THE
CALIFORNIA POWDER WORKS
MANUFACTURERS OF
HERCULES POWDER
FOUR GOLD MEDALS AWARDED
Sporting, Cannon and Mining Powder
MILLS AT SANTA CRUZ, CAL.
HERCULES POWDER WORKS
PINOLE, CONTRA COSTA CO., CAL.
OFFICE: 830 MARKET STREET
SAN FRANCISCO, CAL.
FOR EXPLODING
HERCULES POWDER

MANUFACTURED BY

THE CALIFORNIA POWDER WORKS

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OFFICE: 330 MARKET STREET
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1897
INTRODUCTION

In issuing a eighth edition of our descriptive pamphlet, we wish to place before our readers a brief statement relative to the properties and composition of Hercules Powder, and to give some directions for its handling, transportation and use.

The increasing demand for Hercules Powder is the best guarantee of its superior quality, and has now rendered it the leading High Explosive, East as well as West of the Rocky Mountains.

The following pages will convey to the readers our claim in simple form. We invite a careful perusal by all who are interested in the subject,
EXPERIENCE IS THE BEST OF TEACHERS.

The California Powder Works have been engaged in the manufacture of high explosives for more than twenty years. The Hercules Powder of to-day is the product of their experience and investigations. Although many mixtures under various names, have sprung into advertised notoriety since Hercules began its career, with one or two exceptions they have had but a brief existence, and one by one have disappeared, while the demand for Hercules has continually increased, and to-day it is the leading high explosive of America.

The elements of the invention were set forth in the original patent. These elements, viz.: safety, strength, non-liability to decomposition and freedom from noxious fumes when exploded, have been steadily kept in view, and extended in the improvements since made. In making these improvements no pains have been spared. Time, talent and money have been freely expended in the good cause. But while we have been progressive, we have also been conservative. At every step we have availed ourselves of the services of two classes of experts. While the chemist has propounded the theory, the practical miner has supplied the tests. No matter how plausible the reasoning of the former might be, we have never accepted it as final till it has been passed upon and approved by the latter. Such is Hercules, the most perfect of modern explosives.

We challenge the world for another mixture that will compare with it when submitted to these two experts—the practical miner and the scientific chemist.

It is the favorite powder in all tunnel enterprises and hard rock mining in California, Oregon, Nevada, Arizona, Utah, Washington, Idaho, Montana, Alaska, New Mexico, Wyoming, Colorado, the Black Hills, Mexico, and Central America.
DISTINGUISHING FEATURES.

The principal features that characterize Hercules Powder are Safety, Strength, Efficiency, Economy and Freedom from Noxious Fumes.

THE PROBLEM OF MAKING GOOD POWDER.

The quality of safety has two aspects, chemical and mechanical. One relates to decomposition, the other to leakage. Nitro-glycerin which has not been properly purified is liable to decomposition. In a certain stage of decomposition it is dangerous, being susceptible to explosion by very slight causes. If properly made from good materials and thoroughly purified, it will keep indefinitely, provided it is not mixed with what Mowbray calls "incompatibles," that is, with substances which have an injurious action upon it. We prepare our nitro-glycerin with the greatest care, and in addition we use materials which are not only "compatible," but are capable of arresting decomposition, should this be started by any untoward circumstances in its storage.

Pure nitro-glycerin itself is dangerous to handle. Being a liquid and nearly incompressible, it is ill-fitted to sustain the shocks and jars of use. To overcome this by providing a cushion in the porosity and resilience of an absorbent is one of the objects of the powder form. **If a powder leaks it is a failure in this regard.**

The problem of dynamite making is therefore three-fold, viz.: to produce a mixture which

1st. Shall not be "incompatible" with the integrity of the nitro-glycerin.

2d. Which shall be chemically balanced so as to give the greatest strength and least noxious gas.

3d. Which shall hold the liquid perfectly, so that it will not leak, and yet be free enough to readily detonate.

When the reader reflects that we produce grades that contain from 80 down to 5 per cent of nitro-glycerin, he will see that the problem assumes many forms, and that there is room for a great deal of study and discretion. How well we have solved this many headed problem we leave the mining public to judge. In this case those most familiar with our products are also the best critics.
In conclusion we will say that **Hercules Powder** is safer to transport on teams, vessels or railroad cars than many articles that are daily carried as ordinary merchandise.

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**STRENGTH AND EFFICIENCY.**

What is the proper measure for the strength of an explosive? Is it the pressure it will produce when detonated under certain standard conditions, as by confinement to its own volume, or is it the mechanical work it will do? The one measure relates to intensity, the other to energy. Fulminate of mercury (used for filling caps) is the most intense, while nitroglycerin is the most energetic of simple explosives.

The tests which we employ to determine the strength of an explosive are those which make **two pounds of a given explosive twice as strong as one pound.** What we measure is the energy, the capacity for doing work, which is to a great extent independent of the conditions of confinement, while the intensity or pressure is directly dependent upon these conditions.

