SCIENTIFIC AMERICAN

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A NEW SOURCE OF POWER.—ABSORBENT STRATA.

M. G. Hanrian, of Meaux, France, has discovered a source of power in wells and absorbent rock strata, which is certainly both curious and original, and possibly capable of a wide utilization. He proposes to drive machinery or raise water through the absorption of water by the lower strata of the soil, the avidity with which the absorbent rock absorbs the water creating, in the descent of the latter, the power, which is transmitted by mechanism to the surface. This will be better understood by reference to Fig. 1 of the annexed engravings, which we select from the *Bulletin du Société d'Encouragement pour L'Industrie Nationale.* A well, D, is first dug until the water-bearing stratum is pierced. This well is suitably curbed, and then another and smaller excavation, E, is carried downward in the impermeable rock, B, until the absorbent stratum, C, is nearly reached. The bottom of this bore is covered with concrete, F; and a small tube, surmounted by a hood to prevent its being choked by impurities, is continued still further down and into the absorbent rock, C. Inside E is a sheet iron tube, H, entering a wide receptacle at its upper end (at the bottom of which sediment is deposited) and extending down into the water in the lower well. I is a valve governed by the hand wheel from above, which serves to admit water from the main well, D, into the tube, H. Said tube has within it one part of an endless bucket chain, J, which passes over and acts as a bolt on the pulley, N. Another tube, K, is placed in the well, D, and this also contains a bucket chain, M, which passes over the pulley, O. The valve, I, being opened, the water in D, of which there is a continual supply from the springs in the aquiferous stratum, descends the tube, H, and enters the well, E; thence it escapes by the tube, S, through which it is forcibly drawn by the absorbent action of the rock at C. In its descent through I, the water, acting on the buckets of the chain, J, thus rotates the pulley, N. This pulley being on the same shaft as pulley, D, the latter also is rotated, and the bucket chain in pipe, K, therefore lifts the water from D, into the receptacle, M, whence it is led away for distribution by the conduit, P. The absorption which takes place through the layer, C, is said to be so complete that, when the valve, I, is closed, the bottom of the well, E (pipe, S, having perforated sides), becomes perfectly dry.

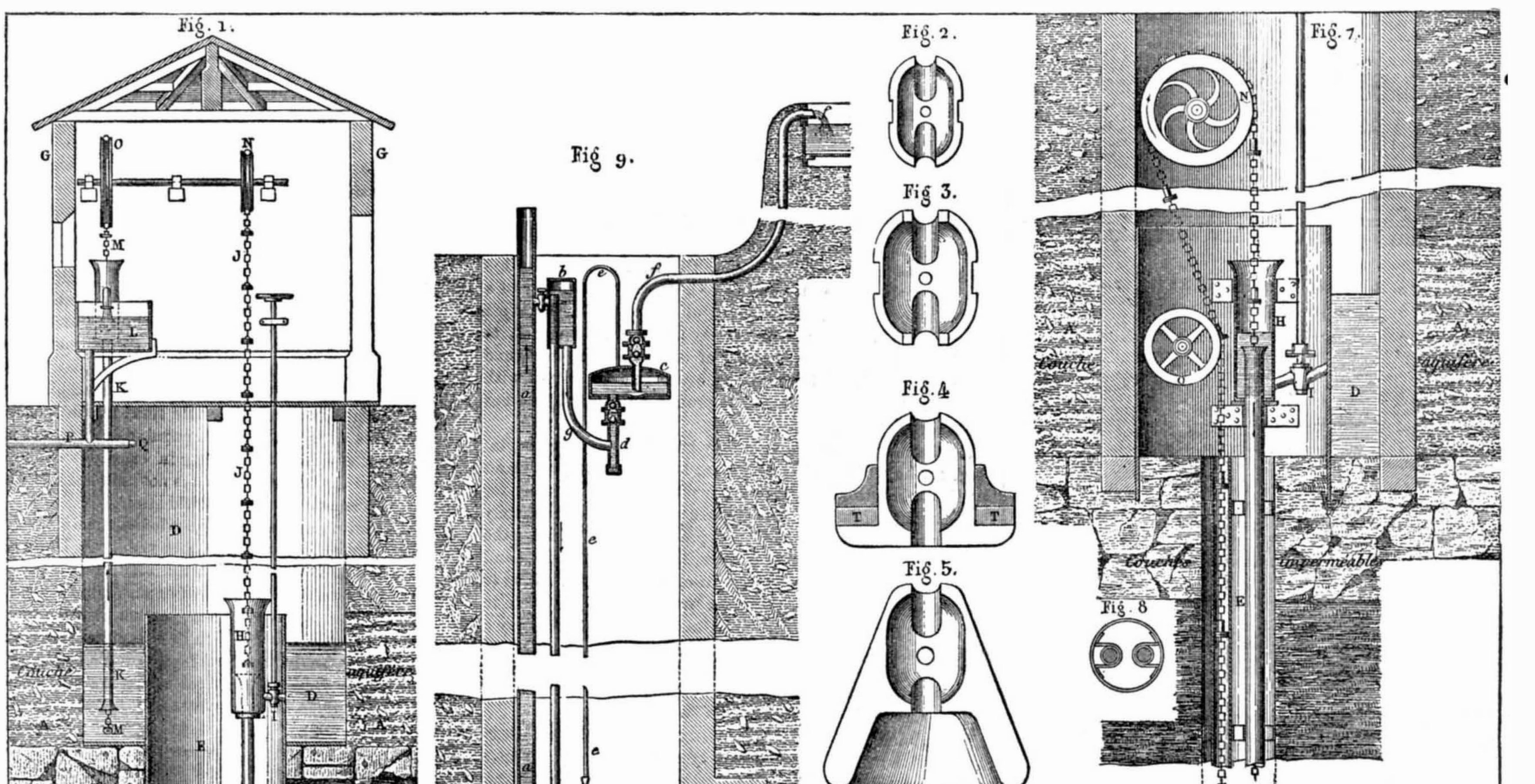
In Figs. 2, 3, 4, 5, and 6 are shown various forms of chain buckets. Fig. 5 is best adapted for thick liquids, Fig. 6 for tubes of large diameter, where the weight to be lifted is heavy. Fig. 7 represents a different arrangement of mechanism designed for the application of the power to machinery. A is the water-bearing stratum, B the impermeable strata beneath, and C the absorbent rock. The well, D, is dug as before, and inside is placed a kind of coffer dam, in the center of the area enclosed by which is sunk a small well, E. The valve, I, admits water from D, into the pipe, H, and the water as before carries down the bucket chain; the ascending part of the chain is guided through another tube, passing over the tightener, O; and finally the power is transmitted to the pulley, N, to the shaft of which the driving pulley of the machine is attached. Fig. 8 is a section of the well, E.

In Fig. 9 an entirely different arrangement of machinery is shown, the device known as Hero's fountain being utilized instead of the bucket chains. This is perhaps best applicable when the absorbent rock lies above the water-bearing stratum, as in the case of an artesian well. From the latter rises the tube, *a*, the water rising in which has access to the reservoir, *b*. A portion of the water descends into the lower receptacle, *c*, by the tube shown, compresses the air in said receptacle, and thus through the small pipe, *e*, causes a similar compression in the reservoir, *c*. But into the latter a portion of the water in *b* has likewise entered, through the conduits, *g* and *d*, and ball valves prevent its return. Consequently the water, in *c*, is compelled to ascend the tube, *f*, and thus is raised the required hight, to a receiving reservoir above. As soon as the water which enters *c* is no longer equilibriated by the weight, *h*, on the lever, *g*, which holds shut the movable bottom, said bottom falls open, and the weight, *h*, rolls to the left along the lever, holding the bottom in this position until all the water has escaped. Then the weight counterbalances, the bottom closes, and the operation above described is repeated. The water is at once absorbed by the surrounding rock; and this water, sinking in said rock, tends to displace the water in the layers beneath, and thus forces the same up the tube, *a*, keeping that conduit constantly filled.

