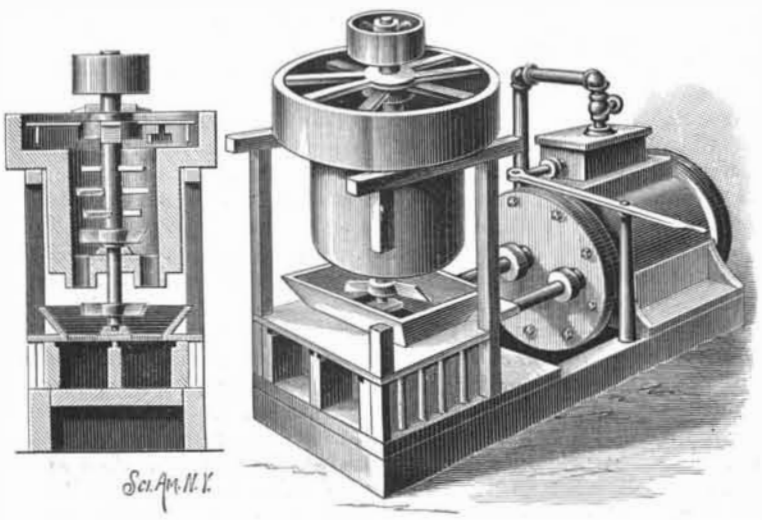
New Observatory.

Denver is about to have an astronomical observatory that will rival the famous Lick Observatory in California. Its dome will rise from a plain and have 1,000 feet greater elevation. The building and instrument have been provided for through the liberality of W. B. Chamberlain, of Denver. The framework of the metal dome is of iron and steel, and is made as light as is consistent with a high degree of rigidity. The covering is of galvanized iron. The weight of the dome will be about twelve tons, and the devices for making it revolve easily are very ingenious; the endeavor is to substitute rolling for sliding friction. For this purpose a live ring is employed. This consists of a number of wheels set at equal distances around a circular track; on the circumferences of these the dome rolls. The telescope, which is now being completed, will be a very valuable and expensive instrument. The diameter of the object glass will be 20 in. and the length of the tube about 26 ft., of the best hard rolled steel.

AN IMPROVED PUG MILL.

A mill designed to thoroughly and economically mix and grind clay, and force the tempered clay into the mould box of a brick machine, is illustrated herewith, and has been patented by Mr. Henry Woodcock, of Perth Amboy, N. J. On the base of the machine is mounted a steam cylinder, together with a frame supporting the receptacle in which the clay is worked and tempered. This receptacle has a circular pan at the top, below which is a cylindrical mill, in the bottom of which are two passages through which the clay



WOODCOCK'S PUG MILL.

drops into a hopper below, in the center of which a vertical shaft is stepped. A spider frame is carried by the shaft in the circular pan at the top, the arms of the frame having blades and a scraper, to work the clay and force it into the mill below. In this mill the shaft carries arms for agitating and working the clay, and a propeller for forcing it through to the hopper, as shown in the sectional view. In the hopper the clay is further worked, and forced through passages in the bottom to boxes below, there being in each box a follower, both of them connected to the same piston head in the steam cylinder by piston rods, so that both are operated at the same time by a single steam cylinder. Each follower is provided with a plate at its upper edge to close the openings at the bottom of the hopper, when the followers are thrust forward to force the tempered clay out of the machine.

New York as a Milling Center.

