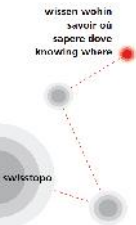


Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

armasuisse  
Federal Office of Topography swisstopo




# Mapping the unknown

## Depth soundings of Swiss lakes in the 19th century

ICA Commission History of Cartography  
Utrecht Workshop *Controlling the waters*

Martin Rickenbacher

Federal Office of Topography swisstopo



## Overview

- Some statistics: Switzerland and its lakes
- From the first unofficial soundings ...
- ... to the soundings for cantonal maps ...
- ... and to the systematic sounding for the Topographical Atlas of Switzerland
- Conclusions
- And today?

---

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## Some statistics Switzerland and its lakes



[https://de.wikipedia.org/wiki/Liste\\_der\\_gr%C3%B6ssten\\_Seen\\_in\\_der\\_Schweiz](https://de.wikipedia.org/wiki/Liste_der_gr%C3%B6ssten_Seen_in_der_Schweiz)

28 Swiss lakes bigger than 1 km<sup>2</sup>

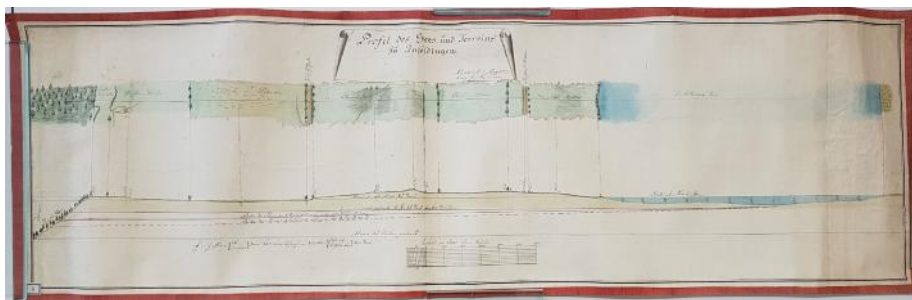
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## Profil des Sees und Terrens von Ansoldingen



SIABE, AA V 238b

«nivellirt im May 1771»

Johann Jakob Brenner (1711/12–1775)

Scale 1:1200

115 x 37 cm

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 **Plan von Ansoldingen und der beyden Seen daselbst**




1771  
1:3000  
75 x 73

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 **Plan von Ansoldingen und der beyden Seen daselbst**

5 + 2 = 7 profiles with totally 45 soundings

Surface 0.38 + 0.14 → 0.52 km<sup>2</sup> → 87 soundings per km<sup>2</sup>

Underwater topography not indicated (only the soundings)

Maximum depth: 63 / 47 Bernese feet  
(18.5 / 13.8 metres / NM25 15 / 14 m)

Motivation of the surveyor (Johann Jakob Brenner) unknown

No evidence neither in the Council's manuals ...


... nor in the documents of the Economic Society of Berne


Test area for a bigger project: the sounding of the Thuner See

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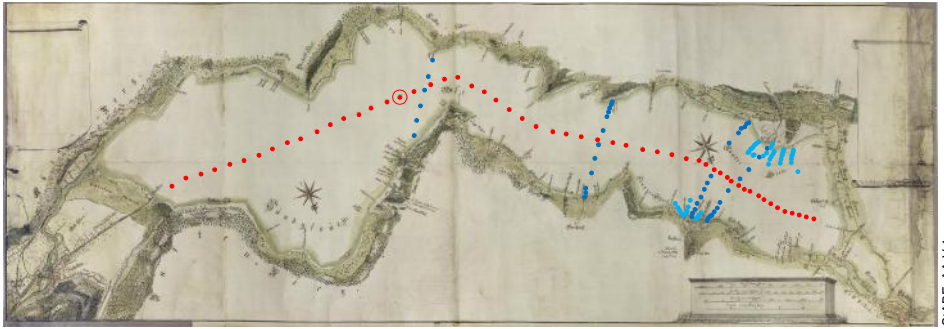
 **[Thunersee]**



«zu Grunde gelegt A° 1771 durch Joh: Jac: Brenner Basileensis»  
 210 x 72 cm  
 Scale 1:5000  
 Unfinished (blank description fields)

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 **[Thunersee]**



Longitudinal section: 55 soundings (18.5 km → every 340 m)  
 4 cross sections: 45 soundings (6 + 11 + 16 + 12)  
 Short profiles / single points: 51 soundings (18 + 33)  
 151 soundings on 47.74 km<sup>2</sup> → 3.2 soundings/km<sup>2</sup>  
 Maximum depth: 121½ «Berner Klaffer zu 6 Schuhe» (213 m)

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## Carte du Lac de Genève ...



