pay after two or three washings. This branch of operations has been resigned principally to the Chinese.

GROUND SLUICING

is a process by which the superincumbent masses of poor gold-producing earth is removed from the richer substrata, by means of water. This process is almost identical with the hydraulic plan—the same agent being employed and the same result accomplished. The only difference is, the latter is confined mainly to the river bed and valley deposits, while the former is made use of only in favorable localities. Some of the claims worked upon this plan pay well, averaging from $10 to $20 per hand.

QUARTZ MINING.

The only other kind of mining operation carried on in California is that known as quartz mining. The mines of this description pierce the mountains and run far below the surface of the earth, following wherever the quartz veins or lodes may chance to lead. The ores of gold are imbedded in the rock, and, in order to extract them, the first operation after they are brought to the surface is that of crushing. This is done with the stamp mill. The ores are then roasted, and the pure gold obtained by chemical processes. The whole number of quartz mills now in operation in the state is not far from 500, running 5,000 stamps, and erected at a cost of $4,000,000. Great improvement has been made in the machinery of these mills during the last few years, and many of them have proved good paying investments. The majority of them are run by steam. Quartz ores yield from $15 to $40 per tun; the latter figure, however, is only reached by a few of the very first quality mines. The veins of ore are often pursued to a great depth. A lode in the celebrated Hayward mine has reached a vertical depth of 1,200 feet beneath the surface.—*Philadelphia Press.*

Sketches from the Late Paris Exposition.

Among the innumerable variety of chemical products and minerals at the late Exposition, it was gratifying to note so many substances which but a few years since, from their rarity, possessed merely a scientific interest, that are now manufactured at will and in large quantities. Wöhler discovered, in the silicate of alumina—pure kaolin—the metal aluminum, and St. Clair Deville, in 1854, first produced it on a large scale, and since then it is used for technical purposes. Although aluminum has not gained the importance which had been predicted for it from its great lightness, it is, notwithstanding, destined to play a conspicuous role in the arts. Cryolite, again, is a mineral which, for a long time known only to the mineralogists as a rarity, was first turned to practical account by Henry Rose. Since the discovery of heavy beds of the "ice-stone," an industry has been established in the extraction of soda and production of fluosilicic acid, a valuable substance, not to be disregarded in the refining of the crude beet molasses. The beautiful iron—free sulphate of alumina, manufactured in large quantities in Natrona, Pa., is being substituted generally for alum, which because of its property of holding a large amount of water of crystallization, increases the expenses of its transportation. The chloride of chromium, a magnificent violet substance, has been applied to the printing of wall paper, imparting a peculiar, beautiful aspect, hitherto unknown. The metal thallium, which was discovered by spectral analysis and exhibited in all its important combinations by Hopkins and Prof. Laury, is already employed by the latter as a substitute for lead, in the manufacture of glass, thus forming a new crude material in the preparation of highly refractory optical lenses, and of brilliant imitations of gems. The indium, exhibited for the first time in bars of several pounds' weight, will find use in pyrotechnics, and, perhaps, also in photography, more so than magnesium, on account of its emitting a chemically, very active light. The naphtaline of the gas works forms the starting point for the preparation of a new coloring principle, which, on account of its relation to the alizarim of the madder, has, with its compounds, found use in dying and printing. The camphor-like smelling sesquichloride of carbon, a substance theoretically important as forming a link between organic and inorganic chemistry, serves at present for the production of the beautiful aniline dyes, not to refer to its value as an antidote to cholera.

Vegetable bases, formerly to be found but in minute doses, were exhibited at the Exposition in enormous quantities. We found among them the rarest opium alkaloids and their derivaties, for the extraction of which at least three hundred pounds of veritable thebaic opium was requisite. The exhibited samples of brilliant crystallized strychnine would have been enough to poison a thousand persons, a single grain being sufficient to destroy life. Four thousand pounds of coffee beans, at least, must have been requisite for the extraction of the amount of caffein we met with. If many of the last mentioned chemicals have not yet gained any technical value, if many are only of pharmaceutical interest, they are nevertheless capable of giving an idea of the extent of technical chemistry and the state of an industry of a country, as their presence proves sufficiently what materials, apparatus, and knowledge must have been at the disposition of the respective establishments. Until a substance has left the laboratory of the investigator, it has no industrial importance; as soon, however, as it comes from the hands of the manufacturer, it is a representative of industy. Hence an enumeration of these preparations would give us an insight into the resources of a country, were the number not too great, nor too tiresome to be calculated. Also those bodies, the discovery of which belonged to a former century, regarded long enough as useless, will give a most brilliant testimonial as to the persistence of progressing science.

