# Pierre Frédéric Ingold
# 1787-1878

by

G. A. Berner,
past director of the Uhrmacherschule, Biel

and

Dr. E. Audétat,
Gymnasiallehrer, Biel

Translated by
Richard Watkins

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# Pierre-Frédéric Ingold 1787-1878

The Swiss horology industry ascended over the course of three centuries to its current position and world-wide reputation. Its success is the work of countless minds and hands, and also the result of innovative machines. From the innumerable army of nameless watchmakers one man stands out, who took crucial steps to bring technology to watch production: Pierre-Frédéric Ingold, an inventive genius, of whom the famous Genevan inventor René Thury said: "he belongs in the category of really great people. In any century only two or three the like are born."

But Ingold was a genius without luck. His misfortune consisted mainly in the fact that he came into this world some decades too early.

Today one has hardly more than a notion of the fact that around the year 1800 most components of each individual watch still had to be made by hand in laborious, fine work. Therefore at that time all watches were very expensive. These beautiful pieces of great cost could only be acquired by princes, rich nobles, patricians and diplomats.

## *The inventor as an "enemy of the people"*

With the idea to reduce the price of watches by the development of manufacture by machines, Ingold aroused the bitter resistance of his professional colleagues. Everyone who had earned his bread as a watchmaker or a dealer was afraid for his future. Myopia and fear appeared everywhere in Ingold's way, which forced him to go on foot to the large enterprises in Paris, London and finally the United States, after he had already seen that no understanding was to be expected in his Swiss homeland.

Even at the end of his life he was pursued by the dislike, by the hate of his fellow watchmakers. It is said that in a hotel in La Chaux-de-Fonds the poor figure of the almost ninety-year old Ingold appeared and one watchmaker said to another: "See that old person there; he wanted to take our living from us by his inventions, but he did not succeed."

## *A combative nature*

Ingold was often called the knight errant of watchmakers. He shared the fate of many genuine inventors and pioneers: his conceptions helped the machine to victory in watch production, but he was neither allowed to see the fruits of his work mature nor to enjoy them. His fellow citizens and colleagues regarded him as a dangerous person, who aspired to push the worker into misfortune. In France, England and also in America his fate was no more favourable. The defeats that Ingold bore would probably have discouraged any other person. But after ninety years he still did not think to lay down his arms. "Yes", he said, "I left several of my machines in the United States and many plans; but the mechanics there, my compatriots, would be surprised to know what is still in my bag!"

This characteristic - as it were the only one we know of - shows Ingold to be a tough fighter. Often such inventors, propelled by the demon of research, possess neither organisational gifts nor a sense of business. Perhaps it was Ingold's misfortune that he did not find the support of an experienced industrialist to advise him; perhaps he was also too self-willed to understand that the implementation of his technically revolutionary ideas required much patience and gradual development. Experience teaches that new, correct ideas win out, if one can wait for long enough. More than anything, Ingold had to accept the animosity of the worker, the craftsman and the businessman. They all were afraid that automatic machines would cause a tremendous increase in production, a collapse of prices, a drop in quality, and a great reduction in the need for workers.

The machine is not responsible for these evils. Probably it has changed the life of the modern industrial company in ways which may give cause for criticism. But we owe to the modern automatic machine such a precision in manufacture that interchangeability, which has been sought for so long, has in recent years come within our reach. The significantly increased production possibilities have as a result worked in the watch industry's favour and have led to a

continual increase of the number of workers required. The need for workers changed, but it did not decrease.

In an article written in 1877, the outstanding horologist Jules F.U. Jürgensen mentions the progress achieved in the area of watch machinery in Switzerland, France, England and America. He points out that most of the tools used were invented overseas by a great Swiss artist, P.-F. Ingold, whose name, already well known, had not yet attained celebrity status. Jürgensen writes: "In Switzerland, in the Val de Ruz, in Travers, in Biel, in Saint-Imier, for the production of the train, screws, escapements, wheels, rough and finished punched parts, and cases, manufacture by machines has reached a degree of completeness that could hardly be exceeded."