ETH-Bibliothek Zürich, Rar 8472

Horace Bénédict de Saussure (1740–1799)

*Voyages dans les Alpes I*, Neuchâtel, 1779

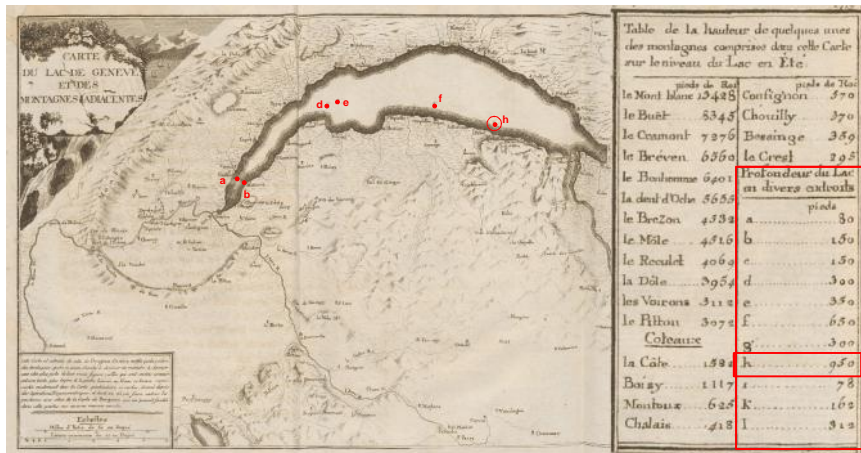
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## Carte du Lac de Genève ...



ETH-Bibliothek Zürich, Rar 8472

11 depth indications (5 of them not to be localized)

Maximum depth 950 *pieds du Roi* → 308 m (310 m)

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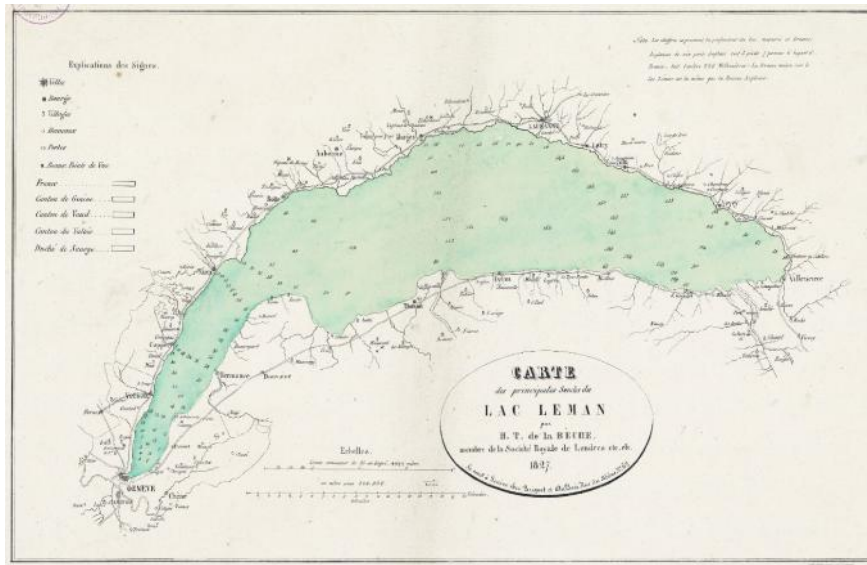
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### Carte des principales sondes du lac léman



swisstopo, map collection, LT KSEE 44c

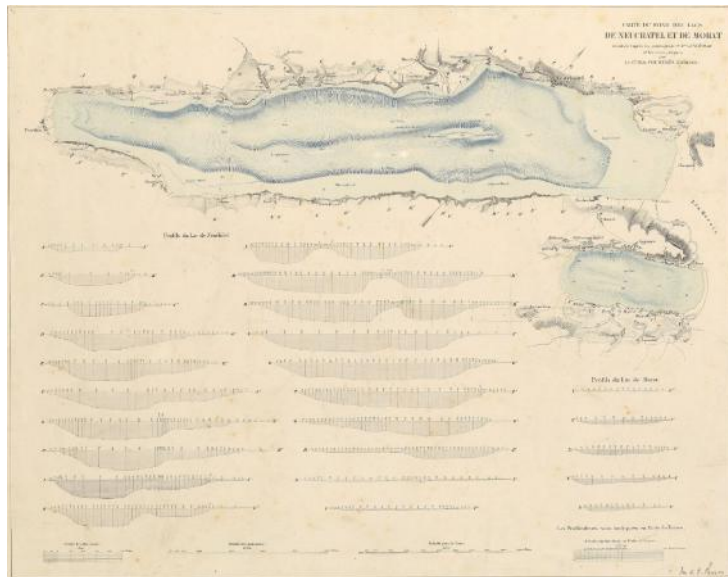
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### Carte du fond des lacs de Neuchâtel et de Morat




Bibliothèque de Genève, BGE 2 H 7/9

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 **Carte du fond des lacs de Neuchâtel et de Morat** [1846]

**CARTE DU FOND DES LACS  
DE NEUCHATEL ET DE MORAT**

dessinée d'après les sondages de M<sup>re</sup> GUYOT, Prof<sup>r</sup>  
et les siens propres  
par  
Le C<sup>te</sup> H. de POURCELÈS GORGIER.

Top. à la lithog<sup>r</sup> de L. Sorel à Neuchâtel.  
Lith. Anst. v. H. Delius.  
Se vend chez Jaquet et Frères.


