THE MANUFACTURE OF DYNAMITE.

It will soon be twenty years ago (it was, as well as I can remember, along about 1873) that a few friends and I were returning from Lucerne to Florence

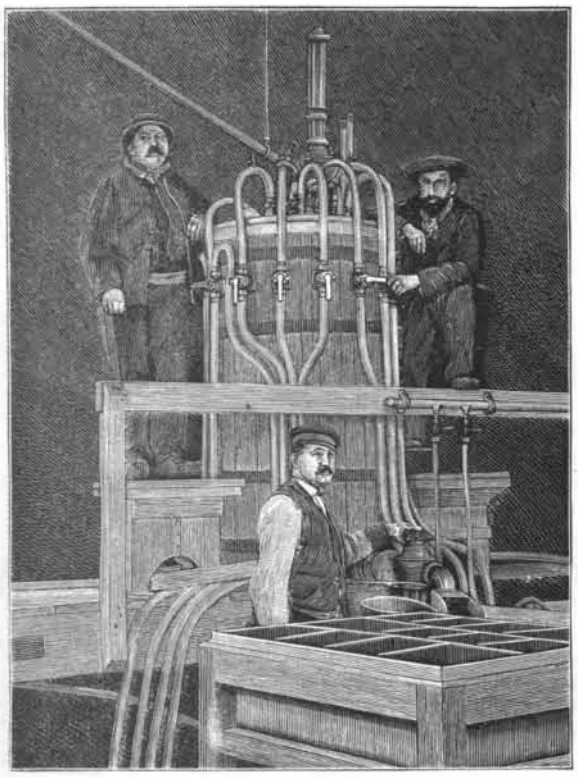


Fig. 1.—NITRO-GLYCERINE APPARATUS.

by the steamboat that performs the service of Lake Quatre-Cantons. At that time, now so remote, it was the only means of conveyance that took tourists, as also the peaceful inhabitants of the primitive cantons of Switzerland, to the St. Gothard route, and thence to the sunny plains of Ticino and Lombardy.

The first blows of the pick were then being given to the granitic sides of the mountain which, eight years afterward, were to hear the snorting of the locomotive

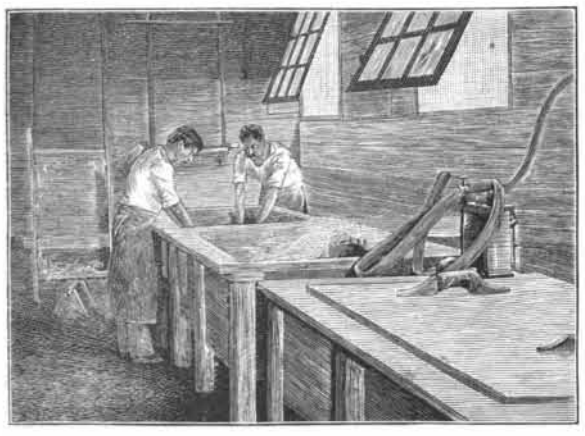


Fig. 3.—KNEADING THE NITRO-GLYCERINE MIXTURE.

and the resounding of the rails under the vault of the great new tunnel of the Alps.

The weather was superb (it was in the beginning of May), and, while admiring the splendid panorama that was unrolling before our eyes, we began an animated conversation, the only one that interested us at this time, upon the chances of success of the colossal enterprise that was then taking its first step.

When will this gigantic, nine mile tunnel be perfected? In nine years, in eight years, or in a greater or less number of years? And we, humble servants of

Fig. 5.—FILLING THE CARTRIDGES BY MACHINE.

the audacious work (a half dozen comrades of us, engineers and employes of the enterprise, had met each other), already foresaw the hour of triumph—the day on which, after proceeding step by step, the last blast, the last explosion of powder, would finally destroy the last obstacle and make the road free between the two as yet virgin sides of the mountain.

That will be hard, said one of us. Think a little, friends. We shall in the first place, before reaching the central rock, meet with more than a mile of granite, and the Gothard granite is not soft, I assure you. And so saying, my old friend Arnaud took from his pocket a piece of rock of a brilliancy and hardness that was not very assuring. Pshaw! have we not dynamite now, carelessly remarked one of the party.