It is stated that at Bailly-Romainvilliers, near Couilly, in France, the arrangement first described, and shown in Fig. 1, is in operation, and lifts from 600 to 1,000 quarts of water per hour a distance of 22·4 feet, absorbing for this work from 2,500 to 4,000 quarts at a depth of 185·6 feet. The apparatus shown in Fig. 1 has raised 1,000 quarts per hour 12.8 feet, the sounding tube passing to a depth of 238 feet. These were little more than experimental trials, and therefore can hardly be taken as estimating the possible capabilities of the plan.

The advantage of course lies in a constant power, available wherever a water stratum and an absorbent stratum can be found. The principal obstacle lies in the choking of the pores of the absorbent rock by impurities, but this the inventor proposes to check by filtering the water, and by occasionally administering doses of hydrochloric or sulphuric acid, which will destroy organisms, etc., and expose a clear rock surface.

THE following shows the degree of heat at which gold of varying degrees of fineness melts: 23 carat gold, 2,012° Fah.: 22 carat, 2,009°: 20 carat, 2,002°: 18 carat, 1,995°: 15 carat, 1,992°: 13 carat, 1,990°: 12 carat, 1,987°: 10 carat, 1,982°: 9 carat, 1,979°: 8 carat, 1,973°: 7 carat, 1,960°: composition, 1,587°



HANRIAN'S METHOD OF RAISING WATER

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NEW YORK, SATURDAY, MARCH 11, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

THE SCIENTIFIC AMERICAN SUPPLEMENT.

No. 11.

For the Week ending March 11, 1876.

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THE publishers of *Forest and Stream* have opened, at their office, 17 Chatham street, in this city, a "Kennel Stud Book," or register for recording the pedigree of thorough-bred dogs. This work will undoubtedly in time occupy the same important position among the owners and breeders of pointers, setters, and spaniels that the "Herd Book" now does among the admirers of fine cattle.

THE COMING EMPEROR.

When the sovereign of a great country visits a sovereign people, not imperially, to conquer or conciliate, but as a private gentleman, to study their works and ways for the benefit of his own subjects, it is obvious that a new order of royal entertainments is called for. The greeting which a barbaric empire like India accords to its future ruler may fitly be characterized by barbaric shows, parades, illuminations, and festive entertainments; but from a free people, to an enlightened sovereign like the Emperor of Brazil, such things would be out of place, and utterly distasteful.

He comes for information, not to be bored with windy speeches or pretentious dinners. Our local cooks and office-holders have few charms for him, compared with the achievements of our explorers and pioneers, our engineers and inventors, our scientific and industrial leaders. We shall, therefore, entertain him most royally by furthering to the utmost the real objects of his visit, showing him, in the most unobtrusive and sensible way, our physical and industrial resources, our works of internal improvement, the means by which a great wilderness has been conquered for man. The great region which he is doing so much to improve is still very largely similar in condition to what the Great West was a few years ago—a land of fertile plains untilled, broad rivers barren of commerce, mountains of precious metals undisturbed. He has railways to build, internal navigation to develop, immigration to foster, and a wild country to subdue and make tributary to the needs of men. His expressed desire is to study on the spot the means and methods by which this country has been so rapidly and enormously developed, withal so largely brought under the dominion of science and civilization. And we may be sure that he will not thank us for any attentions which may draw him away from the grand purpose of his visit.

We may be equally sure that he will be royally grateful for any proper assistance that may be given to the prosecution of his studies. There is talk of his entering the country by way of the Mississippi. That course would be singularly happy, since it would lead him straight to an engineering enterprise in which he cannot but take the highest interest; and at the same time his visit would give *éclat* to the completion of a work which may do very much to increase the social and commercial relations of the two countries. It is morally certain that, by May, the Mississippi will be open to navigation by vessels of the highest class, and nothing could be more appropriate than for the ruler of the Amazons to be the first to demonstrate the freedom of the Mississippi to the commerce of the world. It requires no prophet to foresee that the largest river of the world and the longest are plainly destined to furnish each the principal market for the productions of the other. The one extends, from north to south almost across the temperate zone, draining the heart of the most productive valley—and likely to be the most populous—in the temperate regions of the globe. The other drains a vast basin, almost wholly within the tropics, and extending across a tropical belt covering thirty degrees of longitude. Between the two there can be no rivalry, for their products are wholly diverse, yet each produces what the other lacks. Before the next Centennial celebration of our country, the trade between these two regions will be vast beyond the wildest dreams of to-day.

A passage from New Orleans to St. Louis, on one of the floating palaces of the Mississippi river, will show the Emperor, as no other journey can, the future aspect of his own great river when it shall have become the highway of a boundless commerce. How many of the cities of the West he proposes to visit, we cannot say: enough, no doubt, to enable him to study the working of our railway system, and other great works of internal improvement. Compared with these, the Exhibition, great as it promises to be, will be but a secondary attraction.

The termination of his visit may be as happy as the beginning, for he will take his departure from this city just about the time when the Hell Gate improvement will be ready for the finishing stroke, and we venture to say that no ceremony of state could give him half the pleasure, as to witness the final victory of Science over Nature, in opening up a new and better channel for the commerce of our metropolis. It is to be hoped that obtrusive placemen will respect his wish to travel as a private observer, and leave him free to enjoy a most unconventional "royal" welcome by the scientific and industrial magnates of the land.

THE FATHER OF WATERS.

We publish, in this week's SCIENTIFIC AMERICAN SUPPLEMENT, a remarkable document written for our paper by James B. Eads, C. E., of St. Louis, being a review of the Report of the United States Levee Commission, made in 1875. This board was appointed, by authority of Congress, to report a permanent plan for the reclamation of the alluvial lands of the Mississippi river. The subject is one of extraordinary importance, as will be readily understood if it is considered that the area of the lands that might be saved to agriculture, by a proper system of reclamation, is estimated at about 70,000 square miles, of unsurpassed natural fertility, and capable, if peopled as thickly as Belgium, of supporting a population of over 300,000,000.

In this aspect of the subject, the work of reclamation may be justly regarded as perhaps the most useful and important engineering enterprise now before the civilized world. Its successful accomplishment would vastly add to the prosperity of our own country, and benefit all nations, by enlarging the special domain of food supply, besides opening the Father of Waters to the free commerce of the world, floating the largest vessels for an inland distance of fifteen hundred miles.

By reference to the review, it will be seen that Engineer Eads and the Levee Commission have arrived at diametrically opposite conclusions, not only as to the best method of executing the work, but as to the results that might be expected from the adoption of their respective plans. The subject is a grand one, but the principles involved are simple, and their relative correctness would seem to be capable of determination without serious difficulty. The most curious thing is that practical engineers should disagree about the matter.

The Levee Commission aver that the volume of the Mississippi is too great; hence the overflow, to prevent which they recommend a reduction of the river volume by means of side channels. These are expected to conduct large portions of the water to the Gulf, and thereby reduce, as they allege, the flood discharge to the limits of the levees. They further advise the raising of the hight of the artificial banks or levees, the cost of which they estimate at forty-six millions of dollars ($46,000,000). This expense, although large when exhibited in figures, is as nothing compared with the gain to be derived from a successful reclamation.

The chief questions to be settled are: Is this plan practicable? Will a reduction of the river's volume diminish the flood discharge? What has been the experience on the Mississippi and on other rivers having analogous bottoms? Is it not a fact that, below the points where side channels have been formed and water drawn off, the river bottom has become filled up, and the flood level raised? Is it not true, in respect to other rivers, that their flood levels have been lowered by increasing rather than by diminishing the river volume, by stopping up old side channels rather than opening new? Is it not plain that, in an alluvial bottom like the Mississippi, the quickest and best way to lower the flood level is to deepen the bed of the river?

