Irrigating Arid Lands in the West.

The many thousands of square miles of land in the western half of the United States which can be profitably cultivated only with the aid of some system of irrigation are now becoming more and more each year the subject of careful investigation, both by the government and by private parties. So much of the readily available and ordinarily good farm lands of the public domain has already been taken up that prospectors in almost every section are finding their choice limited to making a selection in some place where more or less irrigation will be a necessity, with the promise of a good reward therefor, or the acceptance of a location where the disadvantages more than outweigh the want of a sufficient amount of water. The wonderfully productive lands of Southern California, where the rich soil is of such depth as to be deemed practically inexhaustible, and the climate is such that two and even three crops can be raised in a year, have been made available almost exclusively by irrigation, and there is no doubt that, over a large portion of the lands now arid, it needs but the efficient conservation and distribution of water flowing from adjacent mountain ranges to create areas of the highest productiveness.

With the view of promoting intelligent work on a general system, this matter has formed the subject of extended investigations by the United States Geological Survey, although it is not proposed that the government shall undertake to carry out irrigation projects at the public expense, further than by the allotment of lands which may be benefited thereby to the State governments making such improvements. A recent bulletin of the census office also gives details of what has been effected in the way of irrigation in Utah, where the system was first generally applied and has been longest in operation. In that Territory there was last year in crop an irrigated acreage of 263,473, about nine-tenths of the farms in the Territory depending upon irrigation in the cultivation of at least a portion of their land, the remaining tenth being either stock ranches or farms where the climate is less arid.

The average first cost of bringing the water to land in Utah is placed at $10.55 per acre, considerably greater than has been the case in most other localities, as the canals and ditches were generally laid out and made by farmers, without the use of surveying instruments, necessitating many subsequent changes. In some cases, however, the cost was below fifty cents an acre. In addition, a certain amount must be expended each year in maintaining the main ditches, cleaning out sediment, and often in renewing the dams and head works, this cost ranging from twenty-five cents up to three dollars an acre, the average being ninety-one cents. The average value of the products on small irrigated farms in 1889 was $19 per acre. It is estimated that the cost of preparing wild land for cultivation, including plowing, grubbing, cutting brush, fencing and leveling, averages $14.85 per acre; adding to this the Government rate of $1.25 per acre, and the first cost of $10.55 per acre for the water right, the entire cost to the farmer averages $26.65 per acre. In comparison with this, the estimated present value of the farms of the Territory, including buildings, fences and other improvements, is placed at an average of $84.25 per acre, showing an apparent profit, less cost of buildings, of $57.60 per acre.

From the main canals or large ditches the water is conducted to the farms by small laterals, and is commonly distributed in three ways—by flooding, by furrows, and by markings. Hay and other forage crops are flooded, the water being allowed to enter the field at its highest point, and find its way if possible in a thin sheet over the whole field. This method requires the greatest amount of water, and cannot always be used on account of the tendency of some soils to bake and form a hard crust. Potatoes, corn, vegetables, and all plants growing in hills or rows are irrigated by furrows, the water flowing therein gradually moistening the ground on either side. Grain is sometimes watered by flooding, but generally by marking off the ground, after the grain is planted the fields being sometimes rolled with a roller having annular projections, which make small grooves in the surface of the ground in such direction that there is a constant and gradual flow from one end to the other.

The use of flowing wells for the irrigation of gardens, orchards, and vineyards, and for domestic supply and watering stock, is also a feature of some importance in Utah. There are 2,524 of these wells, of which the census enumerators obtained particulars concerning 897, showing their average depth to be 145½ feet, and their cost $77.60 each, or 53 cents per foot. Their average diameter was about 2 inches, the flow of water averaging 26·37 gallons per minute.