When the miner buys powder he buys energy in a **portable form.** For his convenience this energy is sold in grades (to be given hereafter). Experience has proved that in certain kinds of rock the greatest concentration of power is not required—hence the necessity for grades. When great concentration of power is required, we give him a very powerful powder.

The simplest classification of strength is based on the percentage of nitro-glycerin.

The cost is also determined by the percentage of nitro-glycerin.

It is our boast that we give the miner greater strength for a given percentage of nitro-glycerin than any other manufacturer; also, that we give the exact percentage claimed, neither an ounce less nor an ounce more. This is **purified, anhydrous nitro-glycerin.**

To claim that one powder is stronger than any other powder is absurd unless similar grades are compared. When this is done, we pronounce **Hercules Powder the strongest and most efficient explosive known to the arts.**
ECONOMY.

In computing the cost of work do not be disappointed if, at the end of a month, you find your powder bill is more than with black powder, but go on and figure up the tons or cubic yards of rock removed and the whole cost per ton, and you will find it much reduced by using Hercules.

You have saved in steel, you have saved in blacksmith work, you have saved in time and labor by drilling smaller holes; in the same time you have removed more rock, and, if you will make a business proposition of it, as a merchant does who estimates his cost of doing business and his profits, you will find you have saved from ten to fifty per cent.

PROPERTIES.

Hercules Powder is a mixture of nitro-glycerin with the Hercules composition in different proportions to form the different grades.

It is a plastic but crumbly white paste. Like all nitroglycerin mixtures, it freezes about 44° Fahr.

We have received many inquiries from rifle clubs and sportsmen about Hercules for their use. We wish to state, once for all, it is entirely unfit for their use.

Hercules is not a "fire" explosive like gunpowder. *When set on fire in any ordinary way, it burns away without explosion. To explode it must be detonated, and there is only one proper method of giving it the detonating impulse, viz.: by using the fulminate cap.

It is not susceptible to explosion by friction or the shocks of ordinary use.

It will not explode by rough handling, jostling, tumbling about or overturning of wagons.

It will explode if exposed to a gradual heating, to say, 360° Fahr.

It will explode if set on fire while closely confined, so that the gases cannot escape, as in an iron shell; also if the mass set on fire is very large, no matter whether confined or not.

*Don't try this. There have been a few instances in which even single sticks of dynamite have exploded in burning.
It may be exploded partially or wholly by shock as follows:

1st. By sharp percussion between hard surfaces, as by a hammer and an anvil.

2d. By the impact of a rifle bullet at any range, or a charge of shot at short range.

3d. By firing a charge of any other high explosive in contact with it or near it, or a charge of gunpowder in contact with it, when it is confined.

STORAGE.

Hercules powder should be stored in a dry, cool, and well-ventilated warehouse. When so stored it will remain in good condition in any climate indefinitely.

FREEZING AND THAWING.

Hercules Powder freezes about 44° Fahr., that is, the nitro-glycerin in it becomes a solid at this temperature. While it can be exploded when frozen and will do some work, its strength is lessened, and it is best to thaw it before using. Only a moderate heat, say 100° Fahr., a temperature which the wrist can bear comfortably, should be used. Nitro-glycerin boils about 256° Fahr. It evaporates very freely at temperatures above 100°, so that you weaken your powder by overheating it, besides running the risk of a frightful accident. Carelessness in thawing has been the cause of nearly all the accidents in handling dynamite. If you thaw it by putting it into hot water, drops of nitro-glycerin may escape from the cartridge and settle to the bottom of the can. If the can should be subsequently used over a fire an explosion will result. The best plan is not thawing, but keeping it from freezing by storing it in a room having a moderate temperature. But when frozen, a good method of thawing is to place sufficient cartridges for the day on a shelf in the top of a warm room.

Miners often carry them in their boots or in the pockets of their woolen shirts till they are thawed.

Numerous forms of special thawing apparatus have been invented. An improvised apparatus which answers a good purpose is a tin or copper can set inside, but without touching the sides or bottom, of another vessel containing hot water, the whole covered.
The above cut represents a thawing apparatus, consisting of two zinc vessels, one inside of the other, the interspace being filled with hot water, having a temperature of about 100° Fahrenheit to supply the heat for thawing. In order to maintain the temperature, the whole apparatus is sometimes placed in a double-walled box, the space between the walls being filled with sawdust or some other non-conductor of heat.

This cut represents a portable thawing furnace for dynamite which was used during the construction of the Northern
Pacific Railroad. It consists of a chamber containing wire shelves to hold the cartridges, which are kept from touching the sides of the chamber by stops or shoulders at the ends of the shelves. The chamber is surrounded by a water jacket, and underneath the whole is a small furnace to heat the water. The water space has a vent on top for steam and a faucet near the bottom for emptying. In using the apparatus be sure the jacket has water in it. To use it without water in the jacket is very dangerous. Use a moderate fire. It is not necessary to boil the water. Be sure that any nitro-glycerin which leaks out of the cartridges is cleaned up each time the chamber is charged with a fresh lot of powder. Be careful and follow directions exactly.

