SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. XXIX.--No. 14. [NEW SERIES.] NEW YORK OCTOBER 4, 1873. [$3 per Annum. IN ADVANCE

DIAMOND CUTTING--A NEW INDUSTRY IN NEW YORK.

Diamond cutting is an art, not merely an industry, requiring that certain degree of deftness of manipulation which, after a few years of apprenticeship, is readily attained in nearly every mechanical operation, but a fine art in the full sense of the term. It is labor which calls not only for an exquisite refinement of manual dexterity, but an unerring judgment, to be gained only by hard study and constant practice, extending perhaps over a lifetime.

HOW DIAMOND CUTTING WAS INTRODUCED IN THE UNITED STATES.

We purpose, in the following paper, to tell the reader how this pursuit, now for the first time in the world's history followed in the western hemisphere, came to be established in the the United States, and then to trace the various processes of diamond cutting as practiced in the city of New York. It is a matter of general information that the art, from time almost immemorial, has been confined to the celebrated lapidaries of Amsterdam, Holland, whither the rough gems were forwarded from all parts of the globe. At the time of the extensive discoveries in the diamond fields of South Africa, however, Mr. I. Hermann, a well known jeweler of this city and an expert in the art, became convinced that diamond cutting could be introduced in this country, both as a valuable accession to the national industries and as a means of attracting large amounts of foreign capital within our borders. To this end he undertook its establishment in the face of many serious obstacles. There was an import duty of ten per cent on the rough stones, the repeal of which had to be secured (a matter of no small difficulty, for the Government seemed unable to perceive the advantage of thus increasing the wealth within the country), large capital had to be obtained to start the enterprise, and, finally, workmen had to be persuaded to leave Holland and try their skill in a foreign land. When these men, in sufficient numbers, could not be induced to migrate, Mr. Hermann sought for other artists among the Dutch already in the United States; and he tells us that he found them pursuing all kinds of callings, in order to gain the support which the art they had studied all their lives was here unable to afford them. Then machinery was imported, only to be abandoned for entirely new inventions, also the work of the projector of the scheme; and thus at last staid old Amsterdam, to the dismay of her artisans, discovered that her long kept secrets were known across the ocean, and her hitherto undisputed supremacy rivaled in the metropolis of the West.

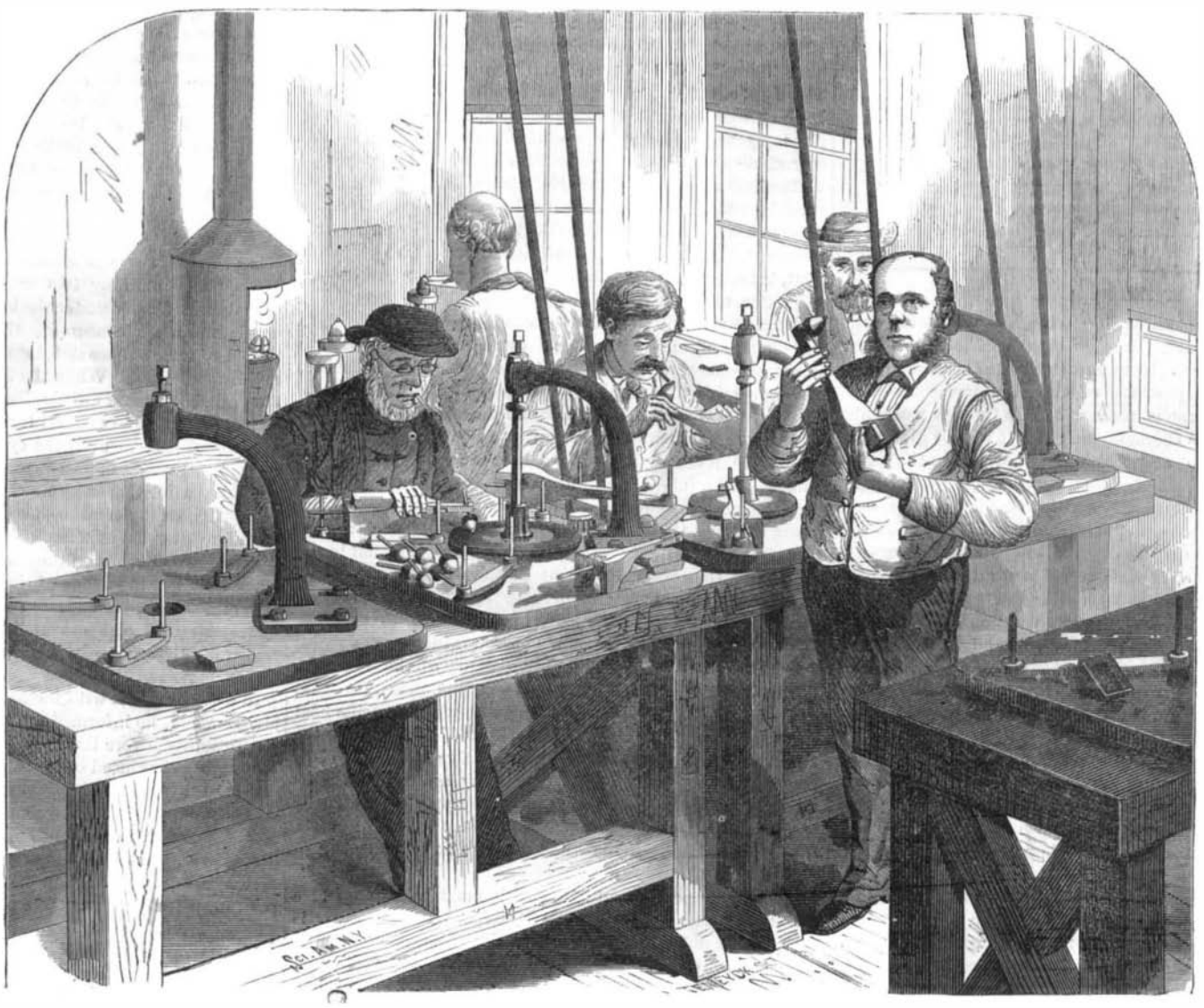
THE MANUFACTORY.

We have thus briefly touched upon the organization of the New York Diamond Company, as a part of the history of the art in the United States, from which others in future will trace its growth. Success, we are told, has been encountered, as jewelers and owners of gems necessarily prefer sending their diamonds to a locality where they may be repaired or re-cut without undergoing the perils of an ocean voyage. Twenty thousand dollars worth of the stones, we learn, are received regularly each fortnight, while millions of dollars worth are yearly handled. The largest diamonds ever brought within the country, one of which weighed 80 carats, have, through the same agency, been imported.