### *The "automat" and automation*

We know today that the progress of technology can never be regarded as complete. Scarcely a century was needed in order to throw our ideas regarding machines and work methods on the scrap heap. Nothing seems to be able to stop the striving for increased output: the machine is entrusted with tasks which until now were fulfilled by humans. This development is described by a word imported from America around 1940: *automation*. This word has a completely clear sense and one differentiates automation from the long since accepted *automatic machine*, whose use in the horology industry Ingold, G. Leschot and some others prepared the way. An automatic machine ("automat") usually works with cams, which cause tools to turn, bore, cut threads, mill and stamp, providing a more or less complete treatment of an article or a mechanical component.1 Automation goes further: it takes over automatic control of the checking of the manufactured pieces and the correction of any errors that have been detected. Indeed, it even ensures the correct processing of these parts, their assembly and the final finishing of an article or a mechanical component.

It is obvious that such a complicated procedure is not suited for every area. In most cases the article concerned must be developed to suit automation. We cannot imagine, for example, that a watch with its present construction methods could be arranged for the principles of automation. If possible another design would have to be created. On the other hand, automation requires such expensive machines that only the mass production of articles is possible, which are for sale in enormous quantities.

In individual industries automation produces such a tremendous output that there is much concern, because at the same time large numbers of workers are removed from the process. Where automation will lead us nobody can foresee. One can only say: It will depend on the wisdom of humans whether this scientific and technical achievement proves to be mischief-making or bountiful.

### *Appreciation of Ingold*

The origin of the machine in the industrial sense goes back to the 18th century. Around 1760 the first inventions appeared, which related to spinning and weaving cotton. Already at that time it was said that the machines could do the work of thousands and represented a danger to hand craft. These inventions remained secret for a long time, their creators fearing persecution.

One century later Ingold faced general opposition for the same reasons. Thus it is not surprising that he was despised as an enemy of the people by his contemporaries and nowhere is praise mentioned. Few interested themselves with his work, except for Jules F. U. Jürgensen, a descendant of the famous Danish family of chronometer makers, who had settled in Le Locle. As a member of the historical society of the Neuenburg canton, in 1877 Jürgensen gave a lecture which was essentially concerned with Ingold and was printed by the Musée neuchâtelois. This is the only writing about Ingold, that we know of, which was published during his lifetime. The authors of this biography have gained much of their knowledge from Jürgensen's lecture.

One of Ingold's inventions was nevertheless crowned with success: the very fine fraises manufactured by him, by which wheel teeth could be smoothed and the active parts of the tooth profiles dressed. On 1 December 1874, four years before his death, Ingold left the fraise

1 See S.V. Tarasov: *Technology of watch production*, 1956.

production to his friend Ferdinand Bachschmid. With the passing of Bachschmid's widow some articles and documents, which go back to Ingold, were given to the horology school in Biel. There they were classified and arranged in a showcase. Some of Ingold's designs are in the horology museum of La Chaux-de-Fonds. Unfortunately they have faded so much that their reproduction is not possible. Among these designs there is a machine for boring and milling jewel settings in the plate. It consists of a vertical platform, whose positions correspond to the polar coordinates of the different centers of the watch plate. By means of an indexed screw the platform can be moved along an axle. All holes are numbered and can be centered by this device on the milling machine. The very careful designs leave no details uncertain, and all the different tools attached to the machine are represented.2 These sketches are proof of the methodical mind of the inventor. Certainly they represent a particularly informative contribution to the history of mechanical watch production.

Ingold was not only a passionate inventor, but he also possessed the skill for exact and clean implementation. The few extant tools and punches produced by him confirm this.

For Ingold the machine was not merely a means to increase production. As an outstanding mechanic he saw in them another, more ambitious goal: the production of high-quality, interchangeable components. And as an entrepreneur, which several times he almost became, he wanted to bring watches to the market so cheaply that they became affordable for everyone.

To Ingold the paradoxical expression *he is just as famous as he is unknown* almost applies. Nobody was interested in his history while he was alive. At that time and later he was called a new innovator, which indeed he was, and it was left at that. Thus, except for some disconnected documents, most of what could provide us with a description of his life and work has been lost.

The only visible public honour to this ingenious but unfortunate inventor was granted to him by his birth city Biel, which gave his name to a road.

