Huelva mines, so that they have practically been idle for fourteen centuries, for the little that was done during the last and the first half of this century can hardly be taken into account. The first great impulse was given by the foundation, between 1866 and 1875, of large foreign companies.

The mines began to be thoroughly opened out, railways were constructed to the Port of Huelva, and magnificent shipping piers were built in the river. Other companies then followed, and a period of great activity set in, completely altering the aspect of the province and of the port.

The copper pyrites, or cupreous sulphur ore, composed of about 48 per cent. sulphur, 44 per cent. iron, and 3 per cent. copper, is the principal ore mined in the district, and contributes very considerably to the copper production of the world. By far the greater part is sent to Great Britain, although large quantities are sent to Holland and Germany; France and the United States are also consumers, and a small quantity goes to Denmark. British vessels convey nearly all the copper pyrites, but a good many cargoes have been shipped to Germany in German steamers. The pyrites sent to the United States is of the poorer class, containing about 1½ per cent. of copper only on the average, and is shipped principally to Philadelphia and New York. The ore is also partly treated at Huelva by smelting, which produces the regulus, containing about 30 to 40 per cent. of copper, and by precipitation on to pig iron in large tanks, giving cascade or precipitate with 60 to 95 per cent. of copper, according to treatment. The iron pyrites is what is called pure—that is to say, it contains 44 per cent. of iron and 52 per cent. of sulphur, but no copper, and it is extracted from one mine only. Besides the considerable quantities shipped to Great Britain, there is a large consumption in France, Germany, and the United States. It is, as a rule, friable, and not hard and compact like copper pyrites. Manganese has been exported in larger quantities recently, but the low price still keeps a great many mines closed. It is very generally distributed over the mining district of the province, and is of a good quality. Neither quicksilver nor lead are products of Huelva, the former coming from the famous mines at Almaden and the latter from the Linares district. They are shipped direct to London.

DIMENSION STONE QUARRYING—THE BLASTING PROCESS.*

QUARRYMEN have, ever since the introduction of blasting, tried to direct the blast so as to save stock. Holes drilled by hand are seldom round. The shape of the bit and the irregular rotation while drilling usually produce a hole with a triangular section. It was observed many years ago that when a blast was fired in a hand-drilled hole, the rock usually broke in three directions radiating from the points of the triangle in the hole. This led quarrymen to look for a means by which the hole might be shaped in accordance with a prescribed direction of cleavage.

As the Portland quarries, in Connecticut, the oldest in the country, were carried to great depths the thickness of bed increased. With beds from 10 to 20 feet deep, all of solid and valuable brownstone, it became a matter of importance that some device should be applied which would shear the stone from its bed without loss of stock and without the necessity of making artificial beds at short distances. A system was adopted and used successfully for a number of years, which comprised the drilling of deep holes from 10 to 12 inches in diameter, and charging them with explosives placed in a lune-shaped canister made of two pieces of sheet tin, with sections, minor segments of a circle, soldered together and the ends filled with cloth or paper. Earth or sand was filled in around the canister in the drill hole, so the effects of the blasts were practically the same as though the hole was drilled in the shape of the canister. Straight and true breaks were made, although the system was expensive, as obviously a larger hole than necessary was drilled.

Another of the older systems of blasting is that known as lewisling. Two or three holes are drilled close together on parallel, the partitions between being broken down. Thus a wide hole or groove is formed, into which the powder is charged by being rammed down or in a tin canister the shape of the trench hole. This system is confined almost entirely to granite. Then again there was the well known plug and feather system, in which the plugs were driven between the feathers by the blast and the rock split. This process frequently resulted in irregular breaks and damage at the top of the hole. During all these years there was conspicuous waste due to the lack of knowledge of the influence of the shape of a drill hole on the effect of a blast. The system devised by Mr. Knox does all and more than was claimed for the old Portland canister system.

In the first place, in this system a round hole is drilled by hand or otherwise, preferably by a machine drill, as it is important that the hole should indeed be round. In sandstone of medium hardness these holes may be situated 10, 12 or 15 feet apart. Then the holes should be reamed out with an instrument made for that purpose, at least one and a half times the diameter of the hole. This is done to the bottom of the hole. When finished the hole resembles the shape of the Portland canister. Then the hole is charged with the smallest possible amount of slow-acting powder; dynamite is unsuitable. The cap should be inserted near the bottom of the cartridge. Then the tamping is put in, not directly upon the charge, as in most systems, but an air space is left between. The tamping should be placed about 6 to 10 inches below the top of the hole, and placed securely, so it will not blow out. The intervening air space may be filled with a wad of hay, grass or paper. The hole is now ready to blast. If several holes are on a line, they should be blasted simultaneously by electricity. The effect of the blast is to make a vertical seam connecting the holes, and the entire mass is sheared several inches or more. The following explanation of the rationale of the blast has been given: "The gas acting equally in all directions from the center is forced into the two opposite wedge shaped spaces by a force equally prompt and energetic.

