rejected by the newspapers. Tensions increased, as the international agreement obliged the government, but as the regime softened, the population had more opportunity to protest. Nevertheless, police forces prohibited and prevented a demonstration organized by the Circle in 1986. The movement thus increasingly gained a political tone, and the GNBS became a symbol of the socialist regime itself and a catalyst for the political transition.[67] The Hungarian Parliament and the government could hardly do anything else but surrender in the end to the will of the people and broke the contract with the Czechoslovaks, and first suspended and later stopped the construction work.[68]

Emil Mosonyi was not able to help in the situation either. He first returned in 1987 to be informed about the project and two years later he was officially invited to help. He gave his opinion in talks and in writing, tried to refute the claims of the environmentalists based on scientific arguments, however, it was fuel to the flames. He was attacked

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[62] VARGHA, J.: Egyre távolabb a jótól; Idem: Vízlépcső vagy Dunaszaurusz? *Új Tükör* 1981, no. 4–6, pp. 6–8; Mosonyi as the main target of the attack is even clearly visible in a short press article based on the original paper, where Vargha never mentioned Mosonyi by name, only as the man "honored by Labor Red Flag Merit Order".

[63] E.g. ERDÉLYI, Mihály: A győri medence természeti-gazdasági értékei és a tervezett vízlépcső. *Földrajzi Értesítő* 32, 1983, no. 3-4, pp. 475–490; TÓTH, János: A Bős–Nagymarosi Vizlépcsőrendszer környezeti hatásairól és néhány várható ökológiai problémájáról. *Földrajzi közlemények* 107, 1983, no. 1, pp. 1–10.

[64] HAJNAL, László Gábor: "Habár fölül a gálya…" : A Bős–Nagymarosi vízlépcső építésének vázlatos története. *Új Látóhatár* 35, 1984, no. 3, p. 378.

[65] SÓLYOM, László: A társadalom részvétele a környezetvédelemben. *Medvetánc* 5, 1984–1985, no. 4–1, pp. 220–222; KIEN, Péter: A Nagy Szlovák Csatorna. *Beszélő* 9, 1984, pp. 496–506.

[66] DOBOS, Lídia – RÁCZ, Judit – VIT, László (eds.): *Utánunk az özönvíz*. Budapest 1989.

[67] Cf. JANÁČ, Jiří: Planned environment in a socialist dictatorship. Complex water management and soil improvement in Moravia. In: BRAIN, S. – PÁL, V. (eds.): Environmentalism, pp. 125–144.

[68] FLEISCHER, T.: Jaws, pp. 436–438; PÁL, V.: Technology, pp. 221–225.

intensely in the media, and became the target even more, especially for Vargha and the followers of his movement, being depicted as the simple originator of the barrage system and as a representative of the communist regime until his death and beyond.[69] But compared to Réthly, Mosonyi had far less room for maneuver. Instead of defense he thought it better to retreat. He became active again only after the change in government in 1994, when the construction of the Nagymaros dam became an open question again.[70]

Conclusions

The stories of the two Hungarian 'hydraulic heroes' have striking similarities, but also differences, since several factors in their lives differ. Their careers crossed but did not explicitly come into contact, however the last hundred years of Hungarian water history can be drawn with the help of their stories. It was visible, for example, how the emphasis changed from the Tisza to the Danube, and from water regulation and irrigation to water power utilization. However, both Réthly and Mosonyi shared utilitarian views and that pure science and technology could be the answer. Yet, both witnessed great changes in the academic field, which changes barely influenced them, perhaps due to their age: Réthly saw the rise of the global anthropogenic idea, and Mosonyi the environmental movement.

The scientific debates highlighted in the article constituted great challenges to the field of water management. The climatic controversy shook hydraulic engineers, however, the judgment and narrative of the water regulation in the Alföld remained predominantly positive until the present, which also helped Réthly during his struggles. In turn, the debates around the barrage system were devastating for the field, and it still has not recovered from the shock,[71] while the unbuilt Nagymaros dam became the symbol of the Hungarian environmental movement.[72]

As a conclusion, we should also realize that the opportunities of science are limited in public debates, scientific argument, being increasingly used by both opposing parties, was unable to help the disputes come to an end or find a compromise, with political power always playing a greater role. This is particularly true for environmental controversies where all the opponents can easily find scientific claims to back up their opinions and decisions. We also need to bear this in mind when climate change slowly forces the reconfiguration of the Hungarian hydrosocial regime.

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[69] KERTÉSZ, Péter: "Kedvező hágai ítélet ellenére is születhet rossz megoldás" (An interview with János Vargha). *Népszava* 125, 1997, no. 79, p. 6; LÁNYI, András: Fenékig! *Magyar Hírlap* 27, 1994, no. 179, p. 7; KARÁTSON, Gábor – BÁRDOS DEÁK, Péter: Nagymarosi gát – újratöltve? *Magyar Nemzet* 72, 2009, no. 147, pp. 32–33.

[70] ÁRPÁSI, Z.: Mosonyi, pp. 238–256. In his interview, Mosonyi reacted violently to Vargha's attacks.

[71] It is not surprising that the climate skeptic movement in Hungary found its ground in an environmental realist circle founded mainly by hydraulic engineers.

[72] PEYTON, Jonathan: Corporate ecology : BC Hydro's Stikine-Iskut project and the unbuilt environment. *Journal of Historical Geography* 37, 2011, pp. 358–369.

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Summary

The Water Histories of Hungary's Major Rivers : Environmental Debates around Antal Réthly and Emil Mosonyi

The question of water, as well as the related fields of agriculture, afforestation, and hydroelectric power, was at the focus of Hungarian environmental history. With a biographical approach, the study uses the histories of two scientists, meteorologist Antal Réthly (1879–1975) and hydraulic engineer Emil Mosonyi (1910–2009), to show how the emphasis changed from the Tisza River to the Danube,

and from water regulation and irrigation to water power utilization. Réthly played a major role in the climatic controversy around the water regulation and afforestation of the Alföld; he argued that these human activities could not modify the climate. Mosonyi strived to conceptualize and to develop the utilization of Hungarian waterpower potentials and remained a supporter of large hydropower projects after his emigration and return. Both Réthly and Mosonyi shared utilitarian views and that pure science and technology could be an answer to environmental questions, however, both pundits were attacked by the press for their views. Yet, they witnessed great scientific changes that barely influenced them: Réthly saw the rise of the global anthropogenic idea, Mosonyi the environmental movement. The climatic controversy shook hydraulic engineers, however, the judgment and narrative of the water regulation in the Alföld remained predominantly positive until the present, which also helped Réthly during his struggles. In turn, the debates around the Gabčíkovo-Nagymaros barrage system were devastating for Mosonyi and the field alike, and the issue of water management has still not recovered from the shock.

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