## *Ingold's origins*

Pierre-Frédéric Ingold was born in 1787 in Biel. His date of birth is not certain; 6 June and 6 July are stated. The Ingold family came from Lauperswil in Emmental; it was one of the Anabaptist families driven out of their homeland in 17th century because of their faith and they went to the Jura (that is, to the land at that time subject to the Prince Bishop of Basel) where they were allowed to stay. Before 1800 the office of the pastor was responsible for entries in the register of births, marriages and deaths, but the Anabaptists were excluded from the church of that region and this makes research into the descendants of the Anabaptists difficult. In spite of this, for the date of 4 April 1804 there is noted, in the baptism book at Lauperswil, the baptism in La Chaux-de-Fonds of Pierre-Frédéric Ingold, son of Michel Ingold and Elizabeth Ingold (nee Oberli). There is no record of witnesses to the baptism; Pasteur Touchon and Abraham Heinrich Droz, Mayor of La Chaux-de-Fonds, were the signatories.

His father, Michel Ingold, seems to have been originally a carpenter, an occupation which was probably common in the family. In 1769 and after we find Michel Ingold working as a clockmaker in La Chaux-de-Fonds and in Biel; as a manufacturer of clocks he had - as Alfred Chapuis and Marius have shown - a good name.

Within three years the boy lost his father. Shortly after, his mother left Biel with her children and moved to near La Chaux-de-Fonds. She worked as a watchmaker and taught Pierre-Frédéric her occupation.

Perhaps the treatment of the Anabaptists by the Bernese authorities, completely incomprehensible in today's ways of thinking, left in some of their descendants a feeling of homelessness or a deep resentment; Ingolds life and fate seems to have been shaped by it.

When Pierre-Frédéric Ingold was born, signs of a profound transformation became apparent in the world - and also in watchmaking. The watchmaker of the 18th century had worked mainly on luxury and artistic goods. The revolution rapidly swept away the politically privileged,

2 This may be the lathe and face-plate illustrated and described in R.F. and R.W. Carrington, *Pierre Frederic Ingold and the British Watch and Clockmaking Company*, Antiquarian Horology, Spring 1978, 698-714.

cultivated and wealthy clients. Outwardly, the horology industry lost its traditional customers. Inwardly, however, necessity and reason pointed to the need to introduce a different organisation; instead of the old, home-based work, the industrial production of series of products with replaceable components. Ingold thus grew up in a completely new time.

### *A watchmaker in Paris*

When eighteen years old he finished studying horology and went, as was the custom at that time, on a *tour*. The road led him first to Strasbourg. Two years later he arrived in Paris. On 1 April 1811 he was issued an identification booklet, which was necessary for workers in France without permanent residence. It served at the same time as a passport, without which one was treated, according to a printed legal warning, as a vagrant. Employers were obliged to register in the passport the start and termination of work and not too long a period of unemployment was allowed between jobs. In this way we learn that Ingold worked for half a year with the master Johann Heinrich Hunziker, from Aarau, at 22 Rue de Bussy, and then until March 1812 with a Carault or Tarault, after which he was given a certificate of good conduct and a visa was issued for the United States of America. Jürgensen explains this emigration as an escape before Napoleon's conscription for a large army. Ingold embarked from Dunkirk. However, immediately after departure the ship was captured by the English and, being considered a Frenchman, he was imprisoned for some months in Dover and Portsmouth. When he was released, he went by foot through Normandy. At the time he regarded this journey with the greatest pleasure. Above all, the lowest aspects of life in those parts of France were noted by him; thus he reported an overnight stay with the mayor of a small locality, sleeping in the same room of the small house as his cattle, and whose wife prepared omlettes in her leather apron at the chimney fire.

Returning to Paris, he again worked for the business which he had left, for a year until July 1813. For further training, London, the center of fine precision watchmaking, came into consideration above all others. In 1814 he travelled there, provided with recommendations from compatriots such as Guillaume and Bovet from Fleurier. Among other positions he was in the service of Rentsch in St. James Square, the royal clockmaker and one of the most prominent in the London Clockmakers Company, who in 1813 patented the much-admired invention of a self-winding chronometer.3

From this preferential position, when he left London the way was open to the largest and most outstanding watch manufacturer in Europe, Abram-Louis Breguet in Paris. In September 1817 he registered a new address in Paris, and in July 1818 Breguet personally confirmed: "I certify that monsieur Ingold has worked for me for about a year."