**Echelle pour la Carte**  
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 Mètres.

**Echelle des ordonnées.**  
0 100 200 300 400 500 600 700 800 900 Mètres.

**Echelle des Abscisses.**  
0 100 200 300 400 500 600 700 800 900 Mètres.

Les Profondeurs sont indiquées en Toises de bannes.  
1 Toise est Mesurée au Poids de Troye.  
Les Profondeurs sont indiquées en Toises de bannes.

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 **Carte du fond des lacs de Neuchâtel et de Morat**

**DE NEUCHÂTEL ET DE MORAT**

dessinée d'après les sondages de M<sup>re</sup> GUYOT, Prof<sup>r</sup>  
et les siens propres  
Le C<sup>te</sup> H. de POURCELÈS GORGIER.

Profil de Lac de Neuchâtel

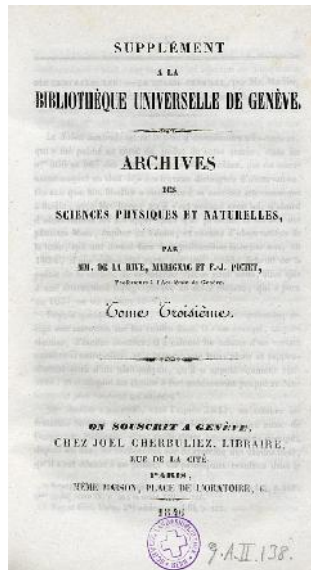
Bibliothèque de Genève, BGE 2 H 7/9

Lake ground represented by hachures  
Underwater topography named  
20+5 profiles and 20+7 single depths → approx. 1100 soundings

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## Carte du fond des lacs de Neuchâtel et de Morat



57. — NOTICE SUR LA CARTE DU FOND DES LACS DE NEUCHÂTEL ET DE MORAT, par A. GUYOT. (*Mém. de la Société des Sciences naturelles de Neuchâtel*, tome III.)

Une des études préliminaires les plus importantes pour connaître la distribution et la variation de la température dans les eaux du lac de Neuchâtel était celle du tracé topographique du fond de ce lac. Cette étude a été faite, au moyen de nombreux sondages, par MM. Guyot et de Pourtalès-Gorgier. Le nombre des points ainsi déterminés est d'environ onze cents. Ils sont placés sur des coupes per-

Les eaux du lac de Neuchâtel occupent une vallée longitudinale parallèle au Jura. Le fond de cette vallée s'abaisse à 444 pieds au-dessous de la surface des eaux, et son maximum de profondeur est à 888 pieds au-dessus du niveau de la mer.

Le lac de Morat est un petit bassin creusé dans la molasse. Sa profondeur est de 144 pieds, et non pas de 360 comme l'a dit Razoumowski. A. F.

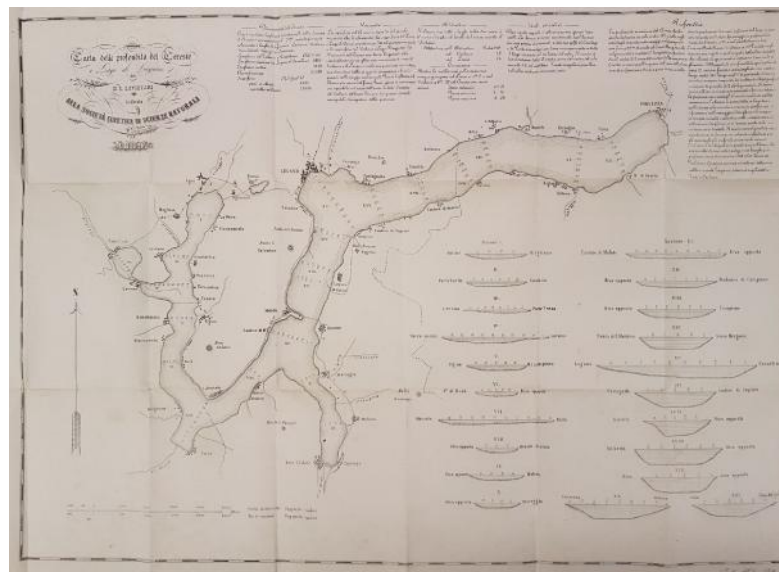
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## Carta della profondità del Ceresio



1859

swisstopo, Kartensammlung, LT K SEE 186

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## Carta della profondità del Ceresio

1859



With text information on the dimensions of the lake of Lugano, its hydrological connections, height information, dangerous winds and the depth

