

# **Rudolf Wolf (1816 – 1893)**

## **A Swiss Astronomer, Geodesist and Historian**

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**Key words:** History, Surveying, Switzerland, Triangulation, Astronomy, European Arc movement, Documentation.

### **SUMMARY**

Rudolf Wolf was born as son of a pastor in a small village near Zurich. At the age of 12 he lost his father and the family moved to Zurich, where Wolf got a scientific education.

Already as a student at the University, he participated in the measurement campaign for the two baselines in Zurich and Bern for the new Swiss triangulation under the management of General Dufour.

He continued his studies in astronomy in Vienna (Littrow), and Berlin (Enke). On his way back to Switzerland, he visited Gauss in Göttingen, Argelander in Bonn and Arago in Paris.

After returning, he became professor for mathematics at the college in Bern and director of the astronomic observatory there.

In 1855 Wolf went back to Zurich and became professor for astronomy at the University and at the newly founded “Polytechnikum”, where he had to organise and design the new observatory together with the famous architect Gottfried Semper.

In 1861, the Swiss government nominated Wolf as first president of the new Swiss Geodetic Commission, giving him the task, to organise and measure the Swiss part of the European meridian project of General Baeyer in Berlin.

Wolf was not only a god scientist and manager; but also a brilliant writer and historian. He wrote different books on mathematics, physics and astronomy together with his famous “*Biographies, part of the Cultural History of Switzerland*” where he describes the life and work of 80 Swiss scientists, presenting even today a valuable source of information.

But his most valuable work is his “*History of the Surveys in Switzerland*”. A detailed description of all surveying and mapping efforts from the 15<sup>th</sup> to the 19<sup>th</sup> century. The book lists over 1000 persons and has valuable and detailed information in 1200 footnotes. It is a must for all professionals and interested historians and has recently been digitized by the Swiss Society for the History of Geodesy.

# Rudolf Wolf (1816 – 1893) A Swiss Astronomer, Geodesist and Historian

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## 1. INTRODUCTION

When in 1962 I started my first job at the „*Eidgenössische Landestopographie*“ — today “*swisstopo*”, my superior, the head of the topographic division, gave me an old rather shabby looking book and said: ”You have to read this, it is an important and interesting book!” It was Wolfs “*History of Surveying of Switzerland*”. But since I never was very good in executing orders, I gave the book to a bookbinder to make it look nicer and to silence my bad conscience and ranged in my bookshelf.

More than 40 years later, our **Society for the History of Geodesy in Switzerland** decided to re-edit the out-of-print book in a modern form on CD-Rom, and, since I was primarily involved in this project, I finally obeyed the order of my old boss and I am glad I did it, because I made acquaintance with a very kind and efficient scientist, teacher and historian, who’s books are still of great value to our country.

## 2. RUDOLF WOLF



Prof. Dr. Rudolf Wolf von Zürich

Rudolf Wolf was born on July 7, 1816 in Fällanden, a small village in the neighbourhood of Zurich, where his father was pastor. Rudolf was the youngest of 3 children. He had an elder sister born in 1810 and an elder brother born in 1813 who unfortunately died at the age of 26 years just after finishing his studies in theology.

The Wolf family originates from Zurich and has roots going back to the 14<sup>th</sup> century. Many of their members have served the town in important official positions.

Pastor Wolf had inherited the Wolf family library and was cultivated man, interested in science and education. Considering the local public school as inadequate, he decided to educate his sons himself. From the beginning, Rudolf showed a strong interest in mathematics. At the age of 10 years, he observed an eclipse of the sun in the mirror of a puddle, and was very much impressed.

His father died in 1828 and the family decided to move back to Zurich. Rudolf entered the so called “*Kunstschule*”, a technical college where he found a very good environment for his interests and excellent teachers and in the persons of J.K. Horner and J. Eschmann.

Johann Kaspar Horner (1774-1834) studied theology, but his interest in astronomy and mathematics were stronger. He abandoned his initial profession and after studies in Gotha under the astronomer Franz Xaver von Zach and later working as partner of the instrument maker Johann Georg Repsold in Hamburg, he joined Admiral Adam Johann von Krusensterns Russian expedition around the world (1803-1806) as navigator and astronomer. Because of family reasons, he gave up an offered career in Russia and returned to Zurich as schoolmaster and private searcher. Horner became the mentor of Wolf, and guided and advised him during his studies.