He travelled several times back and forth between London and Paris. He was so enthusiastic that in 1815 he hurried from London to Paris in order to be present after the battle of Waterloo, which caused the fall of Napoleon and the triumph of the allies. In addition, as in 1813, he travelled to La Chaux-de-Fonds. There he may still have had a mother, brothers and sisters, and always immediately found work, as he did not work for himself. Everywhere he went he gave this city as his place of origin4.

### *A noteworthy museum piece*

In those years he made an ingenious watch, which today is still able to excite much attention and which was saved by accident, so that it is now a valuable piece in the small collection of the Horology School in Biel. It is a cylinder watch with the inscription *P. F. Ingold à La Chaux-de-Fonds*, and the year 1816. The idea for it apparently came from Rentsch, with whom it was perhaps partly developed. The characteristic it possesses is that it is wound, not automatically but without a key, by the bezel. The bezel is provided with a 72 tooth wheel which winds the mainspring. Further, the hands, as in modern watches, are set from the pendant; in the normal position it is not connected, but when it is pulled out its stem meshes with the wheel-work for the hands. A history is connected with this watch, which may seem a

3 Self winding in the sense of a keyless watch.

4 In Switzerland a person's citizenship is tied to the district or canton of birth. Thus Ingold was acknowledging the community that accepted his Anabaptist family and not his true birth place.

strange adventure, but it is not impossible: A Mr. von Claparède bought it from Ingold in order to send it to Naples, where it was given to the Polish princess Jablonowska. She then gave it to the Empress Marie-Louise of France, the second wife of Napoleon I, who carried it for 30 years and then bequeathed it to a court lady, who was a cousin of the watchmaker Sylvain Mairet. Ingold bought it back from Mairet, and then through F. Bachschmid and E. Hofmann it finally arrived where it is now.

With this work Ingold had done no more than others of his occupation, and his career up to then hardly differed from that of his colleagues. Each strove to make a name for himself with some extraordinary work and benefit from it by offering it to wealthy people for purchase. Ingold also acted in this way and thereby still remained locked in the past of the 18th century, when watches were works of art like pictures and statues, and almost only found in castles and palaces. As customers, princes and the Russian envoy to Austria are mentioned. The first application of some technical feature was not so imortant as the way in which it was applied and integrated with the watch, without impairing its beauty or the convenience of its use.

Through his employment with Breguet, Ingold saw the best work methods of his time and gained connections to a circle of experienced watchmakers. He also took a step forward in society, since the opportunity was offered to him to form valuable relationships. Breguet - originally a Neuenburger - must have been a magnificent model. In addition he was a man of high repute, to whom the state had granted many honors. Ingold worked with him from 1817 to October 1822; one year later Breguet unexpectedly died. Ingold's identification document unfortunately ends at that date. The reason for this lies in the fact that he was no longer in the position of a dependent worker. This is confirmed by the fact that he sold several watches in these years at good prices, up to 600 francs each piece. And at that time he married Gabrielle Ruc from the Auvergne.

### *Journey to Turkey*

His stay in Paris was interrupted by a short journey to Neuenburg (1818) and by a business trip to Constantinople. At that time Breguet honoured Ingold by appointing him as his business representative in the Turkish capital. He left on 1 August 1820 and returned to Paris on 8 September of the following year. The Turkish rebellion made a longer stay impossible.

### *Ingold becomes a jewel maker*

Breguet's company enjoyed a reputation for the production of jewels of great quality. A noteworthy ability had already been attained in splitting, polishing and boring sapphire and ruby; they had also gone a long way in the production of jewels with oil reservoirs, from which the friction surfaces were fed. From the few pieces we can examine, which come from Ingold's hand and have been preserved to this day, we can see that he understood the art completely. The tiny, eight-leaved sapphire pinion 2.8 mm in diameter, which is in the collection, is a unique work of art. It looks like a nick-knack of Chinese origin. One must admire the perseverance which Ingold, and with him many others of his craft, applied to perfect an individual piece. However, the jewel bearings of a watch are also of considerable importance.

For a while Ingold seems to have planned to shift entirely to jewel making. However, he did not remain faithful to this intention for very long, probably only two or three years. Whether he gave up this work for particular reasons is not known; probably it happened because, as he shows by his previous personal record, he was an extraordinarily inconsistent journeyman. Urged on by a great insatiability and discontent, he was always ready to drop something he had begun and seize the pilgrim's staff. He does not seem to have ever known a feeling of belonging.