We recently were enabled to visit this establishment, situated in a small building in Fifteenth street, a few steps from Union Square, in this city, and there to follow the interesting operations which we are about to describe. As, in all descriptions, general explanations are first in order, we were at the outset informed that the business is divided into three entirely distinct branches—cleaving, cutting, and polishing. Also, that each class is a separate art, and that the workman finds the attainment of any one sufficient labor for the balance of his existence without troubling himself about the others. Hence, no one man can carry a stone through all the manipulations. A cutter cannot cleave, nor does a polisher know aught about cutting; and even further, a polisher or cutter of a brilliant cannot produce a rose diamond, and *vice versâ*; so that, in fact, each individual has his specialty, and there stops his knowledge.

NATURE OF THE DIAMOND.

The diamond itself, as all are aware, is nothing but carbon, a combustible body. It is crystalized mostly in the shape of an octohedron (two four-sided pyramids united at their bases) or rhombic dodecahedron, the latter being the commonest. In its black form—as used for stone drilling or sawing—it is the hardest known substance, and in this state differs from the jewel, which has foliated passages parallel to the faces of figure, in which directions it may be split. In the accompanying engraving (Fig. 4) is represented an enlarged section of the rough gem, showing the grain, along which it may be as cleanly cleft as a piece of wood. The resemblance to the latter substance is increased by the fact that there are so called knots, which cause a conchoidal instead of a straight clean fracture.

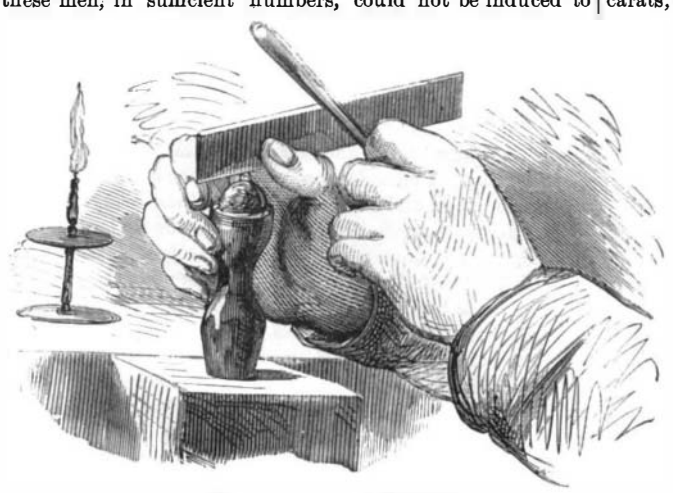


DIAMOND POLISHERS OR SLYPERS.

THE CLEAVER.

This much imparted by way of preface, we were conducted to the apartment occupied by the cleaver, or *klover*, as he is called in Holland. This artist, we were informed, must possess a greater degree of skill than any other workman. So difficult is his labor that probably there do not exist twenty-five cleavers to every five hundred polishers and cutters in the world. The *klover* in Holland is taught from boyhood, and is usually the son of the owner of the establishment, outside parties being rarely instructed. On a small table in front of the workman was a little box divided into two compartments, the furthest containing a covered tray for the reception of stones. The other division was made deeper and had a false bottom, being finely perforated. Also on the table were a number of sticks like spindles, which, with a couple of knives (to which we shall presently allude), a metal rod for a hammer, a pair of scales, and a spirit lamp, constituted the entire kit.

Opening a number of little envelopes, each marked with a full description of its contents, the cleaver first put into our hands a quantity of rough stones. They seemed of irregular shape and varied in size, from that of a pin head to a large pea. Some pieces were quite flat and closely resembled mica. Selecting a diamond from the heap, the artist glanced at it a moment and then secured it in a knob of cement (brick dust and rosin) on the end of one of his spin-



SPLITTING THE DIAMOND.

CUTTING THE DIAMOND.

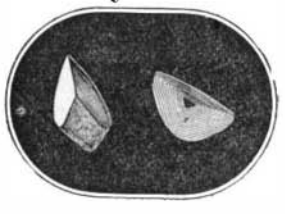
Continued on page 215.

[*Continued from page 207.*]

dles. Taking a fragment of a stone that had already been operated upon, he fastened it in a second spindle in similar manner. Next, with an implement in each hand, he brought the diamonds together, steadying the shanks of his tools against two metal projections on the edge of the box before him. Applying the second diamond to the rough gem, with a quick grinding motion he rapidly cut a notch in the latter; it was hardly the work of an instant, but the line was perceptible.

At this point our curiosity prompted us to ask explanation, and suspending his labor, the cleaver showed us that there were flaws in the stone which had to be cut off and, besides, other pieces to be removed to give the gem its proper shape; so that probably, of the whole rough jewel, hardly one half would be available. We looked wisely for the flaws but utterly failed to detect them, a fact not be wondered at when we were informed by the artist that this ability constituted an important part of his art. "Indeed," he observed, "I have to know the structure of a diamond far more intimately than a physician that of the human body." As hardly any two stones are alike, and no rule can be laid down for the work, some idea may be gained of the consummate skill which enables a man to pick up a tiny fragment, glance at it once, and instantly detect not only flaws or streaks but where they are located, in the heart or on the surface, to make up his mind exactly what microscopic pieces must be removed, their size, and how they may be cut to turn them to best account, and, finally, how to so divide the stone as to produce the best color. And all this so quickly that, although we saw half a dozen stones operated upon, we asked afterwards: When the workman had examined them? We had not noticed the single swift look given at each, as one after another was split by the artist as he continued his explanations.

Fig. 4

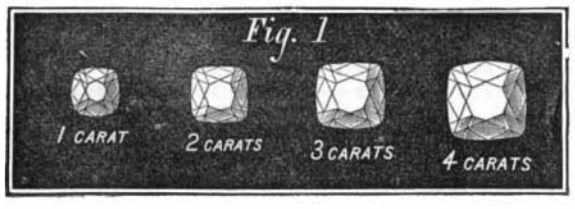


SPLITTING THE DIAMOND.

We left the diamond, to indulge in the above digression, with a streak cut across it at the point at which it was to be divided. Placing the spindle containing the gem upright before him, the operator placed one of his knives directly over the cleft. The knife used was nothing more than a piece of steel, perfectly flat, with a square edge, and about six inches long. It is ground blunt purposely, for if it were keen, the hard stone would quickly turn the edge. Tapping the back of the blade lightly with his iron rod, the artist split off a fragment and then, melting his cement and removing the parts, showed us a clean smooth cut (see Fig. 4).

