Albert Einstein and Heinrich Wild:
The Beginning of two Great Global Careers

At the beginning of the last century, two federal officials in Bern began their world careers: Heinrich Wild (1877-1951) and Albert Einstein (1879-1955). Today, the knowledge and technologies they discovered at the time are combined in modern surveying stations. While the former revolutionized the surveying and mapping of our planet Earth with completely new instrument designs for geodesy and photogrammmetry, the latter's unconventional findings and theories influenced the world view of physics as it had existed until then.

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Heinrich Wild is still considered today to be 'the most important designer of geodetic instruments who ever lived'; the discoverer of the dual nature of light ('photoelectric effect') and Nobel Prize winner in physics Albert Einstein, due to his theories of relativity, is considered by Time magazine to be the person with 'one of the most significant, if not the most significant, expressions of human thought'. Heinrich Wild and Albert Einstein came from Winterthur to Bern at the age of 23 to take up their first civil servant positions. There they had studied (Heinrich Wild) or taught (Albert Einstein) at the technical college. It was in Bern that Heinrich Wild first developed his concept of intelligently miniaturizing and combining device functions using fine mechanical and precision optical components in such a way that completely new instruments could be brought to market.
Einstein's theories are much more elementary and can only be used in surveying after they have been implemented in application technologies by physicists, electronics engineers and industrial engineers, and integrated into instruments for a wide range of surveying tasks in a user-friendly way by design companies with personalities like Heinrich Wild. With Einstein's findings, this has only been the case since the second half of the last century with the laser, the digital sensor and the relativistic corrections in space travel, as well as the GPS satellite networks. Since then, devices based on the basic concepts of Wild's designs have been enriched with the new technologies derived primarily from Einstein's theories – right up to the 3-D point cloud scanner and the 'self-learning robotic total station'.

Heinrich Wild: topographer, inventor and company founder

The global success story of the elder of the two Swiss began in Bern in April 1900, when Heinrich Wild was accepted by the director of the Topographical Bureau (known as the Topographical Survey from 1902; now also known as swisstopo), Jean-Jacques Lochmann, into the coveted position of a second-class topographer. Under the instruction of Dr Robert Hilfiker, Heinrich Wild's first tasks as a topographer were to carry out the Neuchâtel-Biel precision levelling, to survey the St. Maurice fortress area with Max Rosenmund, to survey glaciers on the Rhône glacier with Leonz Held, and to independently carry out triangulations and forest surveys in the canton of Valais.

One of Heinrich Wild's most important special tasks is taking responsibility for all the instruments available at the office. This also means maintaining contact with their manufacturers or with instrument-making companies that are emerging, which is why the Zeiss precision optics company in Jena registers Heinrich Wild as a freelance scientific employee from April 1900. Although Zeiss does not yet have any geodetic instruments in its product range, it does have photogrammetric devices and military rangefinders. On 1 February 1904, Heinrich Wild applies for a correctable double-image distance meter as his first patent and sells it to Zeiss in the same year. He adds a further invention, a protected adjustment device for the construction of telemeter in 1907, which will bring him a royalty of 6% of the sales of these devices.

On 1 September 1902, Heinrich Wild had a particularly negative experience with a repeating theodolite of the time during a triangulation on the summit of the 3257-metre-high Dents-du-Midi in the Lower Valais, an experience that haunted him. Through years of observation and reflection, trial and error, and consistent error analysis, he improved the triangulation method and identified and eliminated sources of error in levelling.

The year 1905 proved to be important for Heinrich Wild in four ways: he was now able to identify all the improvements that needed to be made to this angle measuring device and drew up a specification for an ideal theodolite: It had to be ready to measure faster and easier to read, as well as smaller, lighter and more reliable than the then-standard 30-kilogram theodolite equipment. Secondly, in the same year, Director Leonz Held promoted him to the rank of Topographer I. Class and, thirdly, the military promoted him to the rank of lieutenant. Fourthly, he was appointed to the Swiss Military Commission for Optical Rangefinders. He received his first patent for an essential design element of his theodolite in 1907 for his invention of a diametrical circle reading using a microscope. But he only trusted Zeiss in Jena to build such a device that could be used in the field – and he had tested it in vain at Kern in Aarau and at

Wandschaff in Berlin. As early as the beginning of March 1906, Heinrich Wild discusses with the Zeiss management a collaboration including his joining Zeiss to set up a geodetic department. ETH professor Fritz Kobold: ‘When Heinrich Wild leaves the Topographical Survey of Switzerland in Bern at the end of 1907, the Swiss national survey will lose the man to whom it primarily owes its revival at the beginning of the century.’

