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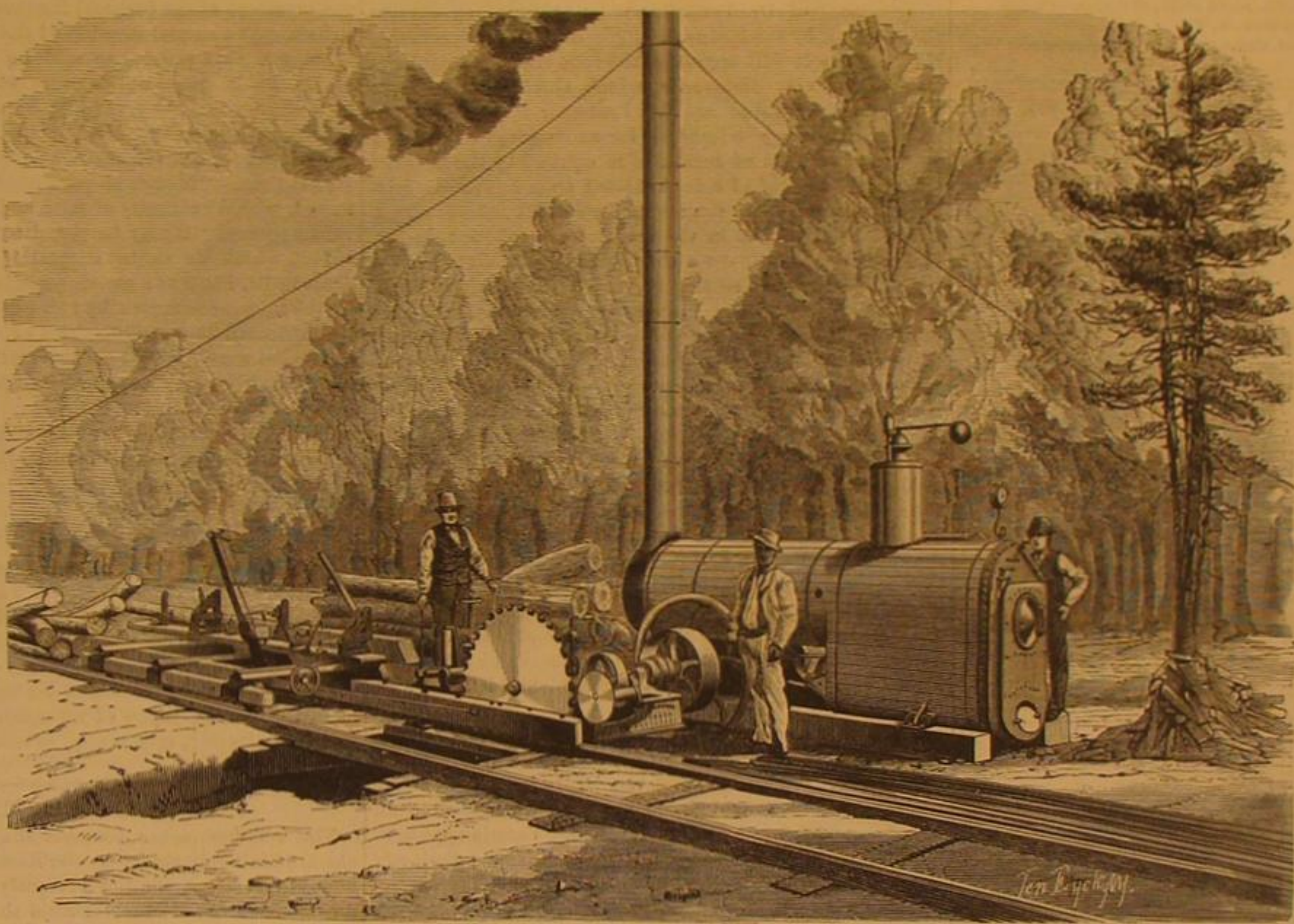
IMPROVED PORTABLE SAWMILL.

There is on exhibition at the Centennial a machine commonly known as the Canada sawmill, which has attracted much favorable notice both on account of the simplicity of its construction and the speed and accuracy with which it accomplishes its work. It was designed by the Waterous Engine Company, of Brantford, Ontario, Canada, expressly for use in the extensive lumber districts of the Dominion, to saw up the timber in the localities where it is felled, and thus to save the trouble and the expense of the carriage or rafting of the logs to distant points; and being portable, it may readily be moved from an exhausted part of a forest to a new situation. The machine is also excellently adapted for employment in shipyards, in most of which establishments in Nova Scotia and New Brunswick, we are informed, it has superseded whip sawing by hand.

In the annexed engravings, Fig. 1 represents the mill as it appeared at work while on exhibition at the Santiago (Chili) Exposition of 1875; and in Fig. 2 the portable boiler and engine are shown. The portable machine has a 20 horse power engine, which, together with its boiler, is of such weight and of such construction that both boiler and engine may easily be loaded on trucks, when changing the position of the mill, without any disconnection being necessary; so that the labor of a skillful machinist is not required to readjust the mechanism. The saw mandrel, feed, and gig work are compactly arranged in an iron frame, and can also be loaded and moved without being taken apart; so that, when resetting the mill, all that is necessary is to frame the foundation timbers previously used in the ground, set the mill on them, coupling the engine shaft and saw mandrel, lay the track, place the carriage on it, and the mill is then ready to start. The whole operation does not take more than from one to two days.



CANADIAN PORTABLE SAWMILL AT THE CENTENNIAL.

The boiler is supplied with sawdust grates, by means of which it is enabled to keep up a full supply of steam with no other fuel than pine sawdust and refuse edgings. It is also covered with hair felting and lagged with wood or sheet iron. Its form is clearly shown in Fig. 2. The plates are of the best English material, and the heads are Lowmoor iron. Each boiler is subjected to 120 lbs. cold water pressure before shipment. The 20 horse power engine drives a 56 inch saw, which will, it is claimed, cut from 6,000 to 10,000 feet of lumber per day, or 1,000 feet of one inch pine lumber in a single hour. The 25 horse power engine, which is usually employed in connection with a tubular stationary boiler, drives any size of saw up to 66 inches, and its capacity is said to be from 8,000 to 12,000 feet of lumber per day.

At the Chili Exposition, the 20 horse power mill, we are informed, sawed and edged 1,060 feet of lumber in 40 minutes, vanquishing all competitors and gaining a medal and diploma. It has received the first premiums at ten Canadian Provincial Exhibitions, besides a highly favorable report from the judges at the Centennial.

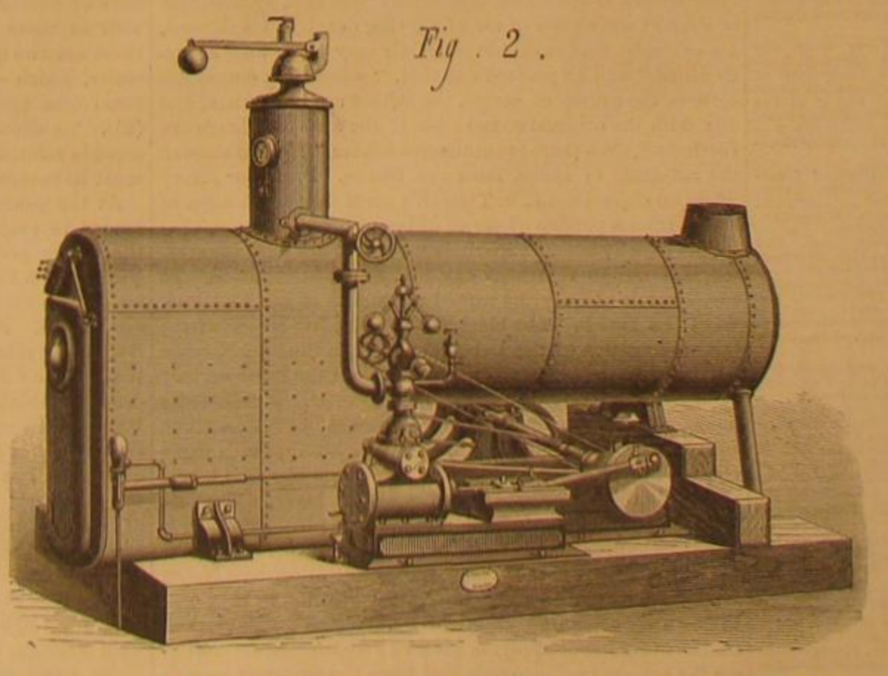


Fig. 2.

To fix fugitive colors in linens, muslins, etc., soak the fabric for an hour in a pail of water containing a tablespoonful of turpentine.

A Hint for Nervous Orators.

That distressing sensation known as stage fright, which often afflicts persons inexperienced in speaking before a large audience, can be removed by a few whiffs of ether Dr. William Fuller, of Montreal, says that either this remedy or a minute dose of morphia will remove all the spasm of the cerebral vessels and violent palpitation of the heart, and obviate the confusion and forgetfulness with which the sufferer is usually seized, so that he does not have to wait for symptoms of reaction to set in to allow him to "get warmed up," as the saying goes Too large doses of either remedy, it should be remembered, produce the opposite condition of the vessels, quite as fatal to a successful result. An objection is that reliance on this means may lead to a dangerous habit.

Drainage of the Eye Ball.

Dr. D. Weeker has introduced another new operation in ophthalmic surgery. It consists of a system of drainage effected by the introduction of a piece of gold wire through the membranes of the eye, which is so arranged that the patient is in no way inconvenienced by its presence. This new method is applicable to all cases in which the drainage of a liquid from the eye would be indicated, such as hydrophthalmia, staphyloma, detachment of the retina, absolute glaucoma, etc. Thus far the results have been encouraging.—*British Medical Journal.*

Open Air the Best Remedy for Consumption.

The conclusion reached by late observers is in favor of the open air treatment of consumption. The following case, given in the *British Medical Journal*, is illustrative: "An officer of a regiment contracted phthisis when stationed in the south of England. He was under medical treatment some time, and had the usual sick leave, but, on his return to duty, got worse again in the same way. The next time he was invalided with the upper lobe of the right lung seriously involved, in the third stage, with cavities; and he was examined by the usual medical board, and finally he sold out of the service and regiment. Under medical advice he took to traveling about this country and the Continent, to riding on horseback instead of walking, and attending meetings of the hounds frequently.

"Two or three years then elapsed, during which his case was withdrawn from my observation; and I was then surprised to meet him one day in the summer at Lord's cricket ground, looking quite recovered."

This report, by Surgeon Major W. T. Black, leads him to formulate the proposition: "It is living in the open air in a fine climate that is really beneficial for consumption, and not the mere climate of itself.'

"If this is not new, it is at least too often forgotten," says the *Medical and Surgical Reporter.* "A friend of ours, a medical gentleman, who has suffered from phthisical symptoms, and has traveled largely, has lauded the climate of Northern Africa as best suited for open air life in winter. The recently published book of Dr. Arthur Leared, "Morocco and the Moors," informs us that at Tangier the accommodation is good and the cost of living decidedly cheap. The ordinary summer temperature ranges between 78° and 82° Fah. The mean temperature of winter is about 56° Fah."

Portland Cement on Woodwork.

Portland cement has many uses in the garden and elsewhere, not generally apparent. Some of them are enumerated by the *Garden* as follows: When made into a thin solution like whitewash, this cement gives woodwork all the appearance of having been painted and sanded. Piles of stone may be set together with common mortar, and then the whole washed over with this cement, making it look like one immense block of gray sandstone. For temporary use, a flour barrel may have the hoops nailed, so as not to fly apart, and the inside washed with a thin paste of Portland cement, and it will serve for a year or more to hold water. Boards nailed together and washed with it make good hot water tanks; and it is of use in so many ways that it may be regarded as one of those peculiar things in a garden which it is always good to have at hand.

A cubic inch of charcoal has not less than 100 square feet of surface in its pores.

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(Illustrated articles are marked with an asterisk.)

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With 69 Illustrations.

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THE OCEAN ECHO—HENRY VS. TYNDALL AGAIN.

Even his arduous labors in connection with the Centennial Exposition, added to his other pursuits, have not been sufficient to cause the venerable leader of American scientists to relax his researches into his favorite acoustical problems during the past year; and he recently came before the National Academy of Sciences with a new series of discoveries and theories, which he modestly announced as a "few additional facts" related to the results of his previous investigations.

It will be remembered that, at the 1875 fall meeting of the above named association, Professor Henry read a paper on a similar subject—in fact, his attention has been enlisted in the same direction for many years—in which he changed the scientific duel between Professors Tyndall and Osborne Reynolds into a triangular controversy. While he contented himself with disagreeing with Reynolds in many points, he hurled such a host of convincing experiments against Tyndall's theories of "acoustic transparency" that those structures, which Reynolds had already badly undermined, had little substantial support left them, even in the minds of those perplexed physicists who watched this war of the giants from afar, and who scarcely ventured opinions of their own in view of the disagreement of so learned a triumvirate of doctors.

Now Professor Henry returns to the fray, and again proceeds to discomfit the results of the "scientific use of the imagination" of Dr. Tyndall, not by propounding adverse theories, but by the inexorable logic of actual experiment. How he does it will appear in the following brief explanation of the new discoveries, which chiefly relate to the "ocean echo." Loud sounds, Professor Henry says, are wanting in analogy to light, so far as concerns obeying its rule that the angle of incidence is equaled by the angle of reflection. Instead of being reflected from a parabolic mirror in parallel rays, sounds diverge in all directions. A whistle being located in the focus of a parabolic reflector, 12 feet in diameter, gave a sound which, at a distance of 4 miles, had diverged so that it reached the whole horizon, and was heard with equal intensity to the rear and in front of the reflector. The cause of this divergence is explained in two ways: first, we may suppose the crest of a sound wave to be abruptly terminated at either extremity, when the tendency of the compressed air which constitutes the wave will be to expand itself in all directions—laterally from the ends of the wave as well as directly in front. Second, another cause may probably be found in the retardation of the two ends of the wave as it proceeds from the mouth of the trumpet. This would occasion a curling of the ends of the wave, as well as an elongation of them as they proceed from the swelling aperture. In the tendency of the sound to spread is to be found an explanation of the action of the trumpet, which gives the sound beam a greater condensation along its axis, and thus checks its spreading. Thus a speaking trumpet may act as efficiently if lined with felt as if lined with metal.

Although the tendency of sound is to diverge in all directions from an axis, yet there are cases where "sound shadows" are produced. Professor Henry mentioned a case where a fog whistle was placed near the water level of an island on which was a conical elevation. Vessels approaching from the other side of the hill heard the sound distinctly at a distance of three miles; but when the distance was reduced to a mile, the sound was lost and not recovered at any smaller distance. Here the termination of the shadow was at the one mile point, at which the diverging beams of sound, passing over the crest of the island, bent down and reached the surface of the water.

These conclusions are applied to the elucidation of the ocean echo, which is a reverberation coming from the horizon, near the surface of the ocean, and from around a point in the prolongation of the axis of the trumpet. It will be remembered that last year, in a lecture before the Royal Institution, Professor Tyndall adduced a number of brilliant experiments to show that echoes may be caused by reflection of sound from clouds of air of varying density. He showed, for example, that invisible warm air may act as an "acoustic cloud," and he pointed out that, "when such clouds are close to the source of sound, the echoes are immediate, and mix with the original sound; but if the acoustic clouds are further off, then there are prolonged echoes." He also showed the reflection of sound from gas flames. Professor Henry offers no objection to Dr. Tyndall's proof that a reflection of sound from a portion of air of different density is possible; but he says Tyndall's experimental conditions are exaggerated, and fail to represent any real atmospheric state. To test Tyndall's theory, he turned the mouth of a trumpet toward the zenith. The blast was intense, but no echo from the prolongation of the axis, that is, from the zenith, came back, although it was audible all around the horizon, half of which was on land and half on water. A rain cloud passed over the trumpet, and even a few drops fell: still no sound from the zenith. Compare this with Tyndall's experiment, in which he showed that, while two hundred layers of muslin did not cut off sound, a single layer, when wet, did, the latter presenting continuity of the air. Certainly it might be supposed that the rain cloud would act in a somewhat similar manner to the wet fabric. Professor Henry repeated his experiments several times, failing in each case to find any substantial basis for Dr. Tyndall's assumption. On the other hand, applying his own conclusions, he considers the echo to be due to reflection from the perfectly smooth surface of the ocean. On account of the divergence of sound, portions of waves in every direction must have descended to the horizon; and as some of these must have reached the plane of the ocean in a path curving inward toward the source of sound, they would, when they reached the ear of the observer in the vicinity of the source, seem as if coming from a point in the horizon, and hence would give rise to the phenomenon of ocean echo. Rays of sound at different distances from the ear would be reflected from the surface of the ocean, and thus occasion the prolonged echo: a blast of 5 seconds in one experiment on this point gave an echo lasting 20 seconds. "This," says Professor Henry, as a final shot at the "acoustic cloud" theory, "could only be produced by ordinary reflection from a series of surfaces placed at different distances, an arrangement of the material of the atmosphere which (on the doctrine of probabilities) would not be of frequent occurrence."

SLADE SUSTAINED.

Speaking of the exposure of the Slade trick, in London a few weeks ago, we expressed the belief that it would not lessen in the least the confidence of spiritualists in Dr. Slade or his practices. Even if strong enough to secure his conviction in the courts as a common swindler, the evidence of Dr. Lankester and others could not and would not shake their assurance of his personal honesty and the genuineness of his mediumship, for the simple reason that their confidence was the result of delusion, not a sane mental condition determined by or amenable to evidence.

Whether we were right or not as to the cause, we certainly were right as to the fact, for which we have the testimony of the president of the (British) National Association of Spiritualists. At a special meeting of the association, in London, October 4, that gentleman said he would willingly speak of Dr. Slade, in compliment to whom the gathering had been announced, but that could hardly be done without being drawn into a discussion of the case before the courts, and respect for the law made such a discussion unadvisable at that time. "It may be permitted me, however," he continued, with a sublimity of faith and felicity of diction marvelous to see, "it may be permitted me, however, to state a fact, which we cannot conceal if would, that our confidence in Dr. Slade as a genuine medium is in no way affected by the inferences drawn by two gentlemen who were quite inexperienced in the difficulties of the subject, and which inferences were founded on observations likely to be unconsciously vitiated by apparently slight but really important foregone conclusions"!

Surely our venerable poet must have been in a satirical mood when he penned the familiar lines:

"Truth crushed to earth shall rise again;
Th' eternal years of God are hers:
But error wounded writhes in pain,
And dies amid his worshippers!"

Since the above was written Slade has been found guilty of trickery at his *séance* with Dr. Lankester, and sentenced to three months imprisonment with hard labor. From this decision, an appeal has been taken to a higher court, pending which he has been allowed to go out on bail. He was given the opportunity of performing his legerdemain in court, and of satisfying the judge of its spiritual character, but declined, not daring, apparently, to testify even in his own behalf.

THE LEVERRIER OF CHEMISTRY.

The correspondence between the hypothetical element eka-aluminum, imagined by the Russian chemist Mendeleef, and the real element gallium, recently discovered by M. Lecoq de Boisbaudran, is so remarkable that the attention of European scientists is now being closely devoted to its examination. In 1869, Mendeleef published a memoir, which attracted little notice at the time, but which announced as a law that "the properties of simple bodies, the constitution of their combinations, as well as the properties of the latter, are periodic functions of the atomic weights of the elements." Without entering into the details of the theories whence arose this conclusion, it will suffice to state that the author considers that this periodic law indicates the gaps which still exist in the system of known elements, and admits of predicting the properties of unknown elements, as well as those of their combinations. Thus, for example, there are two gaps in the groups D III and IV of the fifth series, which elements, yet to be discovered, M. Mendeleef some time ago named eka silicium (Es) and eka-aluminum (El). To show how this last mentioned hypothetical element is related to gallium, the characteristics of that metal must be reviewed.

At the present time, M. Lecoq de Boisbaudran has succeeded in preparing 7·5 grains. In a liquid state, gallium, the fusing point of which appears definitely to be 86·27° Fah., is of a fine silver whiteness; but on crystallizing, it takes a very marked bluish tint, and its brilliancy notably diminishes. By suitable cooling of the melted material, isolated crystals are obtained, in octahedral shape, and these M. de Boisbaudran is now measuring. As regards density, which is the important point to be noted, M. de Boisbaudran says: "In May, 1876, I attempted to measure the density of gallium by a specimen weighing 0·92 grain. I obtained 4·7 at 59° Fah. (and relatively to water at the same temperature). The mean of the densities of aluminum and of indium being 4·8 (to 5·1) the specific gravity provisorily found for gallium appeared to accord quite well with the theory placing that metal between indium and aluminum. The calculations established by M. Mendeleef, however, for a hypothetical body which appears to correspond with gallium, show the number 5·9. Gallium, crystallized under water, sometimes decrepitates on heating. Perhaps my first metal contained bubbles fill with air or water. To eliminate this possibility of error, I heated the metal highly and solidified it in a dry atmosphere. Then I obtained higher densities, varying from 5·5 to 6·2, the weight of the pieces tested being some tenths of a grain. Finally, I combined six specimens, aggregating 8·7 grains." The mean of two different experiments gave (1st) 0 5935; (2d) 0·5956. "It is hardly necessary to insist," adds the author, "upon the extreme importance which attaches to the confirmation of the views of M. Mendeleef concerning the density of the new element."