At this word dynamite, a group of travelers that had left Lucerne at the same time that we did, and that our conversation upon the work of constructing the great tunnel must certainly have interested, approached. One of the group, a large and stout fellow, dressed in gray velveteen, and who had all the air of an engineer or a contractor of public works, took part without ceremony in our discussion. But I am bringing you dynamite, said he abruptly, and you will just see how your granite is going to crumble! I believe, upon honor, that while speaking he cast a significant glance at a carefully buckled valise insidiously covered with a Scotch shawl of peaceful aspect, very surely to conceal its belligerent intentions. This valise, as we assured ourselves an hour later in touching glasses at the hotel of the Poste de Fluelen, must have hidden a volcano! The traveler was none other than one of the most enterprising manufacturers of the epoch. The intelligent engineer had got a glimpse of the colossal future in store for dynamite, the new explosive, which was then making but very little noise in the world.

Three months after this meeting, a dynamite manufactory was installed at Isleten, at the foot of the valley of Isenthal, very near Fluelen. It still exists, and the tourists of to-day do not fail to cast a glance at the red roofs of the works from the deck of the boat or from the railway. You are surely going to ask me the name of the traveler with the mysterious and inflammable valise. It was Mr. Barbe, who was afterward, in 1887, in the Rouvier cabinet, and who, as we know, was the soul of the dynamite industry. The friends who accompanied him were Mr. Brüll, who was vice-president of the Society of Civil Engineers; Mr. Vian, now deputy of Seine-et-Oise, and also one of our most active dynamite manufacturers; Mr. Xavier Bender, who was to construct the Isleten works; and Mr. Nobel himself, the inventor of the new explosive.

Dynamite has made its way since those twenty years back. The entire world manufactures; millions upon millions of pounds of it. There is scarcely a civilized country that does not possess its dynamite manufactory. France has three of them, which represent, one with another, four million pounds of dynamite manufactured, say five million cartridges like those that produced the recent and criminal anarchist explosions.

After having acquired a just renown for the exceptional services that it has everywhere rendered in mines, great public works and military science, dynamite has not contented itself with this specific halo of glory; and (it is necessary to say it) its universal reputation did not cross the circle of its special relations until the day when it strayed off in bad company.

Finally, you say, tell us, then, you who have used and manufactured it so long, what dynamite is. How is it manufactured? And who are the beings unfortunate enough to live in the midst of this hell, still more terrible than the legendary one, since one burns therein and is blown up therein, to boot. And, especially, don't perplex us with your formulas and your acids with uncouth names.

Well, my friends, I offer you an exceedingly simple thing. I am going to pass you through the door of the Isleten manufactory that I have just mentioned, in awakening my old, very old recollections of the time when I was still under the orders of Louis Favre, a contractor on the great St. Gothard tunnel, and when my old friend Xavier Bender, now at the head of the French Society of Explosives, directed the manufactory in question. And now, attention! Simply have the extreme obligingness to follow with me, in the order that I shall point out to you, the series of engravings that are herewith reproduced with great fidelity, and that represent the different phases of the manufacture of a dynamite cartridge. It is a good fortune that falls to your lot, curious readers, to be able to consult these engravings, since the entering of a dynamite manufactory, simply to visit it, is not a thing within the reach of all. To carry away photographs thereof is a true miracle, and I do not think I deceive myself when I say that such a publication as this is made for the first time. Do you wish in the first place to admire a remarkable collection of cartridges exactly identical with those that were stolen at the depot of Soisy-sous-Etoiles, and that were found later on, upon the information of Bricou, under the hay of the fortifications, after being concealed in the Garden of Plants? Look, then, at our figure representing the store room wherein the manufactured cartridges are put into cases of 55 pounds each. You have them everywhere. To the right there is a basket full of them, piled up one on top of the other. The women