### *The idea of the machine tools*

In 1829 he again appeared in Paris. Here he was most nearly in an environment which suited him and where he could hope to attain recognition and so bring to fruition some of the many ideas that he carried around with him. At that time a belief, which he had already held for a long time, matured in him. He was now convinced that the horology industry could not develop

further. The achievements in the individual production of watches could hardly be surpassed. Their great disadvantage was the high price of the products. As a modern person, which he undoubtably was, he was infected by the spirit of the machine age, at that time in its infancy. His idea was to apply the machine to watch making. That could be done by producing the components by machine, assembling them and so producing a cheap but nevertheless exact timepiece. The newness of this idea cannot be measured today. The whole trade had to change if it were to be implemented. Ingold had placed himself thereby amongst the foremost inventors of his time. However it happened like nearly all - one thinks for instance of Arkwright and his loom. He not only had to fight for acknowledgment of his ideas, but he also had to prove their correctness. However the necessary tools were missing and were yet to be created.

Ingold held to nothing as strongly as to this principal purpose. It looks as if he was possessed by it, and he sacrificed all his time and energy to it. He had already begun, making models of punches, cutting machines, presses, drills, and designing lathes and other tools with which components could be made in series. The fact that there were numerous unsatisfactory attempts is obvious; in addition he required great patience, which fell particularly heavily on his volatile nature. Besides he lacked funds. He was forced to earn his living in the old-fashioned way, by opening a workshop and making individual new watches and repairing old ones; he must have soon been a sought-after watchmaker. As well he did everything to initiate connections, with whose assistance he wanted to convert his plans into reality.

### *The "Compagnie de l'Horlogerie Parisienne"*

In his impetuousness he risked the first attempt too early. He had succeeded in getting the interest of three Parisian watchmakers of importance: Louis Berthoud, Japy and Monnin. These three wanted to work in group to produce watch components following Ingold's plans. The contract was ready when Japy, the most important participant, withdrew because he, although financially strong, was frightened by Ingold's high flying desires. He did not want to expose his secure business to such a venture, by aligning himself too closely with that somewhat adventurous foreigner who had nothing to lose.

Ingold continued to work for himself in the Palais Royal district. His large regulator, a show piece which was valued at 10,000 francs, was much admired. He received orders from others to bring the automats of the deceased Vaucanson back into working order; these were artfully built figures which moved, or birds which could sing. But these meant less to him than his designs and experiments. Plans, sketches and notes accumulated and some of them still exist. In them are ideas to solve difficulties; some are playful, vague and not completely thought-out designs. It is not possible to say how many requests for patents he submitted, but it was a large number. In the main they concerned improved escapements, which strongly interested him, tools and machines. He had the satisfaction of gaining many customers from the best society. Louis Philippe, the citizen king, was one. He also came to the notice of Benoit, the director of watch production at Versailles, who made some use of his inventions.

Ingold is believed to have extended his sphere of activity in 1836 by starting a school for watchmaking appentices. He called himself the "director" of this "Fabrique d'horlogerie parisienne". The young men would live in the boarding school with him and pay a tuition fee of 400 francs (excluding the cost of tools and board). Of the success of this watchmaking school nothing is known.

The next step to his goal occured in 1838. A number of outstanding technical and financial people had, on his initiative, jointly founded a production company. They included Arago, the scholarly secretary of the Académie des Sciences (he was the main promoter and Ingold's trusted friend); Armand de Séguier, member of the Institut de France and the Cour Royale; Count von Gueheneuc; Pouillet, director of the Conservatoire des Arts et Métiers and professor at the Ecole Polytechnique and the Sorbonne; Juannin, the King's secretary; Gambey, the official responsible for the clocks at the royal observatory; the Duke of Praslin; Count von Thénard; General Baudrant; in all a very select company. Count von Rothschild had also committed himself, but with the reservation that he might be represented.