This, however, is by no means all. Seven years ago, M. Mendeleef said, eka aluminum will have an oxide of the form El_2O_3." The oxide of gallium is Ga_2O_3. "It will be almost fixed, and will melt at a very low temperature. This answers exactly to gallium, which melts at 86°. He said, further, that the future element, volatile and taking its place between indium and aluminium, would be discovered by spectral analysis, and so gallium was discovered.

We may agree with *La Nature*, whose editor, M. Tissandier, discussing this same subject, holds that Mendeleef's prediction abstracts nothing from De Boisbaudran's merit as the original discoverer. The French chemist attained his result in no fortuitous manner. He also foresaw the existence of gallium, and he isolated it only after ten years of persevering labor. He compared the spectra of different metals minutely, and thus was led to suspect the intermediate element between aluminum and indium.

The analogy between Mendeleef's discovery in chemistry and that of Leverrier in astronomy is most striking. Leverrier, from the perturbations of Uranus, deduced a hypothetical planet by purely theoretical considerations, treated it as if it were a real world, and then verified his calculations and theories by his magnificent discovery. Mendeleef likewise, by considerations as purely theoretical, conceived a hypothetical element. Had Adams, who discovered Uranus almost at the same time as Leverrier, worked from that astronomer's calculations, the analogy would be without a flaw, for he would then stand as De Boisbaudran now does toward Mendeleef. As it is, the discovery seems to open as wide an horizon in theoretical chemistry as did Leverrier's achievement in theoretical astronomy.

PANICS IN SCHOOL HOUSES.

It seems to us that remedial measures are needed to prevent the occurrence of the panics which, on the breaking out of a fire, real or imaginary, always occur in crowded schools, or at least to obviate the dangers incident to the headlong rush which takes place when the tumult overpowers the means of prevention. Several such scenes of confusion have lately been witnessed in this vicinity, and they are becoming sufficiently frequent to render parents unwilling to permit young and feeble children to attend the crowded public schools. A panic occurred the other day in a large school room, because a steam pipe, leaking, discharged into the apartment a cloud of steam, which the children supposed was smoke from a fire. Another was just avoided through the scholars being at recess, when a genuine fire broke out near the recitation rooms, and on one of the stairways which formed a means of egress.

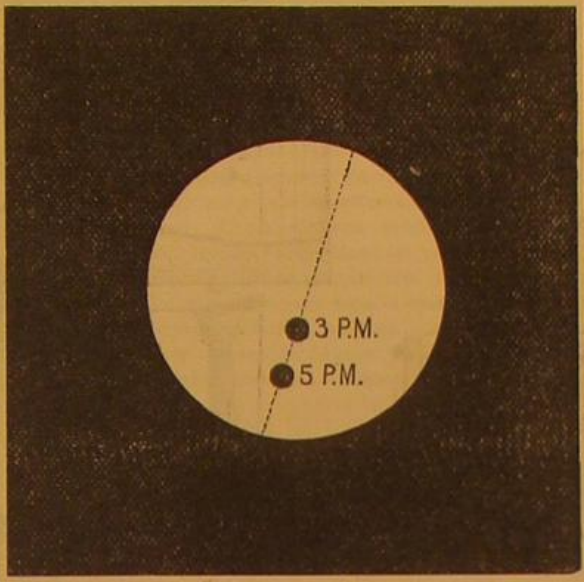
The prevention of disastrous confusion demands the greatest care, especially from those who construct school buildings and those who are responsible for their management. That such care is not exercised, we are persuaded from the frequency with which panics occur. Had the steam pipes been in proper order, or inflammable materials not existed in the school houses, neither of the above examples would have happened; and so, in every instance, some provoking cause can generally be found, which is attributable to a lack of proper vigilance or the absence of proper precautions. School houses should be fireproof and contain no material likely to feed flames. Even the probability of spontaneous combustion should be considered, and no dry or pulverulent material should be allowed to accumulate upon or around the steam heating apparatus. So carefully should risks be avoided that, while considering plans for new structures, or the introduction of new appliances into old buildings, the question whether there is anything in the schemes or projects proposed, which by any possibility might determine conditions sufficient to cause a panic, should be fully weighed. The case is one in which the ounce of prevention is worth a great many pounds of cure, although in the latter respect much can be done in providing ample modes of exit. If some rigid system of inspection of all school buildings, to be made by men thoroughly conversant with all the causes of schoolhouse panics—the principal of which, of course, is fire—were enforced, we probably should hear much less of children killed and injured through the efforts of a frightened crowd to escape.

VULCAN AGAIN.

Still another correspondent, as the subjoined letter shows, informs us that he saw Vulcan, or something on the sun which may answer to the description of that fugitive planet. This time the date is October 24, which is within Leverrier's first predicted period when observations should be made; and singularly enough the hour, 3 P. M., coincides with that of the reported observations of our other correspondents. The motion of the body, according to Mr. Wright, is different from that hitherto reported, as hitherto the spot has appeared moving upon the sun's disk, while now it is traveling off. The observation, in any event, is especially interesting, because it is the only one made since Leverrier's announcements in which anything resembling Vulcan has been seen; and moreover, it is also the only one of late date where the observer was not "taken by surprise," and where he adopted the best measures possible under the circumstances to verify the discovery. The following is the report:

To the Editor of the Scientific American:

I was reading last night in the SCIENTIFIC AMERICAN about the transit of Vulcan, and was so interested that I decided to make search myself during these clear, unclouded days. So this afternoon at 3 o'clock I got out my tube (4 inch lens); and at the very first focus the transit stood before me just as distinctly as it is printed in your paper (page 257). I was so astonished and delighted that I had to look and look again to satisfy my wondering eyes. Then I called my family, and they all saw it as plainly as I had done. Having satisfied myself by a half hour's observation that it had motion, I at once telegraphed to Professor Davidson (of the U.S. coast survey) at San Francisco: "Transit of Vulcan this afternoon; look for it." Then I went to the photograph rooms and used every effort to get a negative of it; but as we had no appliances, no facilities, and no knowledge how to take such a negative, it is not surprising that the one plate exposed is not of much value. The transit, however, was seen by four persons; others I did not summon, as I was more anxious to get a photograph. Had it been earlier in the day, I would have telegraphed to some eastern observers, but at the time I saw it first (3 P. M) the sun was already set to eastern people; but I did the best I could by telegraphing to San Francisco, and then trying to get a photograph.



The apparent path of the planet, as near as my observations show, for the two hours' time before sunset, was as indicated on this diagram; and the time occupied in its transit I judge to be from about sunrise till 9 in the evening, about fifteen hours. In this diagram, I have drawn Vulcan's appearance too large: the relative size is perfectly shown in your diagram, page 257, this current month. W. G. WRIGHT.

San Bernardino, Cal., October 24, 1876.

If we might pin our faith to M. Leverrier's recent utterances, and assume, as we stated last week, that the supposed planet rotates about the sun once in 33 days, an even number of such periods from July 23, the date of other reported observations, would bring us to October 30, or within a week of Mr. Wright's observation. But M. Leverrier's views on the subject appear at present to be in a transition state, and our French mails each week bring us new statements from him, which of late have invariably failed to accord; in fact they often wholly differ from those enuciated seven days before. The reader will therefore understand that the data we now give, as well as those which we have presented, represent merely stages of progress in M Leverrier's investigation, through which we are endeavoring to follow him. The latest dictum of the eminent astronomer is more logical than some previous announcements, but at the same time seems to contradict flatly his previous results. In lieu of Vulcan swinging in a regular orbit in equal periods about the sun, we are now told that its orbit is highly eccentric, and that the planet behaves like Venus, making two transits within a few years, and then not repeating the passage for a century. This, of course, puts a stop to any such off-hand calculation of future transits as is above referred to.

M. Leverrier's reasoning whereby he reaches this conclusion is very interesting. He starts with the idea of finding a formula which will enable him to predict the Vulcanian transit, and to do this he makes use of Mercury, the theory of the motions of which planet, as is well known, is complete. Taking five good observations of Mercurial transits, dated 1789, 1802, 1832, and 1845, he determines this expression for the Mercurial orbit: $V = 56{\cdot}04° + 4{\cdot}092307°\,j - 7{\cdot}66°\ \sin.\ \varepsilon - 9{\cdot}18°\ \cos.\ \varepsilon$, in which j is counted from 1875. From this he calculated the next Mercurial transit, which he found would fall on November 9, 1848. Now this is exactly the date when a transit of Mercury did occur, and it was observed by Hind in London. In other words, had Mercury never before been seen, it would then have been discovered through the calculations.

M. Leverrier applies this method to Vulcan; and assuming the data of previous observers to be correct, he reaches the formula $V = 139{\cdot}94° + 216{\cdot}18°\,k + (10{\cdot}901252° - 1{\cdot}972472°\,k)\,j$, in which k is unknown, but the values of which are necessarily whole numbers. It is to be noted first that, if the solutions differ in the majority of points on the orbit, they coincide at the node, and this circumstance renders the problem much simpler. Besides, the variation of which k is capable is confined within very narrow limits.

With $k = 0$, the distance to the sun is 0·201, or one fifth of the earth's distance. The elongation is then 10°, that is to say, Vulcan is always so near to the photosphere that it is easy to understand why the planet is so rarely visible. With $k = 1$ almost the same results are obtained. The distance is not more than 0·181, and the rarity of observations is still better justified. But if $k = 2$, the rotation of the star must take place in 24 days, or in a less period than that in which the sun revolves on its axis; and consequently this solution is inadmissible, unless Laplace's cosmogonic hypothesis is rejected. Inversely, if $k = 1$ (or -1) in the above equation, the elongation becomes so great that for this reason the planet could not often be observed.

Now there has always been noted, in the transits of a single planet, periods of frequence and rarity. Venus, as we before stated, crosses twice in ten years, and then a century elapses before another transit occurs. The same is true of Mercury, a[illegible]. Leverrier says, also of Vulcan. The period of the latt[illegible], he states, is 7½ years, and there should be a transit on March 22, 1877, and not another until 1883. He advises that even the passage next year is not certain, the calculations showing that the trajectory of the planet will be sensibly tangent to the sun's edge; and besides, they do not determine its position with accuracy. But he counsels careful observations on the day noted.

Meanwhile there will be a chance for spectroscopists, as passages will occur frequently in the coronal region. These M. Janssen has already begun to search for.

IRREGULARITY OF THE EARTH'S MOTION.

Professor Simon Newcomb, of the Washington Observatory, is to be credited with a new astronomical discovery, which bids fair to be of some importance. He has found that our planet, instead of rotating regularly about the sun, is pursuing an apparently irregular motion, sometimes running ahead of, sometimes falling behind, the time based upon its own movement at any given period. The consequence is that the motion of the earth becomes no longer an absolutely exact standard for time measurement; and thus our reliance on our globe, already impaired since it has been demonstrated that there is no such thing as *terra firma*, and that its surface is constantly changing, is again weakened, and in a new direction. It is safe to believe that, now the discovery is in the hands of the astronomers, we may look for remarkable deductions.

Professor Proctor, who has recently been discussing it, says that for about half a century there has been a doubt among astronomers as to the steadiness of the earth, and that Sir William Herschel suggested the possibility that, if a careful comparison were instituted between the turning motion of the earth and that of other planets, minute changes might be recognized. Accordingly he undertook the study of Mars, and measured the Martial day to a tenth of a second in a day; but this was of no use in testing the errors of our terrestrial time piece, where the same errors have to be measured by hundredths of a second in a year. Besides in Herschel's time the doubt on the earth's motion had been raised by Halley's recognition of the moon's apparent hastening; and this suggested little, because the lunar movements had never been closely analyzed, and the lunar hastening, as it was, indicated too small a change for Herschel to measure by his standards. Still this vague doubt was deemed of sufficient importance to cause Laplace to investigate it; and he showed that, among the various circumstances which affect the moon, there is one whose effect, at present and for many centuries to come, will hasten her motion. Then calculating the amount of such hastening, he concluded that it exactly corresponded with the hastening actually observed. "Perhaps there is not, in the whole history of Science," says Professor Proctor, "a more remarkable circumstance than this seemingly exact solution of a most difficult problem, where in reality the solution was incorrect." There was no forced agreement of figures; the work was placed in all its detail before the scientific world; mathematicians and astronomers recomputed it, and all agreed in its accuracy.

About a quarter of a century after Laplace's death, Adams (the co-discoverer, with Leverrier, of Neptune) re-examined the reasoning and found a flaw. Laplace judged a certain effect might be neglected. Adams thought not, and tested the matter; and then it appeared that it exercised so important an influence that, when due correction was made in Laplace's work, only one half the hastening was accounted for. Then arose a storm in the astronomical world. Leverrier, with all his acumen, failed at first to perceive the nature of the correction, and declared Adams to be mistaken. Pontécoulant sneered at it as "analytical legerdemain;" but the English mathematicians first accepted Adams' result, and then, after Delaunay had verified it, the continental astronomers followed. Delaunay not only admitted a retardation of the earth's motion, but pointed out where and how the same might be affected, namely, by the friction of the great tidal wave, which travels round in a direction opposed to the earth's rotation. This view has been generally accepted; and it can be shown that, if a clock could be made to go at a rate corresponding precisely to the earth's rotation, as indicated now, for 100 years, at the end of that time the earth would be found to have lost 22 seconds.

Now comes in Newcomb's discovery to show that the earth (judging from the moon's movements) undergoes irregular changes. It lost seven seconds between 1850 and 1862, and then, turning too fast between 1862 and 1874, gained eight seconds. Meanwhile smaller changes, some in one direction, others in the other, have taken place, generally lasting about four weeks at a time.

Two theories are suggested to account for these movements, either that the earth's motion is nominally irregular, or that some unseen body passes near enough to the moon to disturb her motion around the earth. Professor Newcomb adheres to the first hypothesis.

UP to the hour of going to press, the list of patents issued during the week ending October 17, and bearing that date, had not arrived from Washington.

SHELL lime, which contains considerable phosphorus, is superior to stone lime for agricultural purposes.

IMPROVED SHOE-SCOLLOPING MACHINE.

In the manufacture of ladies' and childrens' fine shoes, it is now customary to scollop the edges of the vamps, quarters, and button laps. This work, as ordinarily produced by hand, by dies, is irregular in appearance, and not uniform through any number of pieces; while, as each part has to be scolloped in turn, the labor involves considerable expenditure of time. By means of the improved process, performed by the aid of the new machine herewith illustrated, the work can be done with ease and rapidity by a boy or girl; and the single tool used answers equally well for all sizes, from the smallest infant's shoe upward. The invention also admits of the use of cheap paper or cardboard patterns, instead of those of galvanized iron or zinc commonly employed.

Fig. 1 is a plain view of the machine, and Fig. 2 an elevation. A is a massive circular cutting block, in the lower

Fig. 1

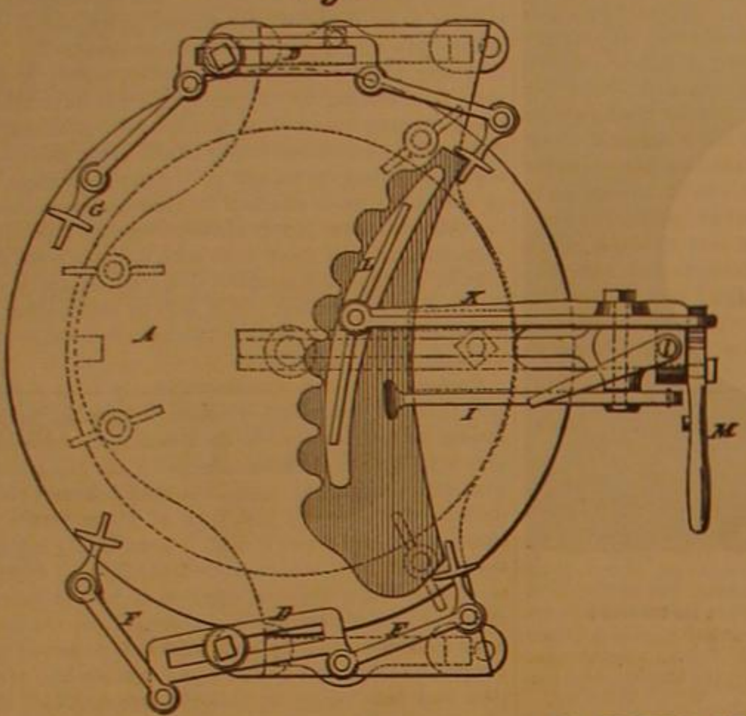


Fig. 2

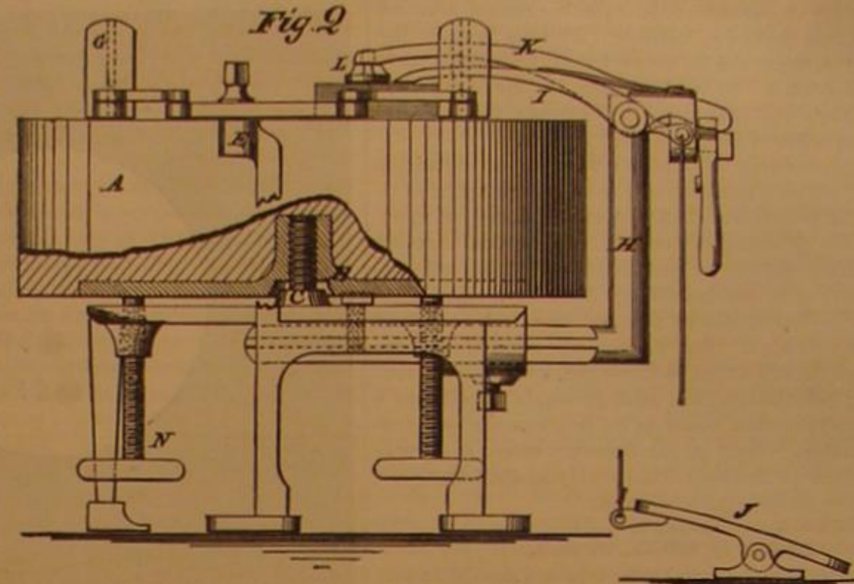
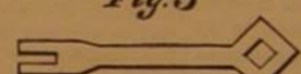


Fig. 3



MANLEY'S SHOE-SCOLLOPING MACHINE.

part of which a hub, B, is let in, and tapped to receive the vertical screw pivot, C, which rests on the circular bed plate. Said plate is supported on legs, as shown On each side of the block are slotted bars, D, which, by set screws passing through the slots, are movably secured to the standards, E, Fig. 2. Projecting from each end of these bars are pivoted arms, F, which at their extremities carry the vertical three-armed guide pieces, G. H is a bar, bent, as shown, at right angles, its horizontal part having longitudinal projections, which enter a guide socket beneath the bed plate; so that by drawing said horizontal part out or pushing it inward, securing it in either case by the set screw, the vertical arm may be adjusted farther from or nearer to the cutting block, A. On the vertical arm, H, is pivoted a presser, I, which is held downward by the leaf spring shown. To an eye in the outer end of said presser is attached a cord connecting with a foot treadle, J, so that when the latter is forced downward the presser is lifted against the action of the spring. Also pivoted on arm H, is a bar, K, at the extremity of which and over the cutting bar is pivoted a curved adjustable slotted bar, L. To the rear of bar, H, is pivoted a cam lever, M, on the cam of which are shallow notches, which engage against the end of bar, K, and thus hold the same when its opposite extremity is pressed by the action of the cam against the cutting block.

Sufficient of the mechanism has now been described to enable its working to be understood. In Fig. 2 a button lap is represented resting on the block; several of such portions are intended to be adjusted and cut at once. To this end the bar, M, is turned back out of the way, and the foot, pressing on the treadle' raises the presser, I, as each lap is in turn adjusted in place upon the one beneath it. The presser, it will be observed, in so acting, leaves the hands free to place the pieces as desired. When a sufficient number are adjusted, the pattern is laid on top, and the bar, K, is carried down, jammed, and locked by the lever, O, as described. Then the scollops are cut by a proper tool placed so as to follow the scollops of the pattern.

Fig. 4

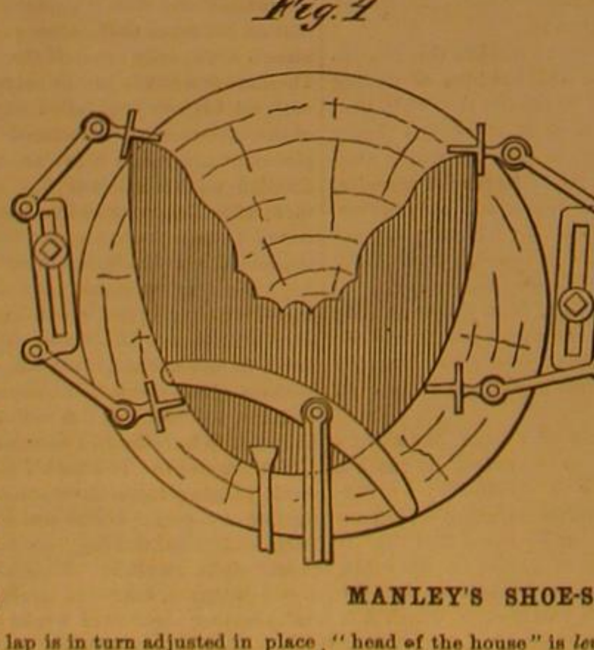
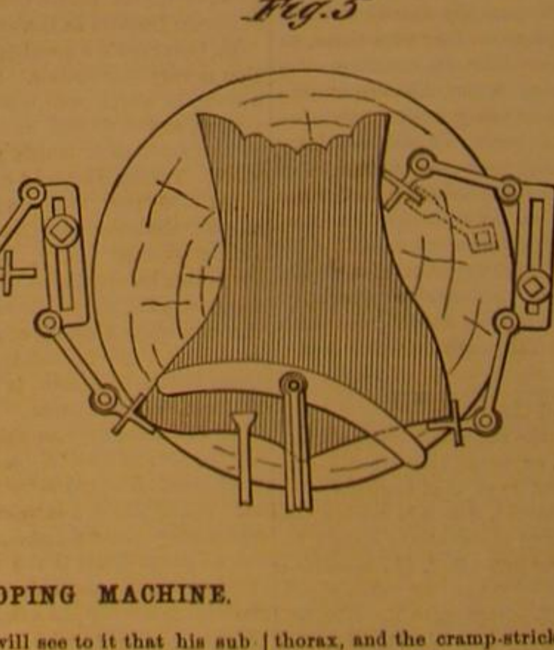


Fig. 5



MANLEY'S SHOE-SCOLLOPING MACHINE.