The carrying out of any general scheme of irrigation necessarily involves considerations which have had but little influence thus far in Utah, where there is already more land under cultivation than there is water available to mature the crops in all years. Some large reservoir sites have been examined and segregated by the Government Geological Survey, with the view to most efficiently and at a moderate expense impounding the flow from elevated areas, the water thus collected to be supplied to large sections by a series of canals on different levels. Considerable work of this kind has already been carried out in California, where the returns generally show ample profit on the outlay, but the large areas of the country which invite this method of cultivation, with abundant promise of yielding large results, have hardly as yet been touched. For this task, simple farmers' ditches are totally inadequate, but competent engineering skill must be called upon to collect and distribute a material proportion of the immense supplies of hitherto unused water often coursing in destructive floods from our great Western mountain system.

The Belgian Firearms Industry.

In the course of a report on the trade of Belgium in 1890, Consul-General De Courcy-Perry remarks that the most important industry of Liege is the manufacture of firearms. There are over 180 gunmakers in the town alone, and in the district the industry gives employment to more than 40,000 workmen. The peculiarity of the Liege gun making is that there are hardly any manufactories, as we understand the term, the various component parts of the firearms being made by the workmen at their own homes and brought in ready-made to the gunmaker, who thus merely requires premises for finishing and storing the arms. It will be at once seen how the economy realized by no extensive plant nor costly workshops being required enables the Liege maker to compete favorably with the manufacturers in, in this respect, less favored countries.

The Liege proofhouse, which is a government institution, is the oldest and by far the largest in Europe, and probably in the world, and has lately been greatly enlarged and improved. Every firearm manufactured in Belgium has to be proved at the Liege proof-house before it is allowed to be sold (with the exception of certain arms that are allowed to be sent to a recognized proof-house, to Birmingham, for instance, to be proved), and the proofmaster, in addition to his ordinary duties, is specially delegated by the government to inspect and control all firearms made in the kingdom, with the exception of the military rifles made at the government factories, which do not pass the Liege proof-house. Every double-barreled rifle and shotgun has to be proved three times. First, each barrel separately; secondly, the two barrels when soldered together; and, finally, after the breech-action has been attached; and the charge of powder employed is considerably more powerful than that used at other proof-houses.

One of the great advantages arising from this triple proof is that each class of workmen has a direct incentive to only turn out, or accept, really reliable material, for no one who has worked upon the gun is paid for his labor unless the arm passes the three proofs satisfactorily. Thus, if the barrels burst at the first proof (viz., that of each barrel separately), the barrel maker loses the cost of his labor and material, for he is obliged to replace the burst barrels without any indemnity. Should the barrels burst at the second proof, it is not the barrel maker alone who suffers, but the solderer as well, who also loses the price of his labor, because he had not examined the pair of barrels carefully enough before working on them. If the gun bursts at the third proof, all those who have worked upon the gun, from the barrel maker upward, lose the benefit of their labor; and thus, as I have said, each class of workmen has a direct personal incentive to turn out a really reliable gun. Revolvers are only proved once, but each portion of the pistol is subjected to a rigorous examination, and any defective arm is at once rejected.

There are in Europe five proof-houses, viz., Birmingham, London; St. Etienne, in France; Fellah, in Austria; and Liege; but none of the others can at all compare in importance with the last, which consumes annually from 3,000,000 to 4,000,000 cartridges and over 40 tons of gunpowder.

Liege exported in 1889 firearms to the value of 724,440*l*., being 233,944*l*. in excess of the amount of those exported the previous year; and the importance of the Liege gun trade, as compared with that of England and France, will be apparent from the following table of comparison of the arms proved at Liege, Birmingham, and St. Etienne respectively:

FIREARMS PROVED IN 1889.

Firearms.	Liege.	Birmingham.	St. Etienne.
Single barrel	338,024	28,146	4,352
Double barrel	233,526	284,247	32,204
Cheap single barrel for exportation	34,557	155,079	—
Horse pistols (per pair)	20,070	3,481	1,033
Pocket pistols	13,907	—	—
Revolvers	452,098	29,850	3,152
Military rifles and barrels	32,249	28,245	—
Totals	1,124,431	529,048	40,741

It will thus be seen that the firearms proved at Liege amount to more than double those proved at Birmingham, and to nearly double those of Birmingham and St. Etienne together; and I anticipate, so great has been the increase during the past year, that when the figures are published, the firearms proved at Liege during 1890 will be found to amount to over 2,000,000.