Johannes Eschmann (1808-1852) grew up as orphan in Winterthur and was recommended as excellent mathematician by his teacher to Horner in Zurich. He worked first as observer and astronomer for Horner and continued his studies in Vienna where he became the favourite student of the astronomer Joseph Johann Littrow (Littrow father). Back in Zurich, he was nominated in 1833 at the newly founded University of Zurich as professor for astronomy.

In the college, Wolf met another student, Johannes Wild from Wädenswil. This was the start of a lifelong friendship. The two had basically the same interests. Finishing the college they enrolled at the University of Zurich, taking courses in mathematics, astronomy and topography.

### **Measuring the baseline of Switzerland**

After the defeat of Napoleon 1813 in Leipzig, together with the French army, the French topographic officers ("*ingénieurs géographe*") had to leave the country, abandoning an unfinished triangulation network. Nevertheless, the seed was there and waited to be cultivated.

Due to the change, Switzerland was politically rather unstable. There was a tendency to move back to a loose government of 24 cantons. Fortunately, under the lead of the bigger cantons the government decided to give more competence to the central government and to build up a federal army. In 1834 Guillaume Henry Dufour from Geneva was nominated as chief of staff and chief of the topographic survey. Dufour had passed the "*École polytechnique*" in Paris and had served in the French army as "*ingénieur géographe*". And he was a brilliant manager and politician.

In a first session it was decided to use the existing triangulation network as far as possible, to expand it with a link over the Alps to Italy. Horner proposed to measure a test baseline in Zurich to get the proper experience to verify the more important baseline in Aarberg, also used by the French engineers. Horner had designed and constructed a special arrangement for baseline measurement in close relation with his friend Repsold profiting of his experiences made during the baseline measurement of German-Danish astronomer, Heinrich Christian Schumann in Hamburg, where Repsold had developed the necessary equipment.

For the fieldwork, Horner proposed his former student Eschmann, who, in the mean time had become Professor for astronomy at the newly founded University of Zurich. Eschmann

founded a small “Topographical Society” and animated his students to participate in practical measuring campaigns.

Here we find the two friends Wolf and Wild again, as the most active members in this society. In 1834 the little group measured the baseline in Zurich to test the equipment and the procedures. Eschmann was responsible for the alignment of the rods and for the reading, Wolf was in charge of the levelling and of the temperature readings and Wild acted as secretary. The results were good and the training of the team proved to be very valuable for the second part, the verification of the real baseline of the triangulation in Bern, which was measured in 40 days starting at September 20<sup>th</sup>, reading in the average 56 rods a day.

Eschmann continued the work and completed the triangulation measurements and necessary calculations. His results gave Dufour the geometric base for the first modern map of Switzerland the so called “Dufourkarte”

In the mean time, advised by Eschmann, Wolf completed his studies in Vienna, under the renowned astronomer J.J. von Littrow and in spring 1838 he moved to Berlin and spent a semester with the astronomer Johann Franz Encke and the mathematicians Dirichlet and Steiner.

In autumn 1838, he decided to return to Switzerland. On his way home, Wolf visited Gauss in Göttingen, Argelander in Bonn (where his brother was studying theology), and later on Bouvard and Arago in Paris. He arrived in Zurich at the end of the year having made very valuable contacts.

### **3. WOLFS TIME IN BERNE**

The start in Zurich was not easy. After some smaller jobs, helping his former teachers, he got an offer as professor for mathematics and physics at the well known grammar school in Berne. He accepted, and since his elder brother had died in summer, he moved with his mother and sister to Berne where he started working in autumn.

At the same time, he applied for the “*venia docendi*” in mathematics at the University, but got refused, out of political reasons. He therefore started a series of private courses in mathematics and had a great success, so that in 1844, he finally got the long awaited “*venia*”.

In 1847, Friedrich Trechsel, the professor for mathematics and physics at the University and director of the astronomic observatory retired, and Wolf was nominated to replace him as head of the observatory, but again, out of political reasons not as professor for mathematics. Immediately, Wolf began to reorganise and reequip the neglected little observatory. Besides the normal positional astronomy, he started with an observation series on sunspots, discovering a periodicity of 11  $\frac{1}{9}$  years. This brought him the long awaited breakthrough. In 1852 he was awarded of his faculty with a “*doctor honoris causa*” and at last got a nomination as professor for mathematics at the University

During his time in Berne, Wolf developed another part of his natural talents, that of a scientific writer and editor. After his arrival in Berne he had immediately joined Academy of Science in Berne. He presented many new ideas and already two years later, he was nominated secretary of this society.