In course of time the surface of the cutting block becomes injured; but its durability is greatly increased by the fact that it can be turned on its pivot so as constantly to expose fresh surface, and through the adjustability of the parts which hold the pieces, to be cut as already described. When, however, the surface becomes too badly scarred, a thin slice is sawn off, and the block turned upward on its screw pivot, until its hight is such that it fits against guides, etc., as before. In order to steady it, the four set screws are provided. These pass up through the metal base plate and are readily adjusted from beneath.

The object of the set screws which confine the slotted bars, D, is to allow of the adjustment of the guides to suit the different pieces to be scolloped. Thus, in Fig. 2 a button lap is being operated upon, and but two guides are used to hold the corners. In Fig. 4 a vamp is in place; and here all four guides are employed, while the quarter in Fig. 5 requires but three guides. Of course when the guides are once adjusted, they enable a series of objects of like size to be laid on the block, always exactly in the same place Another point to be noted is that the set screws of the bars, D, may be removed by the wrench, Fig. 3, and the bars reversed (as will be seen by comparing the different positions of said bars in the various figures). This admits of accurate and easy adjustments which would be impossible were the bars immovable.

Patent pending through the Scientific American Patent Agency. For further particulars address the inventor, Mr. William Manley, 111½ North Water street, Rochester, N. Y.

Nothing to Do.

Under the above heading, Anthony's *Photographic Bulletin* counsels studio operators to put their places in order during slack times. The editor's hints are equally appropriate to other professions.

Necessarily there are no idle moments in the photographic studio—no need of yawning and lounging about for want of useful occupation. In every department there is work enough for willing hands to do, rain or shine; and if the "head of the house" is *level*, he will see to it that his subordinates are provided with useful if not at all times particularly agreeable occupation. To say nothing of the requirements of order and neatness in the several work rooms, as well as the reception and sales rooms, there are always little matters of repairing and adjusting, which the operator, closet hand, and printer in hurried moments deferred till "a more convenient season," which season is now, when no orders are pressing, and no sitters in waiting.

Your bath needs cleansing and renewing; your shields are loose-jointed and leaking light; your chemicals need filtration: your camera and lenses require readjustment; your posing chairs are shaky, discolored, and sadly in need of renovation for decency's sake; and numerous other little matters, apparently of trifling consequence, would be all the better for a little, or, if you please, a good deal of, timely attention.

And then the printer's quarters: Is everything in place and there a place for everything—we mean, of course, everything needful? Are the printing frames in working order, the negatives carefully classified—accepted, doubtful, and rejected—and conveniently placed for the duty that awaits them? Are the silver clippings and solutions prudently bagged and bottled, and have you done all that an ingenious and enquiring turn of mind would suggest to make this branch of the photographer's savings' bank a paying success? Finally, have you straightened up things about the rooms with a view to safety as well as neatness, so that the insurance examiner, calling unannounced, would not write you specially hazardous, and charge your employer accordingly?

And now, Miss Blank, of the reception room: are you waiting for a customer, and while waiting have you taken up your embroidery or the last novel, or, what is more likely, a position of rest on your elbows with hands supporting a head not able to comprehend the fitness of things in the duties assigned you? If unable to wield the broom and dust brush, you have, of course, had the service performed, and in the meantime you have brightened up the showcase, arranged in tasty order the specimens therein and thereabouts, and you have not forgotten the disorder in which you or some one else left the cabinet of drawers the other day in looking for a needed mat, passepartout, or frame; and you have looked into the toilet or dressing room, and seen that the mirror reflected the image of a neat and tidy attendant; and then you have carefully looked over the promised work and appointments to know of yourself that they are not to result in disappointment when the specified time arrives; and finally you have carefully surveyed the field over which you hold dominion, and find it not deficient in any of those little attractions and matters of taste which your thoughtful brain and industrious hands could supply. Then you, and the operator, the closet hand, and the printer, are always busy and usefully occupied, and the proprietor, if he is observant and appreciative, as he should be, is happy in the possession of such help.

Swimmer's Cramp.

The loss of body heat in water is now held to be intimately associated with the cramp which so often seizes even able swimmers. Here there is not only a general powerlessness induced, but the spasm of the muscles connected with respiration diminishes the capacity of the thorax, and the cramp-stricken swimmer often disappears immediately without warning, never to appear alive. The buoyancy conferred by the chest being full of air is largely reduced by this diminished thoracic space, and the body at once goes under water. No skill in the art of swimming will secure any one from this risk; and when the water is cool it is well that the swimmers keep near the shore, or at least near each other, so that aid can be readily rendered if required.—*Sanitary Record.*

IF, during a frost, the moles throw up fresh earth, within 48 hours the frost will be gone.

CURIOSITIES OF THE CENTENNIAL.--I.

We have collected a number of the most curious and interesting objects, to be seen at the Centennial Exhibition, in the series of sketches herewith given. These articles, as well as those which will follow in future issues, are mostly unique either in value, handiwork, or historical interest, or as representing some unusual phenomenon or occurrence: and hence are, we think, the features likely to remain uppermost in the mind of the visitor, while the rest of the display may be remembered in its immense entirety. The engraving inscribed

SWEDISH BOILER

represents a steam generator of Bessemer steel, which in itself illustrates the great strength of its material in withstanding effects which might, in an ordinary boiler, easily have determined an explosion. The generator was constructed at the Göteburg Engine Works, in the summer of 1869, and, with a 10 horse power engine, was placed in a small steamer. After a year the vessel returned for repairs. On examining the boiler, it was found that the crown sheet had evidently, through lack of water above it, been rendered red hot, possibly repeatedly. The pressure above had forced the plates in, as shown in the two views given, without injuring them or causing the slightest rupture, thus affording proof of the great strength of construction obtained by flanging the edges of the flue joints as well as of the excellence of the material. The plates were rolled from Fagersta (Sweden) Bessemer ingots. The diameter of the box is 2 feet 3 inches, length about 5 feet. The plates are ⅜ inch in thickness, and the flanges 2 inches in width. There are four depressi ns, the deepest of which is 6 inches, and ⅜ inches by 1 foot in area. The outline diagram given shows the general construction of the boiler. We also give a sketch of one of the Swedish iron exhibits, a four-stranded rope made of ⅞ inch round iron and tied into a complicated knot while cold. No fracture is visible. This is but one of many similar objects displayed to show the excellence of Swedish iron. The famous

$72,000 SILVER INGOT,

exhibited in the Mexican section, looks like a huge cake, smooth and rounded beneath and having an irregular surface above. It was produced from 272 tuns of argentiferous lead, and was cupelled in a German cupelling furnace. It weighs 4,002 lbs., and thus averages 235·4 Mexican ounces to the tun of ore. The cost of production was $1.76 per tun. Its diameter is about 6 feet, and thickness at thickest part nearly 5 inches.

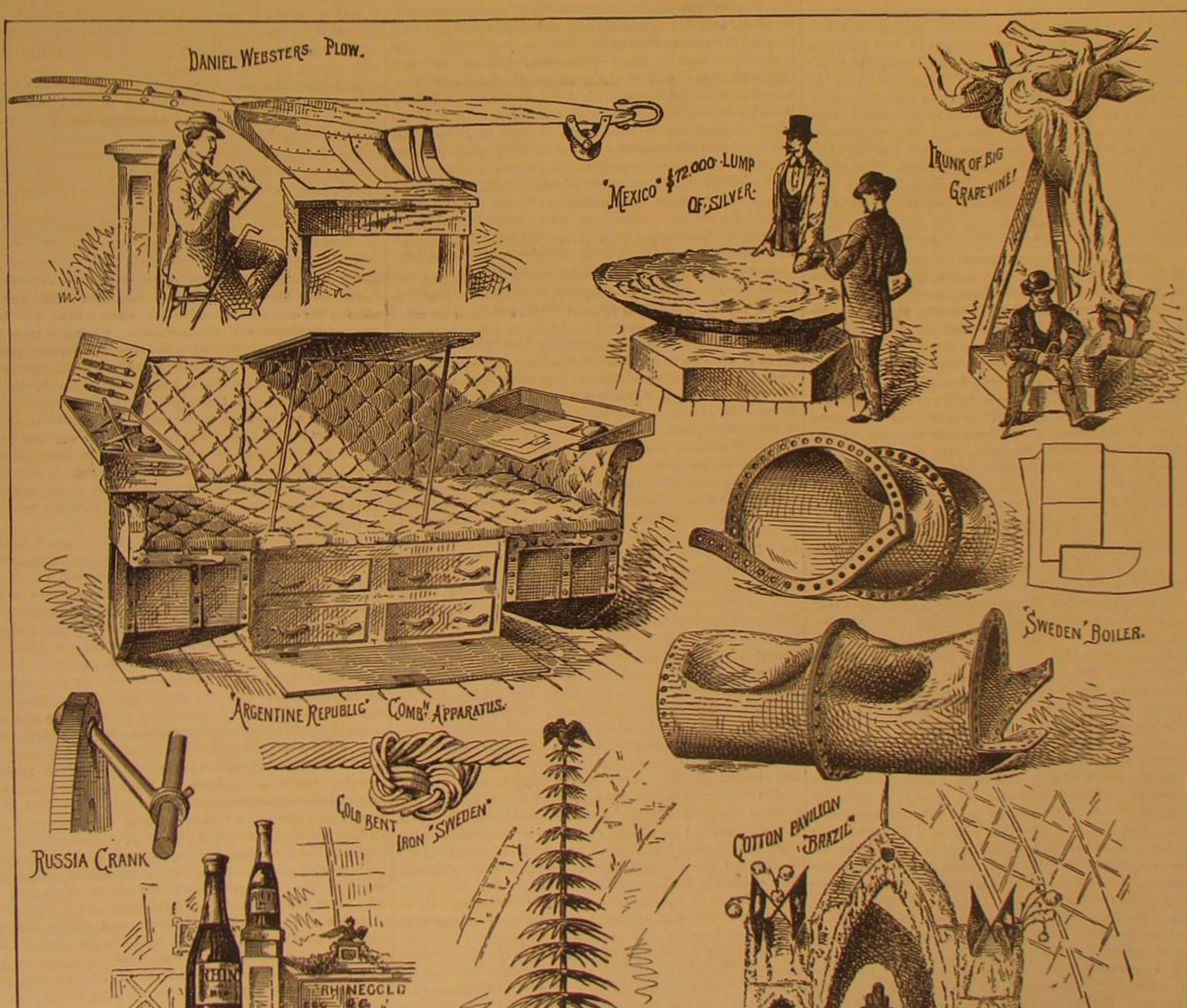
THE BRAZILIAN COTTON PAVILION

and the Rhine wine exhibit, both in Agricultural Hall, are remarkable for tasteful and striking design. The cotton pavilion is a large roofless enclosure having numerous gothic arches. The frame is of light wood, but entirely hidden by masses of pure white cotton which cover every portion. Balls of cotton on stems, to represent flowers, project from the angles, and inside the arches long fragments of the staple hang down in a graceful fringe. At a little distance the structure looks as if made of snow. Inside, arranged upon a pyramidal stand, are glasses filled with samples of fine cotton, and outside are cotton bales and similar packages, tastefully disposed. The Rhine wine exhibit is notable for the four enormous bottles which stand on pedestals at each corner of the platform. They are accurate imitations of the bottle peculiar to the variety of wine displayed, only on a colossal scale. Smaller bottles, perhaps 3 feet in hight (the large ones measure about 10 feet) are placed in huge vases and surrounded by imitation ice. Vines are trailed over the pedestals, and with painted decorations render the exhibit one of the most noticeable in the entire building. Another German exhibitor, a scythe manufacturer, disposes his productions in the form of a tree, so artistically that at first sight the object looks like a leafless pine. The scythes are turned backs up, and placed radially about the trunk. An eagle perched on the apex adds to the illusion.

To agricultural visitors there seems to be no object in the entire Exposition which possesses a greater interest than

DANIEL WEBSTER'S BIG PLOW.

The crowds around this venerable machine are immense; and if it were not for the close watch of the police, the relic hunters would probably carry it off piecemeal. It is a huge affair, 13 feet long, its beam measuring 9 feet 1 inch and its handle 6 feet four inches. The share is 16 inches, and its mold board 20 inches, in width. It was made by the great Webster of colossal brain himself, in 1837; and although rudely constructed and bearing the marks of age in numerous cracks and weather stains, it looks capable of good service yet. That it once did great work we have the famous statesman's own word. In one of his speeches, he says: "When I have hold of the handles of my big plow, with four yoke of oxen to pull it through, and hear the roots crack and see the stumps go under the furrows and out of sight, and observe the clean mellowed surface of the plowed land, I feel more enthusiasm over my achievement than comes from my encounters from public life in Washington." This extract is posted up beside the plow, and we suppose it may be found in a great many more note books than in the 50,000 copies of the present issue of the Scientific American. We watched one aged and enthusiastic granger study it till he knew it by heart, and then depart, repeating it over to himself, in tones and with gestures doubtless born



SOME REMARKABLE EXHIBITS AT THE CENTENNIAL of a vivid reminiscence of the "Great Expounder's" matchless oratory.

AN INGENIOUS MECHANICAL DEVICE,

whereby the reciprocating of a piston is transformed into rotary motion, and the piston at the same time oscillated on its axis, exists in the Russian valveless engine. As represented in our sketch, there is an arm attached rigidly to the piston rod, and having on its end a ball which enters a socket near the periphery of a disk. The latter answers for a flywheel, and is rotated by the arm as the piston rod reciprocates, while the rod itself is vibrated. The effect of oscillating the piston is to open and close the steam valve passages suitably arranged therein.

We have hitherto labored under the idea that in ingenious combinations of furniture our American inventors excelled the rest of mankind. But now we doubt it. There is an exhibitor from the Argentine Republic from whom our inventors may take lessons. He contrives to stow more utterly diverse articles into a smaller space than any one we ever saw; his furniture is at once a puzzle and succession of surprises. No drawing would do justice to the principal object which he displays. It is a dressing case which contains everything in the housekeeping line, from a coal cellar up. There are places for utensils, for blacking boxes, for cigars, hair brushes, garments, gas stoves, provisions; and the rest a New York *Herald* exploring expedition might profitably be fitted out to discover. If there is a cradle and baby tender also combined, and we dare say there is, the young housekeeper needs nothing more to complete her *ménage*. For people who have no fixed abode, but who "live in trunks," this South American inventor provides a less complicated but none the less ingenious combination, which is depicted in our sketch. To begin with, there is a trunk about as large as the average "Saratoga," presenting nothing remarkable in aspect except an exterior strength calculated to defy the most persistent baggage smasher. You seize the top, throw it over sideways in two portions, lift up and open out the back part, and behold the trunk is a comfortable lounge. Where are the garments? In the drawers under the seat, which the fall of a false front piece reveals. Is a table needed? A flap hung to the back is raised and firmly supported by props. One arm may be developed into a writing case with all the appurtenances, the other into a dressing box containing all the toilet articles. The empty spaces in the lid are to be utilized. Step around to the rear, pull on a couple of knobs, and there are two small tables set with plates, knives, forks, tumblers, napkins, and all the *et ceteras*. That trunk is an exposition by itself.

THE CALIFORNIA MAMMOTH GRAPE VINE

is exhibited in Agricultural Hall, and is probably the largest vine in the world. It has produced yearly 12,000 pounds of the variety known in California as the Mission grape. It was planted by Doña Maria Marcelina de Dominguez, according to the custom of the country, at the birth of a child, some sixty years ago. For several years it has shown signs of decay, and was dug up, sectionized, and boxed for removal to the Exposition. There the sections are bolted together, and the vine is set up as nearly as possible in its natural position. It is, of course, very irregular in shape, so that no definite dimensions can be given. The size of the trunk can, however, be estimated from that of the figure represented beside it.

Correspondence.

Boiler Explosions.

To the Editor of the Scientific American:

In the last number of the SCIENTIFIC AMERICAN I read your notice of a disastrous boiler explosion at Pittsburgh, Pa., in which you state that "no cause is yet assigned for the casualty," and that "the boilers were inspected some five weeks ago, and were then in good condition." There has been much argument on the subject of boiler explosions; and from an everyday experience of nearly forty years in the construction and management of steam boilers of various kinds, I will venture to give you my opinion on the subject, although I shall differ from many.

In the first place, I think there is one, and only one, cause of boiler explosions, and that is the want of a sufficient quantity of water. But a boiler may be burst from many causes. You will see here that I draw a distinction between the explosion and the bursting of a boiler. An explosion is an expansion with great force, followed by a violent report, and a burst is simply a liberation from confinement, without the great force and violent report of the explosion. Bursting may result from various causes, such as a weak or defective boiler, an over pressure of steam, or water, or air, as the case may be. A boiler may be made defective in several ways. First, by letting dirt and sediment collect on the bottom of the boiler, which is directly over the fire. Boilers can be and are very frequently burnt entirely through in this way. Second, by using inferior qualities of iron in the construction. Third, by poor riveting. Fourth, by injury in testing, by subjecting the boiler to more pressure than the iron is capable of bearing. Fifth, by freezing. Sixth, by the present ruinous practice of blowing the water out of the boiler under a pressure of steam, and while the fire box or bridge wall is still hot. The consequences of this practice are cracked sheets, broken rivets, grooving, etc. Moreover the dirt and sediment dry and adhere firmly to the iron, and form a crust or scale; while if the water was drawn off cold, the sediment would be soft, and the most of it would be drawn off with the water, or at least could be washed off.

A boiler may be burst either by steam pressure or hydrostatic pressure, and the destruction of property be the same; but of course life would be endangered by scalding water and steam. The bursting of a boiler makes little or no report, no more than the opening of a safety valve or a blowing-off valve. But a boiler is seldom allowed to burst, as timely notice is usually given by the leakage of steam and water from the defective part. Not so with an explosion. This agent of destruction never seeks the weak places of a boiler; and the strength and thickness of a boiler has nothing whatever to do with its explosion. In fact the stronger a boiler, the more terrific the explosion, and the more disastrous will be the effects. And as far as boiler inspectors are concerned, they can pronounce a boiler good or bad, and determine its liability to burst, but that can do no good in preventing its explosion. That depends wholly on those having it in charge.

Boiler manufacturers are often and unjustly blamed for the explosion of a boiler which, I repeat, can only occur from the want of a sufficient quantity of water, caused by the carelessness or inexperience of those in charge of it. If employers were more careful to secure competent engineers, there would be fewer explosions. There need be none.

L. B. DAVIES.

[For the Scientific American.]

THE MERITS AND DEMERITS OF LINNÆUS.

To the great Swedish naturalist Linnæus, who was born in the year 1707, belongs the honor of having first originated a system of classification of the vegetable and animal kingdoms, which system (although Linnæus himself remained perfectly orthodox, believing in the theory of special creations) contained in itself the germ of the evolution doctrine, now grown to such mighty proportions. In regard to the account of the creation given in the book of Genesis, we must (with Haeckel) acknowledge that it reveals two grand fundamental ideas, namely, differentiation and progressive development of the matter "created" "in the beginning." Together these form a grand conception, perhaps, far more important to the truth of the narrative than the now ascertained error of considering this little earth as the center of the Universe, around which sun and stars revolve. This error was confuted by Copernicus, Galileo, and their successors. Another important change in the popular ideas of creation, namely with regard to the position of man in the whole scheme, has been effected by Lamarck, Darwin, and others. It is strange that theologians should so frequently, as they do, content themselves with asserting the literal accuracy of so ancient a book as the Bible, which has suffered severely by the course of tradition and the vagaries of translators, in place of confining themselves to the grand moral lessons and the pure religious principles it inculcates. The Bible is not a text book of natural science, nor has it ever pretended to be one.

