

BÜRKLI-ZIEGLER Arnold

Born in Zürich, Switzerland in 1833 – Dead in Zürich, Switzerland in 1894.



Figure 1 : Portrait of Arnold Bürkli-Ziegler
(from www.xn--brkliplatz-9db.ch).

1. SHORT BIOGRAPHY

Arnold Bürkli was a municipal engineer in the city of Zürich, Switzerland (Stutz, 2004). He worked in various technical fields, including railway, electrification, city planning, water supply and also urban drainage and sewer systems.

In 1850-1853, he was municipal engineer assistant for road and water works in Zürich. He then became a railway engineer in 1853. Between 1855 and 1858, he studied architecture in Berlin, Germany and travelled in other European countries (Belgium, England and France). In 1865, he married Berta Ziegler and adopted his full name Bürkli-Ziegler. Berta Ziegler was the daughter of Adrian Ziegler, who was an administrator of the Zürich hospital, a book-seller and the co-owner of the Orell Füssli publishing company which e.g. published the report written by Bürkli-Ziegler in 1880.

From 1860 to 1882, he worked as a municipal engineer. He designed and supervised the construction of many significant projects which contributed to the modernisation of many districts in the city of Zürich (railway station, new bridge and main streets, new urbanisation of districts, tramway, river banks planning and construction, etc.). After the cholera epidemic in 1867 which killed more than 500 persons in the canton of Zürich, Bürkli-Ziegler completely reorganised the municipal sewer system, the water supply system (e.g. Bürkli-Ziegler, 1867, see Figure 2) and the solid waste removal service between 1867 and 1873. He was then internationally recognised as an expert in water supply and worked in many cities in Switzerland, Austria, Rumania and Italy.

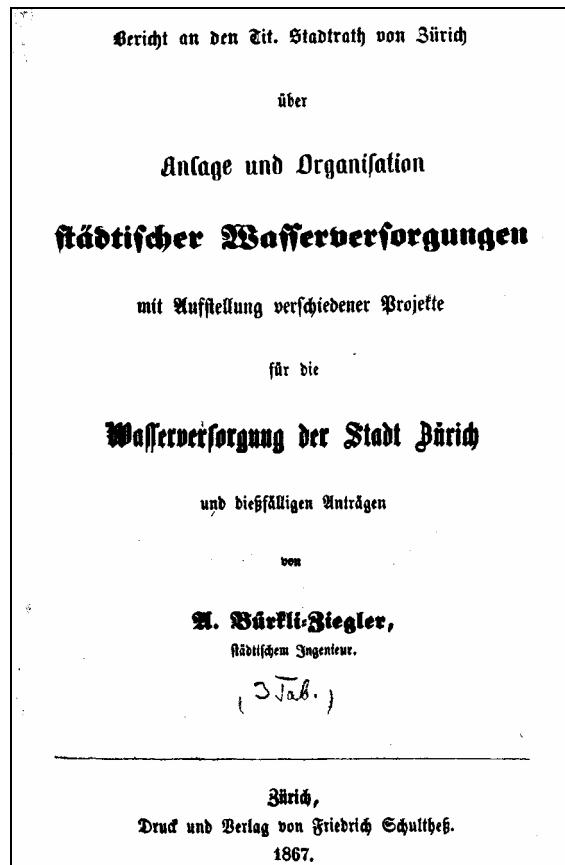


Figure 2 : Front page of the report written by Bürkli-Ziegler in 1867 about the water supply of the city of Zürich.

In 1872, he collaborated with the German engineer Friedrich Eduard Salomon Wiebe* (1804-1892) to establish the drainage master plan of Basel, Switzerland. In 1873, he worked for the city of Mannheim, Germany to improve its drainage system (Hansen, 2004).

He was chairman of the Swiss society of engineers and architects (1876-1893) and of its local section in Zürich (1869-1885), member of the Great Council of Zürich (1883-1892) and member of the Swiss National Council (1888-1892). He has been nominated *doctor honoris causa* of the University of Zürich in 1883 for his great role and actions in municipal hygiene. The square he designed along the margin of the lake of Zürich now bears his name, i.e. *Bürkliplatz*.