He started to reorganise the scientific work and proposed to present interesting reports and result of the Academy members in a new publication series called "*Mitteilungen der Naturforschenden Gesellschaft in Bern*". He worked as editor of this "*Mitteilungen*" until 1855 and participated himself with over 50 contributions, the most important one in 1852, describing his research on sunspots.

Already in 1841, he proposed the society to publish a collection of biographies of important Swiss scientist and in 1844 he started with the first notes on his "*History of Surveying in Switzerland*"

#### **4. PROFESSOR AT THE "POLYTECHNIKUM" AND THE FEDERAL ASTRONOMIC OBSERVATORY**

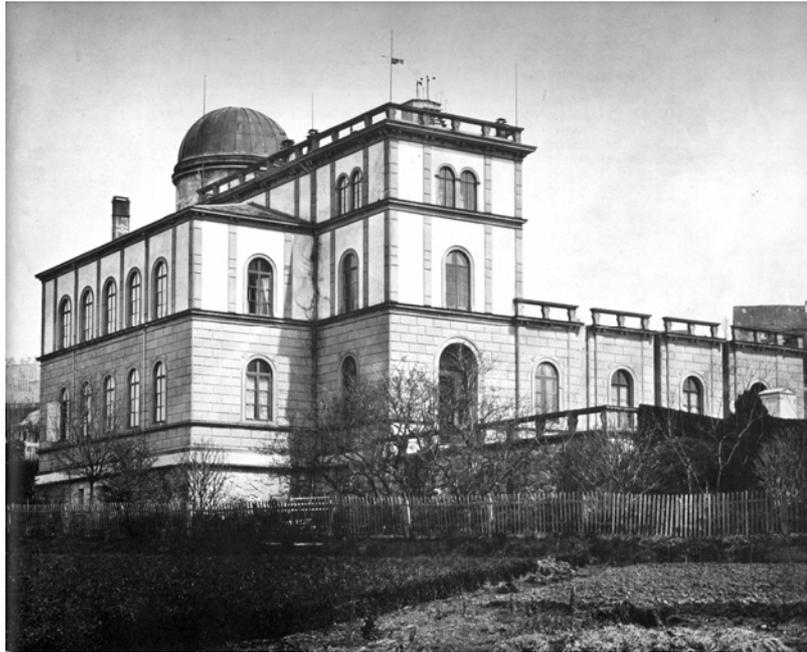
According to the new Swiss constitution of 1848, the central government was entitled to build up a Federal University and a Polytechnic school (similar to the famous French "*Ecole Polytechnique*" in Paris). But in the mean time, many cantons had already established their cantonal university and after long discussions in the parliament, the idea of a Federal University was abandoned and a law was passed, permitting the government to establish a Polytechnic school in Zurich.

In a preparatory session in Berne, Wolf as advisor succeeded to persuade the committee members of the importance of astronomy and of the necessity of a corresponding observatory, in the frame of higher mathematical education.

It was therefore not a surprise, that in 1855 he got a call as professor for mathematics at the college in Zurich, together with a nomination to build up a course in astronomy at the polytechnic school.

Despite the existing small observatory, he had to use, his courses had a great success and the number of students grew rapidly. After several interventions at the school management, he was asked to present a project for a new observatory. But the project delayed and Wolf decided to look for sponsors. With the help of his friends in Zurich, he managed to collect a considerable sum of money and gave the project a new impulse.

In 1861, the government decided to build a new observatory according to plans of the



German architect Semper and according to Wolf's technical specifications. The building was completed in 1864. It included an apartment for Wolf, where he finally settled down with his "family", that is – since he was a bachelor – with his mother and his sister, and stayed there until his death in 1893.