Already the ‘most important designer’ in 1908

From March 1908, Heinrich Wild was able to establish the Zeiss Geodetic Instruments Department in Jena, Thuringia. His completely new levelling instrument with a rolling telescope surprised experts and competitors alike. Theodolites were added, making Zeiss the market leader in the field of geodetic instruments by 1921. Geodesy professor Fritz Deumlich:
‘Since 1908, Heinrich Wild's inventions have become more and more accepted. This has led to a standardization of the instruments’ principles.’ In this way, Heinrich Wild also earned a reputation as the most important international designer of surveying instruments. In 1921, Heinrich Wild founded his own company with Dr Robert Helbling-Spoerry and Jacob Schmidheiny in Heerbrugg in the St. Gallen valley of the Alpine Rhine. This Heerbrugg-based company is still an international market leader today under the name Leica Geosystems, and has been continuously expanding this positionfurther since 2005, thanks in part to its affiliation with the Swedish high-tech group Hexagon. However, after the introduction of numerous geodetic and photogrammetric devices, company founder Heinrich Wild left the company with a heavy heart in 1932 due to differences in opinion. Without the responsibility for a company, but only focused on optimal designs, he once again succeeded in creating spectacular theodolites with short, fast telescopes and double circles for Kern + Co., Aarau, between 1935 and 1951, which represented a further advance in surveying. In addition, there is an optical telemeter, a high-performance rifle scope for the Swiss Army and a photogrammetric evaluation device.

Heinrich Wild's hidden youth

While Heinrich Wild's life is well known from the time he joined the Topographical Survey, little is documented about what shaped him. After years of research, we now know for sure (!) or with a high degree of probability where Johann Heinrich Wild, a citizen of Mitlödi/GL, who was orphaned at the age of three, was born (in Bilten!); how teacher Grünenfelder allowed him to skip two grades at once after only six years of schooling and let him leave school early (due to his mathematical abilities and exceptional intellectual grasp!); and how much the small and adolescent Heinrich missed the security of a family life (because he was not even three years old when his father Jost Heinrich Wild was buried in 1880, and also because his mother Elisabeth Wild-Weber worked in Zurich and visited less and less often); how Heinrich Wild, who was brought up extremely strictly by his maternal grandmother Regula Leuzinger-Tschudi, was already on the payroll of the Linthwerk at the age of twelve (because he had to earn money to make a living and his uncle on his mother's side, Heinrich Leuzinger, a surveying engineer trained at the Polytechnic, who was later a Linth engineer, took him with him to the construction sites and surveying projects of the Linthwerk and assigned him increasingly demanding work!); how, as a fifteen-year-old, he learned far more than was envisaged in the curriculum during his three-year apprenticeship under the Linth engineer Gottlieb Heinrich Legler (because in Gottlieb Heinrich Legler he had an internationally renowned hydraulic engineer as a teacher!); why he did not pursue a diploma at the Winterthur Technical College (because he already knew more and had more practical experience than many a lecturer and he promised more than two semesters of attending a school for surveyors!); why he was already earning well before being accepted into the school for surveyors (because he had already set up his own business after purchasing his own surveying equipment); and why he had made a name for himself as a highly qualified surveyor and cartographer by the age of nineteen (!) in 1896 (because in that year the perimeter plans created by engineer Heinrich Leuzinger and Heinrich Wild between 1889 and 1896 were published, for which Heinrich Wild had spent seven years draining swampland, surveying and evaluating plots of land and, together with Heinrich Leuzinger, had drawn 46 perfect 70 cm × 70 cm plans at a scale of 1:2000 (!).

Einstein: ‘I was sitting in a chair in the Bern Patent Office...’