The printed statute for establishment of the "Compagnie de l'Horlogerie Parisienne", as their name reads, is an extensive document. It was instigated by Ingold, as the notary entrusted with it stresses explicitly. The purpose of the company was to manufacture components, with the help of special machines, which would be cheaper but nevertheless excellent. For many years Ingold had sacrificed time and money in order to test these machines. Secondly it was to manufacture and make available to the trade pocket watches as well as wall, standing and travelling clocks. The office would be in the Palais Royal, 175 and 177 Galerie de Valois, the address of Ingold's business. The name of the company read "Ingold & Compagnie". He became the operations director, but he had to select an accountant to act on an equal footing and to be jointly responsible. He committed himself to work only in the interest of the company, to let it benefit from all his inventions and improvements and to always personally lead the management. The intended capital was to be quite high at two million francs, with a dividend of 12 per cent. What was more, Ingold was assigned a large rôle; thus his salary was increased to 6,000 francs and as surety he had to take 200 shares. The society took possession of the whole of Ingold's business, including his customers, valued at 50,000 francs.

A prospectus described the project. The enterprise would not be operated in factories, but in home workshops; however, for the first time machine tools would be used to a large extent. The products which were promised, were high-quality watches, "fine horology", in the price range from 200 to 1500 francs.

### *The "British Watchmaking Company" in London*

The Paris establishment was not successful. Watches came out, but far too few; the production facilities were too small. The accounts did not show a profit and there were no dividends. The friends and sponsors soon withdrew. Only one year later (1839) they had to take refuge in the London branch, which had been set up by statute, in order to gain access to English funds. After three years the French company was completely dissolved and in its place stepped the English. Envy, gossip and disputes must have contributed to this change. Ingold had the need (in 1842) to get confirmation in writing from about 20 Frenchmen that he was a man of honour and a complete watchmaker, that in the interests of his occupation he left Paris and a slander was spread against him, that he had been made bankrupt; he brought his machines to England with agreement of all his business partners, as is stated in the minutes (which have not been found) of the situation in November 1842. Signed by Lacroix, army physician, Juannin, Gambey, Chapelain and one other.

The English company was to be an even larger enterprise. It modelled itself after the French, although differing in some respects. Under the name British Watchmaking Company a capital of £250,000, which is 6¼ million francs, was to be raised. The Dukes of Hamilton, Brandon and Chatelherault took over the patronage. Three authorized trustees were appointed (Mildred, Howell and Sedgwick), probably notaries; the supervisory board had six members (Addison, Barwise, Earnshaw, Hewitt, Rentsch and Vieres); there were two operations directors (Barwise and Earnshaw); and finally, Ingold's name appears in the position of superintendent. It is clear that other well-known people also joined and the prominent chronometer and watch makers of London participated. Sigismund Rentsch, Ingold's former master; John Barwise, a progressive manufacturer who one year earlier had announced a patent for electrical clocks; Thomas Earnshaw the younger, of that famous English horological dynasty; Thomas Hewitt and Antony Vieres (or Vieyres) were owners of chronometer businesses; and Addison, who was described as an engineer. 84 companies in the United Kingdom had committed themselves as agencies, and agencies were also intended in other European countries and on all the continents except Africa. Indeed a great organisation!

The goals were again: "cheap watches manufactured by machinery and to win foreign markets for the watch trade." The description of Ingold's valuable machines, which he invented over twenty years of laborious work, takes up much space. Stamping machines, drills of different kinds, thread cutting and buffing wheels, in total about thirty different machines all able to produce up to 300 pieces per day. After the trustworthiness of the offer and a net yield of 30 per cent had been assured, the prospectus went on to describe the novelty of the manufacturing process which would be used. It consisted of the entire watch being made under one roof, without taking into consideration whether the fabrication of individual components was profitable which, with a division of labor without supervision, would naturally be impossible. At the end the prospectus launched into an appeal to nationalism, to which is added a barb

> directed at the Swiss; it should be in the interest of every Englishman, we are told, to finally eliminate the competition of the Swiss, even though each year ten Swiss watches are sold for every English one.

A promising beginning - however a beginning it remained. We do not know in detail how things turned out. It is not even certain whether the company was actually created. Again the fear of disadvantaging the old manual work in existing businesses became apparent. This mood was made public, signatures were collected and a petition was addressed to the government. The parliament took up the affair and in 1842 refused to grant the enterprise legal recognition. This time Ingold really did experience bankruptcy. He left England and probably went to Geneva, where he worked two long years; but 1844 he again went to Paris, to this city full of gold and misery as he was to say. He rejected an invitation from King William of Holland to shift his activity to the Netherlands.