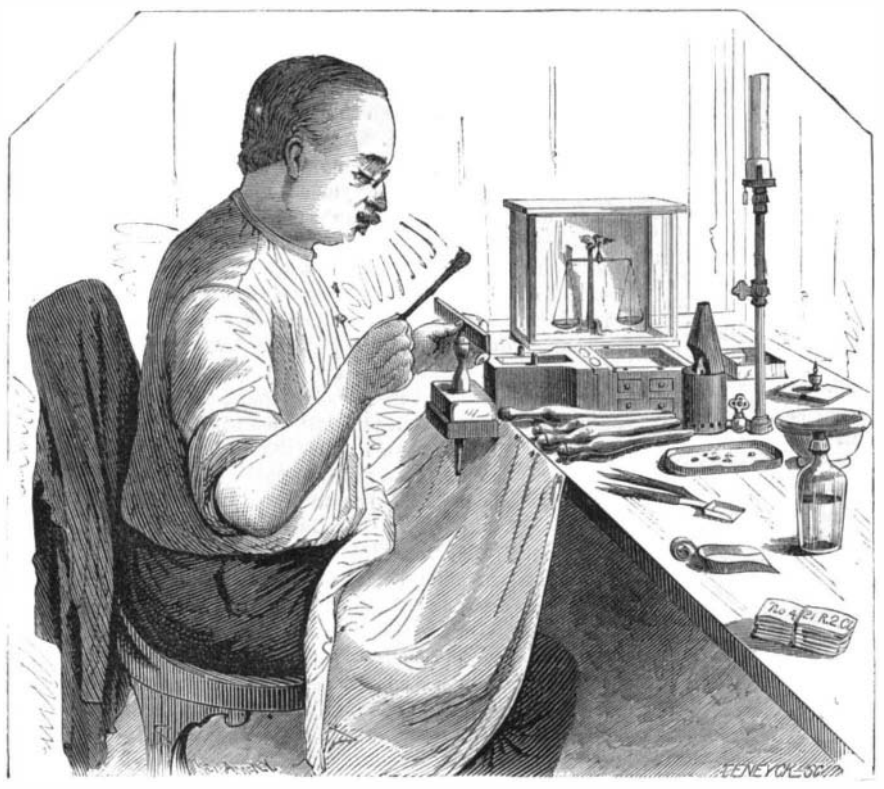
"But is not this a very risky performance?" we almost involuntarily exclaimed. "Suppose that you make a mistake?" The workman smiled superior, and explained that such is hardly possible, though he admitted that it would be a very easy matter to halve the value of a gem by a single false stroke. Imagine a $5,000 diamond—and that is not a large one—thus treated; $2,500 irretrievably lost by a single tap of the hammer! But then, with good sized stones, the work does not seem so difficult as with jewels no larger than pin heads, so small indeed that, in some cases, they number as many as 300 to the carat in the rough, or 400 finished. An idea of the relative sizes, proportionate to the weight of the stones, may be gained from Fig. 1, representing diamonds of 1, 2, 3, and 4 carats. Of course nothing is wasted; the dust that falls through the false bottom of the box, we shall find again in the hands of the polishers, while the odd scraps are cut into rose diamonds, or the little sparkling grains used for inlaying initials and similar fine work in gold jewelry.

Fig. 1

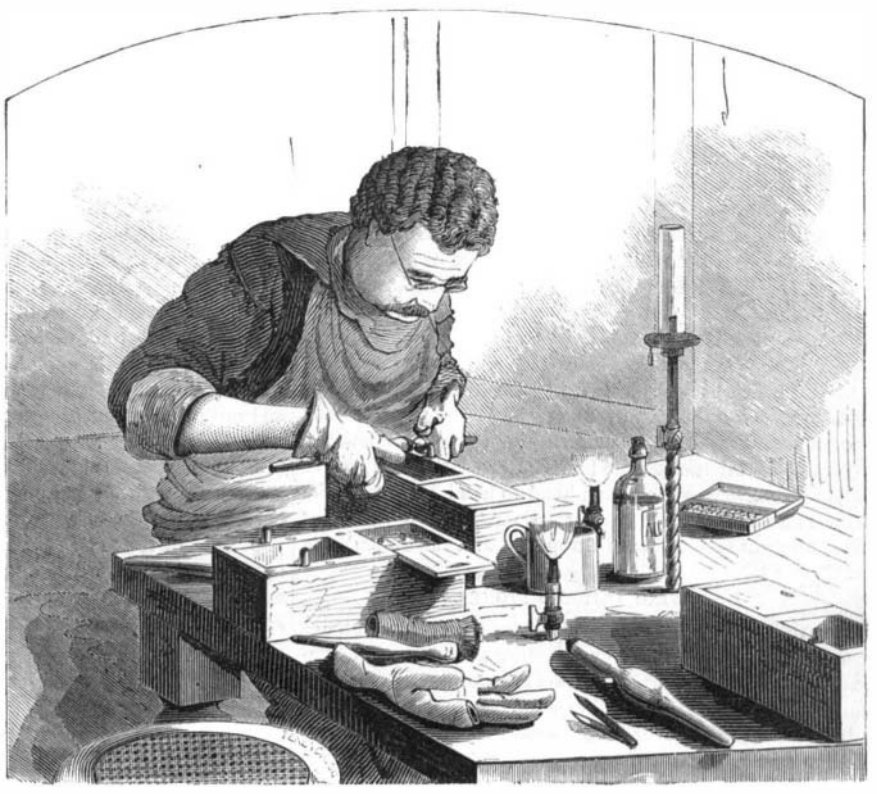


THE SHAPES IN WHICH DIAMONDS ARE CUT.

Leaving the *klover* at his delicate labor, we were afterwards conducted to the cutter or *snyder*. Three workmen were engaged in shaping the diamonds after the rough forms indicated by the work of the cleaver. Regarding these shapes, a word is here necessary. The brilliant (Fig. 2) displays the luster of the stone to the greatest advantage, and is described as obtained by two truncated pyramids united together by one common base, the upper pyramid being much more truncated than the lower. *a* is the crown and *e* the collet, the two principal divisions formed by the girdle, *c*. *d* is the table, and the opposite side below, the culasse. The faces are called facets, and, including table and culasse, may number sixty-four. The rose diamond (Fig. 3) has a crown but no collet, that is, one side is flat; and it is usually made from stones and fragments which would not, without loss, form good brilliants. Then there are table diamonds, which are flat and have little luster, and bastard diamonds or those of mixed shape. The brilliant and the rose are the general types, and those with which we have in the following description to deal.



THE CLEAVER OR *KLOVER*



THE CUTTER OR *SNYDER*.

THE SETTER.

THE CUTTERS.

Our artist has graphically depicted the cutter at his work in the engraving. The same form of box used by the cleaver is before him, and the diamonds are fastened by cement, as before, in the ends of spindles. The cutter's labor is purely "diamond cut diamond." The stone to be cut is held in its setting firmly in the left hand, while the cutting piece is moved by the right. Both gems are of course affected by the mutual abrasion, but the attention of the workman is directed to but one. Very slowly the faces are ground away; no measurements are taken or angles calculated. The eye is the only guide, and it seems to be a faultless one. As soon as the first stone was finished, the diamond used for cutting it is operated upon, so that diamond No. 2 is, in turn, cut by No. 3, this by No. 4, and so on. Again the gems were handed to us for examination; all their mica-like sheen was gone; and, were it not for their form, they presented no different appearance from rough quartz pebbles. The friction dulls them, for they are ground together with considerable force, the workman being obliged to protect his hands by thick coatings against the rubbing action of the tool.