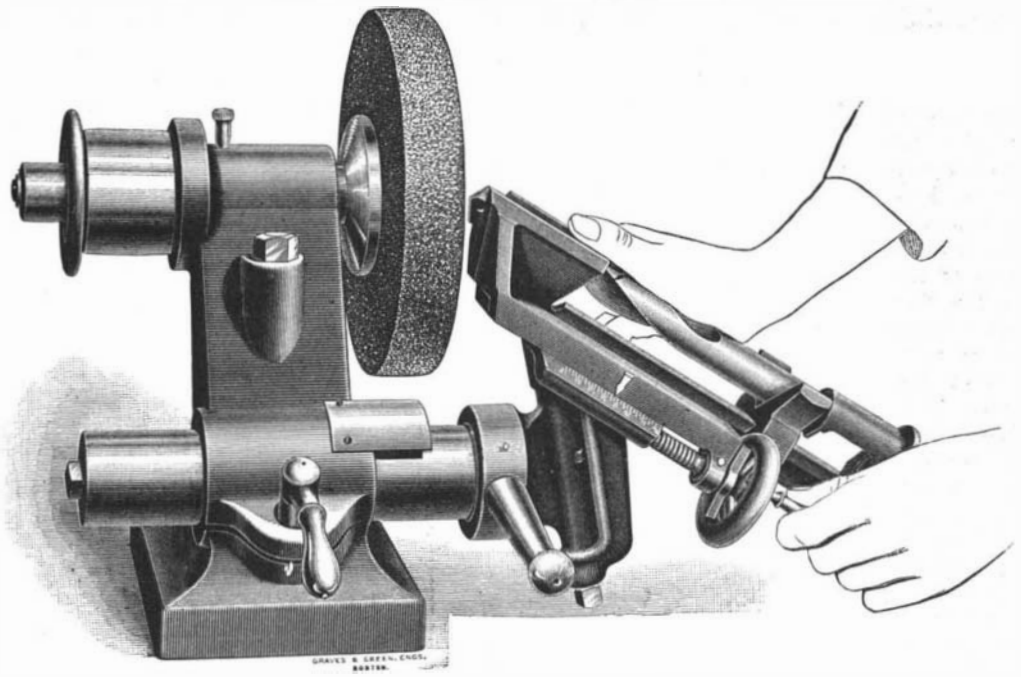
There is a steadily growing impression that New York City is destined to be one of the chief milling centers of the country ere long. There are many cogent reasons for this belief. Being the leading seaport and moneyed center of the country, with a large storage capacity, and also the natural terminus of the principal railways, as well as the Erie Canal, the available supply of wheat is generally likely to be abundant. Furthermore, as it draws its supplies from all quarters of the country, the assortment is, of course, apt to be better than ordinarily obtainable at interior points. This will assuredly give the miller a decided advantage. Loud complaint has been heard recently from the West, but particularly from winter wheat States, regarding the difficulty of obtaining supplies of wheat at prices on a parity with those current in New York. These facts have induced several gentlemen of means and experience to erect a first class mill here. Among the leaders in this enterprise are Messrs. B. B. Stewart, a well known citizen of Cincinnati, J. C. Ott, of the Produce Exchange, and William Sumner. The mill, which will be chiefly brick, and six stories high, with a daily capacity of 1,500 barrels, is now being constructed under the personal supervision of Mr. William D. Gray, the well known expert of the firm of E. P. Allis & Co., of Milwaukee. No pains or money will be spared to make this mill perfect in every respect. The location is an excellent one, being at Mariner's Harbor, on the Kill Von Kull, Staten Island. The property is 987 feet deep, 300 feet wide in the rear, and 265 feet front on the water. The dock will have 20 feet of water at high tide and 14 feet at low tide. Moreover, the Baltimore & Ohio Railroad will run tracks down the entire length of the property. This will give first-class railway as well as water facilities. Hence wheat can be delivered direct from cars or boats into the mill, and the flour out in the same way.—*Produce Exchange Reporter.*

Purification of Mercury.

The following process for the purification of mercury has been in use for some years at the Physical Institute at Kiel with the best results. The mercury containing chemical and mechanical impurities is poured into a glass tube, into the lower end of which is cemented a piece of bamboo cane which acts as a filter. The mercury passes through this into a larger glass tube almost entirely filled with dilute nitric acid (1 in 50), and on leaving this bath is sufficiently pure for some purposes. The distilling apparatus to prepare chemically pure mercury consists of a glass tube about 15 mm. wide and 80 cm. long, at top of which is a bulb of about 6 cm. diameter. The open end of this tube is placed in an inverted bottle with the bottom knocked out. Through the cork in the neck of this bottle is passed a second tube about 1 cm. wide and 145 cm. long, which passes through the other wider tube and up into the bulb at the top of it. This narrower tube is also contracted into a capillary one about 40 cm. from the top, and at the lower end is bent upward. To work the apparatus, the wide tube and bulb are filled with mercury and inverted, which creates a vacuum in the bulb, and more mercury is poured gradually, drop by drop, into the narrow tube to increase it, and the apparatus then acts like a Sprengel pump. The bulb is then heated by the flame from a circular burner, and distillation takes place continuously, the absolutely pure mercury flowing out at the bent-up end of the smaller tube. Unless the atmospheric pressure varies greatly, the apparatus can be left at work night and day, and only requires the addition of mercury two or three times in 24 hours.