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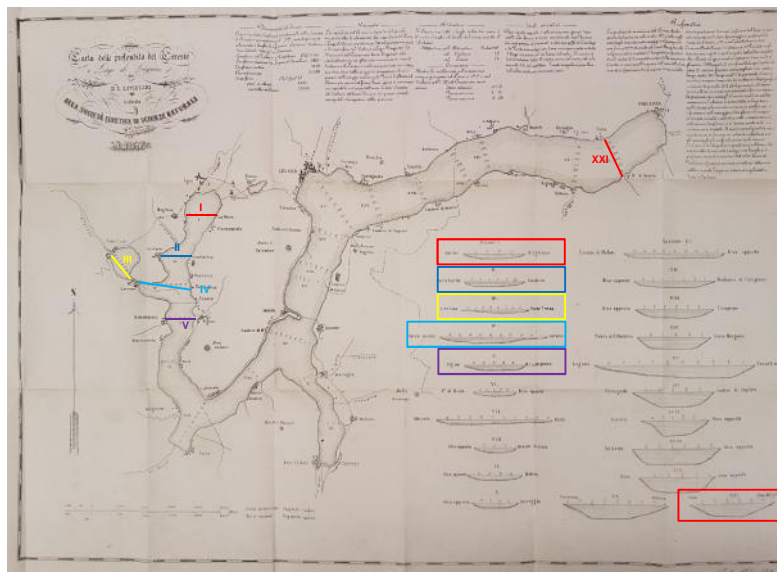
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## Carta della profondità del Ceresio

1859



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## Carte topographique du Canton de Genève



1837–1838  
1:25000  
soundings  
and «filage»

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## Topographische Karte der Schweiz 1:100000



Only «filage» and height of the water surface

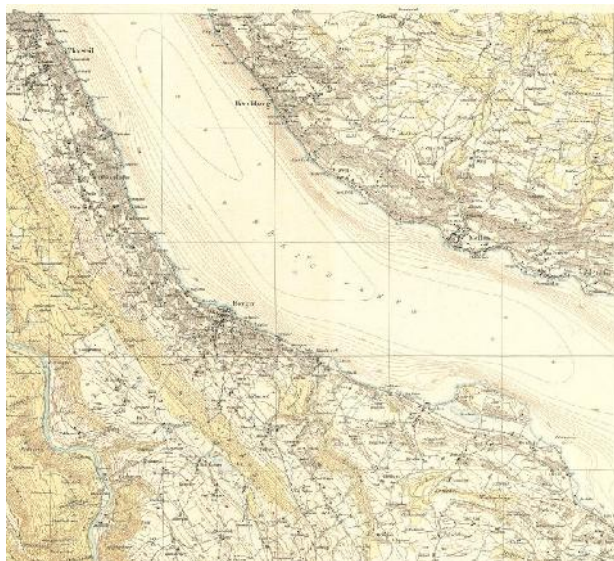
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## Topographische Karte des Kantons Zürich



«Wild-Karte»

1:25000

N: XXVI. HORGEN.

1210 soundings  
in the Zürichsee

Sounding machine  
constructed by  
engineer Zuppiger

1853–1855

First use of depth  
lines

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## Topographische Karte des Kantons Zürich



Hans Heinrich Denzler  
(1814–1876)

1853 Pioneer of the first cantonal  
lake soundings (Zürichsee)

1854–1862 First engineer at the  
topographic survey of the Canton  
Berne

1862–1866 Director of the  
Topographical office of Berne

1866–1873 Director of the  
cadastre of the Canton Solothurn

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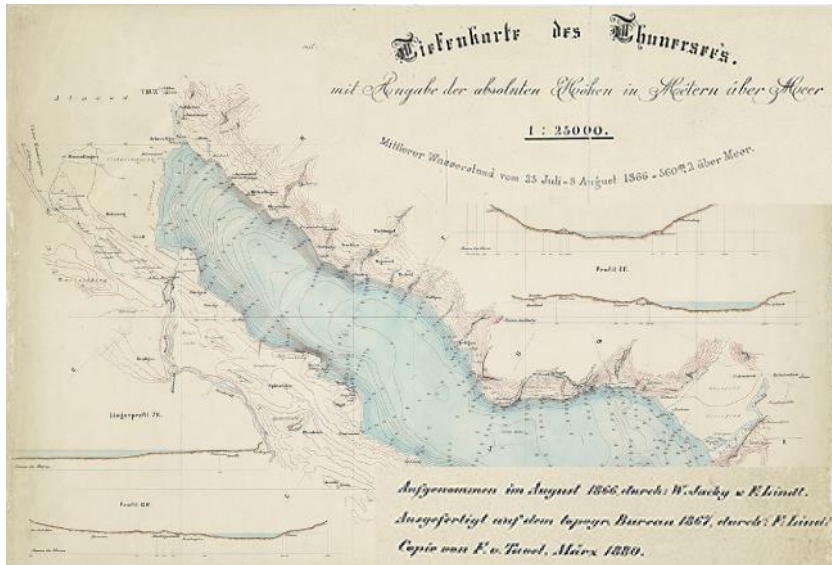
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# Topographic survey of the Canton Berne



swisstopo, Kartensammlung, LT K See 8 b

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# Topographic survey of the Canton Berne



swisstopo, LT K See 8 b

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## Topographic Atlas of Switzerland



[Journey through time](#)

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## Topographic Atlas of Switzerland



swisstopo.