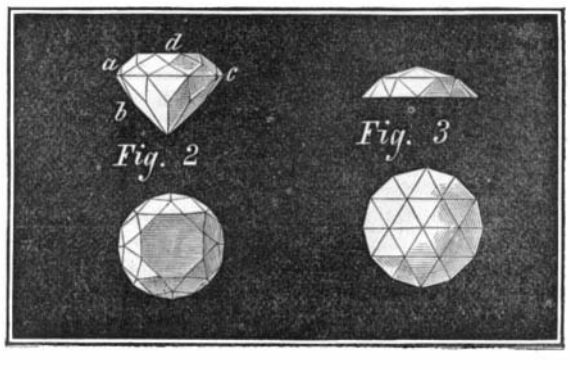
POLISHING THE DIAMOND—THE SETTER.

The polishing operation next claimed our attention; and ascending to an upper story, we found the polishers or *slypers* at their work, each man with a machine before him, as represented in the large engraving on our front page. In addition to these workmen is the setter, and with him we have first to deal. At one side of the room was a small charcoal furnace in which a number of metal acorns seemed to be roasting. Each of the latter consisted of a copper cup about an inch and a half in diameter, provided with a stem of stout wire of the same metal and filled with plumber's solder. As these rested on the glowing coals, the setter occasionally tried the hardness of the solder with his forceps until the metal became of about the consistency of putty. Quickly removing an acorn, or, to use the technical name, a "dopp," from the fire, he placed it upright in a small stand. Then he fixed a diamond exactly in the center of the plastic metal, and, with his fingers, coolly molded the latter in conical shape around it. Burning seemed to have no terrors for him, and although when the dopp was plunged in water it hissed at a great rate, the hand of the workman showed no effect of the heat. Each brilliant, large or small, has to undergo this operation once for each facet; that is, the setter must reset it so that every one of its facets in succession may be exactly horizontal and outside the holding metal, in order that each face may receive its proper polish—an operation requiring no small amount of delicacy and skill.

THE DOPP.

THE POLISHERS.

Again referring to the large engraving on our front page, the polishers were seated before long tables, on which were swiftly rotating horizontal disks fastened on vertical spindles, the lower ends of which revolved in antifriction steps. The disks, we were told, revolved at the rate of 2,000 turns a minute, and yet the bearings kept perfectly cool. The machine is an invention of Mr. Hermann's and an improvement upon the old apparatus used in Amsterdam, a specimen of which he exhibited to us. The construction of the latter



seemed very rude and primitive, being formed almost entirely of wood; the bearings, it is stated, were continually beating and wearing out.

The disks or *shives* are circular plates of a composition containing both iron and steel, and are made and turned in the establishment. They are ground in lines, at an angle from center to circumference, so as to hold the oil and diamond dust used in the polishing operation.

Three diamonds, set as above described, are ground at once, by each polisher. The stem of the dopp is fastened in tongs or clamps, the extremity of the latter being supported by legs an inch or so high. Two thirds of the dust ground off in the cutting is allowed to polish each diamond, and this, mixed with oil, is applied to the stone by the quills which the men seemed to be phlegmatically chewing. The adjusting of the gem on the disk requires wonderful accuracy in order that exactly the proper facet be ground and no more; for the slightest mistake might cutaway an angle and produce serious damage to the stone. The reader will share in the astonishment we felt on learning that this extremely delicate work was done by feeling. So sensitive is the touch of the artist that he tells by pressing on the stem of the dopp exactly whether it lies true against the shive or not, and by his fingers adjusts the stone over incredibly minute angles and distances. This goes on until each facet is brought to the requisite brilliancy. Standing by one of the machines, we saw, as the diamond was removed from time to time from the disk, the bright spot on its dull face gradually enlarge, as heavier weights were put upon the tongs to press the stone with increased force against the shive. Sometimes the gem defies all efforts, the hard outer coating refuses to yield, and then it is passed from hand to hand, and for weeks each workman tries to conquer it. Sometimes they fail; at others, a bright spot at length appears, and the difficulty is over.

RENEWING INJURED STONES.

It is to this portion of the establishment that injured stones are sent for repairing. We were shown a number of diamonds that had been through the Chicago fire. They had become intensely heated and then suddenly cooled. A white hard film had formed over them, necessitating as careful repolishing as the unfinished gem. We were told that it is a common fault among jewelers to thus hurt the stones during the process of setting them. The difficulty can be easily avoided by allowing the diamonds to cool gradually instead of plunging them at once into cold water. It is the sudden transition and not the heat that does the injury.

ABOUT THE WORKMEN AND THEIR PAY.

Our examination here concluded, for polishing is the last process. The workmen, numbering thirty-five in all, we learned, were all Israelites, and, with the exception of the cleaver, were paid by piece work. Their wages reach from 60 to 200 dollars a week, depending on the skill and experience of the artist. The greater number of carats manipulated and the more diamonds there are to the carat, the higher the price paid for the work. The establishment is necessarily organized with great strictness, and every diamond is weighed, registered and fully traced throughout its entire course. Large and valuable stones, before being operated upon, are made the subject of a consultation between the head of the company, the cleaver, chief cutter and chief polisher. Each gives his view, and thus the question of shape, color, etc., is carefully determined.

WHERE THE DIAMONDS COME FROM.

The diamonds are principally imported hither from Brazil. South African gems have caused no very marked effect in the market. They are fine, but, it is stated, more difficult to cut than those from South America. The Arizona swindle created considerable excitement when the first "salted" stones reached the trade, but of course the dismay of the diamond merchants was allayed when the fraud was exposed.

DIAMOND CUTTING IN ENGLAND.

We notice that diamond cutting has recently been introduced in Birmingham, England, where there is every prospect of the art reaching a flourishing state. Recent advices also inform us that a huge diamond has been discovered and brought from the Cape. It weighs 288⅝ carats in the rough, and when cut will be half as large again as the world renowned Koh-i-Noor.

PROSPECTS OF THE ART.

We see no reason why the art which we have described should not grow in this country to be an important branch of national industry. To Mr. Hermann, now the President of the New York Diamond Company, a corporation of wealthy gentlemen, founded by himself, belongs the credit of its establishment among us, and the consequent enabling of the artisans of the United States, who may be instructed in his *ateliers*, to compete with and successfully rival the monopoly which, for centuries, has maintained an exclusive and undisputed supremacy in the old world.

The Smokometer.