Two years after Wild, Albert Einstein, who had graduated from the Swiss Federal Polytechnic School in Zurich as a maths teacher, took a job as a third-class technical expert at the Federal Office for Intellectual Property in Bern after teaching in Schaffhausen and Winterthur. As his biographer Jürgen Neffe describes, ‘At work, Albert Einstein also pursued “private” projects of a fundamental nature. In a hitherto unknown explosion of ideas, the ingenious Albert Einstein presented a fivestage cascade of work in 1905, which is still being continued in 1907. Einstein discovers and describes atomic forces in the Petri dish, the dual nature of light and its light quanta, and the relationships between energy, mass, speed of light, time and space in the special theory of relativity. Einstein described the decoding of his equivalence principle, which he discovered in 1907 and which was the first major step towards the general theory of relativity that was only completed almost a decade later, and which he described as the ‘happiest thought of his life’. ‘I was sitting in a chair in the Bern Patent Office. Suddenly the idea dawned on me: ‘In free fall, a person should not feel his own weight at all’.’

Einstein's relationship with surveying goes far beyond the theoretical tasks of a university physicist. As an instrument designer, the pacifist Albert Einstein supported the development of a gyrocompass device that was particularly suitable for submarines. This was patented in the name of the main inventor Hermann Anschütz-Kaempfe and manufactured in Kiel in such large numbers that it provided Einstein with a substantial income. Furter Einstein was so fascinated by the development that he not only interrupted his work on the general theory of relativity in 1915, but also used the functional principle of the gyroscope as a model for his atomic description of permanent magnetism.

Parallel developments at universities in Zurich, Bern and Germany

In many cases, the topographer Heinrich Wild was setting a signal at the new location before the physicist Albert Einstein. The parallel changes of location and profession, which were in no way coordinated by the two people, are reminiscent of ‘entangled’ energy quanta. According to modern quantum mechanics, the random behaviour of the smallest particles was suspect to Einstein. But outside of the quantum, Einstein's postulated ‘spooky action at a distance’ does exist: if you know where Heinrich Wild currently lives and when he changes jobs, then it is highly likely that you can also deduce the whereabouts, and a job change of his ‘entangled’ companion Albert Einstein over a quarter of a century. Like Heinrich Wild, his contemporary Albert Einstein, who was two years younger, left school early due to his excellent knowledge of mathematics and, like Wild, enrolled at a Zurich Technical University to study in 1895/96; like Wild, Einstein worked as a federal official in Bernese offices more than a century ago and it was here that he developed groundbreaking new ideas in 1905; like Wild, Einstein married at the age of 23, lived with his family at the same time as Wild in the Thunstrasse in Bern and left the Swiss capital eight years later, exactly like the topographer Wild, when he was exactly thirty years old; Albert Einstein followed a professional call to Germany like Heinrich Wild before the outbreak of the First World War and also lived there during the famine and the collapse of the German Empire; like Heinrich Wild, Albert Einstein is also the father of a son of the same name, both of whom completed engineering studies. And when the professorial council of the Swiss Federal Institute of Technology Zurich awarded Heinrich Wild an honorary doctorate in technical sciences in 1930 ‘for his outstanding achievements in the field of geodetic and optical instrument design’, Albert Einstein was also awarded an honorary doctorate by ETH Zurich in the same year ‘for his outstanding achievements in the field of theoretical physics’.

Conclusion

It is quite remarkable what developed in parallel in the early years of the last century, and particularly in 1905, through the activities of two luminaries in their fields in Bern, and what presents itself today as a useful unity: The creations of Heinrich Wild with the further developments of Einstein's findings improved our knowledge and orientation on Earth, but also on the Moon and in space. The largest peaks of the continents also bear the measure of the instruments developed from their theories and constructions, as do the most significant structures, energy generation and environmental protection projects, as well as numerous national maps around the globe.

Notes:

The longer and more comprehensive article with references ‘Heinrich Wild and Albert Einstein: The Beginning of Two Global Careers’ is available at www.geomatik.ch. or https://people.math.harvard.edu/~knill/history/wild/index.html

Picture credits:

Albert Einstein Archives, Schweizer Nationalbibliothek Bern: Fig. 5; Author's Archives: Fig. 4; Deutsches Museum: Fig. 10; ETH Image Archive library.ethz.ch: Fig. 1 (Einstein); Hans Heinrich Wild: Fig. 1 (Wild); Leica Geosystems: Fig. 2, 6, 8, 9, 11, 12, 13; Lintharchiv: Fig. 7; St. Galler Tagblatt: Fig. 3.