Will not the river deepen its own bed if its volume is increased?

The weight of evidence, derived from past experience on the subject, clearly gives an affirmative answer to the latter question, and this, substantially, is the position taken by Engineer Eads. He declares that the recommendations of the Levee Commission are founded in error. He avers that the proper way to lower the flood line of the Mississippi is to do the very opposite of that recommended by the Commission. He advises that the side channels be closed, so as to increase the volume of the water; and that, excepting repairs, the levees be not raised, because the increased flow will deepen the river bed, rendering the artificial building-up of the levees unnecessary. He adduces an array of practical evidence, in support of his position, that seems unanswerable.

We shall recur to the subject hereafter.

SOME ANNALS OF A SUCCESSFUL INVENTION.

If we may judge from *Punch's* frequent cartoons, and from the attention paid to the subject in the English journals, all England is undergoing a skating mania, which outrivals the velocipede *furore* of six years ago. It is not gliding over the ice on glistening steel blades which has captured the British fancy, for frozen lakes and rivers in England are of rare occurrence, and it is now several years since any regular skating club has had its winter carnival. Asphalt floors have replaced the ice; and over their smooth surface John Bull cuts "spread eagles" and "figure eights," and otherwise disports himself on that ingenious Yankee invention, the roller skate. There is an interesting history connected with that device and its inventor, which may here be reviewed. It is a record of how an enterprising man has managed, and is managing, an invention so as to make it yield a fortune, how he has fought and triumphed in protecting his right; and, at the same time, it conveys suggestive thoughts as to the value of popular devices, not merely at home but abroad, emphasizing in brief our oft-repeated assertion that the inventor's field is not restricted to any one country, but is as wide as the world itself.

It was about eighteen years ago when a then-termed "parlor" skate *furore* broke out in this vicinity. Halls in various parts of the city were fitted up with smooth floors, and one part of the public flocked thither and hired the skates at so much per hour, while another portion paid for the privilege of viewing the others learn how to manage the new invention. Education in that direction, though vastly amusing to lookers-on, was just the reverse to the learners; for however good skaters on ice the latter might be, they soon found out that managing roller skates was a very different affair, that gliding straight ahead was easy enough, but to attempt to guide oneself by turning the foot was to invite sudden and painful precipitation to the floor. Perhaps for this reason public interest in the first forms of parlor skate soon waned. Meanwhile, however, Mr. J. L. Plimpton, of this city, perceiving the difficulty, set to work to remedy it by devising a skate which would keep the floor without reference to the angle of the body or the sharpness of the curve turned. With remarkable perseverance he labored on for several years, expending some $25,000 in fruitless efforts. Finally, however, he produced a device which a learned English judge has recently pronounced "almost as ingenious as the wonderful adaptation of bones to be found in a horse's pastern and fetlock." In the center of the sole of the skate, he fixed a spherical spring of india rubber, yielding to the slightest inclination of the foot, a mere change of motion by well known mechanical means causing the axles of the roller wheels to converge. This invention was patented in this country, through the Scientific American Patent Agency, in January, 1863, and subsequently in England, in 1866.

His device perfected, Mr. Plimpton began its introduction in certainly an ingenious and novel way. He first fitted up a hall adapted to his purposes in this city, and for a long time practised himself, and taught invited friends to use his skates. Afterwards he took with him a few of his best drilled pupils to other cities. In lieu of hiring a room and trusting by general advertising to draw a promiscuous throng, he would, after preparing his establishment in any town, issue neatly printed cards of invitation to the most in fluential people in the place. These would usually accept from curiosity, and, finding a genial, pleasant gentleman ready to tell them something new without apparently aiming at their pockets, would become interested, try the skates, and in a very short time "set a fashion" which would speedily be followed by the remaining townsfolk. No long period would elapse before the skating rink would be doing a thriving business, and enterprising investors would speedily seek a share in so profitable a concern. Then Mr. Plimpton would dispose of the lease of his hall and fixtures, with the right to use the invention within certain counties and States. His next step would be to locate in another town, and repeat the operation of introducing the invention; and thus he continued until he had sold rights for ten States to one firm, besides territory in all parts of the Union. Since 1867 he has realized $50,000 for State rights alone, and this sum is nothing beside the profits of the lucky purchasers, who generally followed the inventor's novel plan of introduction, as already described. One man bought the right in the State of California for $4,000, and resold it for $36,000; and the purchaser of the right for San Francisco, it is stated, made $45,000 in one year at the rink in that city. It would take far too much space to recapitulate all the instances of this kind, therefore we may turn to the inventor's efforts toward the introduction of his skate in England. Mr. Plimpton had already an agent in Great Britain, whose success had been very great; so the inventor concluded to join him. The presence and tact of Mr. Plimpton resulted in measures which kindled the present *furore* abroad. Rinks have been established all over England and France. In a single rink in London $500,000 is said to be invested, and in Brighton $40,000 has been refused for the establishment by its owner. Paris has a magnificent rink in full operation. The skates are manufactured in Brooklyn, where a new and large factory is shortly to be erected for this special purpose. We are informed that $60,000 worth of the skates have been made during the past six months, and that the average weekly shipment to Liverpool is now 2,000 pairs.

It could hardly be supposed that so successful an invention would lack infringers, and the latest attempt in England has resulted in a patent suit, considered so important in a legal aspect by the press of that country that whole columns of the London journals are given to *verbatim* reports of its proceedings. One Malcolmson, it appears, substituted a steel spring for the movable rubber spring in the Plimpton skate, and started rinks on his own account. He, out of a dozen infringers, was selected as the typical offender. Celebrated counsel were engaged on both sides, and Sir George Jessel, Master of the Rolls, himself a scientist and a mathematician of great ability, presided at the trial. The questions to be settled were: First, was or was not the Malcolmson skate a colorable imitation of Plimpton's device? And if it was, was Plimpton's skate "new within the realm," so as to come under the protection afforded by the patent laws to all novel inventions? His Lordship disposed of the first point by deciding that Malcolmson's device was "a simple mechanical alteration, which is, if anything, a little worse than the plaintiff's, as it cannot be adjusted," and rendered a decision at once in favor of Plimpton on that issue.

On the second question came the tug of war, and (as is usual in most patent litigations in this country) the SCIENTIFIC AMERICAN came into prominence, forming part of the defendant's evidence. When Mr. Plimpton obtained his first patent in 1863, we, in accordance with our usual custom, printed a brief abstract of the claim, and prefaced it by an editorial note describing the gist of the invention. A copy of the SCIENTIFIC AMERICAN was sent to the British Patent Office, where it was open to public inspection. At the same time the proprietors of *Jewett's Illustrations*, in which was a drawing of Plimpton's skate, together with other patent drawings used in our Commissioner of Patents' annual re port, found its way to the same place. But this book, it appears, was lost; at all events, it was not discovered until during the progress of the trial. But the book containing the patent drawing and the paragraph from the SCIENTIFIC AMERICAN, which was published in connection with the claims, comprised the evidence of the defendant in his efforts to prove that the invention of the plaintiff had been introduced by publication into England before the patent of Plimpton was applied for. The courts declared against the defendant's evidence as insufficient, decided in the plaintiff's favor on all the issues, and granted an injunction restraining the defendant from using the plaintiff's invention, or any part thereof, and from selling or letting for hire any roller or runner skates not made by the plaintiff or his licensees, or differing only colorably therefrom by the substitution of mere mechanical equivalents, ordering him at the same time to deliver up or destroy those in his possession, and to pay the costs of the suit. To afford the defendant an opportunity of presenting an appeal, the judgment would, however, be suspended for six weeks; and in the meantime, though restrained from making or selling skates in infringement of the plaintiff's patent, the defendant would be at liberty to continue his rink at Brighton, keeping an account of the proceeds.