To avoid accidents we give a short chapter of

"DON'TS."

Don't roast your cartridges before a fire.
Don't attempt to thaw them in any vessel without a water jacket.
Don't put them on hot brick work.
Don't put them in your stove oven.
Don't thaw them in hot water.
Don't store caps with the powder.
Don't cut your fuse too short.

COMBUSTION AND DETONATION.

When Hercules Powder is set on fire in any ordinary way it generally burns without exploding. The gases evolved by this combustion are different from those produced by detonation. The gases produced by the combustion of nitro-glycerin are carbonic acid, water, carbonic oxide and hyponitric acid. The last two are noxious—carbonic oxide is an active poison, the other is irreparable and throat rasping. In addition to these a certain amount of nitro-glycerin vapor is produced, that is, some nitro-glycerin is volatilized by the heat without burning.

The gases evolved by a perfect detonation of nitro-glycerin are carbonic acid, oxygen, nitrogen and water. If the detonation is imperfect, we have what is sometimes called an "explosion of the second order," that is, part of the charge will be burned and some noxious gases will appear, together with
the vapor of nitro-glycerin. The presence of this in the air of the drift causes the miner's headache.

To insure a perfect explosion we insist upon the importance of using primers, so that the exploding cap may be properly adjusted; also, that the primer be put in last on the top of the charge, and that the charge be properly tamped. Moreover, beware of using weak caps. They are a delusion and a fraud. We have to carry them to supply the demand, but we do not recommend them.

GUNPOWDER AND HERCULES COMPARED.

The chief elements in the effectiveness of an explosive used for blasting are three: First, the volume of gas produced. These gases are evolved at a high temperature and under enormous tension. The volume is supposed to be measured, however, when the temperature has been reduced to the freezing point of water, and the temperature of ordinary atmospheric pressure. Second, the heat generated in the explosive reaction. This is expressed in heat units or by the amount of water which can be raised one degree in temperature by the heat. Third, the period of time covered by the evolution of the gases. The relative importance of each of these elements varies in different cases, depending upon the nature of the work.

In a general sense the effectiveness increases with the first two elements and decreases with the third. That is, an explosive will be more effective in blasting as the volume of gas and heat are greater and the time is less.

Here are a few comparisons. The figures given are the results of careful calculations—not wild guesses. Those for gunpowder are true for a certain average composition: those for Hercules are for our regular grades:

Nitro-glycerin gives 100 per cent of its weight in gas.
Hercules No. 1, 70 per cent, gives 89 per cent.
Hercules No. 1**, 50 per cent, gives 78 per cent.
Gunpowder gives from 40 to 50 per cent.
One pound of gunpowder will produce about 4.6 cubic feet of gas.
One pound of nitro-glycerin, 11.42 cubic feet.
" " Hercules, 70 per cent, 10.93 cubic feet.
" " Hercules, 50 per cent, 9.20 cubic feet.
The heat of exploding nitro-glycerin is 1483 units. That is, one pound of the explosive would raise the temperature of 1483 pounds of water one degree centigrade.

The heat for one pound of Hercules, 70 per cent, is 1190 units.

The heat of gunpowder is about 630 units.

A further comparison can be made to the advantage of Hercules:

The gravimetric density of grained gunpowder compared with water is 1.

The density of nitro-glycerin is 1.6.

The density of Hercules in the cartridges is 1.4. We could make it more, but that is all the paper cases will stand. When properly rammed in the drill hole, its density is 1.6.

When a charge of gunpowder is fired in a drill hole, the volume of gas produced is about 287 times the volume originally occupied by the powder.

When a charge of tamped Hercules, 70 per cent, is fired in a drill hole, the volume of gas produced is 1093 times the volume occupied by the charge.

The third element of effectiveness, time, is of great importance in certain kinds of work. In breaking boulders and masses of iron by surface blasting, in hard rock and tough iron and copper ore, quick action is essential.

In the case of gunpowder, the period of time covered by the evolution of the gases depends upon the size of the grain. The velocity of combustion in the open air is about half an inch per second. If the grains are about one-tenth of an inch in diameter, since the burning is from all sides, the evolution is complete in about one-tenth of a second. Since the velocity of combustion increases with the pressure, it is much greater than this in the bore hole and the time of burning much less, probably less than $\frac{1}{10}$ of a second.

In the case of Hercules or other dynamite, the explosion is not instantaneous, as generally believed, although it is very rapid. The velocity of the detonation has been measured and found to be about 15,000 feet a second. The actual period will depend upon the length of the charge. If it occupies just one foot in length of the bore hole, the detonation will be complete in about $\frac{1}{15000}$ of a second.
MATERIALS AND IMPLEMENTS FOR BLASTING.