Philipp Charles Gosset

1838–1911

First engineer of the Federal  
topographical office charged  
with the soundings of lakes

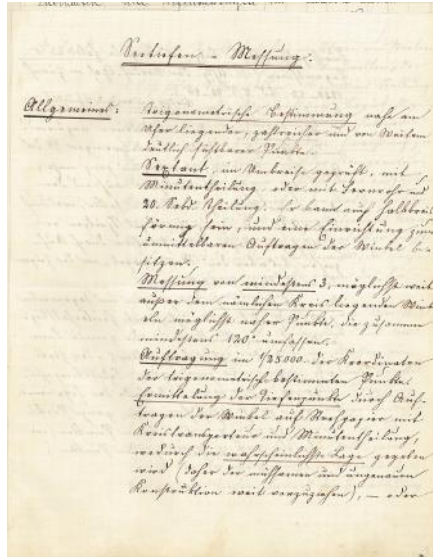
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## Topographic Atlas of Switzerland



swisstopo, Kartensammlung, LT K SEE 18a

Instruction for the depth soundings of the lakes  
Manuscript by H.H. Denzler  
Experiences gained with cantonal projects were applied on the federal level

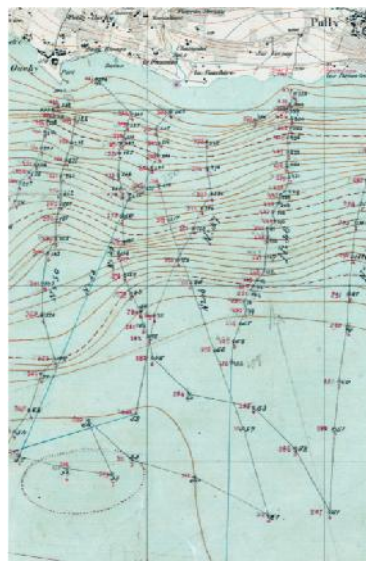
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## Topographic Atlas of Switzerland



swisstopo, Kartensammlung, LT K SEE 44q

Manuscript map 1:25000 of the Lac Léman with the altitude of the sounded points. The contour lines were gained afterwards by interpolation to represent the underwater topography. The soundings 308, 309 and 311 indicate a cone, which was not confirmed a dozen of years later with the following soundings executed by engineer Hörnlimann.

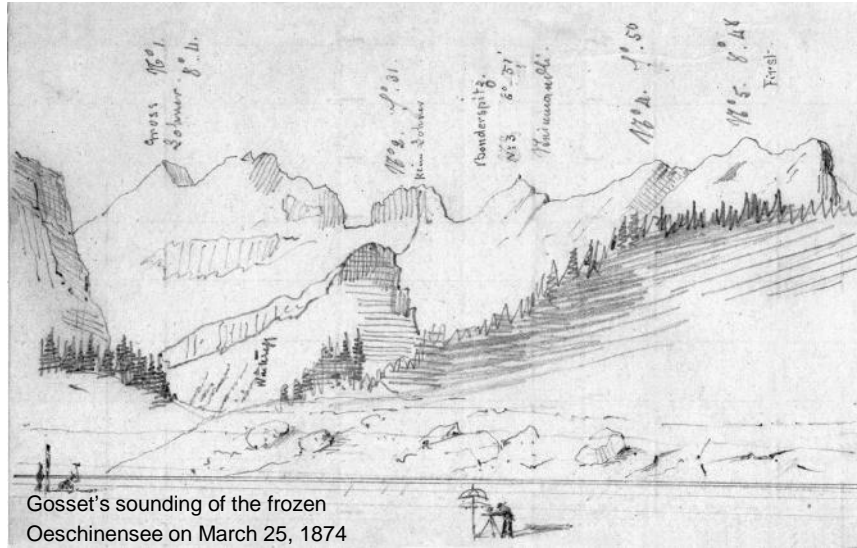
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## Topographic Atlas of Switzerland



Gosset's sounding of the frozen  
Oeschinensee on March 25, 1874

swisstopo, Kartensammlung, provisorische Signatur LTK SEE, A.Nr.78 | (Beobachtungseft)

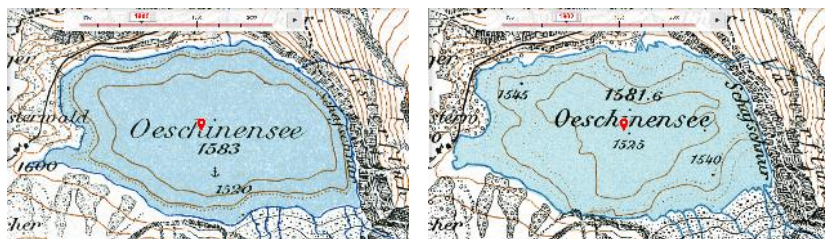
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## Topographic Atlas of Switzerland



Until 1901: Results of Gosset's survey

1901: New survey by Dr. Max Groll  
published in 1902 ([Text 1903/1904](#))

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## Topographic Atlas of Switzerland



Jakob Hörnlmann

1846–1933

1876–1921 engineer topographer at the Federal topographical office

He is *the* «hero» in sounding the Swiss lakes for the *Topographic Atlas of Switzerland*

swisstopo, Bildsammlung

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## Topographic Atlas of Switzerland