*Ingold goes to America and returns*

Characteristically, however, his will was not broken. Now 58 years old, he set his hopes on America and emigrated there in 1845. Unfortunately there is no detailed information from this time, which must have been particularly varied. The only existing document is a naturalisation certificate, a rather pompous document, according to which on 17 May 1852 he was made a citizen of the State of New York. It is said that he was accepted with open arms and received a willing hearing. In Boston his suggestions were implemented to a large extent. But then he had his fall; he was soon put off, pushed aside and experienced black ingratitude. His disappointments were such that after seven years he returned to Europe as a last refuge, in order to complain of his lot and warn others of America. He, as Jürgensen says, was driven out of America "like an eagle stripped of its plumage". During this time he seems to have tried to establish a watch factory in Switzerland, but in his destitution he did not find the necessary support.

Due to the nearly complete uncertainty which exists about his time in America, it is in consequence difficult to correctly measure his influence in that country. One hears statements that the whole American watch industry goes back to him, but that is undoubtedly exaggeration. However, it might be that the Americans took up his thoughts on machines and mechanical manufacturing processes and continued to develop them, more so than happened or was possible in Europe. Anyhow, Jürgensen reports that in 1852 in Boston the first factories started with Ingold's machines. A set of circumstances occured to bring success and progress to the Americans. Above all was the general upswing of their industry; but also mainly the absence of resistance from an old, closed group of manual workers, as existed in Europe, which would see its earning capacity endangered. The warning calls, which issued from the Swiss delegates to the world exhibition at Philadelphia in 1876, also contributed much to the over-estimation of Ingold's influence. The high standards the American industry displayed there jumped unexpectedly into view5. As far as it concerned watch production, but expressed vaguely, Ingold was made directly responsible. In reality the Swiss watch industry stood in the middle of one of its many crises, whose causes lay deeper than just American rivalry. They were better organized and worked by newer procedures. The lowest point at that time is illustrated by numbers; for instance, in 1872 Neuenburg exported 366,000 pieces to America, but four years later the number sank to 75,000; the recovery only began around 1880. Regarding the labour organization mentioned in the report, a thorough and strict rationalization was required. In addition there was effective patent protection and better apprentice training.

All that we know of Ingold's time in America is from a personal event: His wife died there and he must have left his son there (did he had several?). In 1858 his son wrote to him, glad to have heard that he was still alive. For many years he had asked in New York for him without learning anything. He describes a watch shop, which he ran with another person. He is particularly proud to have become an American Colonel. "It goes without saying that I am

5 See Jacques David, *American and swiss watchmaking in 1876, reports to the International Committee of Jura Industries on the manufacture of watches in the United States*, 2003.

married" he says, and he finishes: "I am six feet tall; your affectionate son Colonel Alfred F. Ingold."

*Ingold's escapement and fraise*

After his return Ingold again lived in Paris and tried to recover his earlier position. Occasionally he must have suffered misfortune. On one occasion, the watch manufacturer Jürgensen from Le Locle found him in very awkward circumstances and helped him out of the emergency. In the main he continued to draw and experiment. Already, on 8 July 1852, he had received from the authorities a 15 year patent for his own escapement, which aimed to combine the duplex, lever and cylinder systems. He later altered this escapement and made use of it, and in 1857 the Société des horlogers de Paris, which he had rejoined, was involved with it. Besides that, again and again he invented new machines and tools. Most of them were raw attempts or only had a short life. He or the work of others transformed them, so that little remained of their original form. Amongst watchmakers, whose products are always subjected to great transformations, this is not unusual, and in those times it was almost the rule. Much of what occupied him, perhaps even the greater part, remained as designs and were never tested for suitability.

Nevertheless, a development of lasting value came to him in the later years in Paris and which is considered by far the most useful and best of his inventions. It was the well-known milling cutter, which long outlived him. The registration of the patent for it was submitted in 1856 in Paris by an engineer named Le Blanc. The description summarizes it as a "machine suitable to retouch gear wheels, to form the epicycloid curve and to give them the required shape".