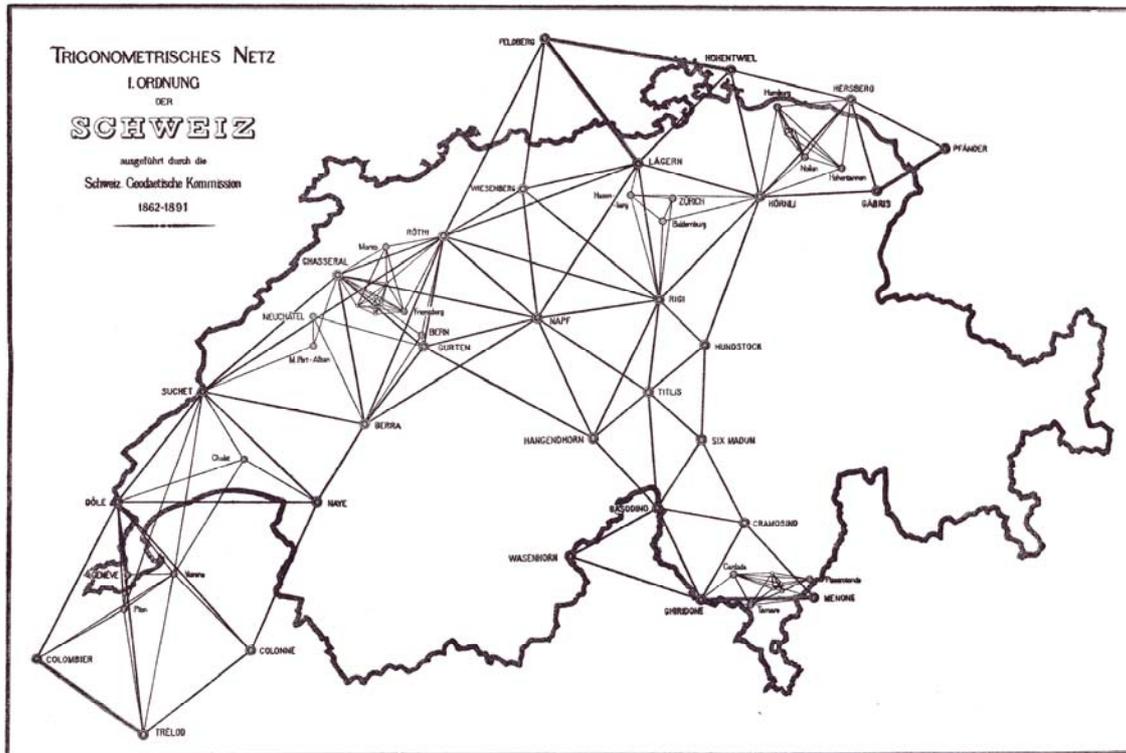
There is another member of the "family" to mention: Wolf's closest friend Johannes Wild – also a bachelor – nominated professor for topography and geodesy at the Federal polytechnic school. During 30 years, he was a very welcome daily guest at lunch and dinner in Wolf's home at the observatory.

## **5. THE SWISS SECTION OF GENERAL BAEYERS MIDDLE-EUROPEAN ARC MEASUREMENT**

In summer 1861, the Prussian ambassador in Berne approached the Swiss government with the request to participate in the measurement of a new European arc. The proposition, outlined by the Prussian General and Geodesist Johann Jakob Baeyer was to measure a triangulation net covering the area between Oslo and Palermo and Bonn and Trunz, (*today Milejowo in Poland*) and to bring together all the countries in this area, to distribute the work and to get the best possible precision and acceptance.

The scientific goal was to increase the precision of the ellipsoid parameters but also to study possible deflections of the vertical in the Alps and north and south of them.

The Swiss government consulted General Dufour and the Swiss Society of Natural Science and got positive answers from both sides. Since Dufours “*Bureau Topographique*” was fully absorbed with the production of the first precise map of Switzerland, it was decided to form a Geodetic Commission within the frame of the Swiss Society of Natural Science and to give her the mandate to participate in Baeyer’s project.



*Réseau de la Commission géodésique*

In August 1861 the Commission was established, Rudolf Wolf was nominated president and General Dufour was offered a chair as honorary president. Baeyer proposed to use the already existing triangulation but a first examination revealed different weak points especially in the parts traversing the Alps. Therefore the commission charged Denzler to design a new net, based on the new Dufour map and proposed this to General Baeyer who was very enthusiastic about the new net.

Furthermore four small secondary networks were planned to link the astronomic observatories of Geneva, Neuchâtel, Berne and Zurich to the new net. In 1863 the Denzler was commissioned to start to organise the measurements and in 1868 he delivered his final report to the commission. Unfortunately the first test calculations revealed that the quality of measurements were in large parts insufficient. This was due to an insufficient signalisation (not using heliotropes) and to a non systematic approach in the angle measurement at the stations. The commission decided to correct this and in the following years 23 out of 29 stations were re-measured, heliotropes were strictly used as signals and the final result was delivered in 1879 and the calculations were published in 1881. Due to important hydrological constructions following devastating floods in the area, the Aarberg base could no longer be used and the base

in Zurich, due to the development of the town was no longer accessible either. Therefore, the commission established 3 new bases in Aarberg, Weinfelden and in Bellinzona in the south of the Alps.