PHOTOGRAPHIC NOTES.

Improvements in the Soda Developer.—A number of experiments conducted by the editor of the *British Journal of Photography* show that the addition of chloride of ammonia to the ordinary carbonate of soda and pyro developer will prevent the yellow staining of the negative, in fact acts as a substitute for sodium sulphite. The strength of the carbonate of soda solution is 15 grains to each ounce of water, even 12 grains to the ounce will do, to which is added 4 grains of chloride of ammonia. In mixing the developer a few minims of this solution, say 20 minims to 2 ounces of a pyro or eikonogen solution, will be sufficient, or more may be added to hasten development if needed. In some cases, it is advisable to add a half grain to the ounce of bromide of ammonium.

It is said to work well in connection with hydroquinone, but sulphite of soda should be present to prevent a slight yellow stain that is liable to occur.

Another modification is the use of caustic soda or potash.

The developer as applied to the plate is prepared as follows:

Pyro	6 grains.
Sulphite of soda	20 "
Caustic soda	6 "

or

Caustic potash	8 "
Chloride of ammonia	8 "
Water	2 oz.

To each ounce of solution one grain of bromide of ammonium should be added.

A Few Improved Developers.—From the *British Journal of Photography* we take the following formulas:

The Paramidophenol Developer, recommended as being energetic, keeps well and does not stain the film, introduced by A. & L. Lumiere.

Water	1000 parts.
Sodium sulphite	200 "
Sodium carbonate	100 "
Paramidophenol	12 "

Another combination is—

Water	1000 parts.
Sodium sulphite	200 "
Carbonate of litmus	12 "
Paramidophenol	12 "

The latter form is preferred. The developer is on the eikonogen order.

Mixed Eikonogen and Hydroquinone Developer.—M. Angerer, after numerous experiments, suggests the following proportions as giving excellent results:

Solution A.

Water	1250 parts.
Sodium sulphite	150 "
Eikonogen	22½ "
Hydroquinone	7½ "

Solution B.

Water	250 parts.
Carbonate of potash	75 "

For use mix one part of solution B with five parts of solution A. If over-exposure is suspected, use less of B. Negatives of any desired density can be had with this developer, made on fast plates.

Direct Platinotype Printing Process.—Invented by Herr Wischeropp. The main point is to use a chemically pure solution of an iron salt, and to dry it on the paper so quickly that it cannot penetrate to any appreciable depth. To effect this, the paper is hung up to dry in a box at a temperature of 56° C. for two minutes. The solutions employed are:

A.

Sodium ferrous oxalate	40 parts.
Sodium oxalate three per cent	100 "
Chlorate of potassium	0·1 "

B.

Distilled water	60 parts.
Potassium platino-chloride	10 "

In A, the solutions which Pizzighelli keeps separate are combined and the useless glycerine omitted.

Solution A requires to be renewed frequently, but B will keep for any length of time. To produce a good effect, the paper, after having been dried, should be kept in the dark room for some time. The more quickly the printing is done, the better the tones obtained.

Danger of Poisoned Fish.

The *Lancet* contains a warning against the use of iced fish. Ice spoils the freshness, firmness, and flavor of fish by rendering it, prior to putrefaction, insipid, soft, and flabby. Where fish is preserved on ice, it appears that the ice only favors putrefaction by furnishing a constant supply of moisture, carrying with it the putrefactive bacteria derived from its unclean surroundings, so that this iced fish remains covered with fresh solutions of filth pregnant with putrefactive bacteria. On the other hand, keeping fish dry and cold can in no way favor putrefaction.

A Great Blast.

A great blast was to have taken place at Mr. P. Callanan's quarries, at South Bethlehem, N. Y., on June 16, but it failed, owing to imperfections in the electric wiring, and was a disappointment to thousands of people who had congregated to witness the explosion, and to many who expected to note some important results from the method employed in charging. The failure was due solely to the inefficiency of the electrician who had charge of the wiring, and the greatest sympathy was felt by all with Mr. Callanan, who had spared no pains nor expense to make the occasion successful and impressive.