Cartridges.—In all cases we recommend cartridges. They are easy to handle and ready for use, and to prevent waste they are closely sealed, in form as in Fig. 1, a. The regular sizes, always on hand, are 8 inches long, \( \frac{3}{4}, \frac{7}{8}, 1, 1 \frac{1}{8}, 1 \frac{1}{4}, 1 \frac{1}{2} \) inches in diameter, but we can furnish, at short notice, any size required. Packed in cases of 10, 25 and 50 pounds each.

We claim to make the most uniform powder as to density, in the market, but we do not guarantee a certain number of cartridges to the case.

We give exactly 10, 15 or 50 pounds to the case—not a certain number of cartridges.

In ordering, be careful to specify both grade of powder and size of cartridge.

Cartridges of the right size are preferable, but you can load the largest hole with the smallest cartridges by slitting them on the side, as in b, and pressing them down in the drill hole with a wooden tamping rod.

Caps.—The regular caps manufactured for exploding Hercules Powder are the best and most reliable; they are very strongly charged with fulminate. Packed in tin boxes, 100 caps each.

Fuse.—The best is the cheapest and as the Hercules is often used under water, the water employed for tamping we recommend, the best double tape for regular use, though triple tape may be necessary in exceptional cases. Single tape may be used where you know your ground is dry. Packed in cases of 3000 and 6000 feet each.

The fuse should fit the cap tightly.

We supply fuse that accurately fits the cap.

Hemp fuse should not be used, because it will not fit the caps, and because it will “spit fire,” and may burn some of the powder without exploding it.

Tamping Rod.—A hard-wood rod should always be used for tamping; first, because it is the best implement to press your powder close to the bottom of the hole; second, it is suf-
ficient for all practical purposes of tamping. There are some persons foolhardy enough to think that a charge of powder is not sufficiently tamped until one holds an iron tamping rod and another strikes it with a sledge ‘to settle it.’

**Nippers.**—Nippers made for the purpose are the best to use for securing the caps to fuse, but in their absence the open end of the cap should be pressed tightly to the fuse with the blunt edge of a dull knife—miners nearly always have a dull knife.

**Tubing.**—In submarine blasting, a thin metal tube is sometimes used to guide the cartridges into the drill hole.

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**DRILLING.**

Lay out and drill your holes with common sense. We only recommend that they be not over two-thirds the diameter required for black powder.

In many cases two men can be drilling two holes, single hand, instead of both working on one.

**Why waste your time in drilling a large hole when one of half the size is better?** Time is money; save it. Adapt the size and depth of your hole to the work you wish to accomplish.

Do not waste your labor or your powder by putting a small quantity in a large, deep hole; or a large quantity in a shallow hole. We repeat, use good sense and judgment.

**Hercules Powder will perform wonders but not miracles.**

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**CHARGING.**

The powder must be packed close in the bottom of the hole. Select cartridges of the right size, if you have them, but if they are too small, slit them on the side as shown in Fig. 1, b. There is no danger in cutting into the powder. It is better to cut the small sized eight-inch cartridges into three sections, and the larger ones into two sections. They can thus be better pressed to the bottom of the hole with your hardwood rammer, and will bulge out and fill the entire space. (See Fig. 2.)
If the holes are filled with water it is better to use cartridges that are the right size for the holes, and press them down tightly without cutting them. The No. 1 is best for water blasting.

**In all cases you must pack it close in the bore hole.**

**PRIMING.**

We recommend the use of primers as surest to explode your charge with. Make your primers fresh as you want to use them.

**To make a primer.**—Cut off a piece of fuse the length required; this insures fresh powder at the end to go in the cap—cut square across. The fuse should be **the exact size to fit the cap**, but if it is too large it must be pared down a little, so as to fit. If it is too small, wind it with paper till it will fit. Now insert the fuse in the cap and press down the open end of the cap on the fuse tightly. This can be done best with cap nippers, as shown in Fig. 3, or with the blunt edge of a dull knife. The fuse and cap are now ready.
Now cut off a piece of cartridge, say, two inches long, insert the cap end of fuse in it to the depth of cap—no more—see that the powder is pressed around the cap, now draw the paper close around the fuse and tie securely with a string, as in Fig. 4.

![Fig. 4](image)

In cases where whole cartridges are required they may be attached as in Fig. 5.

If the primer is to be used in water, care must be taken before inserting the capped end of fuse into the powder, to make it water-tight at the juncture of the cap with the fuse, with white lead, grease, tar, or otherwise.

Now press the primer down upon the charge, as shown in Fig. 6, and you are ready for tamping.

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**TAMPING.**

In deep holes, water is a good tamping. "**But shall I tamp with Clay or Sand?**" asks the miner. *Yes! as much as you please.* The better the tamping the better the execution. Fill in for an inch or two carefully so as not to displace the cap and primer, then with your hard-wood rammer, pack as solid as you please, ramming it with your hand, not with a sledge.
GRADES OF HERCULES.