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Fig. 1: The start of a global career: Heinrich Wild (1877–1951) and Albert Einstein (1879–1955).

Fig. 2: Dinosaur tracks: 3D laser point clouds: the latest Einstein technology in laser scanning, based on Einstein's work from 1916/17 'On the Quantum Theory of Radiation'. The 3D laser point cloud, measured to the nearest millimetre using a Leica LaserScan in 2003, shows dinosaur tracks in Courtedoux/JU.

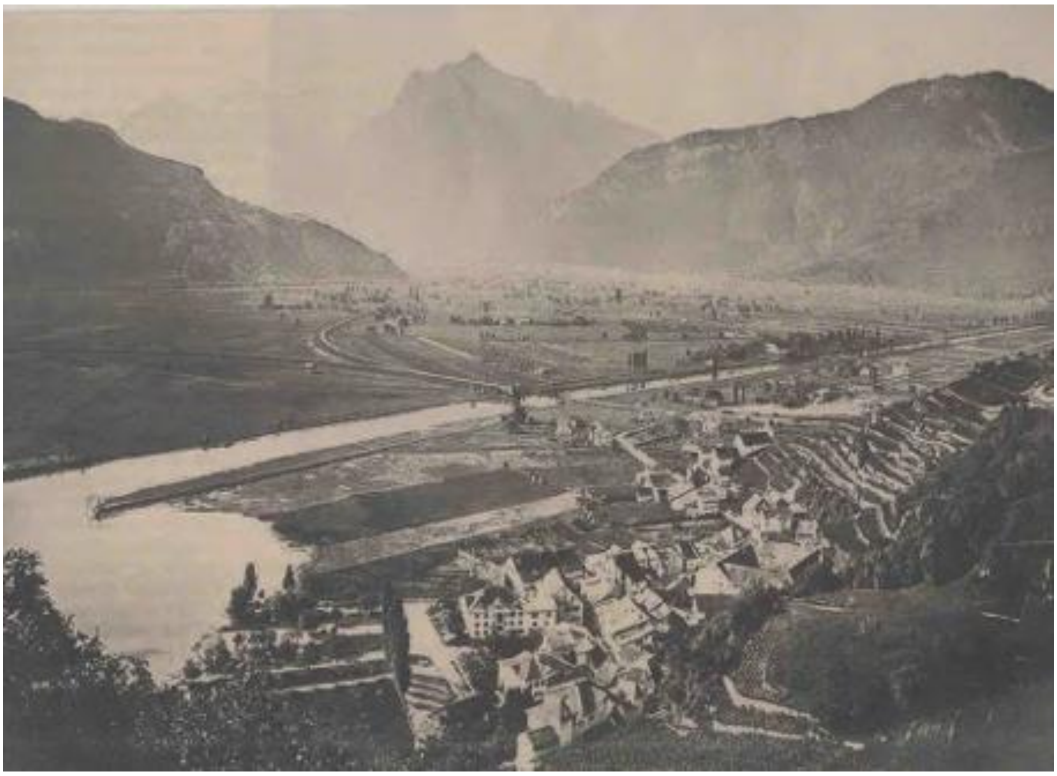

Fig. 3: Improved: Weesen on Lake Walen in 1889, when 12-year-old Heinrich Wild began his work on the irrigation of the Linth channel.

Wild und Einstein in Berns Kirchenfeldquartier 1900–1909

Wild-Wohnung		*Jahr*		*Einstein-Wohnung* (von/bis)
Thunstrasse 8	1	1900		
Thunstrasse 8	1	1901		
Thunstrasse 8	1	1902	1 2	Thunstrasse 43a (06-08) Archivstrasse 8 (v: 08) *Mileva:* Thunstr.24 (06-07) *Mileva:* Mottastr.3 (08-12)
Thunstrasse 8 Thunstrasse 37	1 2	1903	2 3	Archivstrasse 8 (b: 01) Tillierstrasse 18 (01-10)
Thunstrasse 37	2	1904		*(Einsteins wohnen von Nov 1903 bis März 1906 in Kramgasse 24 und Tschamerstrasse 28)*
Thunstrasse 37 Kirchenfeldstrasse 32	2 3	1905		
Kirchenfeldstrasse 32	3	1906	4	Aegertenstrasse 53 (v: 04/1906)
Kirchenfeldstrasse 32	3	1907	4	Aegertenstrasse 53
Kirchenfeldstrasse 32	3	1908	4	Aegertenstrasse 53
		1909	4	Aegertenstrasse 53 (b: 10/1909)

Fig. 4: Close quarters: Wild and Einstein's places of residence between 1900 and 1909 in the Kirchenfeld district of Bern.