The quarries are situated at an angle in the great limestone ridge which passes through this section. Previous excavation has given the quarry a very uniform face, crescent shaped, and about 400 feet long, with a perpendicular height of 100 feet. About 60 feet from the base of the cliff is a ledge or offset, so that the top of the cliff is set back some 20 feet. The blast holes were drilled on the ledge and at the top, being at an average distance of 13 feet back of the face. The holes were drilled to a depth of 26 feet, and were charged with from 30 to 60 pounds each of 75 percent "miner's friend" dynamite. The entire charge amounted to 5,000 pounds of dynamite, divided between 132 holes.

The circuit was connected with a dynamo situated in the crushing mill, close to the quarry. At 4 o'clock, in the presence of Governor Hill and his staff and about 5,000 spectators, Mr. Callanan's pretty daughter turned the switch, without result, as the wires were somewhere grounded. Mr. Callanan, however, succeeded in connecting up three sections of his blast, discharging them separately at intervals of 15 or 20 minutes by a hand battery.

At the second discharge the entire cliff, 300 feet long and 75 feet high, was seen to fall over to an angle of 45 degrees, and then drop, completely crumbled.

The American Petroleum Industry.

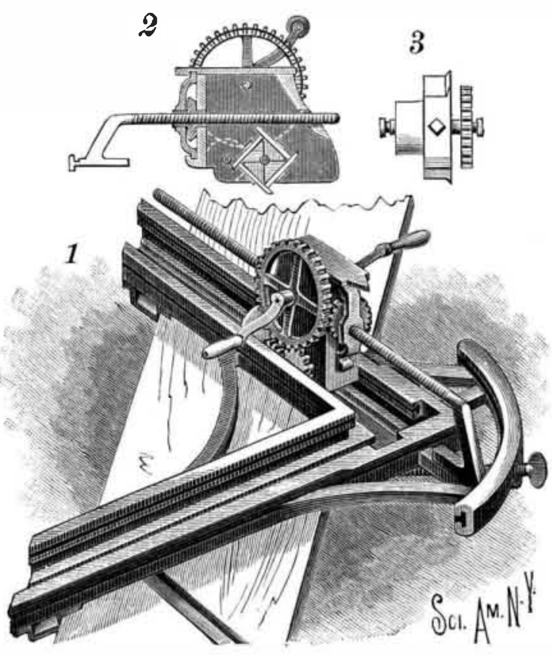
Bulletin No. 76, on the production of petroleum, has been prepared by Mr. Jos. D. Weeks, special agent in charge of statistics relating to petroleum and natural gas, under the supervision of Dr. David T. Day, special agent in charge of the Division of Mines and Mining, of the Census Office. The statistics show that petroleum was produced in eleven States in 1889. The total production is shown to be 34,820,306 barrels, of 42 gallons each, valued at $26,554,052, as follows:

	Barrels.
Pennsylvania and New York	21,486,403
Ohio	12,471,965
West Virginia	358,269
Colorado	316,476
California	147,027
Indiana	32,758
Kentucky	5,400
Illinois	1,460
Kansas	500
Texas	48
	34,820,306

Mr. Robert P. Porter, Superintendent of Census, says that the returns show that of the total product of petroleum, 109,891 barrels were disposed of for lubricating, 12,330,813 for fuel, and 22,379,602 for illuminating purposes. Nearly the entire amount produced in California, Indiana, and Ohio was used for fuel, while nearly the entire amount produced in Colorado, New York, Pennsylvania, and West Virginia was used for illuminating purposes.

AN IMPROVED MORTISING MACHINE.