2. BÜRKLI-ZIEGLER FORMULA

In 1880, Bürkli-Ziegler published a detailed report entitled *Grösste Abflussmengen bei städtischen Abzugs-Kanälen* (Highest flows in urban stormwater channels) (Figure 3)

where he analysed and compared many historical strong storm events and their respective runoff flow rates and volumes in France (Paris, Toulouse, Ardèche), England (London, Scarborough), Hungary (Budapest) and Zürich. Based on this analysis, he derived a formula (Figure 4), known today as the Bürkli-Ziegler formula, between the rainfall intensity (especially during the most intense period of the whole rainfall event) and the maximum flow rate at the outlet of large urban catchments.

This formula was written as:

$$\frac{A}{R} = 0.5 \sqrt[4]{\frac{G}{F}} \quad \text{Eq. 1}$$

with A runoff flow rate (L/s/ha)
 R mean rainfall intensity during the intense period (L/s/ha)
 G slope of the catchment (‰)
 F area of the catchment (ha).



Figure 3 : Front page of the report written by Bürkli-Ziegler in 1880 on the design of sewers for the city of Zürich.

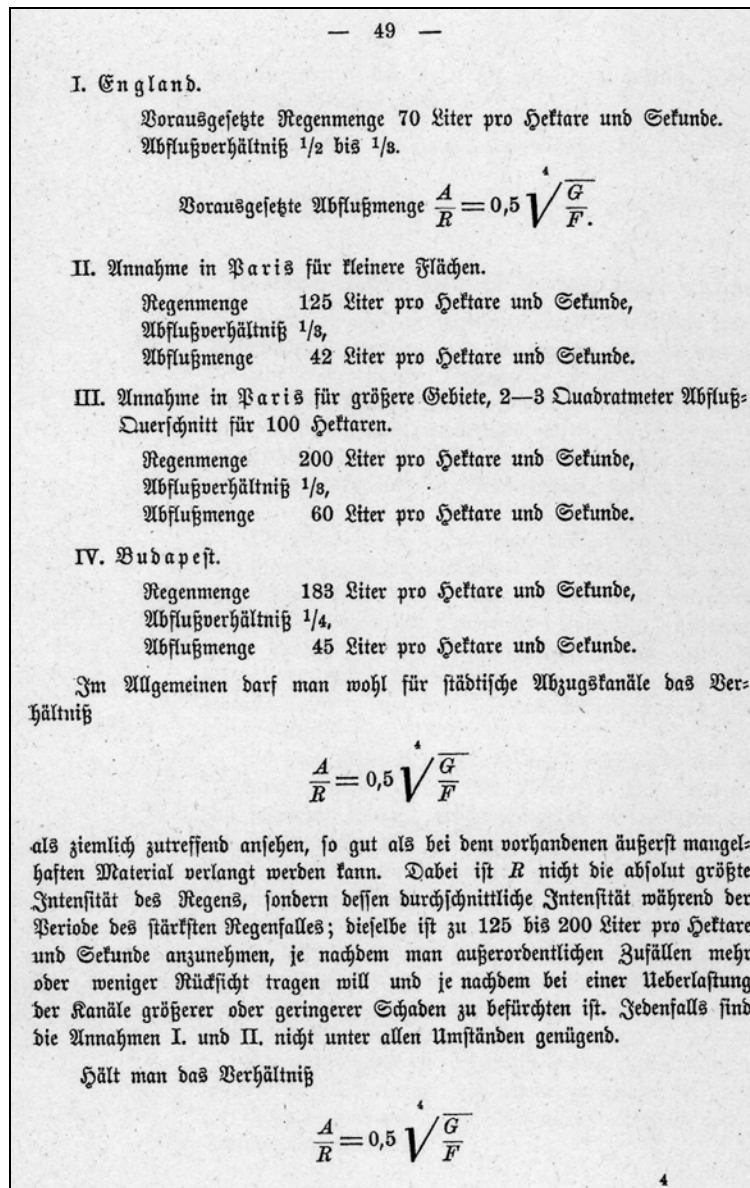


Figure 4 : Rainfall-runoff formula for Zürich proposed by Bürkli-Ziegler (1880, p. 49), including comparison with England, Paris and Budapest.