Apart from the importance of this trial to the parties in direct interest, it has a bearing of significance in relation to the rights of American inventors in England. At the present time, printed copies of all American patents, which include both the drawings and full descriptions of the inventions, are forwarded, directly after each week's issue, to the British Patent Office. From the proceedings in this trial, and the ruling of his Lordship, there can be but little doubt but that the introduction of these copies into England constitutes a publication, and therefore, in the eye of the law, an introduction of the invention, which would prevent a patent subsequently taken there from being sustained in the British courts.

But, on the other hand, this very apparent disadvantage is met and counteracted by that admirable provision of our patent law which accords to every inventor six months delay between the allowance of his patent and the payment of the second government fee. Not until that payment is made does the patent issued; and hence, during the above interval, the inventor, at once knowing that his right is secure and at his disposal at any time during the half year on his paying $20, and besides that it is kept secret from all the world, has abundant opportunity to proceed with his applications for foreign protection. Should he neglect to avail himself of that opportunity, then the unfortunate result noted in the preceding paragraph might well occur, but he can then blame only himself. There is not so great and beneficial a safeguard in the patent law of any other country; it is a standing monument to the wisdom and good sense of those who framed it.

There is one more suggestive point to be noted by way of conclusion to this already over-long article, and that is that this successful invention is one out of fifty of similar nature. Moreover it is an unimportant device, one which offers no such large benefit to humanity as does a sewing machine or an electric telegraph; it is little else than a plaything, and yet look at the money that is being made out of it! If a little thing like this, properly managed, yields a fortune what should be the proportionate returns from a great or highly useful invention—one not out of fifty, but standing alone in its value, novelty, and utility?

CYLINDER CONDENSATION.

We have recently received from the author, Mr. George Basil Dixwell, a pamphlet bearing the above title, and containing much that is of interest to engineers. Mr. Dixwell, if we may judge from his treatment of the subject, is not an engineer, but he states that he has been aided by the advice of an eminent expert; and all his experiments seem to have been carefully conducted. We could wish that he had followed the example of Mr. Isherwood, which he commends so highly, and given full details of the apparatus employed and the results obtained, in his many experiments. But it will doubtless be more interesting to our readers, if, instead of criticising, we proceed at once to give a summary of Mr Dixwell's views.

Most persons who have devoted any attention to the question of the expansion of steam are aware of the very great economy that might be realized by high grades of expansion in perfect engines, and know also that this economy is far from being attained in practice. Mr. Dixwell devotes a considerable portion of his pamphlet to discussions of the reasons for this difference, which is chiefly illustrated by the results obtained from experiments with the United States steamer Michigan: results which have been, as he states, confirmed by fifty other examples. The reasons for the enormous condensation shown by these experiments are detailed under the following heads:

External radiations, which he considers very slight in general, and which may be almost entirely prevented by covering the cylinder properly.

Conversion of heat into work. Under this head, Mr. Dixwell has given some remarks which are well worthy of attention. He discusses the point as to whether the whole work is to be considered in estimating the condensation from this cause, or only the work performed during expansion, and decides, as a corollary to some experiments which he details, that the latter measurement is the correct one. We think he could have drawn a more logical proof from Régnault's experiments on the properties of saturated steam, or from the fundamental principles of thermo-dynamics; but he is entitled to great credit for giving prominence to a truth that is too often disregarded by experienced engineers.

Internal radiation, or alternate cooling and heating of the cylinder, and re-evaporation of the steam condensed for work, is another of the causes of condensation, and Mr. Dixwell shows that the maximum amount due to this can readily be calculated. Mr. Dixwell, in common with a great many others who have examined the subject, is disposed to look with little favor upon Mr. Isherwood's theory of condensation from "expansion *per se*," and gives some pertinent reasons for accepting an opposite conclusion. Having disposed of these generally received causes of cylinder condensation, which he finds far from sufficient to account for the whole loss, the author gives his theory of the manner in which the principal loss occurs, and which he calls 'cumulative action." Suppose, for the sake of illustration, that the cylinder is so much cooled, from the causes enumerated above, that 4 ozs. of the entering steam are condensed, up to the point of cut-off, and that, during the remainder of the stroke and during exhaust, 3 ozs. are re-evaporated: the cylinder will thus be cooled to such an extent that during the next stroke 7 ozs. will be condensed, and some of it re-evaporated. At each successive stroke, the amount of condensation will be increased, until the amount of heat received by the metallic surfaces from the entering steam, up to point of cut-off, is just equal to the amount of heat lost from condensation due to causes previously enumerated, increased by the amount of heat required for re-evaporation. Hence this action, which multiplies the effect of primary condensation, may properly be called "cumulative."

In his interesting review of the causes of cylinder condensation, we think that Mr. Dixwell is somewhat in error when he assumes that the results obtained from the Michigan experiments are generally applicable; and we think that he overlooks some important elements, notably the effects of the relation between diameter, length of stroke, and piston speed. As far as he has gone, however, his views are very reasonable. Having discovered all the causes of cylinder condensation, as he imagines, Mr. Dixwell next discusses the means of preventing it, showing the effect of steam jackets, compounding, and the use of superheated steam. He has devised a pyrometer which can be placed in a cylinder, and will give the temperature at various parts of the stroke, by means of suitable connection with a dial on the outside. We regret that the author did not devote more space to a description of this instrument, but he merely states that it is a thin strip of copper, rolled up into the form of a hollow cylinder, and pierced with many holes. By the aid of this instrument, he discovered that, when using highly superheated steam, it parted with all or the greater portion of its extra heat as soon as admitted into the cylinder, and that the temperature in the cylinder remained nearly constant throughout the stroke. This is a genuine discovery, so far as we know; and were this the only fact stated in the pamphlet, it would be enough to make it an important addition to engineering literature. The general supposition is, as our readers well know, that superheated steam does not immediately have its temperature reduced, when admitted to the cylinder, and that there is in consequence some danger of overheating the working parts of the engines. Mr. Dixwell explains the sudden cooling by reference to experiments, in which it was shown that a highly polished metallic surface, when covered with a thin film of a powerfully radiating gas, like steam, is itself converted into a very energetic radiator; and he makes a calculation to determine the thickness of metal that was alternately heated and cooled in one of his experiments. On this theory, it is evident that the proper degree of superheating is dependent upon the conditions under which an engine is running; and this Mr. Dixwell finds to be the case in practice. He is thus led to recommend two plans, for the purpose of preventing condensation and increasing the efficiency of an engine: one, superheating the steam just enough to enable the internal surfaces to repel the spray formed by condensed steam, or, secondly, superheating the steam to a degree that is found safe for any given cut-off. He takes the limit of safe temperature in the cylinder at about 400° Fah. The experiments do not appear to have been carried far enough to determine the proper degree of superheat for each point of cut-off; and the author suggests that it can be conveniently ascertained, in any given case, by the use of his pyrometer.

It has been impossible, in this brief notice, to do more than call attention to the most prominent points discussed in this interesting pamphlet, which treats in a rational manner of one of the most important matters connected with the design and management of steam machinery.

PATENT RIGHTS VS. STATE RIGHTS.

We have heretofore had occasion to call attention to the unconstitutionality of the various attempts, by State legislation, to interfere with the rights of inventors and patentees in the disposition of their patents. In some States, laws have been passed which practically authorize the citizens of such States to cheat the inventor out of his fees if he sells on credit. Such laws provide that a note given in purchase of a patent must state on its face that it is given for the patent, the number, date, and other particulars whereof must be designated on the note, otherwise such note shall be void and the holder debarred from receiving payment. All such laws are, under the constitution of the United States, void. A note given for a patent right will be binding if drawn in the usual manner, all State laws to the contrary notwithstanding.