A portable machine especially adapted for mortising wall strings to receive the risers and treads of steps is shown in the accompanying illustration, and has been patented by Mr. Paul Swieter, of No. 24 Howard Street, Allegheny, Pa. Fig. 1 is a perspective view of the machine, Fig. 2 representing a vertical section through the carriage, while Fig. 3 shows the cutter detached. The base of the machine consists of two parallel angular sections, the members of which are at a right angle to each other, and each of which has a lower horizontal slotted flange, and also an undercut T shaped recess. Opposite the angle of the outside section a segmental plate is secured by radial arms, the plate having a T shaped undercut recess and a downwardly extending central lug through which a set screw passes. The members of the two sections are united by diagonally located connecting plates, by means of adjustable bolts extending up through the slots of the base flanges, whereby the width of space between the sections may be regulated, and in operation the base is attached to the wall string by bringing one side edge of the connecting plates against a face of the string piece and causing the set screw of the segmental plate to engage the other side edge. The carriage is adapted to travel in the space between the sections, and consists of a box-like casing, through which passes the feed screw, having a downward and outward extremity terminating in a horizontal foot, with a button at one end adapted to enter the undercut recess of the segmental plate. At one end of the casing is a vertical bracket, and in the bracket and an aperture in the end of the casing is the hub of a pinion, the bore of the hub being threaded and the pinion turning upon the feed screw. On a shaft near the top of the casing is journaled a crown wheel meshing with the pinion, the shaft being rotated by a crank arm on each side, the crown wheel also, through connecting gears, operating the cutters, which revolve between the sides of the casing in its lower open face. The cutter head is made in two sections, one of which is nominally fixed and the other held to slide, producing a mortise cut of any desired width, or such adjustment may be made that the mortise will be wider at one end than it is at the other. When one mortise groove or channel has been completed, the position of the carriage is reversed, it being then placed

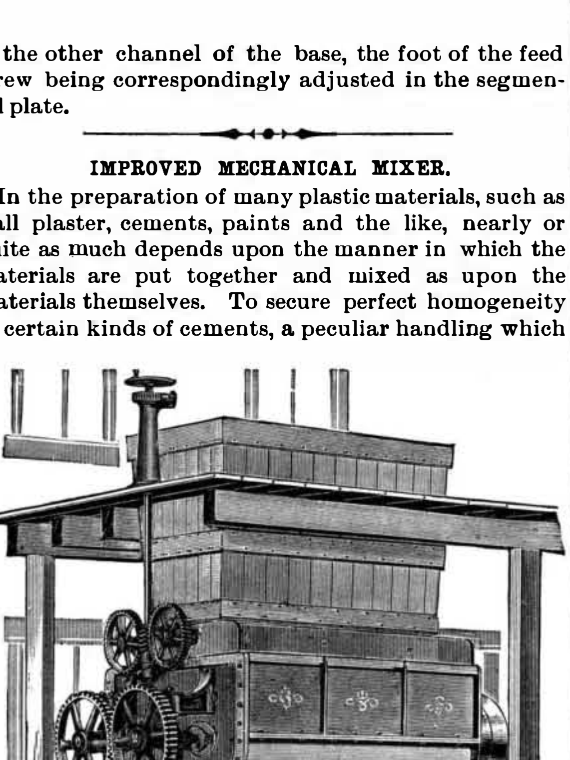


SWIETER'S MORTISING MACHINE.

at the other channel of the base, the foot of the feed screw being correspondingly adjusted in the segmental plate.

IMPROVED MECHANICAL MIXER.

In the preparation of many plastic materials, such as wall plaster, cements, paints and the like, nearly or quite as much depends upon the manner in which the materials are put together and mixed as upon the materials themselves. To secure perfect homogeneity in certain kinds of cements, a peculiar handling which



THE IMPROVED BROUGHTON MIXER.

will insure a thorough mixture of all the ingredients is absolutely necessary.

We give an engraving of a machine which is expressly designed for mixing patent wall plaster, but it is equally adapted for mixing other materials. The casing contains two shafts which rotate in opposite directions, and are provided with spirally arranged paddles which lift the material from the bottom of the casing and throw it in opposite directions from one end of the case to the other, thus insuring a constant motion and obtaining a perfect mixture.