MESSRS. JACOBS BROTHERS of Columbus, Ohio, have sent us a specimen of large crystallized sugar, made from sorghum, without chemicals or bone filtration.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

Efficiency of Small Fire Engines.

MESSRS. EDITORS:—In your paper of January 11, 1868, page 21, is an account of experiments made in Germany, to prove that small quantities of water thrown from little engines are very efficient for putting out fires. This subject has been understood and acted upon by a few persons in this neighborhood for years, and I now propose to do what I can to bring it into general use by comparing it with the workings of the "Extinguisher," as it is called, which has the past year been exhibited nearly all over the country.

I have no engines now which I care to sell and my motive is the same which prompts me to take my engine to a fire, to save property and prevent distress. I have no doubt whatever that the general introduction of small engines into fire departments, with steam fire engines, will result in preventing at least three fourths of our fires, and of lessening the rate of insurance an equal amount, that is, three fourths. I am sure this will be so when a new kind of engine, of which I intend to write to you soon, is brought into use with the small and the steam fire engines. At present, however, I wish to write only of small engines, and to address myself to the pump makers of the United States. A cast-iron pump can be made by any one, weighing no more than forty pounds, which will stand up when left alone, which can be put at first in a water pail and yet there can be fired from it by one man a perfectly steady stream of water three eighths of an inch in diameter that can be raised to a hight of more than thirty feet, and that water will put out more fire of any kind of wood, tar, kerosene, resin, or, in short, that of any fire, however made or composed, than any "Extinguisher" which has ever been exhibited.

I do not make this assertion without knowledge, but I have such an engine which has done this work, which has been to and extinguished fires quite equal to those described in your article of the German exhibitions, and from fifteen and more years of experience I tell you that the time has come when the people of this country should understand and act upon the knowledge that fires to be combatted successfully must be reached and fought sooner than they are now or will be by the steam fire engines, or by large man engines. Every person has had an opportunity of seeing the apparently wonderful power the "Extinguisher" has over fire. Your article of the German experiments proves that little engines throwing only cold water will, can, and did extinguish more fire than the "Extinguisher" has done. The building experimented upon in Germany was twice as large as those used here for the "Extinguisher" experiments, and only one engine was used for throwing water, while at the trials here half a dozen were always ready and from three to five used. And now will every maker of pumps engage in the effort to prove their great utility and efficiency for checking two of the great evils of our country, fires and insurance; fires first from their disastrous effects, and insurance from the everlasting strain upon the business portion of the people which it involves. A pump, such as I have described, with six feet of hose and ⅜-inch pipe should cost at retail no more than twelve dollars, or to towns and cities in large numbers from eight to ten dollars. Will every pump maker make experiments like those in your number of Jan. 11th. They will be astonished, for the idea in this country has been that a stream less than an inch in diameter and a power of fifty men or steam were of no use to quell a fire with. And this is true. There are so few of them and it takes so long to put them at work, that the fire, increasing by geometrical progression, doubling its proportion and power every three minutes, has become uncontrollable before they have got well at work. Take the fire which destroyed the city of Portland, for example. People supposed it was one fire. At first there was one fire, and the great engines from every part of the city rushed to it. Before a stream of water had been thrown upon it from one of them, the burning shingles and sparks of the fire had been taken by the high wind which was blowing to other places and set six other fires, so that by the time that the first engine got water upon the first fire there were seven fires in the city in a gale of wind, and before the engines could be put at work upon them, they had in their time made more fires than there were engines in the city. The result we all know. Now let us suppose that there had been, beside the large engines, five hundred such as are described in your paper of the 11th of January, or as much better as a Yankee can make, and that they were equally distributed about the city, in the houses of careful and judicious working men, and that each one who could extinguish a fire before a large engine could be put to work should have five dollars. The six fires before spoken of when they were seen were no larger than a man's hat, and one of them could have been extinguished in half a minute. So of all the others. There would never again be a great fire like that at Portland after a common sense fire preventive system were adopted like that of our people who, when at war, used every means large and small, but vastly more of the last than the first, to destroy an enemy. JOSEPH BIRD.

Mt. Auburn, Mass.

Things to be Remembered by Machinists.

MESSRS. EDITORS:—Believing the observance of the following points to be indispensable to good workmanship, I make no apology for submitting them to you. If they were carried out in every shop in the land we should have fewer complaints of slovenly workmanship:

Never turn a shaft without drilled centers. Never turn the body until the ends are squared to the center and to the length. Never allow a nut and bolt to pass that will not run down properly on each other. Never pass a nut that does not screw down fair on its seat. Never take the last cut on a thin casting, whether in the lathe or planer, without easing off the chuck or clamp that confines it. Never use a tool square across the face to rough-off with. Never attempt to work steel that is harsh from want of proper annealing; better carry it back to the smith and have it annealed properly than waste time and tools in doing what will be only a poor job. If you can buy good tools cheaper than you can make them, buy them. E. P. W.