AN IMPROVED DRILL GRINDER.

A drill grinding machine which can be sold at a moderate price, and which will hold twist drills varying in size from ¼ inch to 2 inches, is illustrated herewith, and has recently been perfected at the Washburn shops of the Worcester Polytechnic Institute, Worcester, Mass. The wheel spindle has a conical bearing, adjustable for wear, while the emery wheel is of cup form, the drill being applied so that its perfect grinding does not depend upon a perfect wheel surface, a new place on the wheel being used each time a drill is ground. The workman places the drill in the V-shaped holder, sets the pointer on the scale to a figure corresponding to the diameter of the drill, and with the thumb of the right hand places the drill with its lower cutting lip against a projecting gauge which secures its correct position. The drill holder is then pushed forward till the drill nearly touches the wheel, where it

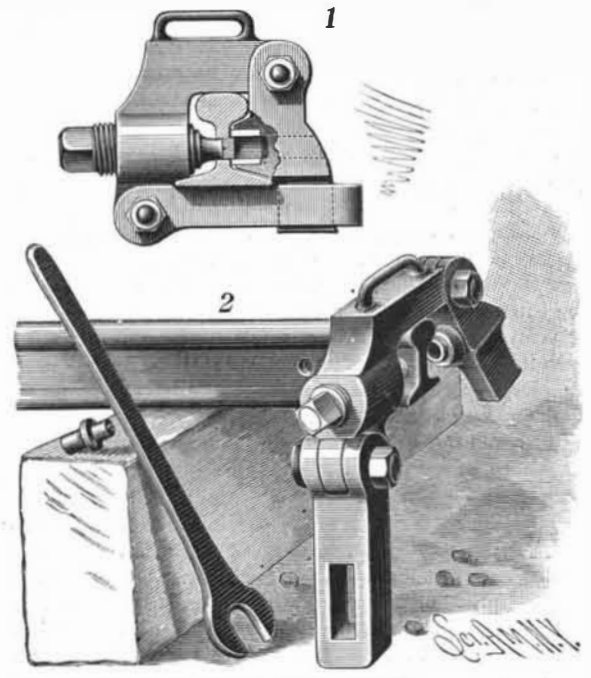


A TWIST DRILL GRINDER FOR GRINDING DRILLS FROM ONE-QUARTER INCH TO TWO INCHES DIAMETER.

is clamped by the handle at the left. Then the grinding is done with the two hands, the correct form of the cutting lip being made by rocking the holder and drill about a vertical axis at the same time that it is fed forward by the hand wheel. The amount ground off is gauged by the left hand on the feed wheel handle. After the first lip is ground, and before the holder is backed away from the grinding wheel, a pointer is set which indicates when both lips are ground alike. There is no adjustment of chuck holders, the rest for the shank of the drill being readily adjustable, and the end stop being adjustable for any length of drill from 16 inches down to a mere stub. The drill point is ground to a helicoidal surface of 59 degrees, and the adjustment for drills of various diameters is obtained by a combination of angles in the sliding holder, giving always the right adjustment when the pointer stands at the figure on the scale corresponding to the diameter of the drill to be ground.

AN IMPROVED RAIL PUNCH.

A punch for making bolt apertures in rails, and specially intended to supersede the use of the ratchet



HULME'S RAIL PUNCH.

and drill for such purpose, is illustrated herewith, and has been patented by Mr. Isaac Hulme, of Yaquina, Oregon. On a downward extension of one end of the frame is pivoted a bar adapted to be brought up against the base of the rail and held in engagement with the foot of a vertical arm pivoted to the other end of the frame. This foot passes through the opening in the bar, and has an offset to engage its bottom, as shown in Fig. 1. In one downward arm a punch screw is operated by a wrench, the central line of the screw and punch coinciding with a die held on the inner end of the other arm of the frame, and made in the form of a collar opening into a longitudinal aperture in the arm. As the operator turns the screw in which the punch is fitted, bringing its outer end against the body of the rail, the die in the other arm resting against the opposite face of the rail, the punch forces an aperture in the body of the rail, the punched part passing into the opening in the die corresponding with the punch. The device is designed to be very simple and durable, and has a handle for conveniently moving it from place to place.