All rocks possess the property of elasticity to greater or less degree, and this principle being excited to the point of rupture at the apices of the section of the hole, the gas enters the crack and the rock is split in a straight line, simply because, under the circumstances, it cannot split in any other way." The new form of hole is, therefore, almost identical in principle with the old Portland canister system, save that it has the great advantage of a shaped groove in the rock which serves as a starting point for the break.

It is also more economical than the Portland canister, in that it requires less drilling and the waste of stone is less. It is, therefore, not only more economical than any other system of blasting, but it is more certain, and in this respect it is vastly superior to any other blasting system, because stone is valuable, and anything which adds to the certainty of the break also adds to the profit of the quarryman.

The popular idea that the system is antagonistic to the channeling process is a mistaken one. There are, of course, some quarries which formerly used channeling machines without this system, but which now do a large part of the work by blasting. Instances, however, are rare where the system has replaced the channeler. The two go side by side, and an intelligent use of the new system in most quarries requires a channeling machine.

The first work done by this method was in 1885, and at the close of that year two quarries had adopted it. In 1886 it was used in twenty quarries, in 1887 in forty-four, in 1888 in upward of one hundred, and at the present time about three hundred quarries have adopted it. Its purpose is to release dimension stone from its place in the bed, by so directing an explosive force that it is made to cleave the rock in a prescribed line and without injury. The system is also used for breaking up detached blocks of stone into smaller sizes.

THE CENTRIFUGAL EMULSOR.

By MARTIN EKENBERG.

By the aid of this machine uncongenial fluids, as for instance oil and water, may be caused to mix mechanically most intimately. In consequence of its continuous work and productive power, the emulsor substitutes most satisfactorily stirring or other means of bringing about a mixture used in the tar industry, soap manufacture, etc. For the benefit of those who do not know the emulsor, I will describe it before entering upon the experiments I have made with it.

The apparatus is very simply and substantially made, and easily managed when in use; it consists of

CENTRIFUGAL EMULSOR IN SECTION.

two massive plates, turned toward each other, and fastened upon a vertical axle (see figure). The plates rotate with a rapidity of 6,000 to 7,000 revolutions per minute. The opening between them may be increased or diminished from 0.05 mm. to 1—2 mm. By the size of this opening the grade of oil in the emulsion is regulated. If the opening be small, 0.05—0.01 mm., a very fine emulsion is produced—for instance, from olive oil and water. In this case the oil globules are much smaller than those in milk. From such an emulsion the fat is separated by gravity within 20 to 25 minutes, but if the water be alkaline, the emulsion remains for a longer period. A larger opening produces a less fine emulsion, which separates itself in much shorter time, say in 2 to 3 minutes, if the opening be 1 mm. The quantity produced is in proportion to the size of the opening, and varies from 300 to 2,000 liters per hour. Previous to the making of an emulsion all mechanically introduced hard and coarse particles which cannot pass through the opening must, of course be separated by filtering. Emulsions containing as much as 40 per cent. of oil may be made, even up to 50 per cent. of certain oils. On the other hand, one may mix 5, 10, or even 30 per cent. of water with the oil; consequently there is a limit for the emulsive process in reference to the quantitative proportions of the mixtures. Emulsions of water in oil become valuable when small quantities of salts or other agents in solutions of water are desired to act on the oil. The consumption of agents may in this way be reduced to the smallest possible quantity. Emulsions of water or salt solutions in oil made by the emulsor have several interesting qualities, of which I hope to speak further in a future article. The emulsor may be used either in an ordinary separator frame with a pulley (see figure), or else in a steam turbine frame, the latter being the most handy, as the machine will work simply by turning a steam valve.

The plates of which the emulsor consists are made from strongly tinned Swedish iron, or from iron with a preparation of antimony and lead, or from acid-proof bronze: which material will be chosen depends upon the purpose for which the machine is intended. The plates may easily and inexpensively be replaced by new ones when worn out, which can only take place after a long and continuous use. Should they become rough from the action of acids, etc., they may simply be ground and tinned with antimony and lead, which will render them equal to new; and this operation may be repeated a great number of times on account of their extreme massiveness. Emulsor plates of Swedish iron are always used for acid emulsions in cases where small quantities of iron in the cleansing water do not harm the product. When used for alkaline

emulsions and washings with water, the plates will prove to possess great durability.

All other parts, frame, etc., are equally solid and constructed on the same principles as the "Alpha" milk separators.

The following is a brief account of experiments made by me for the purpose of ascertaining the fitness of the machine for the object intended, namely, intimate mixing of uncongenial liquids. The experiments are made with quantities varying between 50 and 300 kilogrammes.