New York city.

The So-called Heat Shadows.

MESSRS. EDITORS:—Your correspondents, in attempting to explain the above-mentioned phenomenon in your number of Feb. 15, p. 101, overlook the true cause of the details they so minutely and correctly describe; it is not that heated and rarefied air transmits the light more perfectly, but simply that the deviation of the light from its naturally straight course, called refraction, caused by those surfaces of the heated and rarefied air when they are in contact with the colder and denser air. Descartes discovered, two hundred years ago, the law of refraction which governs the changes in the direction of light when passing from a rarer into a denser medium, or *vice versa*; the phenomenon in question is simply one of the consequences of this law of refraction of Descartes. Complete explanations of this law are found in all good text books on Natural Philosophy, to which I refer for further details. I will here only speak of it in so far as regards the case in question.

When light falls from one transparent medium perpendicularly on the surface of another, its direction undergoes no change; when it falls obliquely its direction does change, and this change in direction, or this refraction, is greater in proportion to the obliquity and the difference in the density of the two media. When now, heated air is in contact with cold air, and a ray of light passes from one to the other, and in falling on such a part where both the media are in contact, passes obliquely through the surface of contact, its direction must necessarily change. When a stove is surrounded by a layer of a transparent medium denser than the air, it would act similarly to a glass lens, and converge the rays; but the air around a hot stove being, on the contrary, expanded, rarer than the surrounding air, it will do the contrary thing, and diverge the rays; that means the light will be refracted outward from the stove, making the shadow of a hot stove larger than of a cold one. The light passing close along the stove will consequently be refracted in such a way that it will fall where other unrefracted light is falling, will reinforce it, and this is the cause of the lighter band, very correctly represented in the figure on page 101. The tremulous motions are simply caused by the continually changing position of the surfaces between the hot and cold air, consequent on the continuous upward motion of the hot rarefied and lighter air; the direction of the rays of light, when passing through such air, is therefore necessarily also continually changing—here increasing the light in one spot, there obstructing it from another; therefore these so called shadows are simply results of continually changing refractions, and are no more shadows than the image in the camera obscura, which also is a result of refraction by means of a properly adjusted glass lens.

By the same cause (refraction), the sun and moon appear, when rising or setting, one half degree higher than they really are, and may be seen in slowly changing forms, and even sometimes in vibration by a similar cause.

P. H. VANDER WEYDE.

Calculating Nominal Horse Power of Engines.

MESSRS. EDITORS:—I have seen the following rule for nominal horse power of the steam engine: Multiply the square of the diameter of the cylinder in inches by the cube root of the length of stroke in feet, and divide by 47, the quotient is the horse power.

Now, suppose we take two engines, each having 70 inches diameter of cylinder, one having 10 feet stroke, the other 5 feet stroke, and ascertain the nominal horse power of each:

$$70^2 \times \sqrt[3]{10} \div 47 = 224{\cdot}6 \text{ horses.}$$

$$70^2 \times \sqrt[3]{5} \div 47 = 178{\cdot}2 \text{ horses.}$$

Now, if the pressure of steam had been the same in these two cylinders, and both pistons moved with the same velocity, it is manifest that the powers will be the same, or nearly so. Yet, by this rule, they are made widely different; and if they are made so widely different, when the pressure of steam is supposed to remain constant, how would it be to use 40 pounds in one and 80 pounds in the other?

New Britain, Conn. W. E. CRANE.

[It appears to us that two very important elements are left out of the above proposition—the pressure of steam and the velocity of piston.—EDS.

NEW ELECTRICAL BATTERIES.—M. Balsamo has presented to the French Academy a battery, both elements of which consist of iron, the one being immersed in a solution of chloride of calcium, the other in diluted sulphuric acid, the two solutions being separated by a porous cell. The iron in the sulphuric acid acted as the positive element, and the other as negative. A constant and quite an intense current is obtained by this arrangement. Another novel battery, termed an "electric buoy," is now being experimented upon at Cherbourg. It consists of a zinc plate and a cylinder of carbon, attached to a cross piece of wood, having sea water as an exciting liquid. Still another variety is that of M. Miergue, of Bonfarik, consisting of a cylindrical cell of porous carbon, containing nitric acid, and an exterior cylinder of amalgamated zinc in a cell full of water.