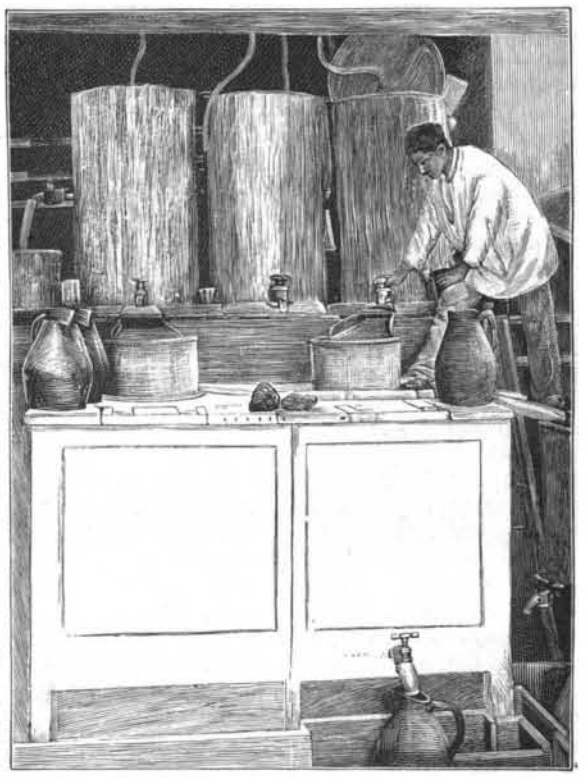


Fig. 2.—COLLECTING THE NITRO-GLYCERINE AS IT COMES FROM THE APPARATUS.

that you see seated pack them in those cardboard boxes covered with tarred paper that encumber the tables. Thirty of them, 5½ pounds in all, are put into each of these boxes. Ten of these boxes are arranged in a case like those that the workmen are screwing up in the foreground. At the rear, the foreman is watching things. The cases afterward go to the magazine, and thence to the railway.

The manufacture of these cartridges is, in the main, very simple. It is necessary to say, in the first place,

Fig. 4.—FILLING THE CARTRIDGES BY HAND.

that before being put into cartridges, the dynamite is in the form of a powder—not a dry, hard, and crystallized powder, like the article for sporting purposes, but in an oily form, easily crushing under the finger. It could not be better compared than to the cocoa powder with which housewives manufacture the fragrant chocolate of the morning meal. I shall tell you presently how this powder is made. I cannot explain it all at once, especially since you have imposed upon me

Fig. 6.—FINAL CLOSING OF THE CARTRIDGES.

clearness and simplicity—two conditions that are very difficult to fulfill here.

Here, then, is our dynamite powder in a receptacle called a "vasque." It is carried to special rooms where the women shown in our various figures calibrate it by hand or with a machine. If they work by hand, they content themselves (as may be seen in Fig. 4) with ramming the oily powder, by means of a wooden rod, into moulds fixed to the bottom of a zinc pan. After the powder is calibrated, it is covered with paper and is ready to be packed.

More curious and much more employed is the mechanical method. Two of our engravings show a group

Fig. 7.—FILLING CARTRIDGES WITH EXPLOSIVE GUM.

of women, "cartouchieres" as they are called in the works, occupied in the manufacture of cartridges of the terrible substance. The machine, which is screwed to a wall, is of the most rudimentary description. A lever, maneuvered by the woman to the right, gives a to and fro, upward and downward motion to a bronze rod (everything is of bronze and not of iron here, in order to prevent rapid heating through friction), and compresses into a cylinder of definite caliber (from 8-10 of an inch to 1 inch) the dynamite powder contained in a leather funnel that is shown in the figure. The woman to the left breaks the roll of calibrated dynamite when she finds it of sufficient length (2¾ to 3¼ inches), and passes it to the cartridge maker situated in the center, who covers it with parchment paper in order to protect it from dampness. The cartridge is then entirely finished. Fig. 6 represents the operatives grouped around the same machine, and occupied in the final closing of the wrapped cartridges. Fig. 7 shows the filling of cartridges of the same length and diameter with what is called "explosive gum," which is composed exclusively of pure nitro-glycerine and nitrated cotton, forming a plastic paste of gum whose high explosive power is utilized for crushing the hardest rocks and for submarine blasting.