We have heard of the idea of laying oxygen in pipes through dwellings for purposes of ventilation and purification of the air, of the scheme for similarly supplying carbonic acid for the extinguishment of fire, and of the ingenious proposal to supply milk to our dwellings through conduits leading from suitable reservoirs. Further still, we have perused the glowing prospectus of the electric piano inventor, who proposes to give us the means of turning off or on a flow of music as easily as a stream from a water faucet, and we remember having read of the telephone by which the choicest vocal efforts of celebrated singers might be brought into our parlors as easily as the voice of the Bridget hailing us from the nether world through the speaking trumpet. But now we have found an idea which surpasses all. According to the *Virginia City Territorial Enterprise*, a Professor Maulesel is going to erect extensive works similar to those of a gas company. In these, there will be large retorts in which tobacco will be burned, and the smoke thus produced will pass through proper pipes to a large bell shaped receptacle, similar to a gasometer, where it will be cooled and purified and so scented as to have the flavor of the finest Havana cigar. From the smokometer a main pipe will lead up into the city, and from this will be small branch pipes leading to all the principal houses and saloons in the town. In every house where the smoke is taken, there will be placed a meter, similar to a gas meter but much more delicately constructed. Running from these meters will be pipes leading to all the rooms in the house, and connected with these pipes, at convenient points, will be long flexible tubes, each tipped with a handsome amber mouth piece for the comfort and convenience of smokers.

When a man desires to take a smoke, he has not to go to the trouble of hunting up tobacco and filling his pipe, then of finding and lighting a match, and perhaps burning his fingers, and afterward getting fire and ashes upon his clothes half a dozen times before his smoke is ended. There is none of this trouble and vexation. He has only to place the amber mouth piece between his lips, turn a small silver thumbscrew, and the cool, delicious, perfumed smoke glides into his mouth. By this ingenious and delightful arrangement, all danger of fires from pipes and cigars will be obviated, and millions in valuable property annually saved.

An india rubber receptacle filled with smoke is arranged in the breast, inside the shirt bosom, for smokers to draw from while walking in the street; and ladies, with whom it is conjectured the delicately flavored fumes will become very popular, are to have for their use elegantly carved amber mouth pieces, hooped about with gold and set with diamonds and other gems. When out walking their reservoir of smoke will be contained in the pannier, to which it will impart a much more symmetrical shape than can be attained by the use of newspapers; besides, by giving the rubber of the smoke tank a suitable thickness and strength, it will be found to be very convenient when the wearer desires to sit, as it will serve as a cushion, a something which is often a great convenience and comfort.

Maulesel is a name as yet unknown to fame; and it may be noticed, as a coincidence quite remarkable, that the generic name of the ingenious idea is contained in its last syllable. The Professor, we presume, is somewise connected with Professor Cantell A. Biglie, who recently aroused popular curiosity in this city by announcing, in widely distributed handbills, an aerial flight from the steeple of Trinity Church.

Three Hundred Miles of Oil Pipes.

The system of transporting oil, by means of pipes laid over moderate distances, has been in practice in the oil districts of Pennsylvania for several years, proving a convenient means for carriage and a profitable investment for large amounts of capital. While the success of the scheme has thus been demonstrated as applied to comparatively small sections of country, it remains yet to be determined whether the project can be carried out on a gigantic scale over more extended space. With the late discoveries in Butler county, Pa., it appears that interest in the plan, suggested we believe some years ago, has revived, and the idea of transporting oil through iron pipes, from Titusville over the Alleghanies to Philadelphia on the sea board, a distance of 260 miles, is now exciting considerable attention.

Mr. G. W. Platt, an engineer quite well known through out the country from the fact of having superintended the construction of the Holley waterworks system in various cities, gives, in a letter to the *Titusville Herald*, detailed specifications for the construction of a huge conduit of this description. He considers the scheme entirely practicable, and estimates its cost at $4,406,150. It is proposed to lay a cast iron six inch pipe, in a bee line between the points above named, which at one locality of its route will be 3,000 feet above the sea level; 40 miles of pipe will be allowed for undulations, so that the tube will, from end to end, measure fully 300 miles. Its contents will be 37,000 barrels of oil, and it is asserted that there will be no more difficulty in ensuring a flow through the bore than there now is in the water mains of London or Chicago, both of which systems each aggregate 300 miles in length. Between Titusville and the summit, a distance of 40 miles, eight pumping stations will be established, so as to relieve undue strain on the pipe. Each pump will have to raise the oil 300 feet. Water by the Holley plan of piston pumps is elevated to this hight, and the friction of eight miles (the space between stations) is overcome at the rate of a million gallons per twenty-four hours, which is equivalent to 23,000 barrels of oil, fluid measure. The cost of the five pumps, machinery, etc., is estimated at $50,000; in addition to which, there must be as many tanks of 25,000 gallons capacity, each costing $72,500, and finally a huge 100,000 gallon reservoir, worth $50,000 more at the summit.

Mr. Platt enters into detail regarding friction with the tube and other drawbacks, which, however, he proposes to obviate at once by establishing, if necessary, more pumping stations: and he finally concludes that 23,000 barrels may be delivered every twenty-four hours, at ten cents per barrel. He figures up the profits as follows: The pipe would deliver 7,300,000 barrels of oil per anuum, which, at a transportation rate of 50 cents per barrel, would yield $3,650,000. The cost of running, together with interest on capital, amounts to $412,717, giving, therefore, a profit per annum of $3,237,738, supposing the line to be run at its full capacity. The pipe could be thoroughly tested with water and thus leakage obviated, while, it is believed that, it would be as indestructible as an ordinary water main. The loss from other sources of waste during transport, it is further considered, would not be so great as is now the case in the regular tank cars.

A Word to Apprentices.

"Forfex" gives our youths the following advice: "Education is the basis of all success in life. It is much to your interest to recognize this fact as early as possible. Your shiftless, elder companions in the shop will tell you that affluence and ease result from mere luck. With display of dignified independence, they challenge your admiration for their manliness by proclaiming themselves as good as those persons whose apparent leisure, luxury and dress awaken a feeling of hostility, which they endeavor to intensify by the bitterness of comparison. As you have little intercourse with the world during the active hours of the day, unless warned by the voice of experience you are apt to imbibe these hurtful impressions, which indicate vindictive jealousy, the consequence of dense, wilful ignorance. The senseless discord that destroys the identity of interest of capital and labor is born of such parentage. Persons advocating these sentiments are generally men who ridicule the efforts of young mechanics desirous of self improvement. They harangue idle crowds at strike meetings and demonstrations, which they are pleased to consider, in spread-eagle phrase, 'the efforts of downtrodden working men to achieve their independence.' Drinking saloons are the chosen theaters of their wordy disaffection. They crave applause, and endeavor, by mock heroism, to entice you to places where lost time and squandered earnings are not the only expenses; for, under their tuition, the root of false principles is made to flourish in the soil of intemperance. Such influences should be shunned as carefully as we avoid a loathsome disease. Every man will gravitate to the sphere of life for which his acquirements fit him, and neither higher nor lower. Those sterling men round us, who represent the wealth and weight of a great people, are but reaping the reward of time well spent; and could we retrace the course they have pursued, we would find the student's lamp illuminating the hours that end days spent in exhausting toil. You may be told that many educated men achieve but little in the great struggle of life; yet would they not have done much less if they had been aided by the brute force of ignorance alone? We know of a man, now occupying a position of responsibility under the government, who, some years since, broke scrap iron with a sledge for a foundery and axle forge, day after day, unsheltered from the weather; yet he found time to read at least one hour per day, as well as to educate himself in useful branches of learning. His first expenditure for mental improvement purchased a Webster's Dictionary, a year's subscription to a leading scientific journal, and a daily newspaper. He now owns a library which would do credit to a university, and he is known to and esteemed by our most prominent citizens. A different course when a young man would have enrolled him in that army which stupidly drudges out a mere existence.