So in the case of that class of State laws that require the taking out of licenses in order to sell patents, or that require, under penalties, the filing of copies of patents with county or State officials as a condition precedent to selling patent rights within the boundary of any State—all such laws are unconstitutional and void. We have heretofore published the decisions of the United States courts declaring their nullity.

Another decision against the applicability of State laws to patent rights has lately been made by the United States Circuit Court, in Massachusetts. We publish the decision in this issue. This was a recent action to recover damages for an infringement which took place as far back as 1863, up to 1867. The defence was that under the State laws of Massachusetts—statute of limitations—the plaintiff could not recover, he not having brought the action within six years from the time of the alleged injury. This defence was not allowed. The court ruled as follows:

"Should the legislature of a State pass an act in express terms limiting the time for bringing an action in the federal courts for infringement of patent rights, there can be no reasonable doubt that such a statute would be unconstitutional and void. The policy of the Government to provide a uniform system of rights and remedies throughout the United States upon the whole subject matter of patents for new and useful inventions and discoveries, by placing it under the control of Congress and the federal courts, would be frustrated if such State legislation could directly or indirectly limit, restrict, or take away the remedy."

Fine gold will melt at 2,016° Fah.; pure copper at 1,994°; fine silver at 1,873° and pure spelter at 773°.

THE ST. CHARLES RAILROAD BRIDGE, MO.

We herewith publish an engraving of the St. Charles bridge, over the Missouri river, built by a company formed for the purpose and leased to the North Missouri Railroad Company at a rental of $100,000 a year. The bridge cost $1,800,000, or nearly double the original estimate, the difficulties in constructing the foundations being greater than were anticipated.

It is the longest iron bridge in the United States, consisting of three through spans on the Fink plan, four Fink suspension spans, and the iron viaduct approaches, making a total length of iron bridge of 6,535 feet. The seven river spans vary in length from 305 feet to 321 feet. There were eight river foundations—most of them presenting new and extraordinary difficulties in construction—varying from 54 to 76 feet in depth, the caissons for which had to be carried down through alternate strata of quicksand, large boulders, and tangled masses of drift logs. Add to these subaqueous difficulties the facts that at the bridge site the Missouri river rises and falls 40 feet; that its flood speed is nine and one half miles per hour; and drift islands drawing 20 feet of water, and which are more than 300 feet in diameter, are not unfrequently carried past in the heavier freshets, and an adequate idea may be formed of the character of the work.

During the progress of the work, owing to an unusual freshet, the general direction of the current was suddenly changed. Four thousand feet above the site of the bridge a diversion of the current carried away 1,400 feet of the south bank, and, curving outward and returning in the form of an S, brought its abrading force directly upon the south abutment. In this emergency, when the entire demolition of the abutment was threatened, the engineer constructed a groyne, which so diverted the current as to reclaim a large tract from the river bed and confine the channel. The south abutment is now surrounded by dry land. This groyne projects 700 feet from the south shore, and extends above the shore some 400 feet. Out from the south shore a spile wall was driven, from which coarse rip-rap was thrown in, and an embankment made upon it, producing an eddy immediately below. In this eddy, material could be deposited without danger of wash, and so the work was carried forward in an irregular line, guided by the slack water which preceded the bank in its progress down stream. This was continued until a space 700 by 400 feet, more or less, was inclosed by the wall meeting the shore below the bridge line. After being properly packed and protected from wash, this immense cofferdam, for such it now was, was pumped out, leaving the former uncertain bed of the river comparatively dry land, upon which the pier could be erected without interference from the principal enemy, the river current.

It was afterward built to such a hight and so strengthened that its outer walls now form the south bank of the river at that point, thus effectually and permanently forcing the current to keep toward the north shore and to be confined within fixed limits. Although the cross section of the river is necessarily narrowed, it does not affect the velocity of the current.

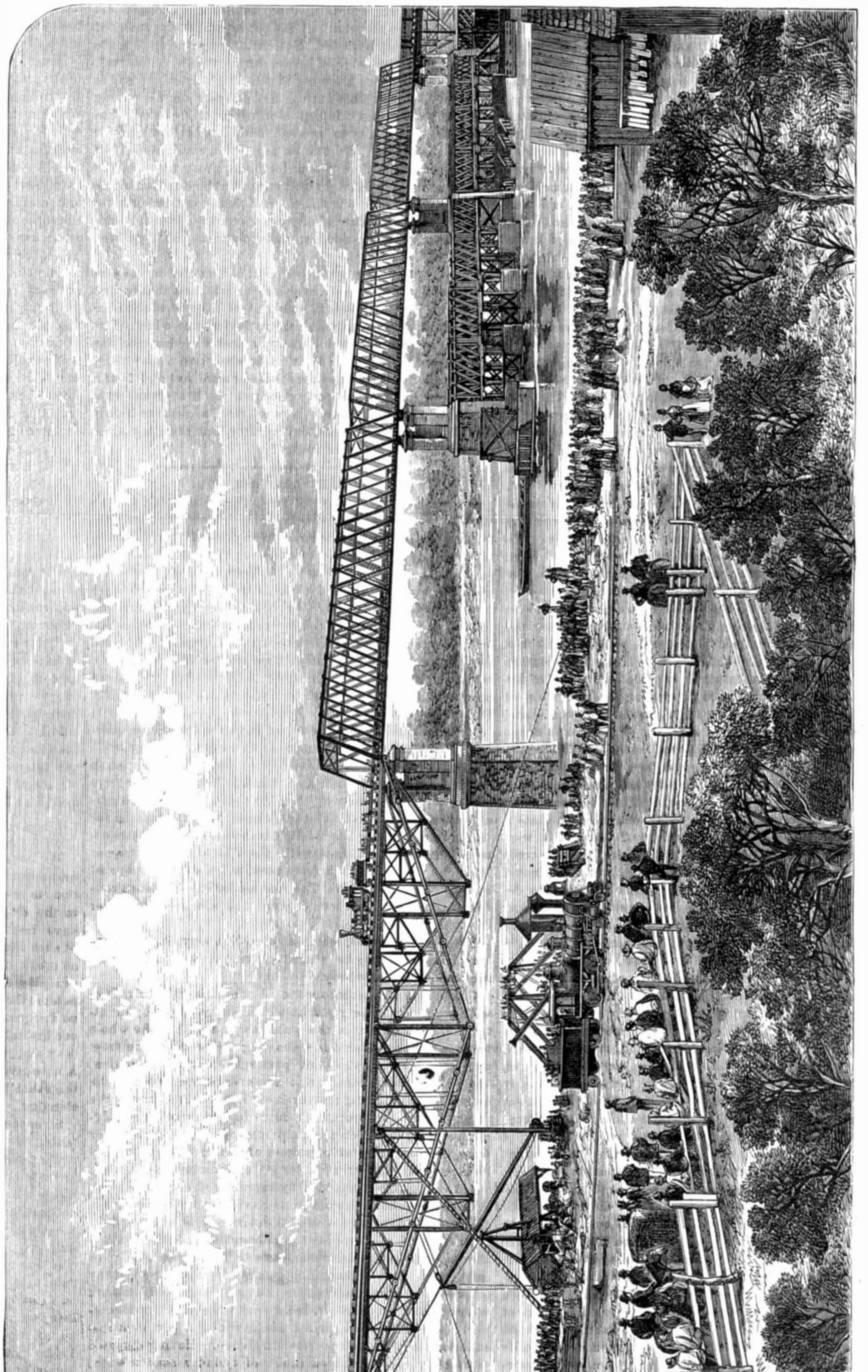
The bed of boulders found immediately below the shifting bottom, although more permanent in position, by their bulky and unyielding nature, made the passage of the foundations through them very difficult. To drive a pile through them required an average of 3,000 blows of a 3,000 lbs. hammer, and, in some cases, over 5,000 blows were required to sink the pile to the bed rock. Sycamore piles alone were found capable of standing the continued batter of the pile hammer. The pile basis was used only when the pile was entirely protected from scour.