The above formula has been quoted by many authors in the late 19th and early 20th centuries, the factor 0.5 being replaced by values depending on the type of surface and on its urbanisation or land use (e.g. Folwell*, 1906 and Metcalf and Eddy*, 1930 in the USA; Imbeaux*, 1911 and Mondon*, 1934 in France) before to be progressively replaced by the rational formula initially introduced by Mulvany* (1851) and promoted

by Kuichling* (1889). But the Bürkli-Ziegler formula was still used more recently in some countries. As an example, it was mentioned in the Spanish technical instructions to design drainage systems for catchments with an area larger than 200 ha (MOPU 1965), in the following form:

$$Q = 3.90 A I_m C \left(\frac{J}{A} \right)^{\frac{1}{4}} \quad \text{Eq. 2}$$

with Q runoff flow rate (L/s)
 A area of the catchment (ha).
 I_m mean rainfall intensity during the intense period (mm/h)
 C runoff coefficient (-)
 J slope of the catchment (m/m).

3. MEASUREMENT OF RAINFALL INTENSITIES

In his report, Bürkli-Ziegler also emphasized the importance of the measurement of rainfall intensities at short time step (e.g. 10 minutes) instead of simple total rainfall depth per event. He gave the description of a modern raingauge (Figure 5) manufactured by the Swiss company Hottinger he considered as appropriate for this purpose, and he displayed the 10 min time step hyetograph obtained with this raingauge for the strong storm event measured on 3-4 June 1878 in Zürich. He also pointed the fact that high intensities may be underestimated with such raingauges.

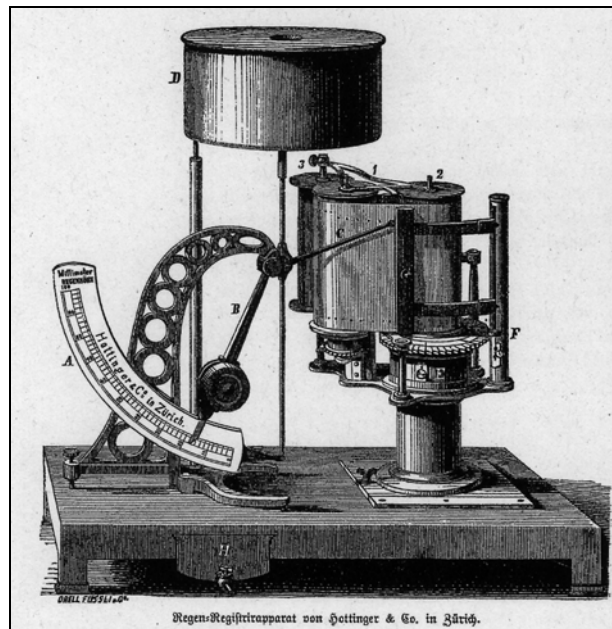
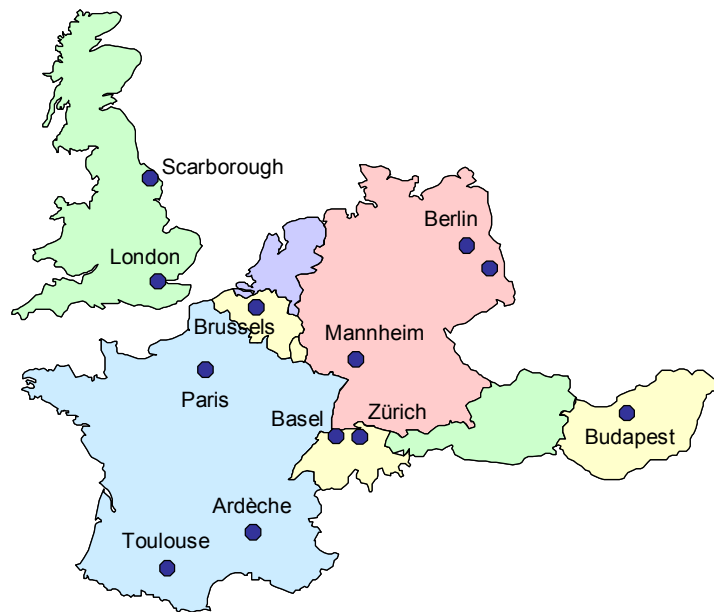


Figure 5 : Hottinger raingauge used by Bürkli-Ziegler in Zürich, with a 10 min time step resolution for hyetographs (in Bürkli-Ziegler, 1880, p. 51).

The Hottinger raingauges were very reliable instruments, used in many meteorological institutes. As an example, a Hottinger raingauge has been used in Brussels in the Royal Meteorological Institute of Belgium from 1896 until the 1920s (Demarée, 2001).



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