The great progressive step made by Linnæus was as simple as it was rich in results. It was the designation of each plant and animal by two names. The first, the genus, was given to each family of plants or animals; while the second, the species, gave greater definition and more individuality to each single plant or animal. Thus, for instance, he included all animals resembling the tiger, whether large or small, under the genus *felis*, and he used the name for the whole class; and he added a second name for the species to which the animal belonged. Thus, he called the common tiger *felis tigris*, the lion *felis leo*, the panther *felis pardus*, the jaguar *felis onca*, the wildcat *felis catus*, and the house cat *felis domestica*. This method was perhaps suggested to him by the custom in society of having family names and baptismal names, by which members of the same family may be distinguished. Before the time of Linnæus, the different names of the individual plants and animals formed a perfect chaos; but the dual nomenclature not only necessitated a classification, but became its basis. The two names soon proved the value of the system, as by them attention was drawn to the similarity and relationship between the various plants or animals. Linnæus in fact attempted to complete the whole system, and divided, for instance, the whole vegetable kingdom into 24 classes, which he subdivided into orders, these into genera, and these again into species. He divided the animal kingdom into 6 classes, which were again subdivided into many orders, genera, and species. Notwithstanding that his classification has been modified, and has been based on facts since ascertained to be more fundamental than those on which he grounded his theory, the honor of the reform belongs to him: although he was often in doubt, especially whether some particular animal had to be considered as a separate species, or only as a variety of the same species. He even went so far as to admit that hybrids may constitute the origin of new species, and even that a great number of new species had originated by the interbreeding of other species. This opinion was very remarkable as that of a man who had already accepted the theory of the miraculous creation of every species; and it would have been in direct contradiction to his creed, were it not that he had claimed as an exception to the rule that some species were originated by hybridism or incidental changes: and all that Lamarck and Darwin did was to extend Linnæus' exceptional theory to the origin to all species whatsoever.

In regard to the origin of the distinct species, Linnæus, as before remarked, believed in special acts of miraculous creation, and adhered strictly to the Mosaic account, according to which plants and animals were created by God, "each after its own kind." Linnæus expanded the idea, and went into details, expressing the belief that, originally, either a single individual or a pair of each animal or plant had been created. He believed that "man and wife created He them" of every species which exists in two sexes; however, in those cases where every individual is possessed of both sexual organs, as is the case with many kinds of snails, worms, parasites, and the majority of plants, Linnæus believed that God created only one individual, as this was sufficient. Linnæus further believed that, in the deluge, all the then existing organisms were drowned, except the few individuals of the various species which were saved in Noah's ark, and afterwards put ashore on Mount Ararat. The geographical difficulty of widely differing animals and plants living together when put ashore, he explained by the fact that Ararat, in Armenia, is situated in a warm climate; and being more than 16,000 feet high, it unites in itself all the conditions for affording diversity of climate to suit animals of different zones. The animals accustomed to the climate of the polar regions, such as polar bears, could therefore at once ascend to the cold snow-covered summits; those accustomed to a warm climate could go to the foot; while the inhabitants of the temperate region could remain where they were, half way up. From this mountain, he asserted, the animals distributed themselves afterward again over the whole earth.

Haeckel makes a serious objection to the possibility of existence of a single pair of animals of each kind at the same time. He says that, for the first few days after the creation or after the deluge, the carnivorous animals would have eaten all the herbivorous cattle, the lions and tigers would have eaten the single pairs of sheep and goats in existence; while the herbivorous animals would have eaten as once all the single plants before there was a chance of propagation. Certain it is that the balance in the economy of Nature, such as we see it now, could never have existed if only one single pair of each species had been created at the same time. It is seen, then, that the hypothesis of Linnæus is scarcely worth a serious discussion; and when we consider that he had a clear head and excellent reasoning powers, it is indeed very doubtful if he could believe in it himself.

This hypothesis prevailed, however, for about a century without being disputed; and this was perhaps partially due to the merits of Linnæus as a naturalist, and the great renown he had earned by his systematic description of the works of Nature. This, added to the prevailing idea of considering the Bible to be intended to teach the sciences, retarded the acceptance of sound and correct ideas concerning the institution of the Universe.

In closing this review of the merits and errors of Linnæus, we cannot abstain from expressing our surprise that Professor Huxley, in his recent lectures in this city, selected Milton in place of Linnæus as the defender of the six day miraculous creation. Milton should be considered by every one as drawing on his imagination, and availing himself of poetical license to the fullest extent. He was no scientist, but a poet; and he should on this account not be held responsible for his *quasi* scientific opinions. But Linnæus was a scientist, and his opinions, hypotheses, and theories fall within the pale of scientific criticism: and he was especially scientifically definite in all he said and wrote. If Professor Huxley selected the poet because everybody knows Milton and his works, we may suggest that some information about the great naturalist Linnæus and his services to Science would have served the purpose, of bringing out the truth of the evolution theory, far better than the beautiful poetical dreams of "Paradise Lost."

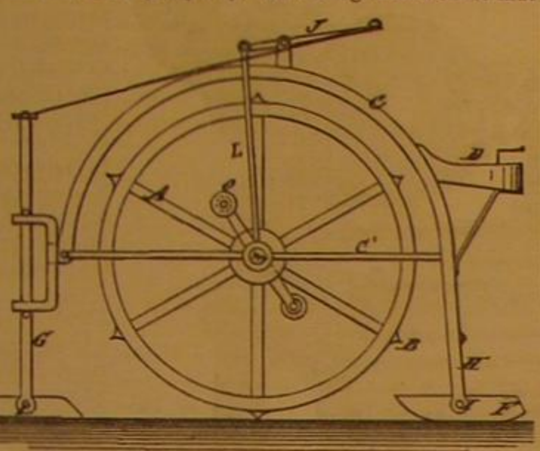
P. H. VANDER WEYDE.

The Thirty-Eight Ton Gun.

For some little time past a substantial target has been in course of erection on the experimental grounds at Shoeburyness, England. The object of this structure was to ascertain the measure of power of the 38-ton 12½-inch gun at the muzzle. This object was satisfactorily accomplished on Wednesday afternoon in the presence of a large number of officials connected with the War Department, besides officers of both branches of the service. The target was composed of three plates of John Brown and Company's make, each plate being 10 feet wide, 8 feet high, and 6½ inches thick. Between the plates were 5 inches of teak packing, bringing the total thickness of the target to 20½ inches. The plates were bolted together in couples, the first to the second and the second to the third, with sixteen 3 inch Palliser bolts. The target was supported in the rear by horizontal and vertical bracing formed of 14 inch square timbers with raking struts abutting upon piles of the same scantling, the latter being stayed against an old target. At the side of the target were placed some old 6 inch armor plates on end strutted with timber, and on the top were some old 8 inch plates tied back to the target with old railway bars. A trial shot was first fired at an old 10 inch armor plate with a charge of 130 lbs. of 1·5 inch cube powder and an 800 lbs. Palliser shell made up to weight with sand. The shell struck the plate with a velocity of 1,436 feet per second, punched a clean hole through it, snapped short a 14 inch pile a couple of feet behind it, and broke up against an old target. The round against the new target was fired with a similar charge to the foregoing, the range being, as before, 70 yards. The shot, which had a striking velocity of 1,421 feet per second, punched a clean hole 13 inches by 12½ inches in the front plates, and passed through the middle into the rear plate, where it broke up. The base of the shot with a portion of the walls was left in the hole, but the point, with 9 inches of solid metal, struck against the rear target some 10 feet off, and rebounded to a distance of 20 feet to the right proper of the target. The rear plate was considerably buckled, but the iron around the shot hole was not cracked or started, the metal showing a fibrous fracture bespeaking its high quality. The timbers were considerably started, a pile next the target in the rear to the left proper being sheared clean off. In fact the proper side of the target was thrown back about 7 inches, and, of course, it generally suffered severely. The results as regard penetration were such as had been anticipated by the Heavy Gun Committee, so that practice here has satisfactorily confirmed theory, and has afforded data of considerable value to the authorities.—*Engineering.*

NEW ICE VELOCIPEDE.

In the annexed illustration is represented a novel ice velocipede, invented by Messrs. Juan Arnao and Juan Arnao, Jr., of Brooklyn, N. Y., and patented through the Scientific American Patent Agency. A represents a drive wheel, having points, B, on its periphery, and arranged on a shaft that



is journaled in two longitudinal springs. C is the frame, and D a seat located on its rear so that the rider may conveniently operate the foot cranks, O. H are rear bifurcations of the frame, to whose lower ends are pivoted the runners, F; while G is an independent standard, swiveled in the front of the frame, and connected, by cross pieces and cords, with the front end of a lever, J. This enables the rider to guide his velocipede with great facility. The lever, J, is pivoted to a stud on top of the frame, so as to bring its power end near the driver, and is connected at the other end, by pivoted rods, L, with the drive shaft. By this arrangement the driver can readily lift the wheel from the ground at any time, and the runners are enabled to pass over small obstructions on the ice.

A Solar Distillery.

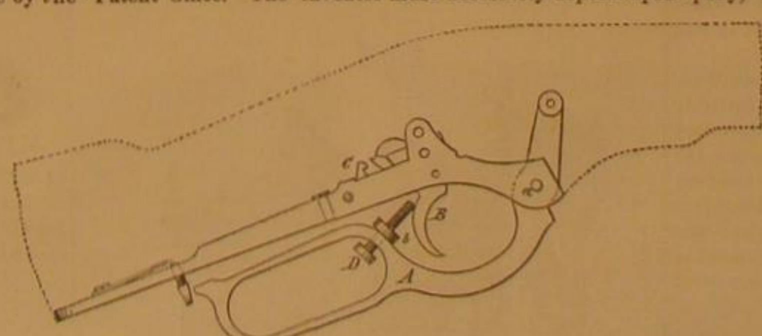
M. Mouchot, whose steam boiler, heated by the sun's rays concentrated by a concave mirror, we described not long ago, recently exhibited to the French Academy of Sciences a new apparatus whereby by solar heat he distilled excellent brandy. The mirror was but 19·5 inches in diameter. A little over a quart of wine was placed in the boiler, and brought to boiling for 15 minutes by the concentrated rays. The alcoholic vapor entered a tube placed in the center of the boiler, traversed the supporting foot of the mirror, and descended into a room, where it condensed. The liquor was of remarkably good flavor, free from the disagreeable taste of alcohol peculiar to that obtained from wine in the usual way, and savoring strongly of the best cherry brandy.

M. Mouchot afterward placed flowers and odoriferous leaves in his boiler, and made a variety of perfumes and essences. Finally leading the steam into a cooking apparatus, he prepared an entire dinner by the agency of the sun's heat.

NEW METHOD OF SETTING HAIR TRIGGERS OF RIFLES.

This is a timely invention, which will interest riflemen and the many amateurs who are engaged in the laudable effort of attempting to rival the famous scores mde by the international teams at Creedmoor recently. The usual manner of setting the set trigger is to throw the trigger, B, in the engraving, forward with the thumb. This operation requires both time and some exertion, and the present device is intended to obviate the difficulties. Referring to the engraving, which is a side elevation, A is a finger lever, which is pivoted to the lock at *a*, in the usual manner. B is the trigger, and C the set trigger D is a milled head screw, which runs through the finger lever to a point near the trigger, and is capable of moving the trigger sufficiently to set the set trigger, C, when the finger lever, A, is moved either away from or toward the rifle stock. *b* is a jam nut placed on the screw, D, that bears on the finger lever, A, to prevent the screw from turning when once adjusted. The rifle can then be discharged with greater rapidity and with less exertion.

The device was patented through the Scientific American Patent Agency, September 5, 1876, by Mr. George O. Leonard, of Red Bluff, Cal.



LEONARD'S METHOD OF SETTING HAIR TRIGGERS OF RIFLES.

What a Patent Agent Ought to Be.

A patent agent ought to be careful and honest, because he is the repository of his clients' secrets. No class of property is more highly valued by its possessors than that which derives its origin from invention. No matter how trifling the idea may be, the person who conceives it is apt to place a much higher estimate upon its value than others, and he is therefore jealous of its possession. This jealousy is excusable, however, on account of the fragile nature of the tenure by which he holds possession, and because his title cannot be permanently established until the patent is actually allowed and issued. An improper exposure or unwise placing of confidence in a third party by the inventor or his confidents is liable to, and often has, cost the inventor not only time and money to obtain his rights, but has entailed the entire loss of his invention.

It is therefore necessary that the patent agent should not only have the confidence of the inventor, but that he should carefully guard the interest of his client and see that no injudicious exposure or explanation is made that parties liable to create trouble can get hold of. The utmost confidence ought to be maintained between an inventor and his attorney or agent.

A patent agent ought to be patient. Inventors are proverbially tedious. They like to talk about their inventions especially to the person whom they have employed to prepare their patent papers and attend to prosecuting their applications. This is also excusable, because it relieves the mental pressure. It is the inventor's safety valve. Fear of exposing his secret to others compels him to keep it locked up in his brain; and there it lies, unfolding itself, expanding in value and importance and permeating every tissue of the human anatomy until the accumulated pressure is relieved by a distribution of the burden with a confidant, and the patent agent is usually that confidant.

The agent should patiently listen, for the talk of an inventor is valuable to him. It gives him the inventor's peculiar ideas; and if he is a student of human nature, it enables him to frame the case so that the inventor will be satisfied with it in every particular.

The patent agent should be accommodating. Inventors are often whimsical; the very nature of their undertaking is apt to lead them to peculiar theories and incorrect conclusions, although the general result of their theories and conclusions may be correct. These theories the agent must not combat, unless they are vital and enter into the essence of the case. He had better let their possessor retain them than incur his distrust and possible enmity by opposing them. The inventor will find his errors when he comes to enter upon the actual and practical field of operation.

The patent agent must be familiar with the law of patents; otherwise how can he guard the vulnerable points of the invention? Every specification must be prepared with a view to its having to pass at some time or other through the ordeal of a judicial examination. and a judgment as to its validity and scope; and unless the person who prepares the specification fulfills the legal requirements, and in a legal manner sets forth the description and claims, the patent will not stand.

No general knowledge which he may possess will make up for the want of legal knowledge: this want is the one thing that may defeat the end sought, and the knowledge must be properly possessed and properly employed.

The patent agent must be a mechanic, theoretical, at least. In this particular, a patent agent must be qualified by nature, and not by education, although education is necessary to enable him to dress his mechanical points in proper language and render his points plain, certain, and intelligible. Technical knowledge of each particular art, trade, or profession is not required, but a general knowledge of the various steps and requirements is necessary. A person who possesses the inventive faculty, if otherwise qualified, makes the best patent solicitor; he can then see each invention through the same medium and in the same light that the inventor himself sees it; he can pick out and embody the small mechanical points that form the real safeguards of a patent, and thus more absolutely prepare the case for the scrutiny of judicial investigation and the criticism of mechanical experts.

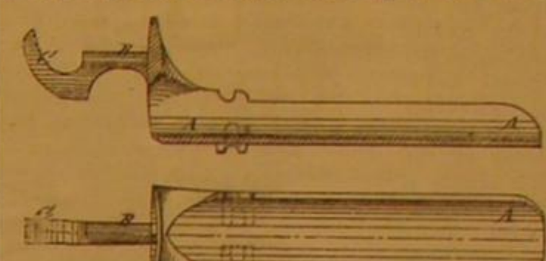
Few men possess all of these qualities, therefore we might say that few men are competent to serve as patent solicitors. The want of proper qualifications in patent agents is the cause of so many worthless patents being issued from the Patent Office. The inventor must absolutely depend upon the preparation of his case for his security and defense, and it therefore behooves him to examine into the character and qualifications of the person in whose hands he places his invention and secret.

The safest and best guide for inventors who require the services of a patent agent is to choose those who have been long in the business and who have acquired a settled reputation for integrity and capacity. Mushroom patent agents exist everywhere. They employ the most specious means to entrap the uninformed inventor, but their services are an actual damage nine times out of ten. It is a hundredfold cheaper to pay a competent attorney or agent a fair fee than to accept the services of such men for nothing.—*Mining and Scientific Press.*

To PURIFY glycerin, add 10 lbs. iron filings to every 100 lbs. glycerin. In a few weeks all impurities will lay at the bottom.

IMPROVED SAP SPOUT.

Mr. Hiram A. Lawrence, of West Shefford, Quebec, Canada, has patented through the Scientific American Patent Agency, September 12, 1876, an improved sap spout, which may be applied to the tree without pounding, and, consequently, without injuring the bark: which will prevent leakage, cannot be forced out by the sap freezing in the hole, and which cannot be drawn out or loosened by suspending a bucket from it. The body of the spout, which is of iron, is made in the form of a half tube. At the base the sides of the spout are extended up to meet above the cavity, as shown in the engraving. The hole in the tree is made of such a size that the stem, B C, can be inserted in it by raising the outer end of the spout. When the stem has been pushed so far into the hole that the upper part of the base of the spout strikes against the bark of the tree, the outer end of the spout, A, is then pressed downward. This forces the transverse edge of the end of the hook, C, into the upper part and the longitudinal edge of the base of the



hook, C, into the lower part of the hole in the tree. At the same time, the edge upon the base is forced into the bark of the tree around the lower part and sides of the hole, so that there can be no leakage.

Solvent for Rubber.

This new solvent consists of a mixture of methylated ether and petroleum spirit—the common benzolene used for burning in sponge lamps. This forms the most rapid and, perhaps, the best solvent we have tried; the mixture is as much superior in power to either of its constituents singly as the ether-alcohol is to plain ether in its action on pyroxylin. We make a very thick solution by dissolving sixty grains of good india rubber in two ounces of benzoline and one ounce of sulphuric ether. If the india rubber be cut up fine and the mixture shaken occasionally, the solution will be complete in two or three hours, when it may be diluted to any required strength with benzoline alone. The india rubber should be as light colored as possible, and all the outer oxidized portions must be cut away. Shred the clean india rubber with a pair of scissors, and throw it at once into the solvent.—*British Journal of Photography.*

Wood Pulp.

Many substitutes for cotton wool have been proposed for the making of pyroxylin, such as linen rags, sawdust, flax, paper, etc., the last-named material alone being the only one used practically, though it is by no means certain that sawdust might not supply a good pyroxylin with organic reactions for special purposes. But the most promising material of all is offered in cellulose prepared from wood, which is now made for the paper manufacturers in very large quantities. The mechanical wood tissue obtained by grinding wood does not answer their purpose at all; but the cellulose prepared by chemical means is a substance whose qualities render it suitable for the manufacture of the highest quality of paper. So far back as 1868, a company made paper from this material alone, without the addition of rags. Three years afterwards five large mills were started (by an English company) in Sweden; and in Germany, at the present time, there are six factories in which the same process is carried out. It is somewhat as follows: The wood of pine and fir trees (oak is of no use whatever) is cut into small pieces a little less than an inch long by half an inch wide and a third of an inch thick, which are then comminuted by passing them into a machine very like a large coffee mill. It is then boiled, under a pressure of ten atmospheres, in a solution of caustic soda for about four hours. The residue is well washed, bleached, pressed, and lastly dried and cut up into sizes suitable for packing. It is also sent out unbleached, in which form it is used for a variety of purposes, besides making brown paper. This is the form we should be inclined to think would be most suitable for the manufacture of pyroxylin. The greatest demand hitherto has been in Germany and Austria, the former country producing, it is estimated, 250,000 tuns of paper a year, and Austria about 100,000 tuns. If only one fifth part of this be made with cellulose, that would mean 70,000 tuns of this material, which would require 280,000 tuns of wood for its production.

REMOVING SUBSTANCES FROM THE EAR.—Take a horsehair, about six inches long, and double it so as to make a loop at one end. Introduce this loop as deeply as possible into the auditory canal, and twist it gently around. After one or two turns, according to the originator of the plan, the foreign body is drawn out with the loop. The method is ingenious, and at all events causes little pain, and can do no harm.—*Medical Record.*

THE Amazon river drains 2,500,000 square miles of land, and is navigable for 2,200 miles from its mouth.

IMPROVED TWIST DRILL AND TOOL-GRINDING MACHINE.

Great difficulty has always been encountered in grinding threading tools to an accurate angle and center. The same is true of drills, and, in fact, of any tools whose edges are made up of straight lines, in which symmetry of shape is a necessity, in order that they may produce true and correct work. Makers of taps, among others, meeting this difficulty, have been obliged to try many devices to obviate it, and often, to obtain uniformity, employ rotary cutters or other and hitherto ineffectual substitutes; but as a rule most machinists rely on their manipulative skill and accuracy of eye to grind their implements to exact shape.

The new machine, which is illustrated herewith, is another instance of that tendency, which is everywhere manifest, to substitute the absolute certainty of mechanism for the doubtful results depending on the judgment; and it is so constructed that the correct grinding of the tool is simply a matter of easy adjustment. Tools may be ground to any given angle, from zero to ninety degrees; any desired clearance may be given to them, and the grinding is done in an improved manner by using a wheel which has an annular recess in each of its sides. This allows the edge of the implement to pass entirely across the grinding face on the side of the wheel, and thus be made perfectly straight and flat, instead of concave, as must be the case when the periphery of the wheel constitutes the abrading surface.

Fig. 1.