The superstructure is of the Fink and trellis or double form, the latter modified by the omission of the usual counter ties. The counter strains are taken by compression ties, extending a few panels on each side of the center, and consisting of two parallel plates stiffened by short diagonal braces of wrought iron riveted to the side plates and at the centers. The wrought iron strut columns are secured to the chord by wrought iron suspension joints, so that they are equally available for tensile strains at points where such strains occur, thus dispensing with the center tie rod usually found in this form of truss. The substitution of the peculiar ties at the center, for counter ties, constitutes the essential difference between this truss and the one used at Kansas City.

The details show many important features of novelty. A leading idea of the engineer has been to construct the bridge of as few pieces as possible. For instance, the upper chord is composed of a single cast iron tube. The structure is fastened throughout by pin joints. The cross ties are placed directly upon rolled iron girders placed between the chords proper, thus throwing all the bending strains upon parts not subject to either tension or compression, dispensing with the ordinary stringers, and avoiding the bulky depth of flooring beams usually seen. The Fink deck spans are proportioned to carry 2,250 lbs. per foot, the chord is 2 feet in diameter, and the main post is 21 inches. The truss itself is a double triangular girder, with inclined end posts and no connection between the systems The counter brace action is secured by stiffening the middle ties and giving the braces a tensile connection. The floor beams are composed of 12 inch channel iron, sandwiched with and forming part of the lower chord, the cross ties being laid directly on these, without the interposition of a stringer. These girders are proportioned in the same manner as in the Fink trusses, but to a working load of 2,400 lbs. per foot. The weight of each Fink span is 680,000 lbs., of each trellis span 788,000 lbs

Probably the most dangerous work of all was the erection of these spans. As no false work could possibly stand at this point in the river, temporary piers were constructed, resting on piles and surrounded by cribs 18 feet wide and 50 feet long, filled with stone. There were three of these piers in each span, and on these were placed, bodily, by means of powerful twin derrick boats, Howe truss spans, 80 feet each. On these spans was placed the false work proper, the top of which was 121 feet from the water.

The bridge was designed and constructed by Mr. C. Shaler Smith. Captain James B. Eads, the engineer of the St Louis bridge and of the Mississippi delta improvement, one of the directors of the bridge company.



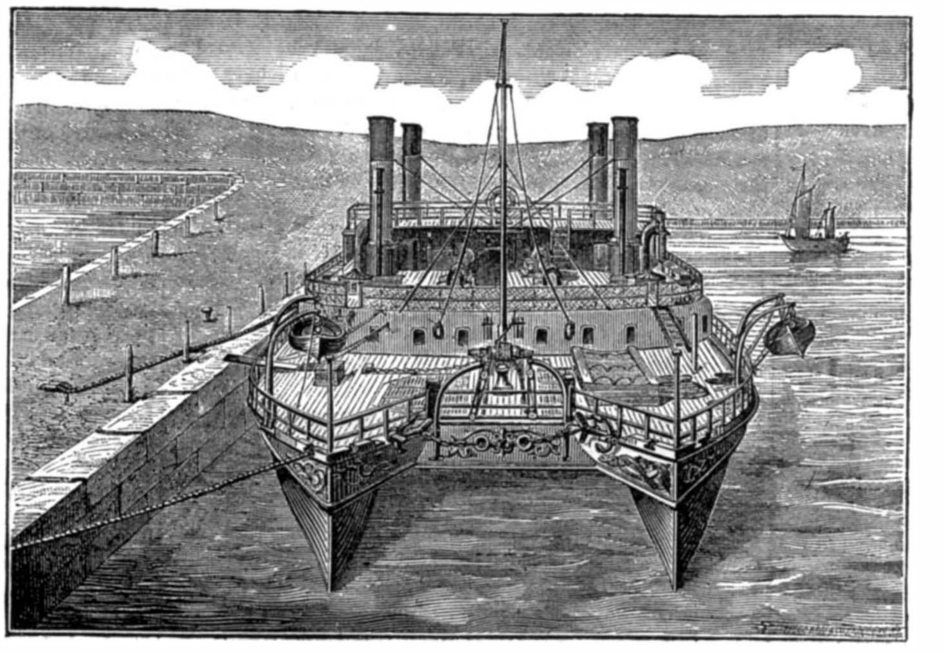
THE ST. CHARLES RAILROAD BRIDGE, MO.

A VERY good impression of any article of metal having a flat ornamented surface may be taken by wetting some note paper with the tongue and smoking it over a gas flame. The article is then pressed upon the smoked part, when, if the operation be carefully conducted, a clear impression will appear. This can be made permanent by drawing the paper through milk and afterwards drying it.

THE TWIN CHANNEL STEAMER CASTALIA.

Unlike the Bessemer, which vessel is now admitted to be a failure, the Castalia, as the twin-hulled steamer plying across the English Channel is named, has turned out a success. Both ships were built with the idea of reducing rolling or pitching motion, and consequent sea sickness among the passengers, to a minimum. The Bessemer, it will be remembered, was fitted with a swinging saloon which, it was imagined, would remain at rest despite the oscillations of the ship. The Castalia has no such appliance, but her inventor has relied on her long and widely separated hulls never being submitted to the action of one and the same wave. While this last might not be possible on the Atlantic, where the long ground swells will affect even the largest of vessels, it is apparently quite true of the English Channel, where the sea is short and chopping. The Castalia therefore has been found to be remarkably exempt from the uneasy motions of ordinary vessels, while she is as readily controlled and directed as the latter.

The length of each hull is 234 feet, beam of each 16·4 feet, depth of hold 12·6 feet, and they are separated a distance of 25·2 feet. The bridge which unites the two vessels is of elliptical tubular section, and is extremely strong, as it necessarily must be in order to bear the opposing wrenching strains of the double hull. On the bridge are located the cabins and saloons, a hurricane deck above serving as a promenade. The ship is flat-bottomed, and draws but 5·7 feet of water, so that she can easily enter any port in the vicinity of her station without regard to the condition of the tide. Her motive power consists in two paddlewheels arranged in the space between the hulls, each wheel having its own engine. An excellent representation of the vessel is given in the annexed engraving.

