

THE HISTORY OF EXPLOSIVES IN SWITZERLAND

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A short overview about the history of explosives in Switzerland is presented. In 1383 for the first time explosives were used in the new founded country of Switzerland. Until the 19th century the history of explosives is the history of Black Powder. In the middle of the 19th century, professor Schönbein of the University of Basel invented the nitro cellulose. Some years later the waterfalls on the lake of Brienz were illuminated by pyrotechnics for the first time. At the end of World War I the powder plant Wimmis was built. It is still producing gunpowder. Today explosives are characterized in the laboratories of Defence Procurement Agency.

Hardly any other material had more influence on human society than explosive substances. This applies both to the historical development and the social changes as well as the mentality. Until well into the 17th century explosives were closely linked with black magic. Even today in the time of modern science the work with explosives often seems to be something unreal.

When we look back to the historical evolution of explosives in Switzerland, first of all we have to consider the political situation in central Europe about 1000 years ago. At this time the Central part of Europe was split up into several Duchies. For example there was the Duchy of Habsburg, the Duchy of Burgundy and the Duchy of Lombardy. In the year 1191 the Duke Berchtold of Zähringen founded a new city on a peninsula on the river Aare, at a place where the river makes a curve, only 50 km from the place we are staying now. The new city was called Berne and is today the capital of Switzerland. The city soon became very important for trade from North to South and therefore very quickly received news of newest inventions.

Around this time an English monk called Roger Bacon conducted experiments with compositions containing Sulphur, Charcoal and Salpeter. It seems that he got the knowledge of such compositions from Dutch sailors who brought it back from China. In the 13th century, the century when Switzerland was founded, a German monk with the original name Konstantin Ancklitzten, today better known as Berthold Schwarz, also made experiments with such compositions to find a new golden ink. During his experiments he realized the pushing effect of the reaction products during the burning of such

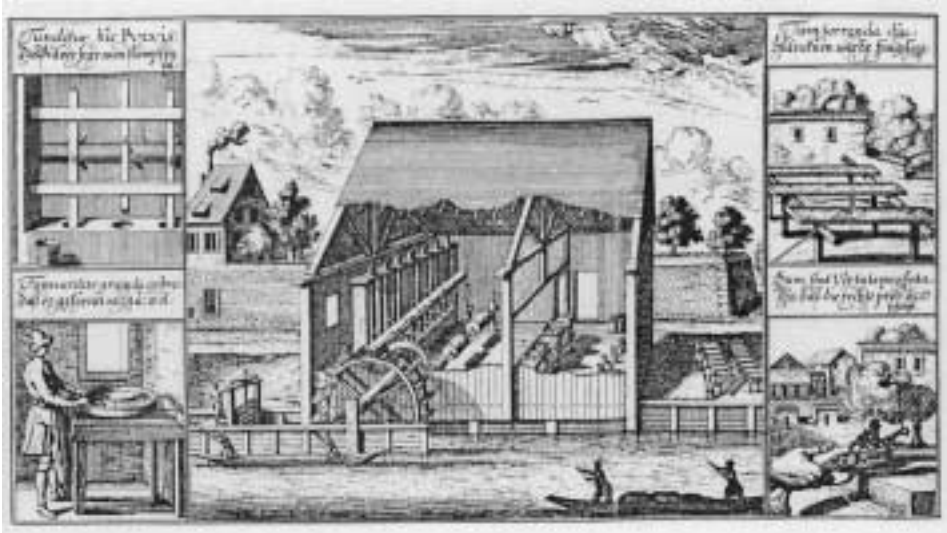
compositions. He used a pot for his experiments, which in German is called a “Büchse”. That’s the reason why in all German dialects the common word “Büchse” is still used today for a rifle.

In 1291 the cantons of Uri, Schwyz and Unterwalden founded a new country called Switzerland. About 80 years later, in 1371 Black Powder was mentioned for the first time in the area of today’s Switzerland. The city of Basel hired a gunmaker from the Alsace. His job was not only to manufacture rifles; he also had to produce the necessary Black Powder. His work contract was the first work contract in the area of the new country of Switzerland.

In 1383 the City Republic of Berne, now part of the Swiss Alliance too, wanted to conquer a small town in its neighbourhood called Burgdorf. A siege was started together with soldiers of the other members of the Alliance. The castle and the city of Burgdorf are located on a hill. To destroy the Castle and the city wall the besiegers used big catapults. In German this weapon is called “Blide” but today hardly anybody knows the meaning of this expression. However the besiegers didn’t succeed in taking neither the castle nor the city. Now the commanders of the Bernese troops remembered that the city bought some pieces of a brand new weapon not too long ago. There were mortars and the first types of rifles. These weapons were brought immediately to the troops in front of the castle of Burgdorf, but at this time no Black Powder was available. Therefore allied soldiers from the canton of Luzern were sent over the Gotthard down to Lombardy to buy some Black Powder. At that time no member of the Swiss Alliance was able to produce Black Powder himself. After the bargain the Black Powder for the Bernese mortars was brought over the Gotthard pass down to the area of Luzern and then over the Brünig pass down to Unterseen, a village which is today part of Interlaken. From there it was shipped down on the Lake of Thun and the river Aare to the city of Berne and then brought to Burgdorf. When the Black Powder finally arrived in Burgdorf, the siege was over, because the City Republic of Berne had bought the city of Burgdorf in the meantime. We know all this through the state accounts of the City Republic of Berne for the year 1383/84.