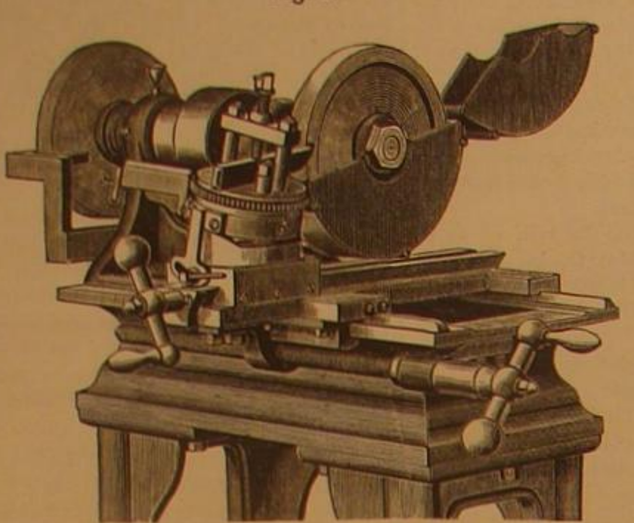
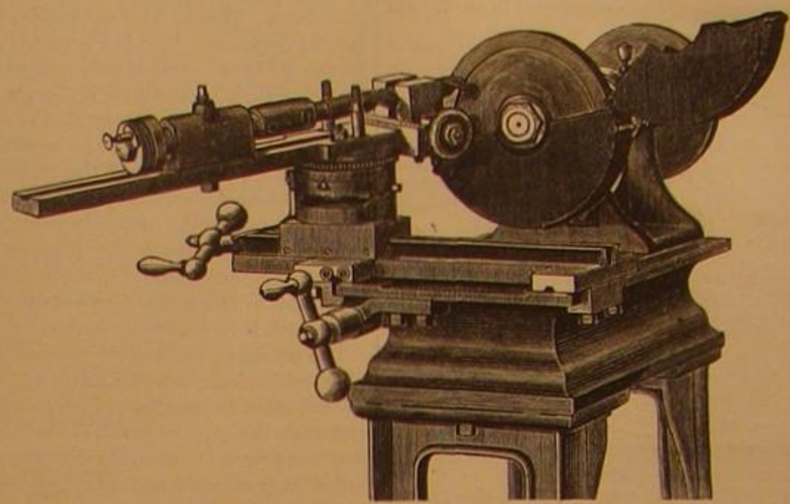


Fig. 2.



FAY'S TWIST DRILL AND TOOL-GRINDING MACHINE.

Fig. 1 represents the machine in use, grinding tools. The tool is fastened to the top of a circular graduated and pivoted tool block, and held the same as when in use in the lathe or planer, being adjusted by the index on the edge of the block to any desired angle and clearance with the grinding face of the wheel; and when brought in contact with and passed across the wheel by means of feed screws, the edge is made perfect. Then (without unfastening the tool) passing it to the other side of the wheel by means of the feed screws, the operation is repeated. This machine has a steel spindle, with adjustable taper bearings, of gun metal. A wheel for general use can be mounted on the other end of the spindle as shown. The machine is furnished with patent corundum wheels, which are made specially for tool grinding, and which will do the work rapidly and effectually without drawing the temper. Fig. 2 shows a drill-grinding attachment, by means of which twist drills or flat drills may be ground with accuracy. The shank of the drill is held in a socket, the same as when in use. The point is held in jaws adjusted with right and left hand screw. By means of the graduated and pivoted tool block, the point of the drill may be placed at any angle and clearance with the grinding face of the wheel and ground the same as a tool, using only one side of the wheel. After grinding one lip, it is turned exactly half round by means of an index on the end of the spindle holding the drill, and the other lip is ground. Then, by passing the point just inside the grinding face and drawing out the index pin, and turning the spindle forward, clearance is given to the back corner without making the edge too thin, and the drill is put in the best condition for use. Twist or flat drills, of any length or size up to two inches, can be ground on the machine.

This machine has been patented by John P. Fay, of Worcester, Mass., and when exhibited at the American Institute Fair of 1874 received their silver medal and commendatory report, as "the first completely successful machine for the purpose." It has also received the same notice at the Centennial Exposition, where it has been on exhibition. It is being rapidly introduced in some of the largest and best shops in the country. For further particulars, address the makers, the Wood and Light Machine Company, Worcester, Mass.

IMPROVED COMBINATION DESK AND BOOK CASE.

We live in an age of condensation, and combination furniture accords with the spirit of the times. Hence inventors of the same find a ready sale for their productions, and make money. At the present Fair of the American Institute, there is a table which transforms itself into a bed, a bed which turns into a bureau, a combined washstand, wardrobe, and dressing case, a mixed blacking box and shaving case, sofa beds uncounted, and so on through a long category of articles, which are always surrounded by a curious crowd. The exhibitors tell us that such inventions pay excellently, and point to the fact that large numbers of regular furniture dealers are now keeping the newest combined appliances in stock, in response to popular demand. On Broadway there are two or three stores, in the large windows of which active individuals constantly display iron chairs, which can be adjusted to form lounges or to suit any position of the body. The throng of gazers renders the sidewalk almost impassable; and if we may judge from the rapid extension of the proprietor's business from one store to several, scattered about the city, his device also has paid. The invention illustrated in Figs. 1 and 2 of the annexed engravings offers a still more striking instance. It is a combined writing desk and book case, adapted to the uses of offices, libraries, hotels, etc., and was patented September 7, 1875. The inventor has exhibited it at local fairs and has displayed it at the Centennial in a very prominent locality. The result is that a number of clerks are employed to show the article, explain its operation, and to fill orders. The desk is an excellent article of furniture, handsomely designed, as our engravings show, and combining improvements in the shape of an ingenious inkstand and paper file, which are the subjects of separate patents, and which are illustrated more fully in Figs. 3 and 4. All were devised by the same inventor, who "didn't know he was inventing," but merely wanted some conveniences of the kind to answer his own requirements, and exercised his ingenuity to make them.

Fig. 1.

This suggests the idea that a process of self examination by every one, to determine whether or not he is an inventor, might result to the profit of a great many people. The probabilities are strongly in favor of any original idea, which will prove lucrative, as in this case, however trivial the invention may seem at first. But to return to the desk

Fig. 2

It is constructed double or single. In the one case it has desk, book shelf, and other conveniences below enumerated, on both sides, and is intended to stand in the center of the room, occupying an area of only 6 x 2 feet; in the other, the conveniences are on one side, occupying even less space, and it may be placed against a wall of the room. The floor space occupied is then but 15 inches in depth.

In Fig. 1 the desk is represented opened, in Fig. 2 closed. The various portions will be understood from Fig. 1. At A are hinged frames, whereon are mounted brackets to receive paper files of the pattern shown in Fig. 4. These files consist of a bent tin back, in which are a number of wires, the ends slipping into sockets at one extremity, and being secured by a locking hinged cap at the other. Newspapers are held by passing the wires through them and then fastening the latter in place, as already described. In the book case, B, a secretary, C, is provided. The folding desk, D, is hinged and supported as shown, and provided with a swinging inkstand, which always remains perpendicular without regard to the position of the leaf. The inkstand is hung on gimbals, and is protected by a cap when the leaf is closed. A similar arrangement of swinging ink wells, designed for use on shipboard, is represented in Fig. 3. In order to afford greater writing facilities, sliding desks, which may be drawn out when desired, are provided at E, and beneath, at F, there is a case of drawers. Into the receptacle at G, waste paper may be placed, and at H, attached to the doors, there are boxes for letters and newspapers for the mail, and in rear, in the body of the desk, are alphabetic pigeon holes for filing printed documents, etc. A set of ingeniously contrived secret drawers are provided, the location of which we leave the reader to determine if he can.

Fig. 3

Fig. 4

The desk received a medal at the American Institute Fair of 1875, and the Centennial judges have awarded it an excellent report. Further particulars may be had by addressing the inventor and manufacturer, E. W. Stiles, 1,020 Arch street, Philadelphia, Pa.

Sulphur Tamping.

Sulphur tamping for iron in stonework ought never to have been substituted for lead tamping, since the presence of the least moisture between the surfaces of the iron and sulphur sets up chemical action, and, in a few years, the sulphur has been converted into a true hydrated sulphide of iron. During this conversion, the tamping swells greatly, and is either forced out of its place, and consequently its utility destroyed, or else it cracks the stone in lines radiating from the tamping, if this is used in a single spot; or, if there is a row of holes so tamped, the stone will be cracked longitudinally. To be sure, it may take fifteen or twenty years to actually break the stone apart; but in that time granite stones measuring eighteen inches by eighteen inches by nine inches have been so broken.

A CORRESPONDENT, writing from Japan, says that one of the practical results of Japanese traffic with this country is the extensive introduction into Japan of kerosene lamps and gas works, which the natives are commencing to manufacture themselves.

A MUSEUM OF BRITISH BIRDS.

Brighton, the Londoner's favorite seaside resort, has not only the largest and most complete aquarium which has yet been built, but also many other galleries of art, science and literature. Among these is a museum containing specimens of nearly all the birds native to the British Isles. The collection is the property of Mr. Booth; and the labor and expenditure must have been very large before so complete a collection was obtained. We select from the London *Graphic* four admirable engravings of subjects selected from Mr. Booth's Museum, the first of which shows a pair of those wonderfully wild and shy birds the herons, the European variety of which has furnished from time immemorial the game of the falconer. It will be seen that the neck is long and flexible, and the bill large, strong, and pointed; so that when the bird stands in a swamp or pool (as its habit is), with the long neck drawn down between the shoulders, the bill can instantly be darted forth and the passing reptiles or fish seized and swallowed.

The European heron (*ardea cinerea*) is of a bluish ash color, with a black crest on the hind head, the fore part of the neck being white with black dots. Its size and strength make it a noble quarry for the trained hawk, whose employment for sport is still practised in some parts of England. The falconer carries a square wooden frame suspended around him by straps over his shoulders. On this frame are perched the hawks, their heads being covered completely with leathern hoods, the caps of which, covering the eyes, can be raised. When a heron appears in sight, on the wing, the falconer raises the cap from a hawk, who is instantly on the alert, turning his brilliant eyes in every direction in search of a victim; the falconer then takes the bird on his hand and lets him go. The hawk flies with lightning speed toward the heron; and a struggle between the courage and skill of the one and the weight and strength of the other takes place, ending sooner or later in the death of the heron.

The peregrine falcons, shown in our second engraving, have been much used for the sport of hawking, as they are capable of being tamed without losing any of their power and courage; and when the battle is ended, they return to the falconer to receive the prize of victory. They are exceedingly handsome birds, the eyes being large and keen; the plumage is very compact, the head and neck in the adult male being grayish black tinged with blue, the rest of the upper parts being of a dark bluish gray with indistinct brown bars; the throat and front of the neck are white, and a broad triangular mark of blackish blue extends downward on the white of the cheeks from the corners of the mouth. The American bird most resembling the peregrine falcon is the duck hawk (*falco anatum*, Bonaparte).

The three owls shown in our third illustration are of the barn variety common in England. The tribe is known to science as *strix flammea* (Linnæus); it is somewhat smaller than the American barn owl, and is lighter colored, the breast being white. The singular look of wisdom of the whole owl family is well shown in the deep set eyes and the solemn, taciturn expression of countenance in this variety; and their zealous hunting after mice and small birds makes them useful in the barn and granary.

Our fourth engraving shows a family of kestrels, birds to which our sparrowhawks are very similar. The kestrel is about 14 inches long, with an extent of wing of 28 inches; the general color in the male is light grayish blue, the back and wing coverts being pale red with triangular dark spots. In the female, the upper parts are light red, with transverse dark bars and spots; the young of both sexes resemble the female. The kestrel hovers at a hight of about 40 feet above the ground, and pounces suddenly on small birds, mice, or reptiles, the numbers of field mice which it destroys being enormous. When not in search of prey it flies high, and is silent; in the breeding season, however, it becomes vociferous.

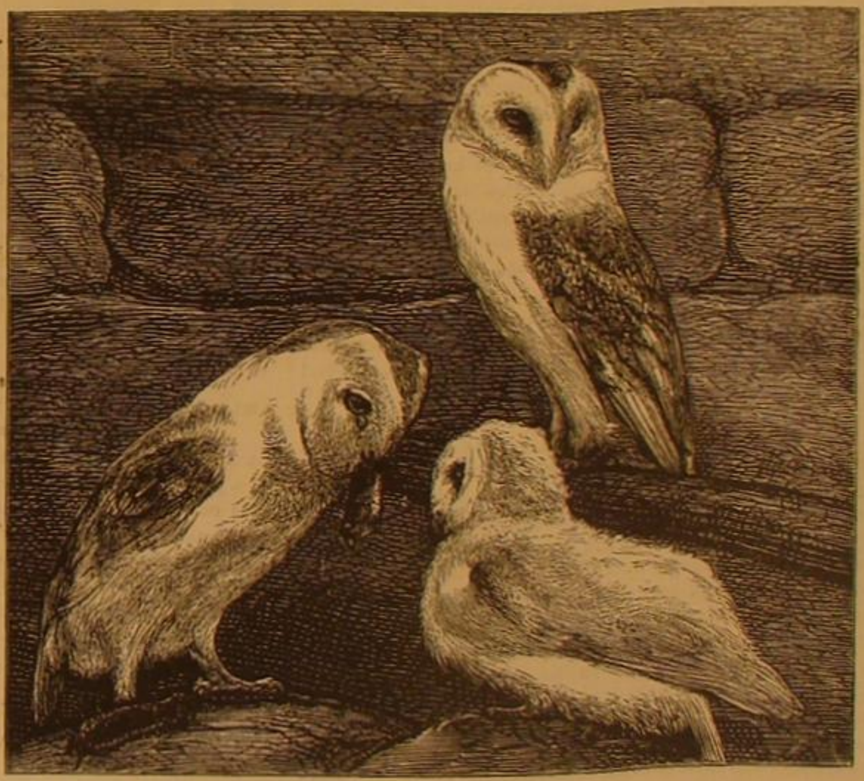
Alcoholic Solution of Shellac.

The production of a clear solution of shellac has been the subject of numerous experiments, but hitherto none has turned out satisfactorily except slow filtration. As is known, by digestion of one part of shellac with six or seven parts 70 per cent of alcohol, a solution is obtained which, when warm, is almost clear, but upon cooling becomes turbid, and is only partially clear after standing a week. The plan of pouring sufficient alcohol over coarsely powdered shellac to form a thin paste yields, upon the addition of more alcohol after the lapse of eight or ten hours, a liquor that does not deposit any more, but which is not clear. Another method suggested, of boiling the alcoholic shellac solution with animal charcoal, gives a clearer liquid, but there is always loss through absorption by the animal charcoal.

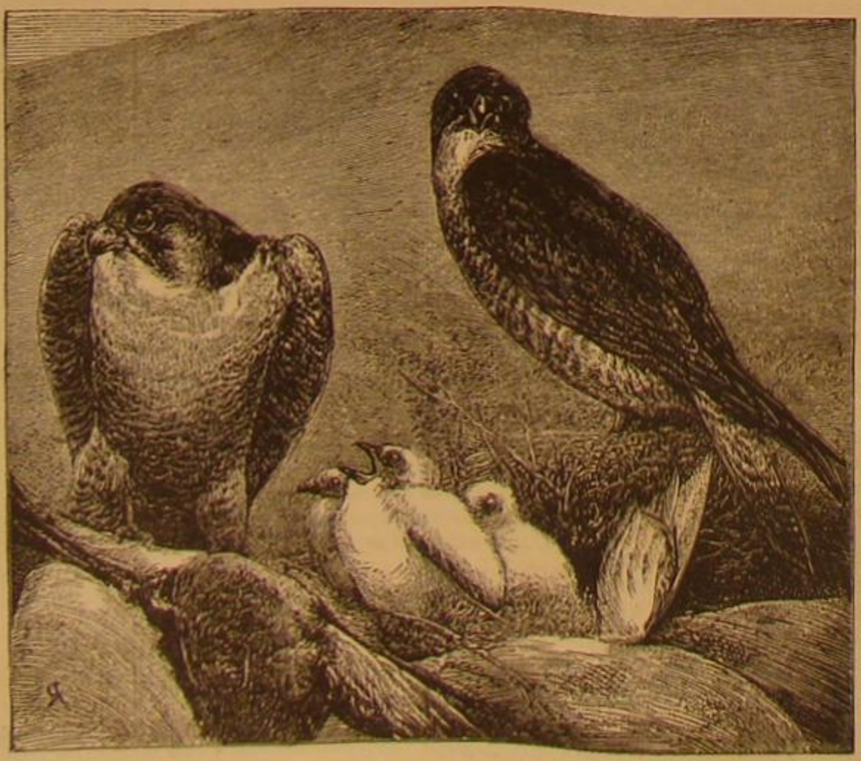
The object sought by the author was to obtain a clear alcoholic solution in a short time without much loss. Previous communications upon the substance occurring in shellac to the extent of five per cent, which renders its alcoholic solutions turbid, and is described by some authors as wax, and by others as a fat acid, suggested an attempt to effect its removal before dissolving the shellac. The shellac, therefore, was boiled with water, from one to five per cent of soda or ammonia being added, but without satisfactory result; a somewhat larger addition of the alkali caused the solution of the shellac. The author next prepared a solution with one part of shellac and six parts of 90 per cent alcohol at the ordinary temperature, which was effected with frequent shaking in ten or twelve hours. To this he added carbonate of magnesia to about half the weight of the shellac used, and heated the mixture to 140° Fah. The solution so obtained cleared more rapidly than a solution to which magnesia had not been added, and filtered in less time; but it did not supply what was sought. When powdered chalk was substituted for magnesia, the solution, after standing some hours, became three fourths clear, while the lower turbid portion could be rapidly filtered. It only required a little alcohol to wash the filter, and a clear alcoholic solution of shellac was obtained. Further experiments—for instance with sulphate of baryta—did not give a better result. When such a solution is made on a large scale, it would be best filtered through felt.

Notwithstanding that the object of the author had thus been attained, one or two other experiments were tried. To three parts of the above mentioned shellac solution, one part of petroleum ether was added, and the mixture was

HERONS NESTING



A FAMILY OF BARN OWLS



PEREGRINE FALCONS AND YOUNG.

KESTRELS AND YOUNG.

vigorously shaken. After standing a few moments, the liquid separated in two layers; the upper light-colored layer was the petroleum ether with the wax dissolved in it, the lower yellow brown layer was a clear solution of shellac with only a little petroleum ether adhering. Upon allowing the petroleum heat to evaporate spontaneously, the wax that had been dissolved out of the shellac was obtained as a white residuum. By using alcohol at 95 per cent to dissolve the shellac, and then adding petroleum ether, a perfectly clear solution was obtained that only separated into two layers after water was added. Consequently an alcohol weaker than 90 per cent should be used.

The shellac solution obtained by means of petroleum ether, however, has the advantage that the shellac is left, after evaporation, in a coarser form, and easily separates: this may be obviated by adding one to three per cent of Venice turpentine.—*A. Peltz.*

[For the Scientific American.]

THE GAS MICROSCOPE.

BY HENRY MORTON, PH. D.

The projection of images from microscopic objects directly upon the screen with the gas microscope has always been a thing much desired by all those who have made use of the magic lantern as a means of demonstration; but the difficulties attending this experiment have been found much more serious than was anticipated beforehand. This is especially the case to one who has been accustomed to use the solar microscope, in which the advantage offered by the parallelism of the solar rays is of no great value. On account of the smallness of the object illuminated, as compared with the errors of focalizing or concentration in the cone of rays coming from the condenser, all the advantages in the use of a lens in a magic lantern, as compared with its use in a camera or the like, disappear, and the lens of the microscopic attachment is left to its own resources*, without any of that aid from the condensers which they afford so effectively to the objective of the magic lantern in its best form of construction.

Among the errors, which thus become conspicuous, the most manifest and vitally important is the want of flatness of field. By reason of this, while the center of the image is well defined, the edges are indistinct and unsatisfactory. To obtain lenses free from this defect has been the continuous effort of some of our ablest opticians for the last ten years; but the success so far has been very limited, and indeed it would seem as if the problem was one for whose solution we could hardly hope, for it must be remembered that lenses whose flatness of field in the table microscope leaves nothing to be desired in that direction, are entirely unsatisfactory when used in the gas microscope.

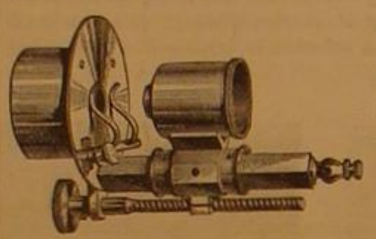
One of the most influential causes of this we shall notice presently; but we will here only remark that, as the result of a larger experience, we have become convinced that one must be contented with a moderate amount of success in this direction, and not expect what is, at present at all events, impossible.

The second great defect that we encounter in the use of the microscopic lens for projection is the irregularity of distribution of light upon the screen. By reason of this we may have a field of light, with a small bright area at the center, rapidly fading off into darkness, with no well defined margin. The causes of this are, among others, the confusion or want of accurate concentration of the cone of rays from the condensers, and the smallness of the objective, causing it to cut off oblique or marginal rays, more or less according to their obliquity. To remedy this difficulty we can work in two directions. In the first place we may improve the spherical correction of the condensers or the concentrated character of the source of light. The first of these improvements, as we have shown in another place†, has already been carried to its practical limit in the best sort of condensers, and the second involves the use of the electric light or of sunlight.