Ingold was, in the end, limited to the production and selling of these fraises, and this time again in his homeland, in La Chaux-de-Fonds. From 1858 he remained in Switzerland. This machine was simple but filled an important gap. For the exact running of a timepiece the precision of the wheel teeth is important. With his fraise, Ingold produced wheels which came close to perfection; by it the teeth became epicyclic, which was recognized as the best form. The sales prospectus refers to numerous acknowledgments, particularly from the *Société des horlogers de Paris* and in the *Revue Chronométrique*. Then in 1860 he received a silver medal at the exhibition of Besançon, and in 1862 an honourary mention at the world exhibition of London.6 If today this intelligently devised small machine is no longer used, it is because the wheels for timepieces are supplied with perfect teeth straight from the cutter, without requiring reworking by a further fraise. This procedure was designated as, in memory of the inventor, *to ingold*, and so there is a monument to his name.

*Old age in La Chaux-de-Fonds*

Ingold lived for another twenty years in La Chaux-de-Fonds. He became an old and lonely man without relatives. His social intercourse he found in the Café de la Croix d'Or, in the Rue de la Balance. Here he became friends with the young Emilie Strub, who in her early years had already made herself independent and worked in this café. Her skill was noticed by Ingold and he decided to teach her his occupation, to take her into his house and work to perfect the fraises. After she and the watchmaker Ferdinand Bachschmid had married, they brought the aged Ingold to their home and looked after him, until he died at the age of 91 on 18 October 1878. He left almost nothing; from his small property, which was auctioned, the Bachschmids acquired some pieces, including the watch described above.

One year before his death he had asked the Neuenburg State Council to become a member of a commission that would examine the establishment of a mechanical school. Clearly this plan went back to Dubied's demand to fight American competition by better training the workers. In 1881, in the catalog of the national horology exhibition in La Chaux-de-Fonds, J. F.-U. Jürgensen again referred to the American lead as due to Ingold; he describes him with warm

6 Ingold fraises were also exhibited at the Philadelphia Exhibition in 1876, presumably by Bachschmid; see E. Favre-Perret: *Philadelphia Exhibition 1876, report presented to the Federal High Council on the Horology Industry.*

words and regrets that his ambitions were misjudged in his own country. The two Jürgensens, father and son, had given his life much attention and had often taken him into their care. Jules, the father, helped him, 1862 for example, when a worker of a Genevan company with the name Carpano copied and sold fraises, even in Le Locle and La Chaux-de-Fonds where Ingold lived. On the other hand however, as it seems, not much happened. The Genevan watchmakers were content with the report, according to which a publication on watches with keyless winding would shortly appear in which Ingold would be celebrated as its inventor.

He did not return again to his birth place. Nevertheless, in order to close the circle, the production of fraises was moved to Biel. After Bachschmid had acquired the right to manufacture and sell them, by a contract of November 1874 and an ammendment of December 1876, he shifted the business to Biel and for many years supplied the horology industry here and overseas with Ingold fraises.

However, although the fate of the man is unusual, it certainly is not strange. Unsettledness and journeys marked the careers of many watchmakers of that time, although he exceeded most in restlessness. In addition he out-ranked them because of his complete lack of commercial sense. In the managing of his interests he was nearly culpably careless. He let himself be completely dominated by the technical problems that he pursued, and remained indifferent to the direct necessities of life, so that he ended up with nothing. Others better understood their opportunity to exploit. For instance, if one thinks of the younger Pierre Jacquet Droz, who approximately equals him in skill and also exhibits much similarity with him in other ways, then even with him the difference was that, after an active life he died in 1790 a wealthy man (in Biel, by the way, where he is buried in the old cemetery beside the technical school). It is not clear to what extent the two achieved inner happiness; and because of this one is not in a position to decide, which of them was more to be envied.

The absence of sources on Ingold's life does not prove, on close examination, to be unnatural. A life like his, in which each stage was strange, did not require introspection. To write letters, to fathom his inner state, his desires - these needs never existed in him. He was the archetype of the one-sided practical man, whose view remained focussed forwards. Into this picture also fits Ingold's independence in relationship to homeland and family, and his relationship with his son is instructive. His abilities lay solely in the technical. It is there that he showed his ingenious and inventive strength. Therefore, he will keep his place in the history of watchmakers for all time.

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