Fig. 5: At the patent office: Albert Einstein at the Swiss Federal Institute of Intellectual Property around 1904.

Fig. 6: United: insight into the electronic tachymeter (total station) from 1998 from Heerbrugg with Wild construction design for angle measurement and integrated laser distance meter, based on Einstein's theory (Leica TC500).

Fig. 7: Linthwerk plan: section of the Weesen area. Measured, drawn and hand-coloured by the 18-year-old Heinrich Wild. 46 individual plans (1:2000), 70 cm × 70 cm. (zVg Lintharchiv, signature LIAR F VIII. 19 [10]).

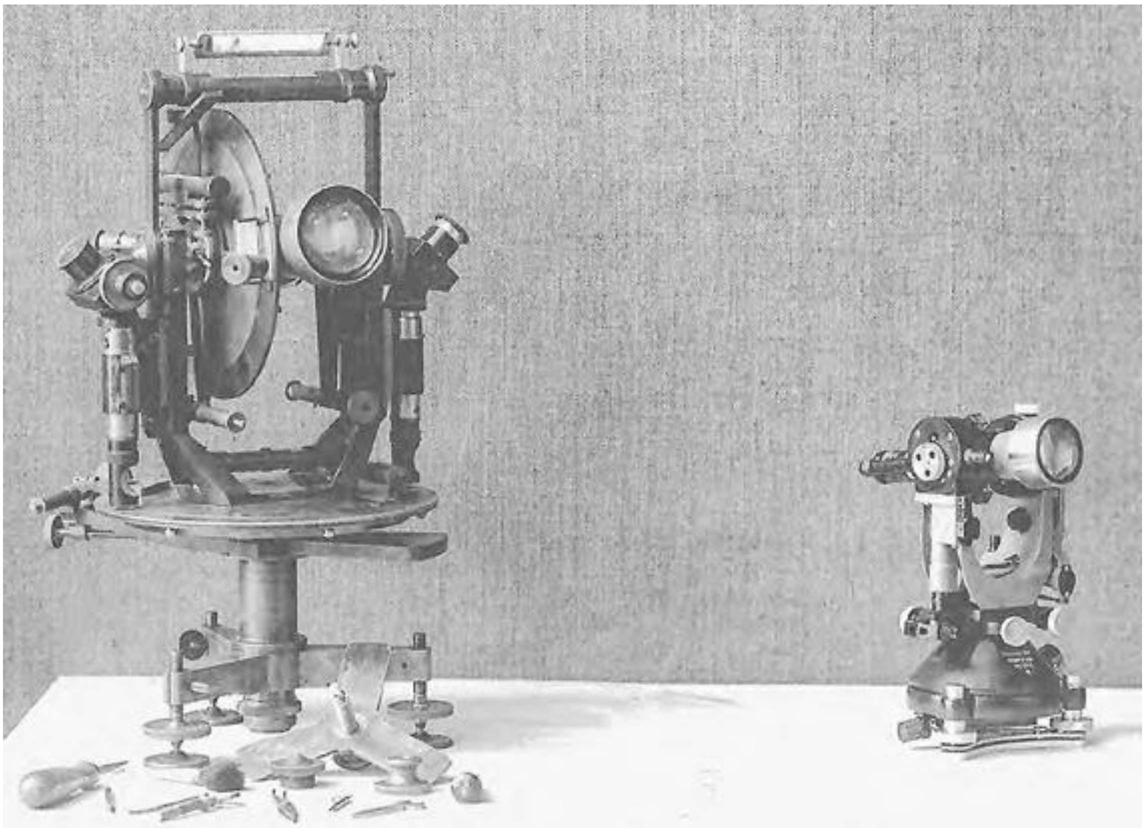

Fig. 8: Theodolite before Wild – and since Wild: Left: typical repeating theodolite around 1900 with a 30 kg transport weight. Right: revolutionary Wild T2 theodolite from 1923. Weight just 3 kg, with numerous other advantages for the surveyor. This theodolite design by Heinrich Wild has also become established worldwide for integrated distance measurement in total stations.