This machine, when set up for use, occupies a position midway between two floors, with the hopper projecting through the floor above, and discharge spouts held at a convenient height for supporting the bags into which the material is discharged from the machine. The hopper is provided with a pair of iron doors which open downward to let the material into the mixing chamber. These doors are attached to shafts which are provided with worm wheels engaged by a worm which is readily operated by a hand wheel on the floor above at the side of the hopper.

After the material is mixed by the spirally arranged paddles, it is dropped into a receiving chamber below by means of sliding doors, which are furnished with shearing edges adapted to cut off anything of a fibrous nature which may be in the plaster, thus insuring a perfect closing of the doors. The receiving chamber is furnished with valves which control the discharge through the spouts to which the bags are attached.

The machine has a capacity of 200 barrels a day of ten hours, requiring only two men to work it, but its capacity can be increased by providing more laborers. No time is lost in operating the machine, for while one charge is being bagged, another is undergoing the operation of mixing, and at the same time the hopper above is being charged, so that really there are three charges in the machine at one time. The machine is arranged to run at a high speed; its shafts are journaled in boxes outside the casing, and stuffing boxes are provided for preventing the escape of the material around the shafts. The high speed and construction of paddles renders it a perfect mixer of hair and fiber with plaster.

This machine is manufactured by Mr. W. D. Dunning, Syracuse, New York.

Extraordinary Increase in the Wheat Trade of Bombay.

The Bombay papers received by the last mail describe the extraordinary export of wheat from that port during the past few weeks. The *Times of India* says that every warehouse near the docks and every available piece of open ground were occupied by towering tiers of bags filled with grain, awaiting the arrival of ships to take it away to other ports, where abnormal prices have been paid for it, and where its arrival is eagerly awaited.

In 1874 the total shipments of wheat from Bombay were 33,071 tons, while in 1886 the figures went up to 617,834 tons, this being the largest total shipped up to the present year. But never since 1874, the year when the wheat trade practically began, have the receipts of wheat in Bombay been so large, or nearly so large, as in the first four months of the current year. They reached during that period the enormous total of 198,097 tons, as compared with 97,420 tons in the corresponding four months of the previous year, and 178,686 tons in the same period of 1886. Steamers representing a total carrying capacity of between 350,000 tons and 400,000 tons were expected to load in Bombay in the course of the present month, and in spite of this large carrying accommodation it will be no easy matter to get the bags, or, at least, those that are not under cover, shipped before the rains. The receipts continue to be so great that as fast as the ground is cleared of one consignment it is occupied by another. The real cause of this unprecedented traffic is the damage sustained by the French wheat crop, which is likely to be about 25 per cent under the average. The traffic over the different railway systems terminating in Bombay has been gigantic during the past few months.

As recently as 1876 wheat was rotting in the Central Provinces, which is now regarded as the granary of India, on account of want of transport, but owing to the railway extensions carried out since that time—the through route to Calcutta being one of the most important—the number of growers has increased materially, and it is now worth their while to produce grain extensively. The lines have been overcrowded with grain, the receipts in Bombay being so vast that the greatest difficulty is experienced in finding warehouse accommodation for the hundreds of tons which are daily brought in from up country. Indeed, the competition for accommodation is so great that the rentals have gone up to more than 100 per cent beyond the ordinary charges. The price of labor and cost of carting have also increased.

Preparation of Lubricants.

The soap formed by treating wool grease with alkaline lye is dissolved in water and filtered. To this a solution of alum or other alumina salt is added, whereby a brown precipitate is formed, which is called "aluminum-lanolate." With this substance, when dried, lubricating oils of any viscosity may be produced by dissolving it in any fluid mineral oil. If dissolved in a small quantity of mineral oil, a gelatinous substance is obtained which may with advantage be mixed with India rubber or gutta-percha. Solvents for India rubber are said to be also solvents for "aluminum-lanolate." In textile industries this substance may also be used as a scouring agent.—*R. Krause, Wittenberg, Prussia.*