In the second place, any increase in the diameter of the microscopic lenses, without a corresponding increase in their actual length, insures a great gain as regards the equal illumination of the field. With this view alone, therefore, a simple uncorrected or single corrected microscopic lens, such as accompanies the regular gas or solar attachment made for the last 50 years and still made by Duboscq and other French manufacturers, would be the best form, and, as regards the equal distribution of light on the screen, this is true; but when such lenses are thus used, and are of sufficient size to secure this result, their errors of spherical aberration and want of flatness become unendurable. We are then fenced in on either side by the necessity of a large and short lens to secure an equal illumination, and the difficulty in securing flatness or correction under these conditions. The most successful compromise which we have yet found in this connection is the gas microscope objective of 1¼ focus inch by Mr. J. Zentmayer, the well known manufacturer of microscopic stands and lenses. With one of these a well defined object, such as a lady bug, mosquito, or the like, may be thrown on the screen with a clear image, pretty well defined up to the margin, and a field of light so brilliant and regular that it is hardly distinguishable from that of an ordinary magic lantern projecting a colored glass slide of the same object. Of course with such a power very minute objects must be rejected; but by a judicious selection, a large series of interesting ones can be secured, such as the lady bug or mosquito already mentioned, the ant lion, field spider, and various water insects, or larvæ of mosquitos and the different sorts of flies, also wood sections, and even objects so small as the eye of a dragon fly; but above all with this power may be most successfully shown what are by far the most popular illustrations with the gas microscope, such living specimens as the various larvæ above mentioned, and such other things as are to be found in stagnant water. For these the very simple and effective form of live slide devised by Mr. S. Holman, Actuary of the Franklin Institute, Philadelphia, is invaluable. It consists of an ordinary microscopic glass slip, of greater thickness and size than usual, with a spherical cavity about ⅝ of an inch across and $\frac{1}{8}$ of an inch deep, ground and polished in the middle of one face. This, when in use, is closed by a thin glass cover, which is kept in place by adhesion and atmospheric pressure, the cavity beneath it being filled with water containing the insect or other object. If it is desired to use higher powers, we must be contented with a limited selection of objects, choosing such as are strongly defined and well colored. Diatoms, blood disks, or other objects which are delicately tinted or colorless, are quite unfit for such use. A strongly colored eye of a fly or sting of a wasp, or other parts of insects, such as a claw of a spider, answer well.

In this case I have obtained the best results with Zentmayer's $\frac{1}{10}$ objective, using an extra condenser consisting of a plano-convex lens of about 3 inches focus and 1½ inch diameter, placed about an inch back of the object. This greatly increases the illumination of the field.

In using the gas microscope much depends upon the efficiency and convenience of the support for lenses and the stage, or what is known commonly as the gas microscope attachment. After many experiments and the frequent alteration of other forms, I have settled upon that represented in the accompanying woodcut as the most desirable. The portion holding the lens slides on a square bar receiving motion from the steep-threaded screw beneath, which is turned by the large milled head in the rear. This gives a very easy, smooth, and steady motion, abundantly delicate and yet admitting of rapid adjustment. The stage is perfectly flat and unobstructed; and two very elastic spring clips, whose tension can also be adjusted by a screw at the side, enable objects of almost any size or thickness to be held in position.



Within the large ring, terminating the apparatus toward the left, and which serves to attach it to the lantern, is a smaller ring which carries the extra condenser when required. This form of microscopic attachment is manufactured by Messrs. George Wale & Co., Hoboken, N. J., who are instrument makers to the Stevens Institute of Technology, of that place.

*On the subject here referred to, see SCIENTIFIC AMERICAN, 1873, volume XXIX, page 163.

†SCIENTIFIC AMERICAN, 1873, page 163, volume XXIX.

Minute Time Intervals Measured by Frictional Electricity.

An invention which will enable us to estimate the velocity of a projectile during its passage through the bore of a gun is one which the great advances which have been and are constantly being made in the science of gunnery has long rendered desirable. To meet this requirement, Dr. William Siemens recently renewed investigations into the subject, undertaken as early as 1847, and his studies have resulted in probably the most delicate and accurate chronoscope ever devised. To understand the nature of the novel principle introduced by Dr. Siemens, it is necessary to review briefly the previous labors of others in the same direction.

The first attempts date from 1837, and were made by Pouillet, who measured the time employed by a projectile to traverse a given path by estimating the intensity of the electric current provoked by the pulsations of a magnetized needle. Wheatstone, in 1840, Konstantinoff and Breguet, in 1842-3, and later De Brettes and others, sought an analogous solution of the problem in the use of magneto-electric registering apparatus, to which the names chronograph and chronoscope were given. Among these was included a device invented in 1845 by Leonhardt, which consisted in a clockwork movement, the index of which was moved by an electric current.

All these attempts, Dr. Siemens thinks, failed because the electric current marks intervals of time, not directly, but through the medium of magnetic or mechanical apparatus. He proposed, in the beginning, to use frictional electricity: but as at the time of his proposition experiments in that species of electricity were little investigated, the methods in vogue were continued. Subsequently these have been greatly improved; but recourse has always been had to the intermediary apparatus. This is the case in the Nobel and Boulenger machines, in which small errors in construction lead to greater ones in the indications. Recently Dr. Siemens has perfected and successfully tested his frictional electricity apparatus, which is constructed as follows. We translate the description from the *Revue Industrielle.*

A very light and highly polished steel cylinder is rapidly rotated by means of gearing, provided with a very sensitive regulator, and capable of being instantly arrested in its movement at will. The mechanism is so regulated that the cylinder makes exactly 100 revolutions per second. The completion of each hundred turns is suitably indicated so as to correspond with the beat of a seconds pendulum. Near the polished surface of the cylinder is fixed a conducting needle connected with the exterior armatures of an insulated battery of Leyden jars. The interior armature of each jar is in contact with a wire, insulated by rubber or gutta percha, which enters the bore of the gun through a hole made for the purpose. The battery is provided with a commutator, which allows of the jars being simultaneously charged by a Ruhmkorff apparatus.

When the gun is fired, the projectile successively destroys the insulating envelope of the wires which end in the bore; the exterior armatures of the jars are then put in communication with the gun, and hence with the earth. As the rotating cylinder is itself in connection with the earth, the jars instantaneously discharge through the needle and mark dots on the cylinder with great depth and distinctness.

The intervals between these points is measured with a micrometric screw, and the cylinder is previously covered with lampblack. Each of the black dots is then surrounded by a pale ring, and is easily recognized. The axis of the cylinder carries a gear, in connection with which the micrometric screw is disposed. The gear has 100 teeth, and the head of the screw is divided into 100 parts, so that at the rate of 100 turns per second each division of the head of the screw corresponds to 0·000001 second, an interval which can be subdivided. With a little practice in manipulation, the apparatus is made to give, for each shot fired, a number of indications of velocity proportional to the number of jars in the battery, and of communications with the gun.

The great precision thus reached in gunnery experiments has determined Dr. Siemens to apply the same principle to the estimate of velocity of electricity even in suspended wires. The usual method has been that of Wheatstone, according to which electricity in copper wire travels at the rate of 62,000 geographical miles per second. Wheatstone, in his experiments, used a rapidly revolving mirror, in which he observed three sparks, of which two came from the two ends of a conductor destined for the discharge of a Leyden jar, while the intermediate spark came from the middle of the conductor. Were the velocity of electricity infinitely great, the three sparks observed in the mirror would appear on a right line, parallel to the axis of rotation. But such is not the case, and Wheatstone deduced the velocity of the electricity from the intervals noted between the extreme sparks and that at the middle. It is evident that this kind of estimate is very uncertain, especially since results obtained later, by Fizeau, Gould, Gonnelle, and others, by different methods, differ greatly from those obtained by Wheatstone. Dr. Siemens' method of measuring the velocity of electricity in telegraphic lines consists in causing the electric discharge from a Leyden jar to reach the revolving cylinder, part directly and part through the length of wire. The interval between the two marks then gives a measure of the time occupied in traversing the wire. The indications have been noted with great accuracy, and they show that the velocity of electricity is just half that announced in Wheatstone's estimate, or 31,000 geographical miles per second.

Pneumatic Tubes.

The Western Union Telegraph Company, in its annual report to its stockholders, just issued, says, of the experiment in adopting the tube system of transmitting messages, that during the past year the central office in New York has been connected with the branch offices at No. 14 Broad street, No. 134 Pearl street, and the Cotton Exchange by pneumatic tubes. The tubes are made of brass, each 2¼ inches internal diameter and ⅛ of an inch thick, and are laid under the pavements in the streets at a depth of three feet.

Messages are sent from the central office to the several branch offices by compressed air, and from the branch offices to the central office by atmospheric pressure or vacuum. The motive power is furnished by a 50 horse power duplex engine situated in the basement of the central office, which operates two double acting air pumps communicating with the compressed and vacuum mains terminating in the operating room. These are connected to the tubes extending under the streets by means of double sluice valves, which are so constructed that carriers containing messages may be sent through the tubes in either direction by turning a cock connected with the compressed or exhaust air mains.

With the usual pressure employed—6 lbs. to the square inch—the time occupied in transmitting a box or carrier containing messages between the central office, corner of Broadway and Dey street, to the office at No. 14 Broad street (700 yards) is about 40 seconds; and between the central office and the offices at No. 134 Pearl street and the Cotton Exchange (900 and 1,100 yards) about one minute and five seconds and one minute and twenty seconds respectively.

The operation of the pneumatic tubes is very satisfactory, resulting in a material saving of both time and money.

The total cost of the system is less than $30,000, and about one half of the outlay will be saved annually, to say nothing of the saving in time, by the decreased cost of performing the service by pneumatic tubes between these stations as compared with the former cost by wire.

There are several other offices in the city where the traffic is large enough to warrant their connection by pneumatic tubes with the central office, and it is probable that the system will be extended to some of them after its value has been more fully ascertained.

A New Phylloxera Remedy.

M. Gachez recently announced to the French Academy of Sciences that red Indian corn (maize) is an efficient remedy against the phylloxera, and that when it is planted between the rows of vines in a vineyard, the vines are never injured. The insect, he says, leaves the vine roots in order to attack those of the corn. This is a new way of combating the phylloxera, and is easily tested.

CENTENNIAL NOTES.

THE ENGLISH SILVER WORK AND ENAMELS.

Some marvellously beautiful silver work is displayed in the exhibit of the Messrs. Elkington in the British section. The *repoussé* decorations on the silverware were produced entirely by the hammer, the plate being struck on the back until the figures of the design are sufficiently raised. One false blow might ruin the work of months. The English enamels are among the finest exhibited, not excepting the Chinese and Japanese. They were produced in the following manner: The vase or other article is hammered into the required shape. In *cloisonné* (panelled) work, which is by far the most prized, requiring as it goes greater skill and patience on the part of the artist, the patterns are traced very finely on the surface of the metal; very thin gold, copper, or other wire is then bent by hand with delicately made tweezers exactly into the shapes of the ornaments, birds, figures, flowers, etc., which are traced on the metal; the wire thus shaped is then soldered to the dish so as to follow out the design in all its intricacy; this requires the utmost skill and delicacy of touch, for upon these lines depends the success of the patterns. The enamel is then put in the spaces or cells between the wires; it consists of metallic oxides made into a paste which, when put into the cells and subjected to a great heat, develops the desired colors.

This process is repeated again and again, the shading of one color into another and the filling of all the cells requiring many meltings. The face of the work is then ground down smooth upon a revolving stone, or stoned down, as it is called. This method of enameling is of great antiquity, though it has never until late years obtained any great development in Europe. The Chinese and Japanese still practise it, and their work, both ancient and modern, has been described and can be seen in their sections. The *champ levé* (raised field) process is the reverse of this, the cells for the reception of the enamel being cut out of the metal on which it is placed, leaving the raised pattern. The enameling is done as before described.

HOW DOULTON WARE IS MADE.

The superb Doulton pottery in the English exhibit is only a refinement upon common stoneware. It is made of Devonshire and Dorsetshire clay, kneaded into a homogeneous mass, to which has been added a certain proportion of crushed stoneware of former manufacture. Mr. Doulton conceived the idea of making each piece unique, that there should be no copying of designs in shape or ornamentation, and that in every stage of manufacture the piece should be the direct result of the mind and hand of the workman. Workmen capable of being entrusted with this discretion he found in the Lambeth School of Art. Every bottle, vase, or cup is turned at the potter's wheel by the hands of a workman, and passes untouched from the wheel to the decorator.

The ornamentation is of four kinds: raised ornaments, indented or etched patterns, scroll work, figures or landscape engraved by incised lines, and they may be painted in various colors. The encrustation is with clay, which has been whitened by admixture with calcined flint, and the ornaments are first formed in a mold. The patterns are both simple and elaborate; the simple ones are laid on by young girls, while the more elaborate have to be arranged by an artist.

The incised work is all done by an artist, Miss Barlow, and some very exquisite productions of her graver can be seen in the Main Building. In animal drawing, she seems to excel, some of her groups of horses being in the highest style of art. This work is done after the piece has been partially baked, and when it is in the biscuit state and easily cut. Color is sometimes rubbed into the lines, or the lines may be left as they are. The coloring is done with metallic oxides, and the piece is then fired. There is a richness and harmony of coloring about a group of this stoneware which produces a pleasing impression. The ware is glazed, like all the common stoneware, by throwing salt in the kiln, and in every instance the piece is finished before it goes to the furnace. This enables the manufacturer to turn out works of great artistic merit at a much less cost than where so many processes are required to produce similar results.

THE ECLIPSE ENGINES IN MACHINERY HALL.

One of the most interesting exhibits in Machinery Hall includes the various forms of Eclipse engine, manufactured by Messrs. Frick & Co., of Waynesboro, Pa. The Eclipse stationary embodies a large number of minor improvements and a novel design governing the distribution of the material of which the frame consists, which keeps the different working parts compactly together, and is calculated to secure the greatest strength with a given amount of material. The Eclipse portable engine likewise is of new and improved construction, and is furnished complete with every appliance, so that it is ready for immediate work. The same may be said of the agricultural engine, which, in point of lightness, easy portability, and high indicated power, is excellently adapted to the uses of farmers. Of some of these improved machines we shall shortly publish engravings with detailed description. In the meantime they may be seen at D 10, 78 Machinery Hall.

THE CENTENNIAL POSTAL ENVELOPE.

In the Government Building is an exhibition of the manufacture of stamped envelopes, and a peculiar pattern of postage stamp is printed upon them. These envelopes were sold only on the ground, and the sale, from May 10 to November 1, amounted to 8,500,000 envelopes, valued at $245,000.

A PERMANENT MUSEUM OF MINERAL AND METALLURGICAL SPECIMENS.

The American Institute of Mining Engineers have appointed a committee to take charge of the arrangements for establishing a permanent museum of mineral and metallurgical products in connection with the Pennsylvania Museum and School of Industrial Art, the collection to be placed in one of the saloons of Memorial Hall. Many of the valuable collections from foreign nations which have been exhibited at the Centennial have been presented to the Institute, and among them the following: The entire collective exhibit of minerals displayed by the German Government, including maps, drawings, statistics, etc., presented by the Imperial German Minister of Trade and Commerce. Siegerland collective exhibit of iron ores, including the base of the Spiegel iron pyramid in Machinery Hall. Mr. A. Börsig's display, and the exhibit of the Luxembourg Mine and Saarbrücken Furnace Company, both in Machinery Hall. The entire exhibit of the Fagersta Iron and Steel Company, of Sweden, including the valuable suite of test specimens by Kirkaldy. The exhibits of Miller, Metcalf, & Parkins, Crescent Steel Works, of Pittsburgh, Pa., and Cooper, Hewitt, & Co., of New York city. Models of blast furnaces and hot blast stoves, by Thomas Whitwell, Middlesborough, England. Rock Hill Coal and Iron Company's exhibit, etc.

CHINESE VASES.

Several boxes of antique Chinese vases from the private collection of Hu Kwang Yung, Minister of Finance in China, were received, on the 2d instant, in the Chinese Department in the Main Building. The vases are extremely rare, and are beautifully tinted in vermilion, ultramarine, blue, and gold, and are regarded as some of the finest remnants of the Eastern lost arts now extant. The specimens of *cloisonné*, antique china, and bronzes are particularly beautiful.

THE CENTENNIAL AWARDS.

It is reported that the Centennial Commission has reconsidered its action, in causing all reports on awards to be signed by the President and Director General, and has decided to issue the papers with the judges' signatures, as previously intended.

THE CLOSING OF THE EXPOSITION.

All arrangements for closing the Centennial are being rapidly completed. The work of removing goods must begin on November 11, and be finished before December 31, unless otherwise ordered by the Director General. Goods remaining without authority after the specified time will be removed by the authorities and sold to pay expenses. Most of the railroad companies in the United States having officially announced that they would "transport at regular rates all articles intended for exhibition at the International Exhibition of 1876, at Philadelphia, as well as all other articles forwarded by exhibitors for their own use, in connection with the Exhibition, and would return unsold articles free; exhibitors who expect to secure free return transportation for their goods must apply for certificates at the office of the Bureau of Transportation, where proper blanks for the purpose will be furnished. These certificates will be issued to those exhibitors who have furnished to the Chief of the Bureau of Transportation duplicate bills of lading or like evidence of being entitled to them."

There will be a general sale of all the buildings belonging to the Centennial Board of Finance on Thursday, November 30, at 11 o'clock A. M. The list comprises the Main Building and Carriage Annexe, Agricultural Hall, with Wagon and Pomological Annexes, the Art Annexe, Photographers' Exhibition Building, Shoe and Leather Building, Judges' Hall, Butter and Cheese Building, Guard Station Houses, and various other small buildings. Particulars of the sale will be furnished in pamphlet form on application, ten days before the appointed time.

New Investigations on the Spontaneous Combustion of Oily Refuse.

Mr. J. J. Coleman, of Glasgow, has recently transmitted to the *Société Industrielle* of Mulhouse, France, a memoir on the spontaneous combustion of oily refuse and on the relative inflammability of the different oils employed for lubricating purposes. He describes a series of experiments upon fragments of cotton, linen, jute, and woolen waste, saturated with oils of different natures. The materials were placed in a box of tin, having a double bottom in which steam entered, so that the part which received the refuse could be maintained at a temperature of 180° Fah. A thermometer was inserted in the oily substance so that the variations of temperature occurring therein could be noted.

The results obtained show, first, that any vegetable or animal oil inevitably takes fire after a few hours, under the above conditions. On employing cotton waste, the mass burns quickly and with flame, in contact with the air. Wool refuse is slowly transformed into a black carbonaceous mass. Second, the addition of mineral oil—known as lubricating mineral oil—serves to retard the spontaneous combustion of vegetable or animal oil if mixed in small quantity. If a large amount be added, inflammation is entirely prevented. The mineral oil used by Mr. Coleman is a very dense product (density 890), having great viscosity and emitting no inflammable vapors even in contact with an ignited body at any point below 338° Fah., or in other words remaining safe at temperatures at which mixtures of less dense mineral oils or colza oil burn. The addition of 40 per cent of mineral oil is sufficient to prevent spontaneous combustion. Twenty per cent doubles the time necessary to determine conditions favorable to the same. Spontaneous combustion occurs most quickly when the cotton is soaked with its own weight of oil.

The Messrs. Dollfus, who presented Mr. Coleman's paper to the above named society, add the results of further investigations of their own. They note the fact that access of air is indispensable to the obtaining of a sufficient elevation of temperature to determine combustion, and that it was found necessary even to blow air into the hot box.

There is another advantage to be gained by mixing mineral oil with that of vegetable origin, in that the latter is thereby prevented from resinifying, or thickening, on prolonged exposure to the air. Mr. Coleman exposed in his hot air bath, for a period of 48 hours, vessels containing olive, colza, sesame, and cotton seed oils. The first thickened, the second the same to a greater degree, the third still more, and the last yielded a semi-liquid, amber-colored mass. The addition of 20 per cent of mineral oil caused all to remain perfectly fluid. The author concludes that, for the lubrication of machinery, as well as for the oiling of textile fibers, it is advantageous to employ a mixture containing as much mineral oil as is possible while retaining the material at the proper degree of viscosity. Colza and other oils employed for lubricating heavy machinery are greatly improved by the addition of from 10 to 20 per cent of mineral oil, the small viscosity of the former preventing a mixture of greater proportions of the latter. For spindles, on the contrary, it is better to use a larger amount of mineral oil, making a mixture of about the viscosity of sperm oil.

Professor Anthony's Electric Light Experiments.

Professor Wm. A. Anthony, of the Physical Department, Cornell University, sends us the following interesting account of his recent experiment, which we briefly noticed on page 289, current volume. In that notice the lamp used for comparison of light values was incorrectly designated as the one used in the engine. Professor Anthony says:

"The following is a brief description of my experiments: To the electro-magnetic machine, which was driven by a Brayton petroleum oil engine of five horse power, wires were connected for conveying the electricity produced to a room some 300 feet distant, from which daylight could be excluded, for photometric experiments. In this room, the wires were connected with a Foucault regulator for the electric light, the light being produced by the passage of the electric curve between two carbon points. The electric light being too brilliant for direct comparison with the standard candle, I took from my house a common coal oil lamp, having a flat wick one inch wide. The electric light was found to be equal to what would have been produced by 234 such lamps. But 234 such lamps would have consumed nearly 16 lbs. oil per hour, while the engine, whose power developed the electric current, which in turn produced the electric light, consumed but 6¾ lbs. oil in the same time. This fact was stated in the paper giving the results of my experiments merely as showing, in a striking manner, how very small a proportion of the energy of combustion of the oil in the common lamp is utilized as light."

Right of Passenger to a Seat.