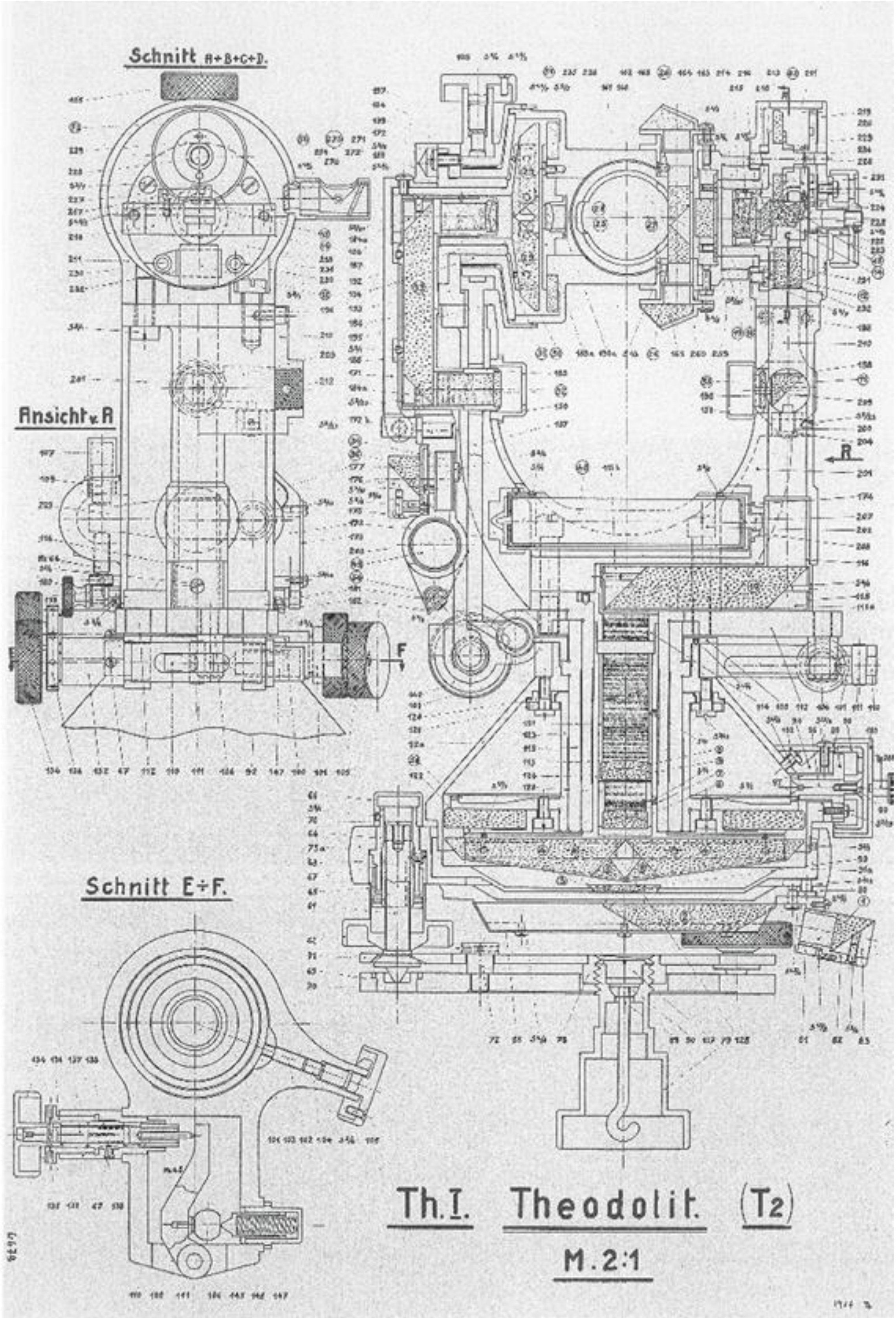

Fig. 9: Wonder: Heinrich Wild's design assembly drawing of the revolutionary fine-mechanical optical miracle of its first Heerbrugg theodolite Th.I,. later called and T2 from 1921/23.