THE plant now employed on the Manchester ship canal includes 98 locomotives, 3,221 wagons, 51 steam navvies, 49 steam cranes, and 104 pumping and other engines, with 161 horses and 8,568 men and boys. Almost the whole of the land required for the construction of the canal has now been acquired by the company.

A Japanese Paper Maker on Cheap Labor.

The following original notes by an eminent Japanese official connected with the Japan government mills and printing offices are taken from the English *Paper Trade Review:*

After my travels through different countries, and from what I noted with regard to the difference of wages in two places, viz., China and the United States, I am induced to say that with regard to the wages question I have clearly seen the truth of the fundamental proposition laid down by almost all political economists, that it is not trade unionism which has raised the wages of labor. Wages are only higher or lower according to the proportion of capital invested for the maintenance of working people and the number of working people in existence. In case the capital destined for the maintenance of working people is excessive compared with the number of working people existing, employers are obliged to bid against each other to secure them, and it is quite certain that the opposite will take place when the number of working people is in comparative excess to the capital destined for their maintenance. This is the only way the wages of labor are adjusted in the natural course of things.

That the United States is a most thriving country and rapidly advancing in the acquisition of riches is a fact well admitted by everybody. The capital destined for the maintenance of the industrious classes increases there so rapidly that, notwithstanding the great number of immigrants from all parts of Europe and China, the scarcity of hand labor is felt by employers every year more and more. The consequence is high wages. Holyoke (in Massachusetts) is the greatest focus of paper making in the world, and 200 tons of paper are there turned out every twenty-four hours. During my stay there of two years, four large new mills were erected, giving employment to about 600 hands at least. Paper machine tenders whom I knew were picked up as managers, and back tenders took their place as machine men. With such circumstances it is impossible for employers not to bid against each other for workmen. For a town like Holyoke an increase of 600 inhabitants in two years is not to be got unless there be an extraordinary stimulus. Thus increased capital means increased improvement of the condition of working people. Men may possibly object to receiving too high wages, but under such circumstances they will be obliged to accept the same! Under contrary circumstances, in a country where the capital existing for the maintenance of the industrious classes is sensibly decaying, it is quite absurd to expect a liberal reward of labor.

No trade union can bring about improvement in a state of things which is the natural and irresistible result of the struggle for existence. In America paper machine men earn about ten shillings a day, and rag pickers about four shillings, while provisions are cheaper than here, thus being a favorable state of things from two points of view, and making the real recompense of labor higher than in England. It is not the actual magnitude of natural wealth but its continued increase which occasions rises in the wages of labor. It is not, accordingly, in the richest country, but in the most thriving, that the wages of labor are the highest, viz., in the one which grows rich fastest.

At present England is certainly richer than the United States of America, but the wages of labor are much higher in the latter country because it is more thriving and progresses the fastest in acquiring riches. As soon as the increase of capital is stopped, the state of things changes. When capital stops increasing, population does not stop increasing. The same will progress until very low wages stop the importation of labor from other places and discourage early marriages or decrease the number of marriages by the unprofitableness of children. In fact, the multiplication of the species was so fast in the United States of America that it is said to have doubled in twenty-five years, this being due to both immigration and multiplication. Labor is there so well rewarded that a numerous family of children, instead of being a burden, is a source of opulence and prosperity to the parents. In England a young widow with four or five children would have a poor chance of obtaining a second husband, but there it is frequently looked upon as almost a fortune. The value of children is the greatest of all encouragements to marriage. Thus a liberal reward of labor encouraging marriage will tend to increase the population, to keep pace with the increase of capital, and at last, when the wages of labor become very low, so that the burden of children discourages marriage, then the population will cease increasing.