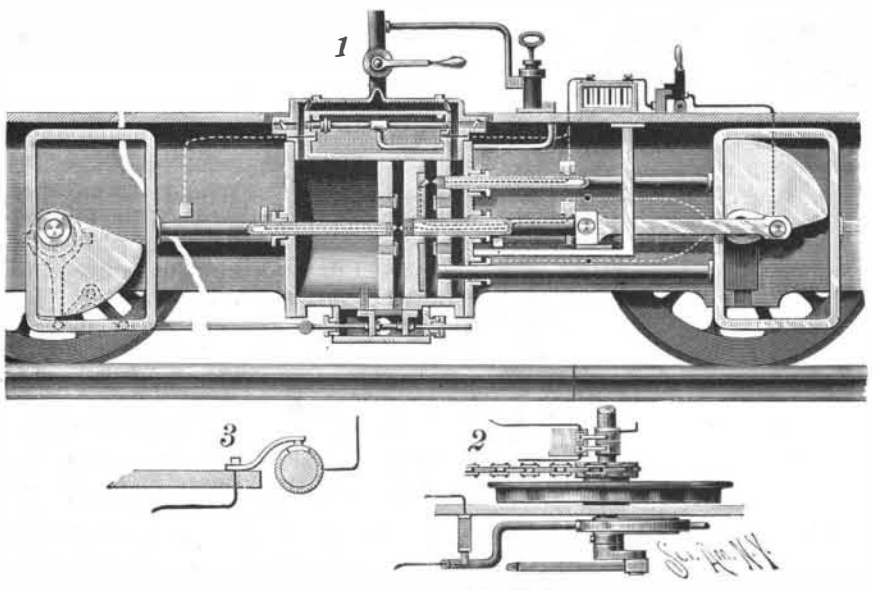
This machine might well be compared to the one used for making sausages. The gummy explosive material is accumulated in the hopper to the right. The winch to the left is turned, and the cartridges make their exit in pairs from the cylinders to the extreme right. Between the bottom of the hopper and these cylinders there is a bronze spiral that carries the substance forward and causes it to direct itself out of the machine. An operative receives the cartridges upon their exit, wraps them in paper and closes the two extremities. These cartridges are afterward carried to the packing room and put into cases, as we have already said.

It now remains for me to tell you the composition of the famous nitro-glycerine, which, up the present, seems to be, as it is in fact, the explosive constituent of what is called dynamite (from the Greek δυναμις, power). If you will refer to our engravings, you will find very faithfully represented therein the industrial manufacture of this mysterious nitro-glycerine.

The huge cylinder (which is of lead) that you see in our first figure contains the terrible mixture of nitric and sulphuric acids and glycerine, the chemical reacrion of which forms nitro-glycerine. The array of pipes that end at the cylinder, or empty themselves at the top, are the ones that lead each of these constituents to the interior of the apparatus, or that conduct the water designed to cool the mixture in order to prevent explosions due to ill-timed elevations of the temperature. In Fig. 2, a workman is placidly collecting the oily and explosive liquid, a glassful of which would suffice to blow him to atoms. This valuable and sometimes criminal liquid is carried to the room represented in Fig. 3, where it is mixed with a silicious powder. It is then kneaded until the nitro-glycerine is absorbed by the powder. . . . The paste thus formed is that which we have just seen put into cartridges, which are afterward sent to the magazines, whence they are shipped to the industries.—*Maxime Vuillaume, in L'Illustration.*

AN IMPROVED GAS ENGINE.

This engine has a double-acting piston adapted to take in the combustible mixture and compress it on either side of the power piston, there being an electric ignitor for igniting the combustible charge. The improvement has been patented by Mr. John S. Biggar, Whitesborough, Cal. Fig. 1 is a side sectional elevation, Fig. 2 shows a plan view of a portion of the engine, and Fig. 3 shows one of the contact springs. On opposite sides of the power piston are pistons drawing in the combustible mixture, one such piston being connected by a tubular piston rod with a rectangular frame acted on by a quadrant cam on one of the drive wheel axles, while the other piston has two piston rods, one of which is tubular, the rods passing through stuffing boxes in the cylinder head, and being connected with a rectangular frame which incloses a quadrant cam secured to the other drive wheel axle. At the top of the cylinder is a valve chest, with gas and air passages, and a gas pump, and in the under side of the cylinder are ports covered by a valve chest in which is a double exhaust valve to open and close the ports alternately, the rod of the valve being connected with an eccentric rod embracing the eccentric on one of the drive wheel axles. On the frame of the engine is located a battery, one pole of which is connected with contact plates, while the other pole is connected with a switch. When it is desired to start the engine from a state of rest, gas is drawn by the pump from the supply pipe and forced into the cylinder, already containing sufficient air to form an explosive mixture, and the charge is ignited by the automatic making and breaking of electrical contacts. The charge having been exploded, and the power piston forced to the extremity of its stroke, the auxiliary piston is made to follow it by the quadrant cam on one of the drive wheel axles, thereby drawing in the combustible mixture, which is thus compressed before explosion, the operations proceeding alternately on opposite sides of the piston. To cause the axles of the drive wheels to rotate together, they are connected by an endless chain running over sprocket wheels on the axles.



BIGGAR S GAS LOCOMOTIVE.

Candy Without Cooking.