We make seven regular grades of Hercules, forming the best schedule of graded energy ever offered to the mining public. The different grades are intended for work of varying degrees of intensity. No. 1 is suitable for the hardest and toughest rocks and ores, for breaking boulders and cast iron by surface blasting, and for submarine work on account of its immunity to the action of water. No. 2 has a very wide application, being the most economical for average blasting. No. 3 finds its functions in the more brittle rocks in which a comparatively slow action is most effective. The seven regular grades are as follows:

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<tr>
<th>No.</th>
<th>Containing</th>
<th>70 per cent Nitro-Glycerin</th>
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<tr>
<td>1*</td>
<td>60</td>
<td>&quot;</td>
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<tr>
<td>1**</td>
<td>50</td>
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<td>2**</td>
<td>30</td>
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<td>3</td>
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BANK BLASTING.

You may find some soft shaly rock or mixture of rock and earth, where none of these powders will work to advantage. For instance, you may wish to take very heavy burdens with
deep holes. Let us suppose you have such a case. The face of the bank is fully twenty feet high, and you wish to set your holes fifteen or sixteen feet back to keep from blowing out in front and losing the effect of the powder. Now drill several holes parallel to the face, about eight or ten feet apart. In the bottom of each one, without tampering, explode—say one and a half pounds of Hercules No. 1. This will chamber a hole in the bottom of each, large enough to put in four or five kegs of common black powder, or two-thirds as much of our Champion; either will give you a good blast. Tamp the holes well and fire them simultaneously with a battery.

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**SUBMARINE BLASTING.**

When blasting is to be done under water, the best examination possible should be made and the holes drilled with the same judgment as in other work.

Clear the hole of drillings and insert a long metallic tube nearly to the bottom. With a long rod that will nearly fill the tubing, press the cartridges down, one by one, and pack them close in the drill hole till your charge is complete, then put down your primer and fire. Hercules No. 1 is the best for this work. Leave the cartridges uncut. If the charges are in very deep water it is best to use a battery and leading wires instead of fuse. Under great pressure the water will penetrate the fuse.

It is difficult to make fuse that will withstand the pressure of more than twenty feet of water.

Details of other methods can be furnished on application at our office.

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**BLASTING BY ELECTRICITY.**

The use of Batteries for exploding several holes simultaneously has now become of frequent use in large quarrying, mining, and engineering operations, and has been employed to great advantage with Hercules Powder.

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**BLASTING BOULDERS AND MASSES OF IRON.**

Hercules Powder No. 1 is the best agent known for blasting boulders and heavy masses of iron.
For large round boulders, the best way is to drill a small hole with a single hand drill, a few inches deep; a small piece of cartridge fixed like a primer is sufficient for a boulder or block hole in a quarry.

In breaking iron we have seen a heavy casting, on which two men had spent an entire day with heavy sledges, without having made a fracture, broken into pieces with two medium-sized cartridges, covered with sand and exploded on the flat surface of the casting.

In this way, also, many boulders can be broken when you can get a flat side to work on, or a crack or crevice to press the powder in. In the latter case, fill with clay or mud all but sufficient room for the powder—then put a few shovelfuls of clay or sand on the powder. In breaking tough boulders by surface blasting the main point is this, the rock must not be free to move under the blow. Therefore, do not put the powder on the side unless the boulder is firmly blocked on the opposite side. If it is on soft ground you cannot easily break it—the ground will cushion the blow. Never put the powder underneath a detached boulder. It will be tossed in the air but will not be broken. The most favorable case is an oblong boulder, flat on top and firmly supported at the ends, but unsupported in the middle. A small charge will break it. The same principles apply in breaking heavy castings.

When blasting "salamanders," it is better to drill holes of sufficient size and depth: but for castings flatten the cartridges and press the powder close on the place you desire to break, then cover with a few shovelfuls of fine sand.

Blasting in cities and towns, and near where there are a large number of workmen, is much safer with Hercules than with gunpowder, as the fragments are not thrown so far.

**MISSED SHOTS.**

You may have a missed shot. This may happen from defective fuse, from pulling the fuse out of the cap, from pulling both fuse and cap away from the primer, or some other cause. If you have a missed shot, never attempt to drill down to the charge, but scrape out the tamping to within five or six inches of the powder, put in a short piece of cartridge and a fresh primer and fire it. This will explode the charge below.
The following cut represents

A HARD HEAD BOULDER
6 ft. long, 5 ft. wide, 5 ft. deep, estimated to weigh 6 tons, before four ounces of Hercules No. 1 were exploded in it; and this cut,

THE FRAGMENTS AFTER EXPLOSION.
BLASTING HARD WOOD STUMPS.

Hercules Powder is used to great advantage in taking out hard-wood stumps from land, tearing to pieces snags and roots in rivers, and shattering sunken wrecks.