As you value your future happiness, devote as much time as you reasonably can to education. Throw away your boxing gloves, for the exercise which they afford can be had from other sources, without pernicious associations. Let your shop mates dub you 'a flat,' if they choose, because you resign billiards, and know nothing of the mysteries of keno; and spend your evenings in the peaceful acquirement of knowledge, which brings length of days, and tranquillity unembittered by the experiences of the mere sensualist."

New and Remarkable Cannon.

The German journals announce that the recent trials of new guns on iron plated targets, which took place at Tegel, near Berlin, fully satisfied all expectations. The shot from the 11 inch ring cast steel gun penetrated an iron plate 12 inches thick, that from the 10 inch gun of the same pattern an iron plate of 11 inches, and there was force to spare in both cases. At Krupp's works, at Essen, trials have been made with the newly constructed 30½ centimeters (12 inch) ring cast steel gun, and the result justifies the belief that this gun will pierce 14 and perhaps 15 inches of armor. Thus, the strongest ironclad now existing, her British Majesty's ship Devastation, which is provided with an armor of 14 inches, will no longer be invulnerable if opposed to such guns.

Church Clocks and Chimes.

W. M. says that the Church of the Holy Redeemer, on 3rd street, between avenues A and B, New York city, has a very interesting clock. This specimen of workmanship was made in 1869, by Edward Emrich, of Rochester, N. Y. The movement is guided by an anchor escapement with solid jeweled pallets; the wooden pendulum is a 2 second one, its length being 14 feet; the weight of the movement is 100 lbs.; the hour-striking part has a weight of 600 lbs. and the hammer striking the bell weighs 32 lbs The quarter striking part has 500 lbs. weight, bearing three levers for the three hammers striking the four quarters. The wheels of the clock are made of fine bronze and are as well finished as a watch. The dials are 8 feet in diameter and the figures are cast in composition. The same maker also finished in 1869 the clock and attachments to the great chimes of St. Joseph's Cathedral in Buffalo, N. Y. The chime numbers 43 bells, which were cast at Le Mans, France, and were ordered and imported by the late Rt. Rev. Bishop Timon, of Buffalo, after being exhibited in the World's Fair in Paris, 1867.

Secondary Spectra.

Professor O. N. Rood, of Columbia College, New York city, communicates a paper to the *American Journal of Science and Arts*, on the secondary or residual spectrum found on passing a ray of white light through two prisms of different substances arranged to compensate each other for color. This secondary spectrum is generally of small dimensions and peculiar appearance, and is due to the circumstance that the spacing of the colors in the two original spectra is not accurately correspondent. In dimensions, it varies with the amount of the disproportion of the original constituents.

The writer, after alluding to Sir David Brewster's investigations in the same direction, observes that, by proceedings of a different kind, he has succeeded in producing secondary spectra, comparatively gigantic in size, which display the fixed lines with a distinctness which allows the study of their peculiar construction by an ordinary spectroscopic mirror. The constituents used are one spectrum furnished by oil of cassia, bisulphide of carbon, or even flint glass, and the other a normal spectrum obtained by the diffraction grating. Thus it is considered that a very near approach is made to the maximum difference of spacing attainable in the present state of optical science; and hence to the secondary spectrum is given its maximum dimensions.

The lines of the solar spectrum not being adapted for the study of the arrangement of the secondary spectrum, a number of chemical lines of easy identification were selected. The cases considered in experimenting were three. 1. Where the opposing spectra are of equal or nearly equal lengths. 2. Where the spectrum from the grating predominates. 3. Where the prismatic spectrum is the longer of the two. Measurements are given, in each instance, of both primary spectra, also of the actual secondary spectrum due to the same in combination, and of the secondary spectrum obtained by construction. In the last case, Professor Rood finds that the distance of any two lines apart in the secondary spectrum will be equal to one half the corresponding distances in the primary constituents; and that the secondary spectrum, thus constructed, will always be half the size of the actual physical spectrum which it represents. From this, he deduces a formula by which, taken in connection with maps of the primary spectra, he is enabled to construct a correct map of the secondary spectrum in any case.

This construction furnishes a simple means of determining the size and arrangement of the secondary spectrum furnished by two prisms of selected angles, placed in any desired positions relative to the incident ray and to each other. The accuracy of the result depends on the exactness with which the measurements on the primary constituents are effected, and, it is considered, may practically prove useful in dealing with the secondary spectra in optical instruments.

In order to reveal the nature of the secondary spectrum at a glance and permit of its study in a qualitative way, instead of using the slit as a source of light, a pin hole is employed; and the refraction edge of the prism being vertical, the diffraction grating is revolved in its own plane, somewhat so that its lines shall be no longer vertical. This process reduces the secondary spectrum to a line which, on rotating the grating or prism, assumes various curves. It is considered, therefore, that a true secondary spectrum must be regarded as a resultant spectrum in which any two, even closely adjacent, lines are united; even although the actual union of different tints has not been effected and the general appearance still resembles that of one of the primary constituents.

A Trap to Catch Lions.

In Algeria, there is annually a great loss of life and property, by the depredations of lions. The loss of property is estimated at $50,000 a year. The inhabitants cut away the forests as a means of protection against the wild beasts. M. Cheret devotes himself wholly to their extermination. As an assisting means in this, his life work, he has invented a lion trap, made as follows:

The frame and bars are of iron. It is 10 feet long, 6 feet 6 inches wide, and the same in hight. Mounted on three cast iron wheels of small diameter, it can be moved on difficult ground. The upper part opens with folding doors, like a wardrobe, which close of themselves at the slightest shock given to springs of steel. Catches retain the lids as they fall, and imprison the animal as soon as he touches the bottom of the trap. The plan is to place this trap, properly baited, on the ground frequented by the wild animals, and then, when the game is caught, to wheel the machine away to some menagerie prepared for the purpose.

Fatalities from Lightning.