In the case of Barnet Le Van against the Pennsylvania Railroad Company, in Court of Common Pleas No. 4, at Philadelphia last week, the facts are given as follows: The plaintiff in November, 1868, purchased at Harrisburgh a ticket from the defendants for passage to Philadelphia, the train on which he was to take passage being known as the Cincinnati express. When the train reached the station at Harrisburgh it consisted of but two passenger cars, an ordinary car and a smoking car. The plaintiff asserts that he was constitutionally unable to ride in the smoking car, and the other car was full. The plaintiff was afflicted with a disease which made standing for any length of time positively injurious to him, and, as some other cars were added to the train at this place, he asked permission of the brakesman, and was directed by him to enter one of them, a sleeping car, where he found a seat. When the conductor took up his ticket he demanded $1.50 extra for the privilege of riding in the car, which plaintiff refused to pay, alleging that his ticket entitled him to a seat, and that there were no seats elsewhere on the train. The conductor afterwards put plaintiff off the train about eight miles from Lancaster. He walked in to Lancaster, and in the long walk his disease, as he alleges, was aggravated to such an extent that he has never entirely recovered from the effects of it. Le Van's suit for damages has been pending eight years. On the trial the company's version of the affair was that the conductor allowed the plaintiff to remain in the sleeping car until there were seats vacant in other parts of the train; that shortly after the train left Middletown the conductor requested him to take one of these seats and he refused, whereupon the train was stopped and he was ejected. There was no force, the defendants claimed, used on the plaintiff except the mere laying on of hands, so that he should not seem to assent to his being put off the train. It was the duty of the plaintiff, His Honor said, to accept the seat offered in the ordinary car, if such had been actually offered him, and that the conflicting versions of the affair must be reconciled by the jury. The jury, after a deliberation of over two hours, returned a verdict of $8,500 damages.—*Chicago Railway Review.*

IT is said that the price of steel rails, which has fallen one third within the last few years, is now so low that the business is really profitless. A movement is on foot for an agreement between the manufacturers for regulating the production and prices.

To Draw and Paint Magic Lantern Slides.

They are first prepared by having them cut the right size in width and about ten inches in length (they can be bought for a small sum at any glass warehouse); clean them, then lay your picture on a pad of blotting paper, and place your glass over it; the blotting paper will serve as a bed, and the glass will keep the picture in its place ready for tracing the outline, which is done with a camel's hair paint brush, using ivory black, ground up in the best drying oil, made thin with a little spirits of turpentine. The best outlines are funny men and women, animals, birds, and grotesque figures, sheets of characters, clowns, harlequins, etc. When done in outline with the black, they are filled in with the transparent colors, mixed up as the black: only use carmine, gamboge, Prussian blue (the more brilliant the colors, the better effect they produce), the above being for red, crimson, yellow, and blue. To form other transparent colors, mix carmine and Prussian blue for purple, and lavender, gamboge, and Prussian blue for all the shades of green, using for light green more gamboge. Carmine and gamboge make a fine orange color, and for brown shades mix a little ivory black with carmine or lake, with a little gamboge to temper it. Many other tints are made by mixing the primitive colors first named—red, blue, and yellow—by using less of one color with another; and if at any time the colors are too thick, thin with turpentine; it works more easily when not too thick and is more transparent.

When all the colors are finished, mix a nice thin black, and fill in carefully all the ground of the glass round the edges of the figures with the black, leaving no part of the glass slide plain. These slides should be made very well; and to take better care of them, have them put in small wooden frames, with a tongue at one end to move them in the lantern without the finger touching the glass part. Many beautiful designs can be copied from a kaleidoscope, which, when copied and painted on slides, are very beautiful, and show the colors to advantage. Drawing and painting slides is an instructive amusement, and worthy the attention of all persons connected with youth, as it gives them original ideas for combining colors, and thus can be brought into use for many pretty designs in a pleasing manner.

The Kahnweiler Cotton Seed Huller.

Some time ago, we published an engraving of what we considered at the time a very excellent machine for hulling cotton seed, the invention of Mr. David Kahnweiler, of this city. Attracted by the publication, an order was given for one of the machines by a gentleman from near Newbern, N. C. A few days ago, the machine was set in operation; and according to the *Newbernian*, a newspaper published in Newbern, "the cotton-seed huller was quite a curiosity; it did the work finely and thoroughly, the kernels being taken from the hulls and separated from the chaff, which operation prepares the seed for feeding to stock, while the hulls can be utilized for stock bedding. One tun of the cotton seed will furnish 1,000 lbs., or about 20 bushels, of kernels which are said to be better for food for mules, horses, cattle, hogs, and sheep than an equal weight of corn. If this is correct, it will enable the South to feed an unlimited amount of stock, and to raise her own mules and provisions, and literally to eat cotton."

A CORRESPONDENT, Mr. H. McMurtrie, of Boston, Mass., informs us that the Russian system of technical education, recently described by us, has already been adopted by the Massachusetts Institute of Technology, and will soon be in full operation.

NEW BOOKS AND PUBLICATIONS.

THE LEATHER MANUFACTURE IN THE UNITED STATES. By Jackson S. Schultz. Illustrated. New York city: Office of the Shoe and Leather Reporter.

The author of this work already possesses a worldwide reputation as one of the most enterprising and intelligent as well as one of the largest manufacturers in the American leather trade. The series of articles, reprinted from the *Shoe and Leather Reporter*, which compose this volume, could therefore have been written by no higher authority, certainly by none whose opinions and advice will command greater respect. While the whole book is eminently practical and is intended for practical use, it defends no preferred theories, nor enforces any especial views. On the contrary, it presents the merits and demerits of known systems and methods of leather making "as their advocates would state them," leaving all to the candid comparison of intelligent men; and this done, the autnor suggests his preference, warranted by his own experience. Mr. Schultz, besides, accomplishes the difficult task of writing a technical book without technicalities; and he does it admirably, for the general reader, knowing little or nothing of tanning, can read the work through with interest, and obtain a vast amount of really useful information. The selection and classification of hides is explained in the first chapter, the next takes up the sweating, then liming, then fleshing and trimming; then follows preparing the bark, and so on through all the various topics, including construction of tanneries, cost of tanning, utilization of refuse, tanning processes, and finally a valuable report on the burning of tan in furnaces—on which subject he possesses more knowledge than he communicates—closes the volume. A number of excellent illustrations are provided, and a portrait of the author constitutes the frontispiece.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED WINDMILL.

Andrew J. Ball, Mount Vernon, Ohio.—This invention relates to certain improvements in windmills, designed to render the vanes of the same automatically adjustable, together and as a whole, in their position to the wind so as to diminish their areas of resistance in proportion to the strength or force of the wind, and thus equalize its power. The invention consists mainly in the arrangement of an oscillating tail blade with a supplemental tail and a deflector blade, which together effect the desired result in a perfect and sensitive manner.

IMPROVED RATCHET WRENCH.

Robert R. Wilson, New Orleans, La.—This invention contemplates the saving of time and labor in putting on or taking off nuts from a bolt or axle where they are inaccessible to the ordinary wrench. The invention consists of a compound wrench, provided with a revolving part having several nut sockets or nut holders of different sizes. It is made to turn in either direction with the handle by means of a two-armed pawl lever held by a spring pin. One of the nut holders or sockets is open or cut out at the corners, to adapt it to turn nuts one or more of whose sides may be close to same obstacle.

IMPROVED PAPER PULP ENGINE.

John S. Warren, Cumberland Mills, Me.—In using the machine for beating and grinding, the case is filled or charged through an opening in the screen, and power is applied to give a rotary motion to the cone and tube and their attached knives. This revolution of said parts engenders a centrifugal force, which causes the pulp to flow up through the space between the tubes and cones, the knives operating upon it during its passage. The pulp, as it is thrown out, passes down the sides of the case and establishes a circuit, thus becoming thoroughly intermingled.

IMPROVED WATER METER.

Sebastian Plymale, Portland, Oregon, assignor to himself and Thomas Hutten, of same place.—This is so constructed as not to become choked by sediment or other impurities passing in through the supply pipe. In the case is placed a tank, which is divided into two equal compartments, and balanced upon pivots. When the said tank is tilted, the head of a valve stem strikes upon a stop attached to the bottom of the case to allow the water in said compartment to flow out. When the tank is tilted, the water flows into the upper compartment of said tank until that compartment overbalances the other and reverses the tank. This opens the valve of the full compartment, and allows the water contained in it to flow out, while the other compartment receives water. By this construction, exactly the same quantity of water must flow into each compartment each time to tilt it, and, by registering the number of times the tank tilts, the exact amount of water that has passed through the meter is ascertained.

IMPROVED GEAR PLANER.

Andrew Hanauer, Covington, Ky.—This machine has a radius bar upon which slides a tool rest, provided with two tool holders capable of moving vertically in opposite directions. One travels with the radius bar as it is guided by a form or templet, and the other moves oppositely, receiving its motion through a lever and connecting rod from the tool rest. It also consists in an arrangement of a crank and slotted lever driven by gearing, and connected with the tool rest by a connecting rod. It further consists in the arrangement of the pivot and feeding apparatus for the radius bar. The object of the invention is to accurately plane both sides of the teeth of cast gear wheels at one operation, thereby saving the expense of handwork or of doing it with ordinary planes or sharpers.

IMPROVED ORE CONCENTRATOR.

Francis E. Mills, Virginia City, Nev.—This invention consists, first, in arranging inclined tables in vertical series, like shelves, one over another, all held in one frame, and sloping in the same direction, but with varying degrees of inclination. The purposes are to enable a concentrator of large working capacity to be constructed at small cost, occupying small ground space, be easily housed and operated in cold weather, and be quickly swept at one operation; also, to insure a proper and easy classification of the sands as they flow upon the respective tables, and thus secure a larger percentage of the ore; secondly, connecting with such vertical arrangement of tables a classifying head box, by means of which the sands naturally grade themselves as they flow out upon the different tables, the coarsest and heaviest flowing over the bottom tables, the finest and lightest over the top table, and grains of intermediate grades of fineness over the intermediate tables, the inclination of each table, respectively, and the volume of current, being adapted to the grade of sand it carries; thirdly, in employing on all stationary tables a traveling water broom, which, consisting of a perforated pipe, extending across the tables and fed with clean water under pressure, is made to traverse the length of the table, close to the surface, and sweep off the deposit in its progress by jets through the perforations.

IMPROVED SAFETY WHIFFLETREE HOOK.

Adam A. Wise, Belle Plaine, Iowa.—This invention consists in securing a trace to a whiffletree hook so that all liability of escape under any contingency is effectually removed, by making the end hook in two sections, each in the shape of a hook, but having the bend in opposite directions so that one may overlap the other, form an enclosed space for the ring or loop of the trace, and be allowed to rise in order to admit said loop or ring.

NEW HOUSEHOLD INVENTIONS.

IMPROVED LAMP CHIMNEY CLEANER.

Daniel T. Freese, North Amherst, O.—This consists in the arrangement of two flat bow springs secured to a handle, the bow of the springs being adjustable by a screw at the end of the handle, and also by a coil spring which permits the bow springs to yield more or less for chimneys of different sizes. The flat springs are covered with tufts of yarn.

IMPROVED STOVE PIPE JOINT.

Robert Mainer, Orilla, Ont., Canada, assignor to himself and Charles McInnes, of same place.—This invention consists of rivets at the end of one stovepipe entering into slits of the other stove pipe end, and being locked by pivoted fastening hooks of the same.

IMPROVED WASHING MACHINE.

Collins Fitch, Garnetsville, Ky.—As the rubber is moved back and forth upon the clothes interposed between it and a hurdle, by operating a lever the hinges of the arms attached thereto enable the rubber to adjust itself according to the amount of clothes being washed.

NEW AGRICULTURAL INVENTIONS.

IMPROVED CHURN.

James M. Roberts, East Monroe, O.—This churn has no metal parts to stain or otherwise affect the milk or butter, and is so constructed that it may be readily repaired at home without its being necessary to take it to a foundery or blacksmith shop. Means are provided to give an oscillating motion to the dasher, which throws the milk toward the center of the churn and gathers the butter; and the cover and its attachments may be readily removed to give access to the interior of the churn body.

IMPROVED ROTARY CHURN.

John R. Bennett, Nunda, N. Y., assignor to James A. Duryea, of same place.—This churn is provided with dashers that revolve in opposite directions; and there is a combination of a floating dasher with a feathered shaft in such a manner that while the dasher floats on the surface of the cream it is carried around by the said shaft. The advantage claimed is that the cream is confined by the floating dasher, so that it is more thoroughly acted upon by the wings of the dashers, producing an increased quantity of butter in a shorter time than when the ordinary dasher is used.

IMPROVED ROTARY CHURN.

Andrew M. Mortimer, Salt Lake City, Utah Ter.—By suitable construction as a shaft and plates revolve, beaters are vibrated to throw the milk into agitation, and the currents thus formed are broken up by the revolving and stationary bars, throwing the milk into violent agitation, and bringing the butter in a very short time. By withdrawing the shaft the entire operating mechanism can be lifted out of the box for convenience in cleaning the churn.

IMPROVED HAY LOADER.

Thomas Elliott, Peterborough, Ontario, Canada.—The hay is elevated by endless belts. The novel feature in the device relates to means whereby the rake teeth may be conveniently adjusted closer to or farther from the ground, as desired.

IMPROVED AGRICULTURAL STEAMER.

Ruliff W. Ruliffson, Stamford, N. Y.—This consists in a fire box made of sheet iron, open at top and bottom, provided with a door a draft opening, a pipe collar, and crossbars, to assist in supporting the cooking vessel. Said vessel is also made of sheet iron, and has a flat bottom to rest and fit upon the upper edge of the fire box and upon the cross bars. Upon the bottom of the vessel is a rack to support the false bottom, which is perforated with numerous holes to allow the steam to pass through. The rack and perforated false bottom support the grain or vegetables above the water, and prevent any possibility of their burning upon the bottom of the vessel; and they also prevent any dirt that may be upon the vegetables to pass through and settle upon the bottom of the vessel.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED AXLE SET AND GAGE.

William C. Carlton, Boise City, Idaho Ter.—This is an improved instrument for setting and laying off axles, and getting the gather and dish of wheels. In applying the instrument to use, it is placed upon the axle, and right hand or double clamps are adjusted to the shoulder and end of the right hand spindle, and the left hand or single clamp is adjusted to the shoulder of the left hand spindle. To obtain the dish of the wheel, the instrument is placed across the wheel close to the hub, with the inner prongs of the double clamps against the tread of the tire. A sliding rule is moved to the center of the hub, and is secured with a screw, thus getting the half diameter of the wheel. The instrument, after having been set and an axle made to conform to it, will bring the wheel on a plumb spoke.

IMPROVED CHIMNEY.

Mercy C. Halsted, St. Louis, Mo.—The smoke is conveyed upward from the furnace at the cellar of the building, between the inner surface of an exterior cylinder and the outer surface of the interior cylinder, by a spiral flue. The interior cylinder is divided by a vertical partition wall into two passages, of which the larger one is designed for supplying fresh heated air to, and the other for carrying off the effete air from, the apartments.

IMPROVED VENTILATOR.

William H. Maxfield, Maysville, Harlan P. O., Ind.—The box fits in a collar, which is set in a hole in the ceiling or wall. From the box a pipe leads to the chimney flue; and in the lower part of the box is a grate formed of two sets of parallel slots, placed the one above the other, and so arranged that the upper set may be slid over the spaces between the bars of the lower set, to close, or partially close, the said spaces. The upper set is moved by a lever.

IMPROVED COMBINED CHIMNEY TOP AND VENTILATOR.

Joseph Harmon, Decorah, Iowa.—This consists of a ventilating tube that surrounds the chimney, and is enlarged at the chimney top, the enlarged part being connected by draft apertures at the bottom of the enlarged part, and at the sides of the base with the outer air, to draw the air drawn up to and out at the exit openings of the top cap piece.

NEW TEXTILE MACHINERY.

IMPROVED FRINGE-TWISTING MACHINE.

Samuel Mortimer, West Troy, N. Y.—The object of this invention is to improve the mechanical construction of the machine for twisting fringes. There are six novel devices introduced, the nature of which cannot be explained without drawings. The invention consists in sockets attached to the guide rods to receive the stems of the shells; in a spring with the jointed upper twisting finger; and in the spiral spring with the shaft that carries the lower twisting finger. A toothed roller and its spiral springs are combined with the front bar of the carriage; and there is a combination of the spiral springs with the fingers of the inner shell.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED GROCER'S SAMPLE CASE.

Hans A. Winden, Clermont, Iowa.—This triangular case is provided with an accurately fitting block of corresponding form. Said block rests on spiral springs which keep the cross partitions, inserted in the face of the block, in contact with the under side of the glass cover of the case, and thus prevent the samples from becoming mixed or wasted.

IMPROVED MASONIC BADGE.

James McCoy, Ypsilanti, Mich.—This consists of a masonic badge in which the legs of the compasses are pivoted to be carried above or below the square. There is a spring-acting pin, that slides by a thumb piece in guide projections at the back, to be readily attached to the coat.

IMPROVED PIANOFORTE ACTION.

Martin C. Knabe, Philadelphia, Pa.—This is an improved device for withdrawing the check from the butt nose, to allow the hammer to drop quickly and freely from the string after striking a blow. It may be adjusted to withdraw the check at any desired point.

IMPROVED PASSENGER REGISTER.

William Mehan, Hoboken, N. J., assignor to himself, Hezekiah Butts, and John Egan, of same place.—This consists in the arrangement of a cam and friction roller with a turnstile and movable platform, so constructed that the person passing the turnstile must step upon the movable platform, by the motion of which, under control of the cam, the apparatus is made to register once, and cannot be made to do more or less.

IMPROVED BREAST STRAP FENDER.

John C. Look, Bremen, O.—This consists of a wearing plate for the breast strap of a harness, made in two parts, hinged together. On one part is a brace for the joint and support for the neck yoke strap, and on the other forks to throw out the neck yoke ring, so that the latter is locked in the fender when the strap is in position. When it is disconnected the ring is unlocked and thrown out by flexing of the plate on the joint. The fender is attached to he straps by loops, through which straps are passed.

Business and Personal.

The Charge for Insertion under this head is One Dollar a Line for each insertion. If the Notice exceeds Four Lines, One Dollar and a Half per Line will be charged.

Notes & Queries

G. E. P. will find a description of a cheap galvanic battery on p. 234, vol. 34.—J. M. will find a good recipe for shoe blacking on p. 27, vol. 34.—H. L. G. will find directions for coloring gold on p. 43, vol. 30.—C. H. will find a recipe for a depilatory on p. 186, vol. 34.—J. R. C. will find something on moles in the skin on p. 347, vol. 32.—W. S. will find directions for straightening wire on p. 299, vol. 34.—L. R. P. will find a good recipe for mucilage for labels on p. 202, vol. 31.—H. R. E. will find directions for making printing inks on p. 298, vol. 31. A cheap battery is described on p. 234, vol. 34.—A. A. A. will find a recipe for a cement for fastening glass to brass on p. 117, vol. 32.—H. N. H. should varnish his brass with the preparation described on p. 310, vol. 35, for silver.—H. E. N. will find directions for making an incubator on p. 273, vol. 33.—F. W. M. will find directions for galvanizing iron on p. 346, vol. 31.—P. will find an answer to his query as to speed of navy cutters on p. 251, vol. 35.—R. T. M. will find an explanation of his wagon wheel difficulty on p. 298, vol. 31.—E. H. will find a formula for the width of belting on p. 244, vol. 34.—A. B. C. will find an explanation of the transmission of vocal sounds by electric wires on p. 327, vol. 33.—E. B. will find an article on taking the kinks out of saws on p. 11, vol. 33.—J. H. will find directions for lacquer or bronze on cast iron on p. 11, vol. 33. For japanning cast iron, see p. 122, vol. 27.—D. & D. will find directions for enameling leather on p. 122, vol. 27.—M. S., F. G., J. A. T., C. A., J. C. C., G. A. C., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) A. E. H. says: I send you by this mail a piece of copper tube taken from a coil used for cooling brine. You will notice that there has been a chemical action which destroys the copper, but this only occurs when it is threaded, or close to the threads. What is it that produces this action? The coil was put together with plumbago and oil as a lubricant. A. It seems very probable that the corrosion was caused by the galvanic action set up between the copper and carbon (graphite) in contact with moisture and the fatty acids in the lubricant. The salt water is in no way accountable for the corrosion.

(2) W. H. A. says: Please give me the theory, causes, and circumstances attending the undertow on the sea coast. A. The following statement, from Maury's "Physical Geography of the Sea," may be of interest in this connection: "Suppose the case of a long trough, opening into a vat of oil, with a partition to keep the oil from running into the trough. Now suppose the trough to be filled up with wine on one side of the partition to the level of the oil on the other. The oil is introduced to represent the lighter water as it enters either of these seas from the ocean, and the wine the same water after it has lost some of its freshness by evaporation, and therefore has become salter and heavier. Now suppose the partition to be raised, what would take place? Why, the oil would run in as an upper current, overflowing the wine, and the wine would run out as an under current."

(3) J. O. G. says: You state under the heading of "English Fire Engines" that the engine lifted the water 32 feet in a perpendicular line. Is it possible for a fire engine, with its many joints and imperfections, to raise a column of water 32 feet without the intervention of a foot valve in the suction? A. From all that appears in the statement, we should say that the engine just lifted the water slowly, which would be quite possible, with a very accurately constructed pump.