In removing stumps a suitable bar should be provided—one with a chisel-shaped edge is best, as shown in Fig. 7. With the bar find the best place to get under the center of the stump, and as close up to the solid part as possible. The up-hill side is best as it offers most resistance.

Place your charge close against the solid wood, put in the primer, and tamp as solid as possible with mud or clay.

The tamping must be well done or you are liable to lose both labor and powder. Fill the entire hole that you have made.

We recommend the No. 2 and 3 grades for this work.

This method is much superior to pulling them with stump machines, and it not only takes the unsightly things from the ground, but it splits them up so it is easy to burn them. Whereas, if they are pulled with a machine you have so many elephants on your hands that you don’t know what to do with.

Besides your work is rapidly done, while the process of digging them out or pulling them with a stump machine is slow and tedious.

SOME INSTRUCTIONS FOR BLASTING HARD-WOOD STUMPS WITH HERCULES POWDER.

A hole should be made under the stump with an iron bar or auger—a 2½-inch auger with a long handle, say five feet, being much the best for the purpose. The hole should be so made that the powder can be put under the center of stump as near as possible. If there is a tap root, it would be well to bore into that; if the powder is put on the side of the tap root it would be likely to blow out that side and leave the other in the ground. If more than one cartridge is required, put them in before you put in the primer; if less, cut the cartridge and take what you want; tamp with dirt, clay, or anything handy.

The amount of powder required will be determined entirely by the size and condition of the stump—a little expe-
rience will enable one to determine very nearly how much will be required—it is always better to get in a little too much than not enough; in the latter case the stump will not be blown out and your powder and time will be partially wasted.

For **soft-wood stumps** or **very large** stumps of any kind, Hercules Powder is not suitable. For these **Champion Powder** is the best agent.

For splitting **hard-wood logs** Champion is also suitable.

For splitting **large, soft-wood logs**, such as redwood, even this is useless, being too quick for the work. In this case, black powder is the only thing that will answer.

**FUSE AND CAPS.**

The **California Powder Works** have fuse manufactured for them of accurate size to fit the exploding caps. It is guaranteed to be of especial superior quality and consists of **Single, Double, and Triple** taped. We recommend the double tape as the most suitable for all work except submarine blasting, for which Triple tape is required. Double costs more than single tape, but you are much surer of your blast.

We are also constantly supplied with **Caps**—Especially for exploding Hercules Powder. They consist of **XXX, XXXX, XXXXXX and Lion Caps**.

We recommend the XXXX for ordinary use.

**HISTORICAL.**

Reviewing briefly the history of Nitro-glycerin powders, we find that Nitro-glycerin has been known since 1847—the date of the discovery by Sobrero. Its career of usefulness did not begin, however, for nearly twenty years. As a mining agent its energies remained latent until Nobel discovered that these could be excited at will by the fulminate cap. This was the first of Nobel’s great achievements. The “ideal portable force” was harnessed thereby, if not subdued. Its complete subjection was attained by the invention of dynamite or Nobel’s Safety Powder, which followed soon after in ’68. This was made by absorbing the liquid in a porous earth found in various parts of the world, and known as Kieselgühr, in Hanover, where it was first used.
This powder was introduced into this country under the name of Giant Powder. It still remains a favorite in Europe and many other countries. It is scarcely used at all in the United States—the Giant Powder of the present being quite a different preparation. It has been driven out of the market by American products. It is a curious and interesting fact that a powder which has held its ground for general work against all comers in Europe, should die an early death in the American market. It cannot be said that its claims were not properly supported. It had the prestige of Nobel's name, and was exploited by a powerful and energetic corporation. The fact of its early decadence can be easily explained. It was not fashioned upon American ideas. In Nobel's dynamite the absorbent being inert, the force is entirely dependent upon the amount of Nitro-glycerin present. The range in grades is very limited—from seventy to seventy-five per cent of Nitro-glycerin, and at the time of its introduction, the liquid was very costly.

The American inventor realized that between black powder and Nobel's dynamite there was a great gap to be filled with graded explosives, to obtain the greatest economy in blasting. The first step in the way of improvement was the use of meal gunpowder as the absorbent. This was found to absorb and cushion a smaller percentage of Nitro-glycerin, while contributing materially to the explosive-strength. Moreover, it was found that the mixture developed a greater force than the sum of the forces of the two elements fired separately. In other words, the gunpowder mixture was detonated by the Nitro-Glycerin. This principle is the cornerstone of modern American dynamites, though still scarcely recognized in Europe. The late Henry S. Drinker deserves the credit of being the pioneer demonstrator of this. Vested and important interests upheld the contrary view, and it required some courage to prove a theory which had been denied by Mowebray, Trauzl, André, Hill and others.

The gunpowder principle, a carbonaceous element on the one hand and an oxidizing element on the other, has since been embodied in a great many mixtures, better adapted to the purpose of absorbing Nitro-glycerin than gunpowder itself, while they are even cheaper.