The human mortality from lightning is not generally on a large scale, and might be very much reduced by precautions on the part of builders; so thinks the *Building News*. Arago estimated that the number of deaths from this cause amounted in France to about 70 in the year; Bondin calculated that from 1835 to 1852 1,308 so perished; none in November, December, January, and February, but most in June and August. The lowest rate is assigned to Belgium, and the next to Sweden, the United States and England being about on a par. As a rule, however, these fatalities do not occur inside a structure of any kind. The peril, as experience shows, is less in a crowded town than in a village or in the open country, and, naturally, the more elevated structures are the most liable to be struck. Fuller, indeed, in his "Church History," asserts that there scarcely ever existed a great abbey in England which had not been, at one time or another, wholly or partially destroyed by lightning, and his citations, taken in comparison with the records of our own times, are certainly remarkable. In all cases it is the spire, the tower, and the dome which has been mutilated. As to ordinary habitations, all sorts of theories are in vogue on the subject of danger and safety. Some rely on thick glass in the windows, and some on register stoves; others recommend stone roofs instead of slate, and others tell timid people that they should live in a hollow. It is contended on this side that there should be the least possible admixture of metal in the combination of an inhabited structure; and on that, that all the bells beneath the roof should be kept continually ringing, just as, in obedience to an old superstition, cannon are fired at sea. The mass of evidence upon this topic points, however, to the one conclusion already suggested, that a good lightning conductor is the solitary safeguard; but that, unless good, it is worse than none.

Cumberland Gap Cave.

A correspondent, A. L. S., says, in reference to this remarkable formation, described in our issue of September 13, that, after General Morgan's retreat from that spot, the cave was explored for a distance of four miles by Confederate soldiers, and a new opening was discovered, 3 miles from the one mentioned by H. B. N. The place has never been thoroughly investigated, but chambers, far surpassing in grandeur that described by our earlier correspondent, have been found. In penetrating the rock, it is found that the new entrance leads for 6,000 yards through sandstone; and in this section of the cave, vast quantities of human bones of gigantic size were found, some of the skulls being large enough to put on over a man's head. It is intended, during the current month, to thoroughly explore the cave.

NEW BOOKS AND PUBLICATIONS.

PHYSICAL GEOGRAPHY. By Arnold Guyot, Author of "Earth and Man." New York: Scribner, Armstrong, & Co.

This is a very excellent work on a most interesting branch of study, and is a model school book, full of accurate information, placed before the reader in a lucid and concise style. It is well illustrated with maps and wood engravings.

A CATECHISM OF HIGH PRESSURE OR NON-CONDENSING STEAM ENGINES, including the Modeling, Constructing, Running and Management of Steam Engines and Steam Boilers. By Stephen Roper, Engineer. Philadelphia: Claxton, Remsen, & Haffelfinger, 624, 626, and 628 Market Street.

This is yet another handy book on the steam engine, and it contains much needed general information, as well as descriptions of many American improvements and specialties.

PRACTICAL DESIGNING OF RETAINING WALLS. By Arthur Jacob, A.B., A. I. C. E., late of H. M. Bombay Service. Price 50 cents. New York: D. Van Nostrand, 23 Murray and 27 Warren Streets.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]
From August 29 to September 4, 1873, inclusive.

BLOWER.—P. S. Justice, Philadelphia, Pa.
BURNISHING PHOTOGRAPHS.—G. P. Critcherson, Worcester, Mass.
ELECTRIC TELEGRAPH.—J. B. Stearns, Boston, Mass.
GAS.—W. Steers, New York city.
PRINTING PRESS.—G. F. Pabst, New York city, *et al.*
RAILWAY CAR SPRING.—H. Gardiner, New York city.
SEPARATING METALS.—S. W. Kirk, Philadelphia, Pa., *et al.*
SEWING MACHINE.—J. Knous, Hartford, Conn.
SURFACE CONDENSERS.—J. P. Bass, Bangor, Me.

Recent American and Foreign Patents.

Improved Hame Fastener.

Thomas L. Booker, Shady Grove, Va., assignor to himself and E. H. Booker, Donaldsonville, S. C.—The object of this invention is to provide ready and convenient means for adjusting and fastening hames on the collars of horses and mules; and it consists in a connecting band, screw bolts, and clips at the ends of the hame. The invention is specially adapted for draft horses, and for plantation use.

Improved Rotary Churn.

William H. Bunch, Windsor, N. C.—The body of the churn is provided with a closely fitting cover, to the lower side of which, upon the opposite sides of its center, are attached wings or stationary dashers. These wings are made curved upon the side against which the milk dashes.

Improved Picture Hangers.

Franklin W. Ely, Duluth, Minn.—The picture frame has a web attached to it at two points, one being below the center of the frame or picture, and the other near the top. The web, similar to suspender webbing, is doubled at one or both points where it is attached to the frame; but to outer portion a ring is attached, with which the suspending cord is connected. The use of the slide is to vary the inclination of the picture or frame. By moving the slide upward, the web is shortened, and the frame is brought nearer to an upright position; and when the slide is moved down the effect is contrary.

Improved Candlestick.

Samuel D. Hill, Downieville, Cal.—This invention consists in arranging the socket of the candlestick for different sizes of candles, by making it in two pieces connected by a slotted band spring.

Improved Metallic Lathing.

Timothy O'Callahan, Boston, Mass.—The object of this invention is to furnish an improved metallic sheathing for the inner walls of buildings. The ceiling and side walls of a building may be covered with sheets of cheap metal, having stamped, cast, or otherwise connected to its face dovetail shaped studs. The studs are in the shape of truncated pyramids, with face recesses for the firm adhesion of the plaster to be placed around and over them. These sheets are to be nailed or otherwise secured to the wall. Much less plaster is required for filling the space between the studs than for covering the ordinary lathed wall, and the work is performed in less time, while the plaster dries quicker, and is not so liable to crack.

Axle Box and Sleeve for Vehicle Wheel.

William H. Cowell, Columbus, O.—In this invention the axle is made of wood and the skein is fitted to the axle in the usual manner. There is a nut on the outer end of the skein and the sleeve is made of sheet metal and fitted on to the axle over the skein. A recess opens in this sleeve for the retention of the lubricating material. The interior of the pipe box is chambered out for containing the lubricating material, and the box is cast on a chill, to render it hard and durable. The sleeve may be made of sheet steel or composition metal, and not being confined, except by a lug or other device, to prevent its revolving with the wheel, it may be turned, when worn, upon one side, thus presenting a new surface for the bearing.

Improved Advertising Lamp.

Francisco R. Warner, Paris, France.—This invention consists of a metallic frame of peculiar form, adjustably attached to a lamp post and provided with removable glass plates, upon which the advertisements are displayed.

Improved Portable Steam Engine.