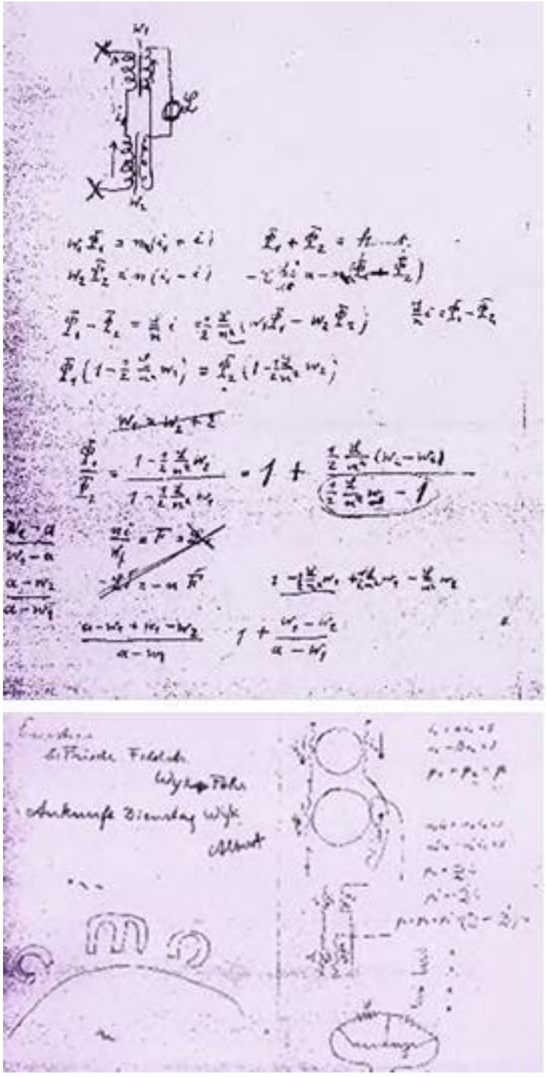

Fig. 10: Magnetic forces: pages from Einstein's calculations of the magnetic forces of the ball-bearing gyrocompass.

Fig. 11: Photoelectric effect: digital images such as this infrared false-colour aerial photograph taken with the Leica ADS40 digital sensor are theoretically based on Albert Einstein's photoelectric effect discovered in the 'miracle year' of 1905.

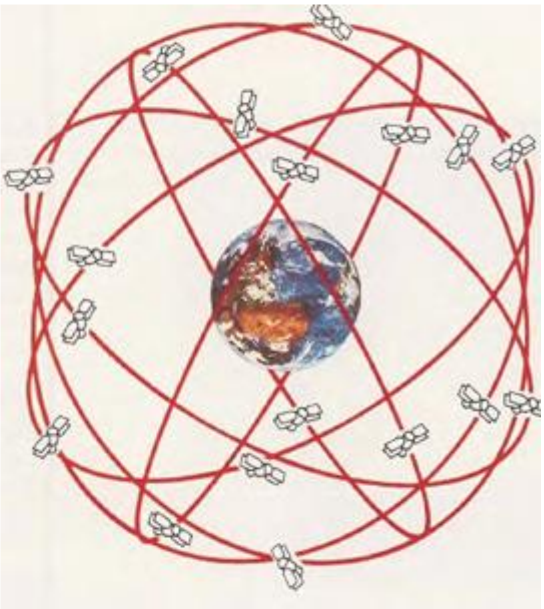

Fig. 12: Correct globally: Correction factors from Einstein's Special and General Theory of Relativity are used to ensure that global navigation systems (such as GPS, Galileo and Glonass) function correctly.

Fig. 13: Multifunctional: the MS60 Multistation from Leica Geosystems Heerbrugg combines Heinrich Wild's theodolite setup with a laser developed from Einstein's theory in two ways: firstly, for distance measurement like a total station and, secondly, with a LaserScan function for capturing, measuring, evaluating and documenting millimetre-accurate 3D laser point clouds.