Nitro-glycerin, the most costly ingredient, serves as the detonating agent to develop the latent energies of these added substances.
This, then, is advanced American practice, and it extends to the use of very small percentages of Nitro-glycerin, even five per cent serving to make an explosive very much more powerful than gunpowder [although costing less].

Between the development of high explosives for blasting purposes in Europe and America there is a great contrast.

In Europe there has been no competition worthy of the name. Governmental restrictions have served as efficient barriers to enterprise, and the manufacture has remained in the hands of a few rich and prosperous corporations. Prices have been maintained at high figures, and there has been little or no incentive to produce cheap powder. The direction of invention has been rather to introduce, besides Nitro-glycerin preparations, other agents (which could not live in the American market) or to develop the maximum energy of the former. In America, on the contrary, the competition has been keen, sharp, bitter. Legal decisions early opened the field to all by destroying the only persistent attempt at monopoly. American enterprise (another name for rashness where dynamite is concerned) which bids men rush into a business whether they know anything about it or not, has done the rest.

Almost every consideration has been forced aside for this, viz.: to produce bottled energy at the lowest possible cost.

While Europe has been aiming at maximum strength, we have been inventing "low grades." While Borland, in England, discovers an absorbent capable of holding ninety per cent of Nitro-glycerin, and Nobel, on the continent, converts ninety-four per cent into a hard jelly with six per cent of Nitro-cellulose, we have been perfecting mixtures which will detonate with five per cent or less. Both are great achievements but in opposite directions. European improvements upon dynamite cost more than the original explosive, while the chief object in our modifications has been to lessen the cost per unit of energy.

We venture to declare it to be a fact in the history of mining, that for the last ten years the cost of powder in the United States per ton of material removed has been less than half the same cost in Europe.

Capitalists have sometimes made a great mistake. Not realizing the condition in America, they have transplanted European products to our ungenial soil, only to see them sicken and die in the struggle for existence. A striking exam-
ple was the failure of "Tonite," brought to this coast from England where it still flourishes.

In America there is only one criterion, the cost per unit of energy, and in this regard American explosives are unapproachable.

**SOME REFLECTIONS UPON POWDER-MAKING.**

The facts we have cited speak well for our methods, and we have no desire to detract one iota from the credit due to American enterprise and inventiveness in which, in fact, we ourselves have borne an honorable share. On the contrary we give honor where honor is due, but the picture has also its dark side for the manufacturer. Powder-making is at best a hazardous business and one which deserves a corresponding profit. Explosives have characteristics which demand considerations as well as the one which has been made pre-eminent in America. These qualities should contribute to safety in handling, uniformity and reliability in action, freedom from poisonous fumes when exploded, and keeping qualities in storage.

Conservative practice in powder-making requires all of these points to be considered. In the fierce competition to supply the miner with bottled energy at the lowest possible figure, some of them are apt to be lost sight of.

The progress of invention and experiment has accumulated an almost limitless list of substances capable of being utilized in the manufacture of this energy. With such a variety of materials to choose from, the temptation to use, without further investigation, the cheapest which will satisfy the energy requirement, is very strong. Some of the materials need refining or purification. The temptation to omit or slight this preparation, if the omission does not noticeably affect the strength, is very strong. Some of the materials differ in grades. The temptation to use the cheapest grade, although it is more or less incompatible with the keeping qualities of powder, is also very strong.

Conservative powder men hold that a certain series of operations in the manipulation of the ingredients by skilled workmen is essential to success in making good powder. The temptation to omit or slight these operations, provided that the energy test is not lessened by such omission, is also strong.
The manufacturer may be supposed to indulge in thoughts like these: "Powder is short-lived anyway. It is of few days and has more or less Nitro-glycerin in it. It lies a short time in the magazine, then goes to the mines and is exploded. The sins of a poor powder are then washed away. It gets no chance to show its good or bad qualities. Then why take so much trouble about it?"

In showing the tendencies of excessive competition, we must not be understood as attacking our competitors. We have no quarrel with them and no charges to make. But the object of this pamphlet is to present the claims of Hercules Powder and this we do without fear or favor. An explosive which has been before the mining public for twenty years must establish a reputation, good, bad, or indifferent. Moreover, if made upon conservative principals, it must attain a certain individuality. The miners' nickname for Hercules, "Old Reliable," is one which we accept with good grace.

Having set up a certain standard of excellence and maintained it for twenty years, we may be excused for telling something in a general way about our methods. We have tempered progress with conservatism. While keeping abreast of the times, we have not used the miner as a patient to try our new nostrums upon without his knowledge. When we have experimented it was with his help and consent. We have never acted on the theory that the miner could not detect the absence of a few per cent of Nitro-glycerin or the presence of this or that material. We have assumed that if the powder differed in any way the miner would know it, though he might not know the cause of the change.

While anxious to produce powder at the lowest possible cost, quality has been our first consideration. Competition has never driven us into making cheap powder or making any change whatever in our methods or materials. Our works are under the most careful superintendence and our workmen are skilled in their art.