Reinhard Scheidler and John H. McNamar, Newark, Ohio.—This invention consists in the improvement of the heaters of portable engines. The pump is arranged in a vertical position on one side of the boiler near the smoke pipe, attaching it to a vertical supporting plate having a concave side, fitting the boiler and bolted to it; also having a bearing at the upper end for a countershaft for driving the pump, said shaft extending across the top of the boilers, in front of the smoke pipe, to a bearing on the other side, where it carries a pulley for turning it by a belt from the crank shaft at the front end of the boiler. The plate is detachably connected to the boiler, so that it can be taken off readily for shipping. The portion of the shaft having the crank for driving the pump connects with the other portion by a clutch which is shifted by a lever, so that the pump can be worked or not, at will. This arrangement is claimed to afford a simple, compact, and reliable connection of the pump in a portable engine, so that it can be stopped without stopping the engine whenever it maybe required to do so, which often happens, and causes considerable unnecessary delay in all portable engines having the pump directly connected to the cross head in the ordinary way. Moreover, it saves the unnecessary loss of power expended in running the pump when it is not required.

Improved Mallet.

Albert Holbrook, Providence, R. I.—The object of this invention is to furnish a durable rawhide mallet for the use of machinists and others in putting together, taking apart, fixing, or adjusting metallic or wooden machinery, and for all similar purposes. It consists in a mallet with one or more rawhide heads secured in a metallic socket, which is made of metal in one solid piece. The handle is secured in the socket in the ordinary manner. The socket or body has a recess at one or both ends which receives the heads. These heads are made of rawhide coiled up and dried, and then turned to the desired size and shape, and secured by means of a screw inside the socket.

Apparatus for Preserving Beer on Draft.

John W. Moore, Bellefonte, Pa., assignor to himself and P. Gray Meek, of same place.—This invention relates to means for introducing air into casks to take the place of the liquid drawn out; and it consists in the combination, with a flexible bag or air holder, of a valve and bellows mechanism of a novel construction. Into the bung hole of a cask containing beer or other liquid that would be injured by contact with air is fitted a hollow bung having a nozzle formed upon its inner end, to which is secured the mouth of the bag, made of rubber or other suitable material, and of sufficient size and elasticity to fill the cask when expanded. By this construction, as the liquid is drawn out of the cask, the air will enter the bag through the hollow bung and expand said bag to take the place of the liquid drawn out.

Improved Extension Table.

Christian Rieger, Morrisania, N. Y.—This invention consists in extension rails, hinged to the rails of the side table, and to extension legs. These extension rails are each made in two pieces, connected together by pivoted strips on the bottom and top of the rails. When the rails are extended, they are held in position by means of knob buttons. These buttons are attached to one part, and turn on a central pivot over on to the other part, thus holding the two pieces parallel with the rails of the side table. The cover of the table is in two parts, hinged together like ordinary card tables. When the extension rail is drawn out, the half of the table top is turned over on to it, thus making a square table. When the extension rails are folded, they are in a position with the half of the top turned back and resting on the other part of the top. There is a spring catch on the bottom of the drawer frame which engages with a lip on the side rail which holds the parts securely together. When the table is extended, the rails of the four sides present a uniform and finished appearance.

Improved Corn Planter.

William Mull, Rantoul, Ill.—In this invention the seed hoppers are attached to the frame of the machine. The ends of the dropping slide enter the lower parts of the hopper through holes in their inner sides. A spring has its upper end attached to a cross bar of the frame, and its lower end enters a hole in the dropping slide, to bring said slide back to its position when released from the device that moves it. To the slide, toward one end, is pivoted the end of a connecting rod, the other end of which is bent at right angles, passing through a short curved slot in a wheel or disk, and is secured in place by a nut or other convenient means. The wheel or disk is attached to the end of a short shaft which revolves in bearings attached to a cross bar of the frame, and to its other end is attached a bevel gear wheel, the teeth of which mesh into the teeth of a similar wheel attached to the axle, which revolves in bearings attached to the frame, and to its ends are rigidly attached wheels, so that the said wheels may carry the said axle with them in their revolution. In each end of the axle, at a little distance from the wheels, is formed a universal joint, so that the said wheels may accommodate themselves to the surface of the ground, however uneven said surface may be. A further use of the joint is to enable the wheels to be lifted by levers and rods when the machine is to be turned about, or the discharge of seed requires to be arrested.

Improved Door Fastener.

Henry Orcutt, Amherst, Wis.—This invention consists in applying a semicircular bar to a door and arranging a weighted lever to engage therewith (the bar being notched or perforated for the purpose), so that the door may be locked in any position, shut, open, or partly open. The contrivance is designed more particularly for stable, carriage house, barn and shop doors but it is alike applicable for doors of dwelling houses.

Improved Steam Generator.

Harry P. Wright, Bonaparte, Iowa.—This invention consists of secondary return flues, arranged in the masonry along the sides of the boiler, above the furnace, into which the heat is turned at the front of the boiler, instead of discharging into the smoke stack, thus economizing the heat by causing it to pass along the boiler once mere than in other arrangements.

Improved Fireproof Shutter.

John B. Cornell, New York city.—This invention consists of a door or shutter composed of three plates of metal united together side by side, the two outer sheets being plane, and the middle one being bent in zigzag or other form, so as to form channels or spaces between it and the outer sheets for the circulation of air or water to cool the door or shutter in case it is exposed to fire, and prevent the transmission of heat through the door.

Improved Earth Boring Machine.

Joseph Burns, Anamosa, Iowa.—In this invention the square auger shaft has a screw point fixed in it permanently. The lower part of the screw auger is fitted so as to be adjusted relatively to the point, to use said point with it or not, and will have a set screw to fasten it where it is required to be. The upper part of the screw auger is arranged to slide up and down freely, and rests on the lower part when boring. By the bar or plate, in which it is fitted to turn freely and in which it is confined by the collar this part of the auger is connected to cords, which pass over pulleys under, the platform to a drum, which is fitted loosely on the crank shaft, and clutches with it to be turned by it for elevating the borings when moved to the right by a lever, so that studs will engage, and it disengages them and lets the auger fall again when the lever is moved the other way. This shaft is the same one that is employed to turn the shaft for boring, and is itself turned by a shaft, pinion and wheel. The driving power is applied to the shaft by a belt from a steam engine, horse or other power; or it may be turned by hand.

Improved Mold or Box for Brick Press.

John McKenna, Cambria, Pa.—The press boxes for making fire brick have heretofore been cast solid and lined with steel. The steel facing soon wears away, so that the bricks are too large and untrue. The steel has then to be taken out and replaced with new, which can only be done at considerable expense. The object of this invention is to furnish a mold which shall obviate the difficulties experienced in the use of the usual press box.

Improved Plow Coupling.

Thomas L. Thrasher, Paris, Texas.—The invention has for its object to furnish an improved coupling for connecting two plows, to enable them to be guided and controlled by one man; and it consists in the bent bars strengthened at their bends by extra rods, provided at their lower ends with swiveled clamping plates and set screws, and at their upper ends with eyes, slides, and notches to receive the key.