SERIES A.—Washing away of Free Mineral Acids from Oils and Fat.

From Olive Oil.—To common machine oil I added 5 per cent. of sulphuric acid of 1.50 specific gravity, and mixed this sour oil in water in such a way that emulsion of about 20 per cent. of oil was obtained. The opening between the emulsor plates was about 0.1 mm. The emulsion separated itself in 10 to 15 minutes. After one more washing with fresh water the oil was free from acids, which was tested with litmus paper, after having shaken the oil with warm distilled water. The oil was at first not clear, owing to the presence of air bubbles and drops of water, which all disappeared after the oil had stood for 24 hours undisturbed. One part of the oil was obtained free from water and air immediately, by filtering through newly burnt sulphate of lime.

The oil may be separated easily from the washing water with a receiver constructed on the principle of the Florentine flask, and capable of holding that quantity of emulsion which is made in the time required for the oil to separate itself from the emulsion.

The washing water contained in the above mentioned cases a small number of minute particles of oil; these could easily be collected in either of the following ways:

1. By filtering through cotton wool and boiling the wool in water, when the oil rises to the surface.
2. By leaving the washing water undisturbed for about 48 hours, when all the oil will float on the top.
3. By mixing more olive oil with the washing water and using a large opening. The large oil globules hereby produced brought the smaller ones with them to the surface and a clear washing water remained. This way of separating minute particles of oil from the washing water is very effective; even from alkaline washing water all oil could be reclaimed by using mineral oil.
4. By centrifugal power in continuous oil separator with the same rapidity as the emulsor.

As I have shown, there was no difficulty in extracting the whole of the oil from the emulsion.

At a repeated experiment with olive oil, when 5 per cent. of sulphuric acid of a specific gravity of 1.84 was used, all free sulphuric acid was washed away in two washings, one with warm and one with cold water. In this case, however, the oil was strongly affected by the acid.

From Tallow.—Raw tallow was melted and about three per cent. of nitric acid was mixed into this. After two washings with water I got a pure, light, acid-free product. When the tallow had separated itself from the emulsion all cell fragments, etc., stayed underneath the pure tallow as a well defined layer. This way of separating membranes, loosened by the action of the acid, seems to come in very handy for refining tallow.

From Mineral Oils.—In a lubricating oil of a brownish color I mixed 5 per cent. of sulphuric acid of 1.84 specific gravity. The oil was then washed twice with water; the first washing water had taken up much coloring water. After a third washing with concentrated solution of caustic soda, I got an oil which had only a slight yellowish tint.

In another experiment I took raw vaseline from Galicia, melted it, and with help of the emulsor I mixed into it about 5 per cent. concentrated sulphuric acid and some chromate of potassium, washed the vaseline with warm water, and then filtered it through a layer of bone black 10 cm. thick (to get rid of carbon particles and newly formed brown coloring matter), and by this process I got an almost colorless vaseline.

SERIES B.—Washing away of Free Fatty Acids from Oils.

From Olive Oil.—I mixed the oil with water containing 0.5 per cent. of caustic soda. The oil extracted from this emulsion was then washed in clean water and lastly in water with some sulphuric acid. After this process the oil was free from fatty acids.

Out of the first washing water, which contained soap, a liquid fat consisting principally of fatty acids separated itself when acid was added.

From Hemp Oil.—This oil was treated in the same way, and was also made perfectly free from fatty acids.

SERIES C.—The Use of the Emulsor in Manufacturing Soap.

a. *Cocanut Oil* was mixed with a strong solution of caustic soda. This emulsion, already containing a great deal of fat in a saponified condition, yielded immediately on boiling a homogeneous soap.

b. *Cocanut Oil* was warmed up to about 110° C. and then mixed with a solution of caustic soda at boiling point. The result was a liquid containing a number of gas bubbles, which caused an opalescence and hardened when cold. On examination it was found to contain no free fat, so that a perfect and almost immediate saponification had been obtained.

Results of later experiments with the emulsor in saponification of fat with sulphuric acid, washing of tar, etc., I intend to publish at an early date.—*Chemical News.*

THE ELECTROLYTIC MANUFACTURE OF WHITE LEAD.

THE *Revue Industrielle* gives the following account of the process used at L'Usine Voad for obtaining lead white. In a solution of acetate of ammonium, lead bars are suspended with pieces of non-conducting substance at the cathodes, such as carbon. When a current of carbonic acid gas is passing through the solution, the acetate of lead is decomposed, the carbonate being precipitated; this is filtered and pressed. The filtrate is reconducted directly to the bath,

* Abstract from article by William L. Saunders, M. Am. Soc. C.E., in *Transactions* of that society.