Our materials are always of the first grade, regardless of cost. We never omit any detail in the manufacture. We purify and refine every material which needs it. The gain in quality is often very slight, so slight that we cannot always expect the miner to appreciate it unless his experience is unusually wide. Still, there is a satisfaction in doing right whether we get the credit for it or not. Moreover, we have
had our reward in the record which Hercules has made. In freedom from accidents of all kinds in transportation, handling and use, this record is unparalleled. Though many million pounds of it have been put upon the market and used, no accident has ever happened that could not be traced to gross carelessness and disregard of instructions laid down for its use.

We trust that in the future, as in the past, we will be rewarded by the liberal patronage of the buyer and consumer.
CHAMPION IMPROVED

(PATENTED)

The best free running "low grade" Powder for Bank Blasting, Railroad and Canal building, Grading, Stump Blasting, etc.
TO RAILROAD AND OTHER CONTRACTORS, STUMP BLASTERS, Etc.

We invite your attention to our CHAMPION IMPROVED, which we are prepared to supply in any quantities, and guarantee SUPERIOR IN EVERY RESPECT to all other "low grade" powder.

This PERFECTED "Low Grade" Powder is the result of a series of careful experiments and tests. We are entirely satisfied our claim of superiority is well founded, and a trial will convince you.

REMEMBER THIS IS A FREE RUNNING POWDER

SEND FOR PRICES

AFTER THE BLAST.
AH THERE!

* *

All the STUMP PULLERS were tried on me and FAILED.

* *

BEFORE BLASTING.

CHAMPION
POMDER

My old Root still Stands
I'M ALL BROKE UP.

* *

AFTER BLASTING

* *

CHAMPION POWDER

DID IT.
STUMP BLASTING

***

Champion Improved

AND

Champion Powder No. 2

MANUFACTURED BY THE

CALIFORNIA . . .

POWDER WORKS

330 MARKET STREET

SAN FRANCISCO, CAL.

***

RAILROAD WORK
DIRECTIONS

1. Measure diameter of the stump.

2. In clay or hard-pan, use two to four pounds of Champion Powder to each foot of diameter.

3. In gravel, use three to five pounds to the foot diameter.

4. In loamy soil, four to six pounds per foot

5. When stumps or trees are on a hill-side, work on them from the upper side.

6. Where stumps are solid, get the powder directly under centre of stump, and as close to it as possible.

7. If stumps are partially burned or decayed, sink your powder into the earth, under centre of stump, so the earth will give a better "purchase" on stump and roots (together).
GENERAL

Drive the hole directly under centre of stump or tree to be blasted, then "spring the hole" with a cartridge of Hercules Powder, so placing it that it will shatter and cut off the tap root (if there be any.) Into the "pocket" or hole, made by "springing," put the Champion Powder. Into that insert a cartridge of Hercules, with cap and fuse attached, tamp the hole carefully, light the fuse and "skip out," remembering that the fuse burns about three feet a minute. The stump will follow you.

REMEMBER

All Nitro-glycerin Powders freeze about 44° Fahrenheit.

All Low Grade Powders are damaged by moisture, or exposure to the air.

If Champion freezes on you, dump it onto a piece of canvas, or in a box, and crush it back to a powder with a stick or board. No danger in doing so, and 'tis easily done.

Hercules keeps best at a temperature of about 60° Fahrenheit. When it is soft, pasty, and free from lumps, it is ready for use.
CONCLUSION

Experience is the best of teachers, and common sense necessary to the successful blaster. Careful trials will prove The Champion the most economic explosive offered for Stump and Tree blasting.

In “pot holing” and “tunnel and drift” blasting, on railroad work, it has no successful rival.

Particular attention should be given to the storing of low-grade powders. Store them only in places that are perfectly dry, as all low-grade powders are seriously damaged by moisture or exposure to the air.

Reports are sometimes made that the powders burn instead of exploding. In nine cases out of ten this is caused by bad storage and the absorption of moisture. We ask our friends and customers, when Champion Powder fails, to send a pound sample to the agent from whom the powder was purchased, that we may test the same, and see wherein the fault lies.

REMEMBER
All nitro-glycerin powders freeze at about 44° Fahrenheit.

CALIFORNIA POWDER WORKS
330 Market St., San Francisco
HERCULES POWDER

NO FUMES......NO HEADACHE

Black Blasting Powder and Sporting Powder

....FROM....

Celebrated Mills at . . .
Santa Cruz, Cal.

CAPS AND FUSE

FOR SALE BY

CALIFORNIA POWDER WORKS

330 MARKET ST, S. F.
CATCH ON TO THIS

HERCULES SLAYING THE GIANTS

We Knock 'Em All Out.

THOMAS PRICE.....

CHEMICAL LABORATORY

Assay Office, Bullion Rooms, and Ore Floors

524 SACRAMENTO STREET, SAN FRANCISCO