Through the wealth of a country be very great, yet if it has been stationary for a long time we must not expect its wages to stand high. The fund destined for the payment of wages may be very great, but if it be for several centuries the same, the number of people to be employed every year can easily be supplied, and at last people naturally multiply beyond the number which can be employed. High wages mean an increase in the number of marriages and consequent increase in the population. Thus at last wages come down to the lowest rate consistent with common humanity. Statistics show that when trade is good and the price of provisions low, there is an increase in the number of marriages. They also show, at the same time, that as soon as it finds the least encouragement, population never fails to increase.

Working people cannot expect a high reward of labor when their numbers are excessive. Employers cannot monopolize a high profit by simply cutting down wages.

Capital is always seeking the best attainable investment, and when any particular business is very profitable, fresh capital seeking investment is naturally introduced, creates more employment, and raises wages for that particular business. Thus the workpeople enjoy a portion of the profits of good business. In the commercial field of free competition, no one can enjoy the monopoly of good profits. If business prospers, both employers and hands should be well off together, and in the same way both should lose when trade is bad. With a natural state of things this is an inevitable condition, and it was exactly so for centuries.

From what I have said it is, I hope, clear that trade unions cannot raise wages. To intend to raise wages by trade unions is "to cast dirt up against the skies; what has been cast up will come down on your face," that is to say, it will ruin your business.

It may be said that trade unions did raise wages by compelling employers to arbitrate, but it is not trade unionism which has done this, but general prosperity in trade and business which supported workingmen's requests. Suppose, for the sake of argument, that unions do raise wages, then we have encouragement to marriage, increase of population, and the same amount of enjoyment as used to exist before.

Then comes the question of the true and permanent remedy for a low rate of wages. This question becomes more serious and important as civilization advances, and there are several opinions on this point—all different. Almost all of them advocate the breaking down of the present system of social organization, viz., to abolish private property. Without going to such an impracticable extremity, what I think working people should do is to raise the standard of living. By standard of living I mean a certain standard of comfort, etc., below which a nation or class does not venture to descend. For instance, in England, to be tolerably well fed, clothed, and lodged, is considered a proper style of living by the industrial classes. Now, in China I noticed that millions of families are living in small boats called sanpan, which expression literally translated means "three boards." The boat in question consists merely of three big boards. Their poverty is of the lowest degree imaginable, the next step downward being actual starvation. The living of a whole family in a boat 12 × 5 feet seems to be the lowest extremity to which the Chinese are willing to descend, thus showing the difference in the standard of living in these two countries.

If the English working people change their habits of living, and become capable of as low a standard of living as the Chinese boat-living people, the population of England may at length increase till it brings them down to the said level. Thus we see what influence the standard of living has upon the well-being of the British workman. Hence I say the true and permanent remedy of low wages is the raising of the standard of living, which can be accomplished by the spread of good general education. If I am not mistaken, I can safely say that for true prosperity of the industrial classes—which means the liberal reward of labor—educate your children by all means in your power instead of resorting to unionism.

The next question is, How does the high standard of living affect the cost of production in general? It may seem that a high standard of living will raise the cost of production, but this is by no means the case. The wages of labor are the encouragement of industry, which, like all other human qualities, improves in proportion to the encouragement it receives. Plentiful subsistence increases bodily strength, and hope in a man of bettering his condition animates him to exert that strength to the utmost. Where wages are high, we find workmen active.

Chinese labor is three times as cheap as that of English people, but also just as much less productive. A fact that struck me very much was the following: In Japan ordinary labor costs say one shilling per day, in England say three shillings, and in the United States of America four shillings, and yet paper manufacturers in all these three countries are paying almost the same for the production of each pound of paper.

Chalcedony Park.

Mr. William Adams, Jr., was the discoverer of the celebrated petrified forest of Arizona, now generally known as Chalcedony Park. This deposit is situated about 25 miles southeast of Holbrook, in Apache County, Arizona. The silicified trees are found protruding from the volcanic ash and lava, which is covered with sandstone to the depth of 20 to 30 feet. Sections of this fallen forest, whose only rivals are the giants of the Yosemite and Calaveras, lie around in profusion, measuring from 2 to 10 feet in diameter, containing all the colors of the rainbow, some of whose hearts are solid crystals of amethyst and topaz, and only a slight degree from the diamond in hardness. Every color found in nature or the arts is reproduced in these fallen agatized monarchs.

PHOTOGRAPHIC NOTES.