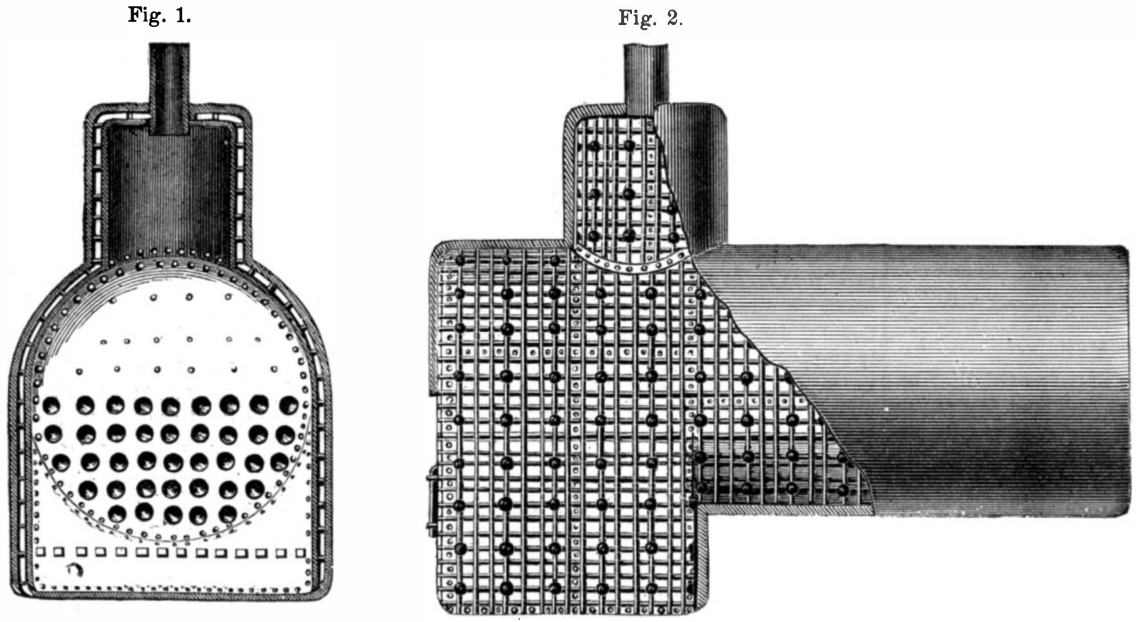


THE TWIN CHANNEL STEAMER CASTALIA.

IMPROVED METHOD OF COVERING STEAM BOILERS, ETC.

Inventions and appliances for economizing steam and fuel are continually being patented and brought into general use, and in times of depression like the present claim the attention of manufacturers and steam users in a more than ordinary degree. By no means the least economizer of fuel and steam is a good durable covering for boilers and steam pipes, such as is illustrated in the annexed engravings. The invention, shown in section in Figs. 1 and 2, consists, first, in leaving an air space or dead air chamber between a wire covering and the surface covered; second, in the keying of some plastic material on the wire cloth; and third, in giving a double check to radiation by the confined air and the non-conducting composition. There are numerous other advantages which might be mentioned, but the abovenamed are the most prominent. The air space is made by taking heavy wire cloth, to which is fastened, every four or five inches, a stud one inch or more in length. The wire cloth is then fitted over the surface to be covered, the studs keeping it the necessary distance off. The plastic material is next applied in two or more coats. The first coat partly penetrates the meshes of the wire cloth and keys itself, obtaining a strong, durable hold. The second coat makes a smooth, even finish, which may be painted, grained, or varnished, as may be desired.

Fig. 1. Fig. 2.



ASHCROFT'S BOILER COVERING.

There are many objections to applying a covering direct to the surface of the boiler, for it has been found, especially in marine boilers, that, when so covered, the inside as well as the outside of the boiler rapidly scales. The air space method, we are informed, is not open to these objections. On the contrary it keeps the iron clean and bright, besides preventing the radiation of heat and condensation of steam. Fig. 3 shows the application of of the invention to steam pipes. We learn that it is used extensively in the United States navy, the boilers of several of the largest steamers being thus covered. The Pacific Mail Steamship Company have also had the boilers in the last new steamers—City of Sydney, City of San Francisco, and City of New York—protected with the air space covering. It has besides, we are informed, been extensively applied to large manufacturing works in all parts of the country.

This method of covering was patented in June, 1866, to John Ashcroft, but has not been prominently brought before the public till within the past year, when the patent was purchased by the Chalmers Spence Company, of New York, who now apply it in connection with their non-combustible plastic covering. Their works in New York city are located at the foot of 9th street, East River, next to the Morgan Iron Works; and they may be applied to, at that address, for further information.

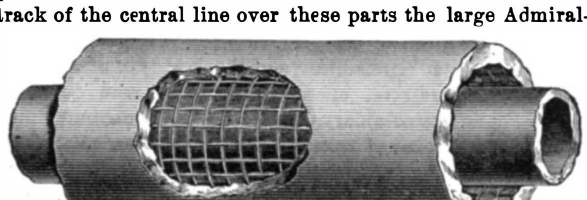


Fig. 3.—ASHCROFT'S PIPE COVERING.

The Solar Eclipse of March 25, 1876.

It is quite possible that this eclipse, which is given as an annular one in the *Ephemerides*, may be total for an instant on the North Pacific Ocean in longitude 140° 16′ west of Greenwich, and latitude 35° 39′ north, or near this position it may prove one of those rare phenomena characterized in our text books as total without continuance. The central line traverses the southern and largest island of the Sandwich group, where the eclipse will be annular for a few seconds. At a point in longitude 155° 56′W., latitude 19° 28′ N., the eclipse commences at 9h. 30m. A.M. local mean time, at 130° from the sun's north point towards the west (direct); and the annulus is formed, according to the *Nautical Almanac* elements, at 10h. 49m. 10s., and continues 10 seconds. This point is a little south of Kaavaroa, by the Admiralty chart, and close to the spot where the monument to Captain Cook was erected; the central eclipse leaves this island, Hawaii, near Manienie, also marked on the Admiralty chart of this group. The eclipse will be central and annular also in Vancouver Island and British Columbia. The central line appears to enter Vancouver at Refuge Cove, Sydney Inlet, leaving it at Orange Point, Duncan Bay, whence its course is to George Point, British Columbia. In Vancouver Island the annulus may continue 7 or 8 seconds, being formed about 0h. 27m. P.M. local mean time. At New Westminster, British Columbia, calculation gives a large partial eclipse commencing at 11h. 22m. A.M., and ending at 2h. 3m. P.M., local times, magnitude 0·95; here the first impression of the moon upon the sun's disk is made at 127° from his north point towards the west. For further information on the track of the central line over these parts the large Admiralty chart of Vancouver Island and vicinity should be consulted; the above names of points traversed by the central eclipse are taken from it.

On the central line this eclipse must prove one of very considerable and unusual interest.—*Nature.*

THE proper velocity for the periphery of a circular saw is nine thousand feet per minute, or one hundred miles an hour. A saw 12 inches in diameter should make 3,000 revolutions per minute.

Coal Dust Fuel.

The grounds on which are erected the works of the Loiseau Pressed Fuel Company belong to the Philadelphia and Reading Railroad Company, and have been leased for five years. All the coal dust made at the wharves at Port Richmond, Pa., during the same number of years, has been secured by contract. When the works are started, if the supply at Port Richmond is not sufficient, additional quantities, as required, will be shipped from the coal regions. The buildings are erected at the southwest corner of Bath and Linden streets. Their length on Bath street is 128 feet, and on Linden street 275 feet. They are seven in number.

The clay is dried in a kind of core oven, and is ground by one of Baugh's grinding mills. In the same room is an iron tank, six feet high and six feet in diameter, in which is prepared a composition of lime, rye flour, and water, which, in a liquid state, is discharged into a wooden reservoir or tank placed under the coal dust and clay pockets. In front of these pockets is placed a very ingenious machine by means of which 95 per cent of coal and 5 per cent of clay are continually and mechanically taken out of their respective pockets and delivered under a chain elevator, and there sprinkled, through a perforated pipe, with the liquid from the wooden reservoir. All the materials which are to make the lump of fuel are here brought mechanically together and are taken up by the chain elevator, which carries them up and discharges the whole into the mixing machine. This machine has a capacity of six tuns, and it delivers through two openings at the bottom, regulated by hand wheels, the materials on a leather belt, 3 feet wide, which carries and discharges them into the hopper of the press, between two rollers, on the face of which are milled out semi oval cavities, connected by small channels. These are the molding rollers, and the materials passing between them are compressed and molded in the shape of eggs, and delivered in that shape on an endless wire cloth belt, which enters the drying oven on top. In this oven, which is a brick construction, 86 feet long, 14 feet wide, and 26 feet high, there are five endless wire cloth belts, geared together, and traveling in opposite directions. This oven is heated, by a fire placed at each end, to from 250° to 300° Fah. The coal enters, as said before, on the upper belt coming from under the press, travels five times in succession the entire length of the oven, at the speed of 12 feet in one minute, falling from one belt to another, and finally comes out perfectly dry on the lower wire cloth belt, which enters the waterproofing building. In this building the lumps of coal are discharged into a tank containing a certain liquid composed of candle gum dissolved in crude benzine. In the same tank, and guided on both sides by a curved groove, travels a wire cloth belt on which the lumps are discharged from the lower belt coming from the oven. The lumps are thus immersed mechanically into the waterproofing liquid, while the belt describes a curve into the tank; and the same lumps are then carried, waterproofed, into the evaporating oven, where all the vapors of the benzine are collected and carried through large pipes into a condensing coil 200 feet in length. The condensed benzine returns to the main tank, and the coal, perfectly dry and waterproof, is carried up by a chain elevator, and discharged on another wire cloth belt, which runs the entire length of the coal pockets (100 feet), and delivers the coal in any desired pocket.