In the 15th century a Black Powder production was started in some cantons of the Swiss Alliance due to the danger of the transports and the dependence on foreign countries. The city cantons such as Bern, Zürich and Luzern started to hire foreign rifle makers who had to produce the necessary Black Powder, too. The required sulphur for the Black Powder was bought in southern Italy, the salpêtre was extracted from the earth under the stables of farms and the charcoal was produced from hazel and alder bushes.

The government of the City Republic of Berne sold licenses to people who were then allowed to dig for salpêtre or to cut the special switches from the hazel and alder bushes. For the licensed salpêtre diggers the farmers had by order of the government to have a dry place, water and dry wood ready to extract the salpêtre from the earth. This license selling was on the one hand a good business for the City Republic of Berne; on the other hand the government was able to control the Black Powder production and the trade.



Picture 1: Potassium nitrate production.

Later in this century farmers or their family members ran the Black Powder plants. The mixing process was done by hand and the resulting Black Powder was more or less a fine powder. Mostly the interest of the farmers in the production was not too high, because it was an additional job they had to do. Therefore the quality of the Black Powder was extremely varied.

In the year 1476 the Swiss Alliance had to fight against the Duke of Burgundy. They went into battle with a few mortars and rifles only. The Swiss soldiers won the famous battle of Murten. The booty included 420 mortars, 800 rifles and 300 “tons” containing Black Powder (probably these “tons” were 50 kg barrels).

In the 16th century the hand made Black Powder production changed to a mechanical process. Old water driven corn mills were used for the production. A lot of such Black Powder mills were located in the area of the City Republic of Berne, some in the city of Zürich, Luzern and other cantons.

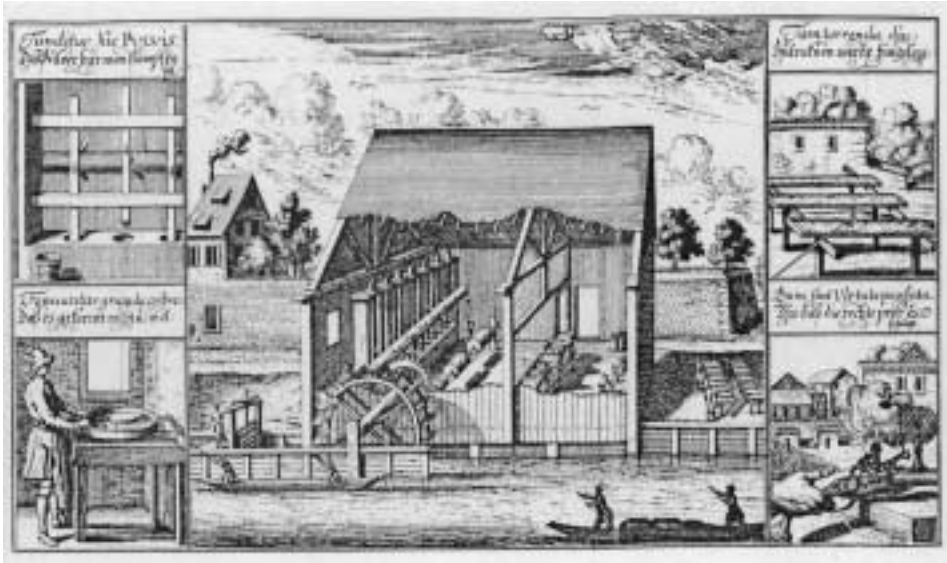


Figure 2: Production process of Black Powder.

In 1652 some of the family plants were closed and the four biggest Black Powder mills in the canton of Berne were put under governmental control. One of them was located in an area called Worblaufen, close to the city of Berne.

At this time the Bernese Black Powder became very famous in Europe because of its quality and performance.

To find out why the Bernese Black Powder was better than the one of the city of Zürich counselor Landolt, who was responsible for the production and storage of Black Powder of the city of Zürich, went to Strassburg to buy a test mortar. The ball of this mortar had a weight of 60 pounds. For the firing 3 ounces of Black Powder were used, that means about 100 g. The firing angle was 45°. Immediately a shooting was arranged to compare the quality of the different Black Powders. The measured flight distances of the ball were the following:

- French Black Powder: 110 Klafter*
- Black Powder from Zürich: 104 1/2 Klafter*
- Bernese Black Powder: 112 Klafter*

*Klafter is an old expression (unit) to measure the length. 1 Klafter is the length of the extended arms of a man, the values could therefore lie in the range of 1.7 to 2.9 m.