The participation in the European Arc Organisation gave a great impulse to the Swiss geodetic development. It was the start of an extensive research to determine the influence of gravity on geodetic measurements and to control the influence of the deviation of the vertical in the Alps.

On the organisational level, Hirsch professor for astronomy at the University of Neuchâtel was nominated secretary of the organisation. Wolf himself remained president of the Swiss Geodetic Commission until his death in 1893.

In 1910 the central government decided to introduce a Federal cadastre in Switzerland and commissioned the Federal Office of Topography to build up the geodetic bases. It was this triangulation that was complemented and used as the first order network, supplemented with a 2<sup>nd</sup> and 3<sup>rd</sup> order net. It was in use until 1992 and was then replaced by a modern GPS based network of some 100 points making triangulation history.

The Geodetic Commission as the oldest commission of the Swiss Academy of Science is still active and acts as is the scientific partner of the Federal Office of Topography.

Despite the political tensions, the European Arc measurement idea was a success. Within few years, most of the European countries participated in the work and developed the base for a coordinated geodetic network. Already in 1886 the organisation was renamed International Association of Geodesy (IAG) and in 1922 the IAG became one of the five constituent sections of the International Union of Geodesy and Geophysics.

## 6. WOLF'S WORK AS A HISTORIAN

*“Wer sich mit einer Wissenschaft bekannt machen will, darf nicht nur nach den reifen Früchten greifen, - er muss sich darum bekümmern wie und wo sie gewachsen sind”.*

*(J.C. Poggendorf, 1796-1877).*

This saying of the German physicist we find as introducing motto of one of the first chapters in Wolfs fundamental work *“Handbuch der Astronomie, ihrer Geschichte und Literatur”*. It shows Wolfs great interest in the historical development of mathematics, astronomy and geodesy. But he did not content himself writing introductory mottos, he searched for the historical roots and wanted his readers to understand them.

His very popular *“Taschenbuch der Mathematik, Physik, Geodäsie und Astronomie”*, first printed in 1852 and refined in five editions is full of historical information and remarks and the same goes for his handbook of astronomy.

But the most interesting work in this context is Wolf's ***“History of the surveying of Switzerland”***. published in 1879 as introductory work for the Swiss Geodetic Commission.

With enormous effort and with the support of his unique network of scientific and political friends, he collected and described the cartographic and surveying heritage of Switzerland, starting with the map of Aegidius Tschudi in the 15<sup>th</sup> century and ending with the first complete triangulation of Switzerland and the Dufour map in the 19<sup>th</sup> century.

In 24 chapters and 180 paragraphs we find an overwhelming wealth of information, describing most of the known surveys, maps, panoramas etc. and covering 400 years of surveying history of Switzerland. Together with 1500 footnotes and the index of 1100 professionals, “the Wolf” is a highly valuable source of information.

Unfortunately, the book has been sold out for many years and interested researchers have access to it only through public libraries. To make this information widely available again, the Swiss Society for the History of Geodesy digitized the book and made it available on CD-ROM.



## 7. CONCLUSION

Rudolf Wolf was an extraordinary and well-balanced person. Normally, his day ended at midnight and his daily amount of work was tremendous. Nevertheless, nobody remembers to have seen him under stress and he lived according to his motto: “No rest, but no stress”. He was a very friendly person, also towards his students, listening and supporting them when and where ever he could.

Despite his success he had a modest character. He once wrote: “I always comforted myself, thinking that being no genius; I can usefully contribute to science, in doing my job correctly and adapted to my qualities”.

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## BIOGRAPHICAL NOTES

1961 Diploma as Surveying engineer at the ETH Zurich,  
1965 Federal licence as land surveyor,  
1967 – 1971 Assistant for Photogrammetry at ETH Zurich  
1971 – Federal Office of Topography,  
1976 – 1992 Head of Photogrammetry and Project manager  
Digital cartography (DIKART)  
1992 – 2000 Head of the Division of Topography  
1998 – 2000 Deputy Director

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