To make a delicious candy, break the white of one egg into a large, flat dish. In one end of the dish put about one pound of the very best confectioners' sugar, carefully sifted. Beat the egg, taking up a little of the sugar at a time and beating steadily for about ten minutes. Before all the sugar is in add a large teaspoonful of some preferred extract, vanilla, lemon, or rose, the first being most generally liked. Beat or stir until the sugar is all in. When done it should stand up in a firm lump and should settle but very little if left standing. Then dust a little fine sugar on a pastry board, cut off with a sharp knife a part of the beaten sugar, lay it on the board and roll it under the hands until perfectly soft and smooth, then make into a roll about as large as a 25 cent silver piece, cut off little round cakes of this about half an inch thick, pat this between the hands until very smooth, then place the half of an English walnut on the prepared pat of sugar and press it a little to bring the two in close contact. Have ready a plate rubbed over with a bit of buttered paper. On this place the candies as fast as made.

They may be set in the oven for a minute or on a shelf above the fire. Many persons put them on buttered paper, but they sometimes stick and tear the paper which adheres to them, and which is objectionable when the confection is eaten.

Sugar prepared in this way may be used to coat fruit or nut confections of various sorts. Blanched almonds are rolled in little cakes of it, care being taken to press and roll the sugar so that the nut is entirely covered. Various sorts of nuts chopped fine may be mixed in with the sugar or fruits, such as citron shredded, seeded raisins cut up fine or candied, or preserved fruits of any sort, care being taken that they are not too juicy, as this would prevent hardening.

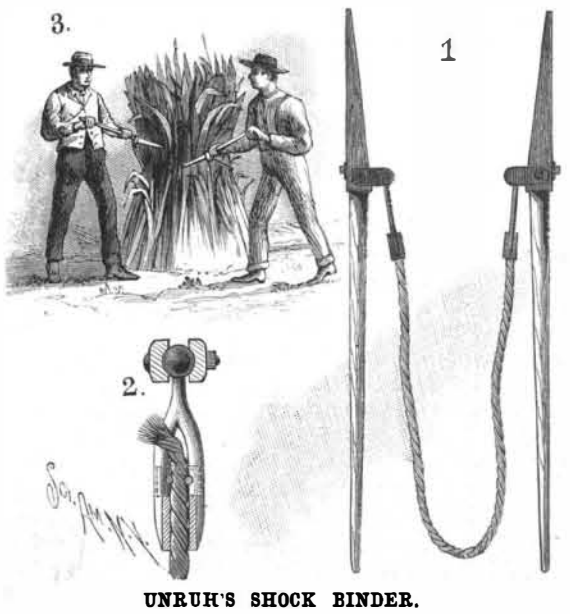
Fresh fruits may be put up in this way. If grapes are dipped in the beaten white of an egg and allowed

Fig. 8.—PACKING AND BOXING THE CARTRIDGES.

to dry, then rolled in this same beaten sugar, they are delicious. Sometimes the confection is made quite soft, then placed in a hot oven for a moment and allowed to remain until thoroughly scalded through, care being taken that it is not browned. In this way it gets the elastic, firm quality so much liked in what are called French confections.—*N. Y. Ledger.*

AN IMPROVED SHOCK BINDER.

The device shown in the illustration is designed to facilitate the binding of corn shocks quickly and tightly, in order that they may be readily tied. It has been patented by Mr. Charles S. Unruh, of Steele City, Neb. As shown in Fig. 1, two levers are employed, a socket being fastened by a bolt on the inner face of each lever, and each socket having a circular recess to receive a ball formed on the shank of a clip, as shown in Fig. 2. The body of the clip is tubular, and immediately above the body of the clip each side face of the shank is engaged by a tie plate, the two tie plates being connected by bolts, provided with suitable nuts. The binding section of the device consists of a rope whose ends are passed through the tubular bodies of the clips, where they are held by tightening the tie plates. When the device is operated by two men, each engages the lever with one side of the shock, and draws the rope around, as shown in Fig. 3, the shock being tied by means of binding twine, after the stalks have been drawn as closely together as possible. The device may, however, be operated by one man, the ball and socket connection between the clips and the levers permitting the latter to be carried in almost any direction without twisting or unduly kinking the rope.



UNRUH'S SHOCK BINDER.

THE auger that bores a square hole consists of a screw auger in a square tube, the corners of which are sharpened from within, and as the auger advances, pressure on the tube cuts the round hole square.