See	Jahr der Aufnahme	Anzahl der Längen	Laufzeit in Stunden	Personen	Ausgeführt durch
<b>Gesamtes</b>		11 056	30,8		
Alpen-See	1853	1 459		Gosset	Edig. topograph. Bureau
Forêt Lac (Copper-Herance-Gefäß)	1878-79			Victor Mallat	Privatinitiative
Saas-See (Saas-See)	1885-90	9 167		Hörnlmann	Edig. topograph. Bureau
Franken-See (Franken-See)	1887-88	4 088			Franken-See
<b>Bodensee</b>		11 147	30,7		
Thursee (nicht Längensounding)	1860-60			Hörnlmann	Edig. topograph. Bureau
Untersee (Schweizer-See)	1858	885		Münzel	
Yssingsee	1859	2 313	9,7	Münzel	
Lampfenlochsee (Schneidloch-See)	1863	1 884	29,8	Suter	
Vierwaldstättersee	1864	4 952	27,3	Hörnlmann	
Zürchersee (im engeren Sinn)	1868-70			König	Zürcher Regierung
Obsee	1880	400		Münzel	Edig. topograph. Bureau
Luzernersee	1880	3 506	49,6	Dr. Leuzinger	Privatinitiative
Tessinsee	1888			Jacoby-Taylor	Edig. topograph. Bureau
Thunersee (neue Auslotung 185 begonnen)	1899			Jacoby-Taylor	
Brünnersee	1899			Jacoby-Taylor	
Zugersee	1895			Weber	
Wilersee	1895	340	12,6	Hörnlmann	
Walensee	1899	720	30,0	Münzel	
Hallwilersee	1891			Hörnlmann	
Saas-See	1892	697	22,6	Hörnlmann	
Baslersee	1893	478	29,8	Hörnlmann	
Jacobs-See, Lac de Brenet	1891	161	66,3	Hörnlmann	
Brünnersee	1877	311	29,6	Suter	
St. Moritzsee	1877	157	47,6	Dübli	
Leisersee	1892	155	50,0	Fischer	
Narajensee	1891	362	31,1	Hörnlmann	
Jegetsee	1884			Hörnlmann	
Oeschlachersee	1901	700	60,3	Dr. Groll	Privatinitiative
Rheinfallensee	1874				Edig. topograph. Bureau
Sälarsee	1892	305	123,4	Hörnlmann	
Silvaplattensee	1893	269	110,7	Hörnlmann	
Piscina Sacra	1842	266	116,0	Hörnlmann	

Table of the soundings of Swiss lakes for the *Topographic Atlas*

**More than 27'100 soundings from 1880 – 1900**

Geographisches Lexikon der Schweiz, Bd. 4, 1906, S. 648.

Federal Office of Topography swisstopo

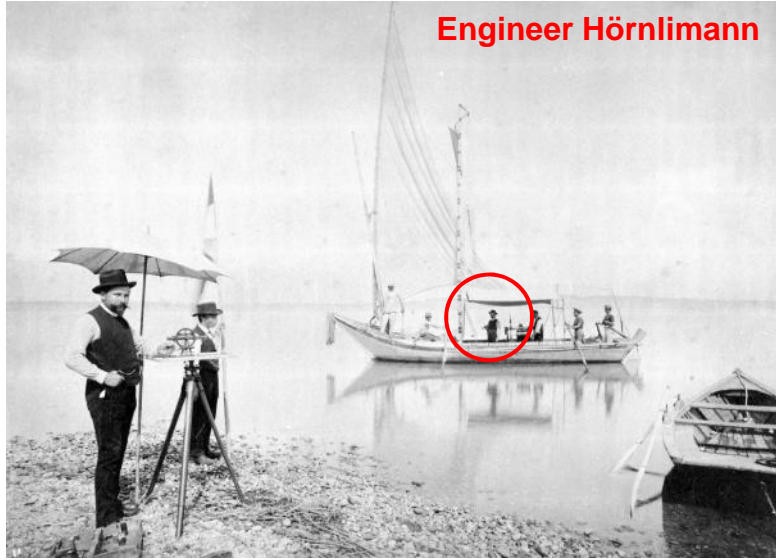
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## Topographic Atlas of Switzerland