Photo-Lithography and Etching Acids.—The *Photo. News* prints the following as the actual formula now used by Dr. Eder:

Photo-Lithography; Transfer Paper.—30 grammes of gelatine and 15 c. cm. of glycerine are dissolved in 1,000 grammes of water, and the solution poured upon the paper. One-fourth of the quantity mentioned is sufficient for a sheet measuring 45 by 50 centimeters.

Sensitizing.—100 grammes of ordinary bichromate of potash is dissolved in 2,000 c. cm. of water and liquid ammonia is added until the solution becomes of a pale yellow color. The transfer paper is immersed in this solution until it becomes quite flexible.

For transfer paper containing albumen, alcohol may with advantage be added to the sensitizing bath. The formulæ then reads, 100 grammes of bichromate of potash, 1,600 c. cm. water, 400 c. cm. alcohol, and ammonia as before, until the deep orange color is replaced by pale yellow.

The paper, after exposure under a negative, is, while in the dry condition, inked with a velvet roller, and then, after immersion in cold water, it is developed with a pledget and with the velvet roller. The transfer on to the stone is effected in the usual way.

Surface Etching on Stone.—The stone bearing the image from either photo-lithographic or other transfer paper is treated in the usual way, and lightly etched with dilute nitric acid and gum. The whole stone is then covered with powdered resin, and this is rubbed in with a tuft of cotton wool. Two narrow strips of millboard are then held by an assistant, so that they lie along the sides of the stone, and so that the edges of the millboard rise about 2 or 3 mm. above its surface. Meanwhile a strip of wood of about 8 centimeters in breadth, and covered with an absorbent cloth, has been moistened with ether. It is now slowly drawn over the surface of the stone, the strips of millboard serving as guides to keep it from touching. By the action of the ether vapor the resin is softened and combined with the ink. The etching may now be completed with a stronger solution of nitric acid and gum than before.

Etching Liquid for Zinc.—1,000 c. cm. of water is mixed in a flask with 1,200 grammes of ordinary nitric acid of 40°, 80 grammes of common salt is then added, and when dissolved 300 grammes of "strong" acetic acid is poured in. Red fumes of nitrous acid are given out, and the open flask is left in an airy place for five or six days. There is then no further, or but very slight, evolution of gas, and the acid is ready for use.

The first etching is carried on with acid of from 5° to 6° Baume, and occupies from five to fifteen minutes. For later etchings the acid may be used of double the strength given, or even more.

Preserving Albumen Sensitive Paper.—At the recent English photographic convention Mr. G. W. Webster related his experience as follows, which we take from the *Photo. News:* So little has the subject been noticed of late, that I am quite prepared to believe that some of the members here present, whose patronage of photography has not been very protracted, may now hear of it for the first time. Take a pound of ordinary washing soda, and dissolve in two quarts of water; by using boiling water the dissolution is facilitated. When cold, sheets of blotting paper are dipped into it, slightly drained, and then piled in a heap with alternate sheets of dry blotting paper, the object of this addition being to permit just the right amount of liquid to be retained that will enable the paper to be readily handled, thoroughly wet porous paper falling to pieces as soon as it is lifted. Next, the paper is hung in a current of air till dry, then thoroughly exsiccated at the fire or in an oven, and stored away for future use. This we may call "soda paper." It may be employed either for preserving paper to be kept some time before being printed, or to keep prints a good color which may have to be kept in the frame over a day. For the former purpose the dried, sensitized, albumenized paper is either rolled up with soda paper, or otherwise kept in close contact with it, as, for example, by placing alternate layers of soda paper and sensitized paper in a printing frame, and pressing down as though a print upon a negative were in progress. For keeping paper white while printing for one, two, three, or more days in the hottest weather, all that is necessary is to substitute soda paper for the ordinary felt pad. Any one who has not yet tried the soda pads, and will only once attempt their use, will be surprised and pleased at the remarkable difference in color that will be seen between paper so treated and that printed under the usual conditions, when it has been in the frame for a few days. In hot weather the one exhibits very little discoloration, while the other is absolutely useless for any but the crudest of results. I have tried both monosodic and disodic carbonates in the pure, as also in commercial qualities, but the common washing soda of commerce answers every purpose.