In the year 1696 Black Powder was used for the first time in Switzerland as a civilian explosive for the construction works on the Albula pass.

During all this time, Black Powder production was a dangerous job. A lot of severe accidents are known, such as the explosion of the Black Powder mill in the city of Zürich in 1723.

Till the 19th century Black Powder was the only known and used explosive in Switzerland.

The 19th century was in Europe as well as in Switzerland the century of the big inventions. During the period of 1799–1868 Christian Friedrich Schönbein taught as a professor at the University of Basel. His working field was the investigation of the influence of nitric acid on different organic materials. Once he also treated cellulose with nitric acid, dried the material and lit it. The new material burnt very fast, the nitro cellulose was invented. Professor Schönbein informed the Swiss War Council about the new substance. The council organized a mortar firing to compare the new material with Black Powder. The performance of nitro cellulose was about 2.5 times greater than that of Black Powder, but because of its instability the new explosive material couldn't replace Black Powder for the present.

In 1848 Switzerland changed its political system from an alliance of different states to a federal state, with one parliament, with a capital, with a federal army and last but not least with its own responsibility for Black Powder production, the so called Powder Regal. Later this responsibility was extended to the production and the trade of all explosives.

In 1853 the Swiss Government founded a new Black Powder Mill in the French speaking part of Switzerland close to the village of Aubonne. At this time there were three Black Powder facilities in Switzerland, split up over the whole country:

- Black Powder Mill Worblaufen
- Black Powder Mill Chur
- Black Powder Mill Aubonne

Today only the mill of Aubonne still produces Black Powder.

The year 1855 was very important for the history of pyrotechnics in our country. In this year a young Bernese teacher was asked by the owner of a hotel on the Lake of Brienz to illuminate the big waterfalls close to the hotel. Professor Hamberger succeeded in coloring illuminations by using pyrotechnic compositions. For many years this illumination was an exciting tourist attraction for visitors from the whole Europe. Therefore Professor Hamberger founded his own fireworks company on the shore of the Lake of Brienz. Still today the company is producing fireworks for big events.

In 1873 and 1895 the first production plants for high explosives were founded in Switzerland. It was Alfred Nobel's plant in Isleten, on the shore of the lake of Luzern and the plant in Gamsen, which is located in the canton of Wallis. What reasoning led to the choice of the two places? It's very simple, both places were close to the planned big construction sites of the Gotthard and Simplon / Lötschberg railway tunnels. Because of an exclusive contract with the Swiss Government Nobel could deliver all high explosives used for the construction work on the Gotthard railway tunnel and the big fortresses which was built in this area. It was good business for him.

In 1890 a nitro cellulose production for the Swiss Army was started in the Black Powder Mill Worblaufen. This led to a Black Powder production stop at this place in the same year. In 1914, at the beginning of World War I the Swiss artillery troops needed a large amount of the new nitro cellulose gun propellant. But the capacity of the existing plant in Worblaufen was too small. An enlargement of the facility was impossible because the city of Berne had grown around it. Therefore in 1917 the Swiss Government decided to build a new gunpowder plant near the village of Wimmis, which is located not so far from Interlaken. The Powder Plant Wimmis, today better known under the name Nitrochemie Wimmis, is still producing gunpowder. The construction work was finished in 1919, in the year when

the war ended. At this time nobody was interested in buying gunpowder anymore and the new factory didn't receive orders. In this situation the management of the plant had a bright idea to produce pasta with the new machines. However this pasta was too expensive, it was impossible to sell it. Finally it became part of the salary of the workers of the plant.

The rest of the history of explosives in Switzerland can be told in a few words. In 1947 the explosive plant Dottikon synthesized the high explosive RDX, which was already used in Europe during World War II for the first time in Switzerland. Today this plant produces drugs against heart attack. In 1971 the Laboratories of the Defence Procurement Agency synthesized the high explosive HMX for the first time in our country. At this time we thought that the time of new inventions in the field of high explosives would be over. Nevertheless in 1997 CL-20, the new high explosive of the US Navy Laboratories in China Lake was synthesized and characterized for the first time in Switzerland by the DPA Laboratories.

This short overview about the history of energetic materials in Switzerland is for the first 500 years the history of only one explosive composition, Black Powder, an explosive composition that can be used as a propellant, as a high explosive and as a pyrotechnic composition.

But there will always be new steps forward in every field of research. The near future will bring us new energetic molecules and new energetic compositions, that have to fulfill higher requirements concerning performance, safety and toxicity and that have to be characterized. It's a challenge, therefore let's look forward to doing it.

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