Engineer Hörnlimann

swisstopo, Bildsammlung, Technische Aufnahme Nr. 6763

Federal Office of Topography swisstopo

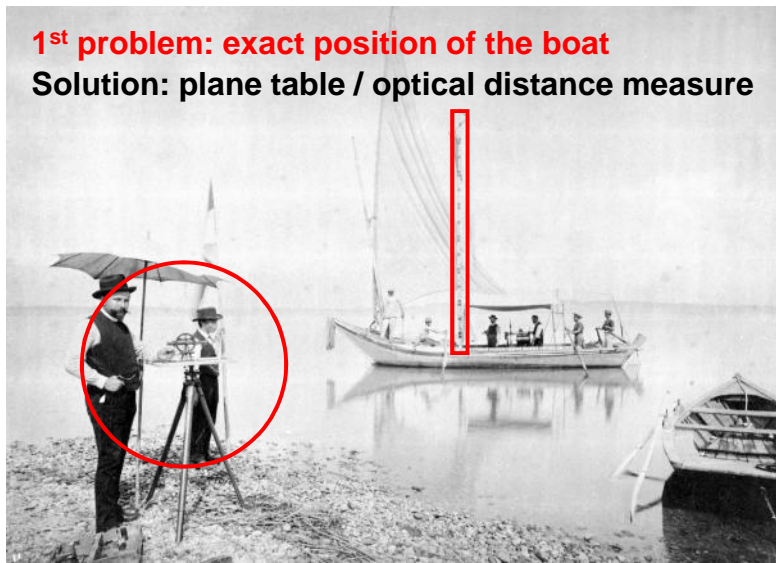
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## Topographic Atlas of Switzerland

**1<sup>st</sup> problem: exact position of the boat**  
**Solution: plane table / optical distance measure**



swisstopo, Bildsammlung, Technische Aufnahme Nr. 6763

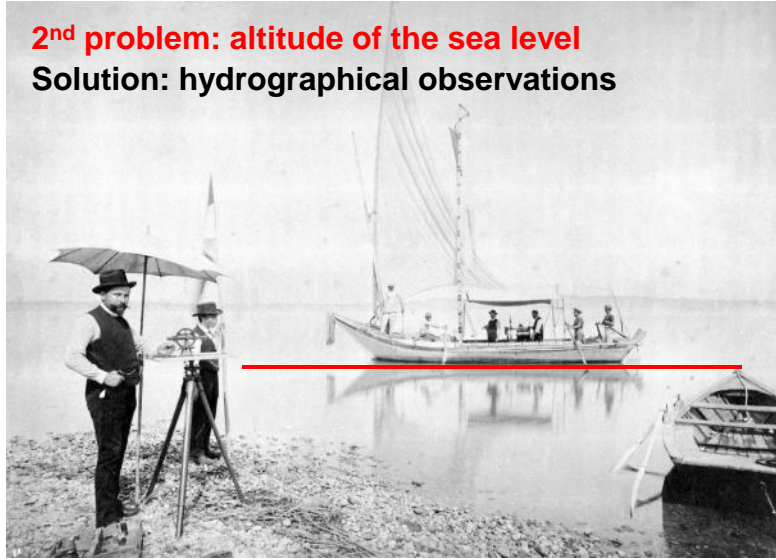
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 **Topographic Atlas of Switzerland**

**2<sup>nd</sup> problem: altitude of the sea level**  
**Solution: hydrographical observations**



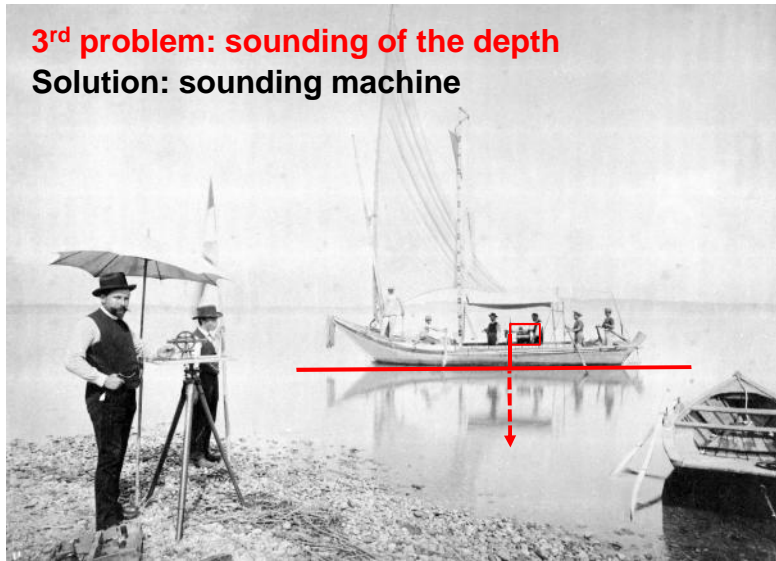
swisstopo, Bildsammlung, Technische Aufnahme Nr. 6763

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 **Topographic Atlas of Switzerland**