(4) G. A. A. says: I am building a steam chimney 90 feet high with 6 feet base, with a round flue 2 feet across inside; should this flue run to the top of chimney or not, to get better draft? A. To the top, as we understand you.

1. For a lightning rod, will common gas pipes do? A. It will be better to make the rod of a single piece of metal, with a copper tip added. 2. Is it necessary in connecting lightning rods with city water pipes to connect underground, or can I connect it with a right and left coupling above the ground, say inside the shop? A. It is better to connect it underground.

I intend to reset my boiler, which is a 50 horse power tubular, horizontal. My principal fuel is wet tan. How shall I set the boiler to get best results? A. See p. 339, vol. 31.

(5) O. T. B. asks: How many cubic feet of water per minute will a cast iron pipe 150 feet long of 6 inches bore discharge, if laid horizontally, receiving its supply under 12 inches head and discharging into open air? A. About seventeen, if the interior of the pipe is smooth.

(6) V. asks: Can the water in a newly cemented cistern of 4,000 gallons, which is strongly impregnated with lime, be made fit for drinking, cooking, and washing with by the use of alum? If so, what quantity should be used? The cistern has been filled and emptied; and having again been filled with rain water, it is not convenient to empty it again. A. The cement lining of the cistern has evidently been allowed a sufficient length of time in which to set and dry perfectly; the result is that the water has dissolved out a considerable quantity of the lime. The greater part of the lime may be removed as sulphate by the addition of a calculated quantity of alum (sulphate of alumina and potash). Take a gallon of the water in question and add to it a strong aqueous solution of alum, of a known strength, in varying quantities, until the precise quantity of the reagent necessary has been determined. This quantity, multiplied by the number of gallons contained in the cistern, will be the total amount required. This is one of the best methods that can be employed in such cases; but it is somewhat objectionable where the water is to be employed for cooking and drinking purposes, as it leaves in solution in the water a notable quantity of the soluble sulphate of potash. There are many other methods by which the lime might be removed from the water; but owing to the poisonous character of the reagents or the impracticability of their application in your case, they are out of the question. Where the water is to be used only for washing purposes, perhaps the cheapest plan would be to precipitate the lime by the addition of a solution of common soap. This answers the queries of several other correspondents.

(7) J. P. M. asks: Will mercury evaporate when heat is applied? How long will it last under a constant heat of 104°? A. Mercury is volatile under the temperature mentioned, and will evaporate, but not very rapidly.

(8) J. W. B. says: Please give the chemical analysis of quinine. A. The sulphate of quinine $[(C_{20}H_{24}N_2O_2)_2SO_4 + 14(H_2O)]$ is the medicinal preparation commonly called quinine. The vegetable alkali *quinia* is obtained from the yellow bark (*cinchona cordifolia*), in which it occurs mixed with cinchona, and combined with quinic and quinotannic acids.

(9) T. M. asks: 1. How many cubic feet of carbonic acid gas can be obtained from 1 lb. of marble dust? A. About five. 2. What amount of acid per lb. is needed? A. About ½ lb. This is the calculated amount; it will require something more than this in practice.

(10) J. D. says: Please give me a recipe for filling the grain of sole or other heavy leather, and making it firm and stiff so that it will resist pressure and dampness, which will not rot or destroy the durability of the leather? A. We understand that very good results have been obtained in similar cases by the use of carbolic acid, but cannot furnish you with the details of the process. It is necessary to have the leather very dry, and to force the acid into the pores by hydraulic pressure.

(11) J. H. N. asks: Does everything that exists on the face of the earth contain poison? A. Every known substance, if taken in excessive quantity, will prove destructive to human life.

(12) W. S. D. says: 1. I have a keel boat 11 feet 2 inches long, 3 feet 2 inches wide. She draws 16 inches when loaded. I have an engine, inverted cylinder style, with link motion. Cylinder is 2½ inches in diameter with 4 inches stroke; the engine weighs 100 lbs. without wheel. Is the engine (with boiler in proportion) too large for the boat? Would it do to build a boiler a little too small, say 16 x 30 inches, and run the engine with a ⅜ or ½ cut off? What should be the diameter and hight of fire box, and the size and number of tubes for upright boiler of that size? A. Build a boiler large enough to supply the engine. You can use tubes 1¾ or 2 inches in diameter. 2. What should be the diameter and pitch of propeller? A. It may be 15 inches in diameter, and have 2 to 2½ feet pitch.

(13) T. J. G. says: In a book of instruction on shooting the following rule is laid down: "When the sun shines from the left, it will illuminate the right side of the back sight and the left side of the fore sight; and when these two points are aligned on the target, it will cause the ball to go to the right of the mark, and *vice versa*." Now I maintain the very opposite, that is, that the ball will go to the right in this case. Who is right? A. As the sights on a rifle are usually arranged, we do not see how the statement in the book will hold good.

(14) J. H. D. asks: What substance, suitable for a traveller's pocket, will, by burning, best disinfect the air of a room? A. The vapor of burning sulphur (sulphurous acid) is one of the best of disinfectants, but has the disadvantage of a very pungent odor, and in any considerable quantity is irrespirable. Chlorine or bromine water, chloride of lime (hypochlorite of lime), carbolic acid, etc., are very powerful disinfectants, so that a small quantity only will be requisite. Such a quantity may be carried in the pocket. These will not burn, but an ethereal solution of bromine probably will.

(15) E. H. asks: 1. In speaking of cement to be used in making concrete buildings, do you mean ordinary water lime, or some of the imported cements, such as Portland, etc.? A. Rosendale and like cements of this country make a very good concrete. Portland cement makes a very superior concrete. 2. There are concrete buildings in this vicinity, the mortar of which is composed of sand and gravel mixed with quicklime only; would such buildings be durable? A. Walls of concrete in which common lime is the only binding ingredient cannot be depended upon for a permanent career in this climate. 3. Would concrete make a good building for a shop in which to run woodworking machinery, or would the jar have a tendency to crumble the walls? A. When properly constructed and time given them to harden, there is no reason why they should not answer well. 4. How thick ought the walls to be for a building 30 x 40 feet, 16 or 18 feet high? A. Such a building would require a girder through the center if two stories in hight, and the walls would do at 14 inches thick; if one story in hight, the walls should be 18 inches thick. 5. Would concrete do for the foundation on ground overflowed by water during part of the year, or would it be preferable to lay up a stone wall with hydraulic mortar? A. Concrete would do.

What is the rule for finding the size of shafts for transmitting a given horse power, speed being given? I wish to know how large a line shaft 30 feet long, to run at 300 revolutions per minute, would be needed to transmit the power of a 12 horse engine. A. About 1⅛ inches in diameter.

(16) C. asks: What is the weight of a 13 inch cast iron ball? A. About 300·37 lbs.

(17) J. H. L. says: 1. I am about to erect an outside cellar of brick; it is to be entirely separate from any other building, and I want to have it frost-proof. It is to be 18 x 22 outside; the outer wall will be 9 inches and the inner wall 4 inches thick, with a space of 12 inches between the two walls. Should this 12 inch space be filled in with something, or left open, to secure a perfectly frost-proof building? A. If your cellar is to be sunk into the ground its whole depth, or the greater part thereof, it would be better to make its outside wall 13 inches, the space 6 inches, and the inside wall 4 inches, the floor joists being extended to rest upon the exterior wall. The intermediate space will answer without filling, if made tight. 2. What is the best means of ventilation? A. A slight ventilation may be provided for the cellar itself without materially reducing the temperature.

(18) J. R. B. asks: Does the ostrich, after laying her eggs in the sand, brood them like other birds, or does she leave them to be hatched by the sun? A. She incubates at night, and leaves them in the sun in the day.

(19) X. says: We are digging a reservoir to supply a trough for horses and cattle on the street; the reservoir is ¼ mile away, fall about 30 feet. Wood pipe, about 2 inches internal diameter, is used. The reservoir is 17 feet deep. Is it economical to dig the trench for laying the pipe as deep as the reservoir, that is, 17 feet? They are doing this for 25 or 30 rods, in order, as they say, to take all the water from the reservoir (or in other words, from the bottom) in a dry season. A. A regularly graded pipe from the bottom of the reservoir will make the surest job, as in many cases siphon pipes have failed to act, mainly, it is thought, from the common cause—the collection of air at the highest point of the pipe. In this case the use of wooden pipes would be likely to add to the difficulty.

(20) A. B. C. says: 1. I have a cast iron frame for a lamp, that has become soiled by smoke and flies. How can I cleanse it for rebronzing? A. Use sulphuric acid diluted in water. 2. How can I put on the bronze so that kerosene smoke will not remove it? A. Try the recipe given on p. 231: vol. 32.

(21) J. M. B. asks: Which is the best way to make a telescope speculum, 5 or 6 inches in diameter? A. We would advise you to make your reflector of glass, and silver it. Unless you have had some experience in working specula, you will find it not easy to make and not very good when made. Take a thick piece of glass and grind and polish it to the curve you wish. If you wish it to have 5 feet focus, you must grind it on a curve of 10 feet radius.

(22) W. L. W. asks: What substance could I put on the sights of my rifle to make them visible in the dark? A. Put a little phosphorus on the foresight.

(23) W. H. E. says: I am copying photographs on glass, in oil paints. Can you give me a recipe for a mixture to make the photograph stick to the glass, so that it will not peel off or leave a shiny appearance between the picture and the glass? A. Use a paste made by mixing starch with a little cold water; then add boiling water, and stir until it is of a uniform creamy consistence. Press out the air bubbles and excess of paste from between the picture and glass, and let dry slowly.

(24) P. H. C. asks: How can I obtain the meridian altitude of the sun for any place at any given date? A. From 90°, subtract the latitude of the place, which gives the co-latitude or its equal, which is the distance from the horizon to the equator; then, if the sun is north, add his declination, and if south, subtract it.

(25) E. C. says: In building a new house, second hand brick were used for partition walls, some of which were from an old chimney. Plastering is laid directly upon the bricks, then hard finish and paint. Several coats of the latter fail to cover a stain which comes through from the bricks. What is the remedy? A. The most effectual remedy is to cut out the smoky bricks and replace them with new ones.

(26) E. S. W. asks: 1. How can I construct a portable retort, to make gas of coal, wood, or grease, to fill a 30 x 40 inch gas bag? How large a retort will be required? A. A retort about 18 inches long, having a diameter of about 10 inches and a movable cap at one end, will answer. The retort may be of iron. 2. What degree of heat is needed to bring the gas over? A. The heat of a good coal or charcoal fire will be requisite. You will find descriptions of gas apparatus in any good work on chemistry or chemical technology.

(27) B. S. C. B. says: I have an astronomical glass of 60 inches focus. How can I fix it so that I can look at the sun with impunity, overcoming the extreme brightness? A. Put a diaphragm over the object glass with ¼ inch aperture; then use a neutral tint shade glass between the eye and eyepiece.

(28) J. E M. asks: Is there a non-conductor of magnetism? A. Yes. An interval of space.

(29) C. E. T. says: An "Engineers' Pocket Book" states: "Water may be reduced to 5° Fah. if confined in tubes of from 0·003 to 0·005 inch in diameter; this is in consequence of the adhesion of the water to the surface of the tube, interfering with a change in its state. Is this true, and if so, how do you know it? A. We do not know whether it is true or not. It might be tested by observing whether the water would flow in the tube at this temperature. Probably the author has some authority for his statement, although he does not give it.

(30) T. M. says: 1. I. F. states that, in building a grist mill, to use 48 cubic feet of water per second, with a 48 inch pipe to convey water, the flow must be 4 feet per second, or 240 feet per minute. Would not a larger pipe or penstock give better results with less velocity, say 100 feet per minute? A. There might be some gain, but possibly not enough to pay for the increased price of pipe. 2. What would be the difference in the velocity of water under any head, say 15 feet, with a draft tube (and vacuum pipe) or without one? What is the formula for velocity in a vacuum? A. Without the draft tube, the total head is that of the water. With the draft tube, the head is increased by the weight of the atmosphere, equivalent, for a perfect vacuum in the tube, to a column of water 34 feet high.

(31) M. B. L. says: I am making a magneto-electric machine, in which I have two 9 inch permanent horseshoe magnets. I tried a pair of electro-magnets 1¾ inches long, with a diameter of 1¼ inches and ½ inch core; the resistance of the magnets is 300 ohms (each spool 150 ohms). The current from these could not be felt. Please let me know what the resistance of a pair of spools for such a machine should be. A. The resistance of your spools is correct, and you ought to get a powerful shock from your machine. If you do not get it, the fault will probably be found in your connections.

(32) C. E. A. says: The following is a cheap device for oiling loose pulleys: Cut a shallow screw thread, of 1 inch pitch, right and left hand, nearly the whole length of the eye of pulley hub (the threads can be cut after the pulley is bored and while it is in the lathe). Then it will readily be seen that, while the pulley is in motion, the oil will follow in the grooves from right to left and left to right, nearly the whole length of pulley hub, without any chance to escape, as the groove ends within ¼ inch from the end of hub. It will be necessary to fit a plug in the oil hole, as the centrifugal force will have a tendency to throw the oil out. A. This is a very good idea where the bearing surface is ample.

(33) J. M. L. asks: How can I make a fluid that, when a stick or paper are dipped into it, and exposed to the air, will take fire? A. Phosphorus is slightly soluble in ether, more so in benzole or turpentine. If a solution of phosphorus be made in either of the above solvents, and a drop of the solution be allowed to evaporate in the air, the phosphorus, which is left behind in a very finely divided condition—thus exposing a very extended surface for oxidation—takes fire spontaneously. If paper or other similar combustible material be moistened with one of the above solutions and subsequently allowed to dry in a warm air, it will become inflamed at the moment of the ignition of the phosphorus; this flame, however, will speedily be extinguished by the coating formed on its surface by the deposition of the white anhydrous phosphoric acid. The best solvent for phosphorus is bisulphide of carbon.

(34) H. B. asks: How can I make hyposulphite of lead? A. Add a slight excess of an aqueous solution of acetate of lead (sugar of lead) to a strong solution of hyposulphite of soda; the white precipitate which forms is hyposulphite of lead. It is very sparingly soluble in water, but dissolves in alkaline hyposulphites with the formation of double salts. It may be dried at 212° Fah. without decomposition; but at a higher temperature it blackens and gives off sulphurous oxide, and leaves a residue of sulphate and sulphide of lead. When heated in the air it glows like tinder.

(35) J. D. B. asks: 1. What will make gelatin insoluble in water, without losing its adhesive property? A. If treated with a strong solution of bichromate of potassa in water, and then exposed to strong sunlight, any form of gelatin is rendered superficially insoluble. Tannic acid renders gelatin insoluble by forming with it an insoluble tannate. Gelatin is also rendered insoluble by solutions of corrosive sublimate. 2. Is glue or gelatin soluble in ether, and how rapidly does it dissolve therein in comparison with water? A. It is insoluble in ether, but dissolves to some extent in a mixture of strong vinegar or acetic acid and alcohol (vinegar 4 parts, alcohol 1 part: heat.) 3. What acid is best for etching type metal? A. Use nitric acid. 4. Is kerosene injurious to leather? A. Kerosene is liable to render the leather brittle and reduce its tenacity by removing a part of its natural oil. 5. Inking rollers can be kept soft in kerosene, but will the kerosene have an injurious effect? A. If the rollers are of the same composition as those usually employed by printers, the oil will not injure them.

(36) W. S. V. says: O W. J. can preserve citron by boiling the sliced fruit, in enough water to cover it well, until tender; then to 2 lbs. fruit add 1 lb. sugar (A) and 1 lemon, sliced, and cook until the sirup is thick. The first water should be poured off, and as much more added before adding the sugar, etc. The better the sugar, the better the sauce.

(37) Professor C. W. MacCord says: You give place to the statement that the curve described by a point in the connecting rod, between the centers of the crank pin and the crosshead journals, is a perfect ellipse: This statement is correct if the length of the connecting rod be equal to that of the crank, and the stroke of the crosshead four times as great, that is, twice the throw of the crank, but not otherwise.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. H. P.—No. 1 is sulphuret of iron. No. 2 is graphite in quartz rock.—J. B. P.—The markings are a thin coat of oxide of manganese, formed by deposition between surfaces nearly in contact.—E. A. C. D.—It is carbonate of soda mixed with some sulphate of soda.—A box, with no name or address on it, contains one of the *epeira*—large garden spiders.—O. S.—The gelatin sent is prepared from the finest material, tinted with one of the aniline colors, by passing it, while in a viscid condition, between rollers.

T. H. B. asks: How can rice imitations of alabaster ornaments be made?—A. R. asks: How can I brighten bronze castings?—J. K. asks: What paint is the most durable for coating mirrors over the silvering?—W. D. asks: Why, in English coaches, are the hind wheels turned in at the base instead of being at right angles with the axle?

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Trisection of an Angle. By A. B., J. B., and H. A. H

On the Russian Frost Plant. By J. S.

On the Sun's Retrograde Motion. By J. H.

On Measuring the Width of a Stream. By W. A. D.

On the Canadian Patent Office. By F. L. J.

On the Sun's Heat. By H. S. W.

On the Ball Puzzle. By J. D.

On Hats and Bald Heads. By J. H.

On Professor Huxley's Lectures. By W. M.

On Land Waterspouts. By S. McD.

Also inquiries and answers from the following:

W. W. P.—C. F. G.—J. W. H.—R. J. L.—J. K. F.—C. M.—W. K.—N. J.—J. C. D.—G. L. P.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells the best utensil for steaming cattle fodder, etc.? Who makes machines for making square biscuit tins? Who sells phosphor bronze? Whose is the best apparatus for extracting lead from ores?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

VALUE OF PATENTS,

AND

How to Obtain Them.

Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent, even when the invention is but a small one. Large inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & CO. during the THIRTY years they have acted as solicitors and publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables MUNN & CO. to do everything appertaining to patents CHEAPER than any other reliable agency.

HOW TO OBTAIN *Patents*. This is the closing inquiry in nearly every letter, describing some invention, which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawings, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them; they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his right.

How Can I Best Secure My Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows, and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & CO., 37 Park Row, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually by return of mail. It is sometimes best to have a search made at the Patent Office; such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such a search, make out a written description of the invention, in your own words, and a pencil, or pen and ink sketch. Send these, with the fee of $5, by mail, addressed to MUNN & CO., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

To Make an Application for a Patent.

The applicant for a patent must furnish a model of his invention, if susceptible of one; or if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft or postal order, on New York, to the order of MUNN & CO. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

Foreign Patents.

The population of Great Britain is 31,000,000; of France, 37,000,000; Belgium, 5,000,000; Austria, 36,000,000; Prussia, 40,000,000; Russia, 70,000,000. Patents may be secured by American citizens in all these countries. Now is the time, when business is dull at home, to take advantage of these immense foreign fields. Mechanical improvements of all kinds are always in demand in Europe. There will never be a better time than the present to take patents abroad. We have reliable business connections with the principal capitals of Europe. A large share of all the patents secured in foreign countries by Americans are obtained through our Agency. Patents obtained in Canada, England, France, Belgium, Germany, Russia, Prussia, Spain, Portugal, the British Colonies, and all other countries where patents are granted, at prices greatly reduced from former rates. Send for pamphlet pertaining specially to foreign patents, which states the cost, time granted, and the requirements of each country. Address MUNN & CO., 37 Park Row, New York. Circulars, with full information on foreign patents, furnished free.

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In order to apply for a patent in Canada, the applicant must furnish a working model, showing the operation of the improved parts; the model need not exceed eighteen inches on the longest side. Send the model, with a description of its merits, by express or otherwise, to Munn & Co., 37 Park Row. Also remit to their order by draft, check, or postal order, the money to pay expenses, which are as follows: For a five years' patent, $50; for a ten years' patent, $75; for a fifteen years' patent, $100. The five and ten years' patents are granted with privilege of extension to fifteen years.

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Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars, address MUNN & CO., 37 Park Row, New York.

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Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at reasonable cost, the price depending upon the extent of drawings and length of specifications.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office $1.

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We recommend to every person who is about to purchase a patent, or about to commence the manufacture of any article under a license, to have the patent carefully examined by a competent party, and to have a research made in the Patent Office to see what the condition of the art was when the patent was issued. He should also see that the claims are so worded as to cover all the inventor was entitled to when his patent was issued; and it is still more essential that he be informed whether it is an infringement on some other existing patent. Parties desiring to have such searches made can have them done through the Scientific American Patent Agency, by giving the date of the patent and stating the nature of the information desired. For further information, address MUNN & CO., 37 PARK ROW, New York.

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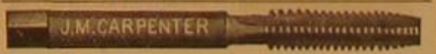

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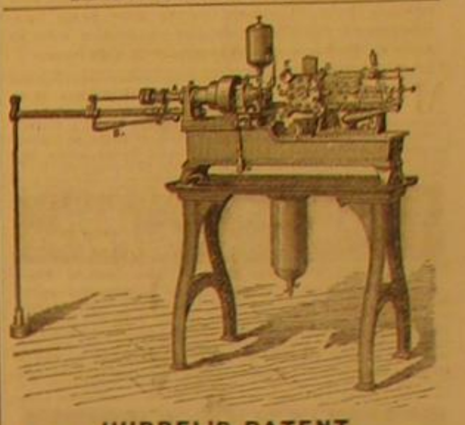

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