**3<sup>rd</sup> problem: sounding of the depth**  
**Solution: sounding machine**



swisstopo, Bildsammlung, Technische Aufnahme Nr. 6763

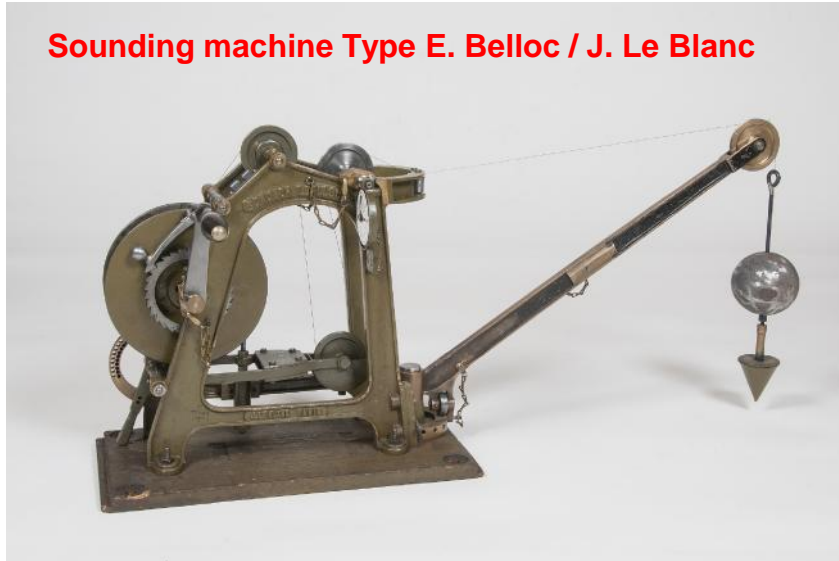
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## Topographic Atlas of Switzerland

### Sounding machine Type E. Belloc / J. Le Blanc



swisstopo, Historische Instrumentensammlung, Inv. Nr. 3100

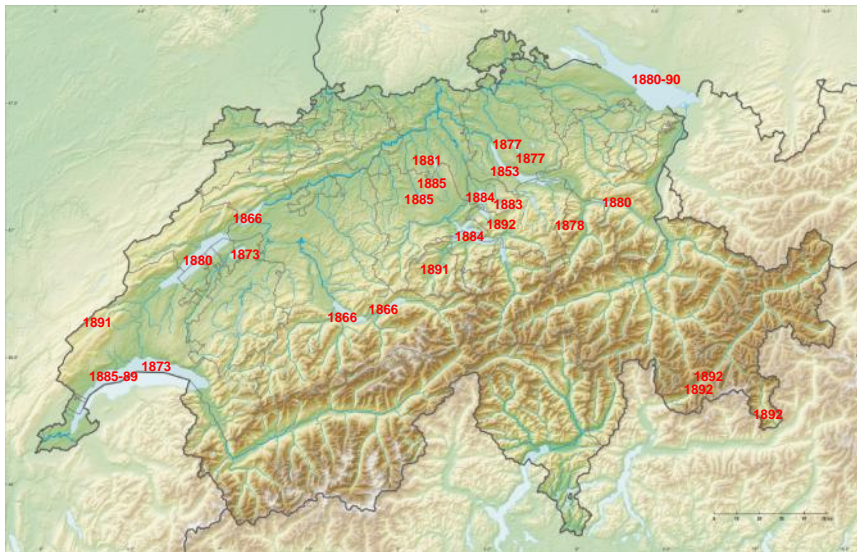
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## Topographic Atlas of Switzerland



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## Mapping the unknown

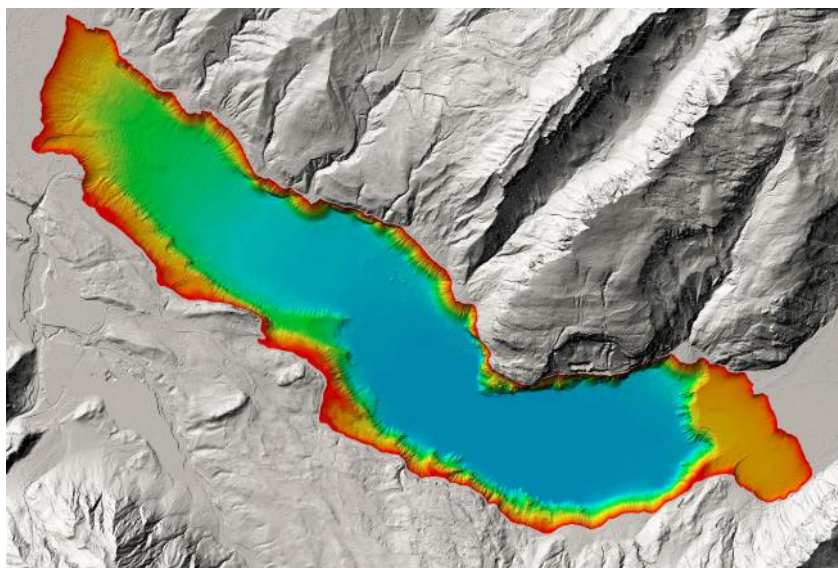
*«Dans la carte terrestre, [...] les courbes sont dessinées en présence du terrain. Dans la carte hydrographique l'on ne voit pas le terrain; le coup de sonde tombe en aveugle, [...] les courbes horizontales sont tracées au juger, dans le réseau des coups de sonde. Aussi, pour l'établissement d'une carte hydrographique exacte, faut-il multiplier indéfiniment les sondages.»*

François Auguste Forel (1841 – 1912)

In the terrestrial map, the curves are [...] drawn in the presence of the terrain. In the hydrographic map you do not see the terrain; the probe stroke falls blind, [...] the horizontal curves are traced to judge, in the network of the soundings. Also, for the establishment of an accurate hydrographic map, it is necessary to multiply indefinitely the polls.



## And today?







**Thank you very much for your attention!**

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