From beginning to end the coal is in motion, from the point where it is dumped as dust until it reaches the coal pockets as fuel. It travels about 800 feet, in about one and a half hours. Buildings and machinery are of the most substantial character. The production with the machinery erected will vary from 125 to 150 tuns per day.—*Saward's Coal Trade Journal.*

American Salmon in New Zealand.

Intelligence has been received of the safe arrival in Auckland, New Zealand, of 40,000 salmon eggs from Columbia River. These eggs were sent from San Francisco by steamer, consigned to the Napier Acclimatisation Society; but on arrival at Auckland they were found to be so far advanced that it was determined not to risk sending them all to Napier, but to distribute them immediately in suitable localities in the neighborhood. One half was thus treated, and the remaining 20,000 were sent on to their original destination, Napier. There is every probability that an actual colony of salmon has now been planted in New Zealand, for the fry were in a healthy condition, and great care was taken by Mr. Firth to protect those placed in the rivers from all enemies.

NEW PHOSPHIDES OF SILVER, AND A METHOD OF ESTIMATING SILVER QUANTITATIVELY BY MEANS OF PHOSPHORUS.

BY WILLIAM FALKE, PROFESSOR OF NATURAL AND PHYSICAL SCIENCES IN MANHATTAN COLLEGE.*

In continuation of my communication commenced on page 148 of the last issue of the SCIENTIFIC AMERICAN: The question now occurred whether the phosphorus solution could be advantageously employed for the estimation of silver; for, as has been previously observed, the whole of the silver can be separated, in a short time, from many of its salts. Silver is generally estimated as chloride, and this is a process in which the very greatest care is requisite to produce accurate results. At first it must be precipitated as a chloride and be allowed to settle, then collected upon a filter and washed very rapidly to prevent any silver from being reduced by the organic matter of the filter, and, lastly, it must be transferred to a crucible and ignited. This method involves more or less difficulty and loss. After a series of experiments, the following phosphorus method is suggested as superseding the use of a filter, and in which the silver is at once weighed in the metallic state. Into a carefully weighed and dried tube or capsule, the salt of silver (the nitrate) is put, and dissolved in a small quantity of water. Then at least one fifth of its weight of phosphorus, dissolved in carbon disulphide, is added, and the tube, with its contents, slowly warmed. At first the silver is reduced with some phosphide admixture, then the carbon disulphide evaporates, and lastly the water is removed by careful evaporation, so as to prevent any spurting. After the whole is nearly dry, which is generally accomplished in less than half an hour, the tube may be heated for a short time, by gradually applying the flame to it. The excess of phosphorus undergoes combustion, and the phosphide also, so that nothing remains in the tube excepting metallic silver and phosphoric oxide, which is dissolved out with some distilled water, and the solution is poured out, as the silver adheres together in a spongy or scaly condition. After washing a few times, by decantation, the tube containing the silver is well dried by semi-ignition, and weighed by subtracting the weight of the tube from the tube and silver, and thus the weight of the silver is known.

A few of very many experiments are given to show how accurate and simple the method is: Tube, 7·275 grammes (112·267 grains); silver nitrate, 0·068 gramme (1·049 grains); phosphorus, 0·025 gramme (0·3858 grains); carbon disulphide 0·5 cubic centimeter (0·0305 cubic inch); water, 3·000 cubic centimeters (0·183 cubic inch.)

After analysis: Tube + metallic silver, 7·318 grammes (112·929 grains) — tube, 7·275 grammes (112·267 grains) = silver 0·0430; calculated in the nitrate, 0·0432, showing a difference of only 0·0002 of a grain.

Another example showed: Silver calculated in nitrate, 0·2617: silver found in nitrate, 0·2615 = 0·0002.

From this it will be seen that (by simply taking a capsule or tube previously well dried and adding the salt of silver or its solution, then the phosphorus dissolved in carbon disulphide, and mixing the whole), by careful evaporation and lastly semi-ignition, and then washing out after cooling the phosphoric acid and again drying, the silver may, as such, be at once weighed and determined. Many other salts of silver are at present under investigation, of which, in the future, more will be heard.

For descriptions of the few compounds of silver and phosphorus thus far known, which are of a very unsatisfactory nature, on account of the difficulty of the investigations, the reader may see Watt's "Dictionary of Chemistry," volume V., page 303.

* A part of this article formed the subject of a paper read before the New York Academy of Sciences (late Lyceum of Natural History), December 13, 1875.

English Railway Car Signals.

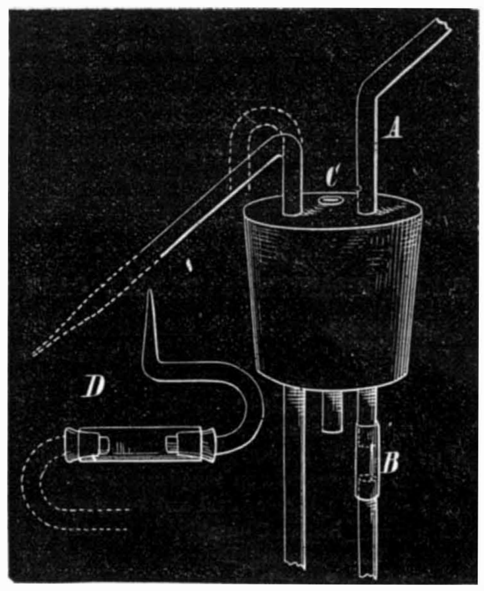
How to establish a suitable means of communication between the interior of the passenger cars and the engine driver is still a harassing and unsettled problem in the minds of our British cousins. The simple cord used in this country, they think, will not do, because they fear that the unruly subjects of the Queen, pent up in the little apartments of the cars, will pull the string when they ought not. Hundreds of devices have been proposed. What John Bull wants is something that is simple, and that will show to a certainty in which of the thirty compartments of a train the signal originated. Here is the last contrivance: Mr. Stewart, patentee of a new flag signal for railway carriages, recently exhibited his invention in the theatre of the Society of Arts. The invention consists of an apparatus which is inclosed in a small wooden box and placed inside of the carriage against one of the top corners of the compartment. On a catch being released by means of a cord suspended from the roof, a flag is projected through the side of the carriage, and at the same time a rope in connection with the apparatus causes the ringing of a bell in the guard's van and the whistle of the engine to be sounded. The intention of the invention is to provide instantaneous communication simultaneously with the guard and driver of the train, and, at the same time, means of informing both, by the exhibition of the flag, of the exact carriage in which the apparatus has been set in motion. A rope, running from end to end of the train, keeps the boxes in the various compartments in connection with the guard's van and the engine. The general opinion of those who examined Mr. Stewart's model was that, provided the machinery should not be liable to get out of order in the working, and that the expense should not deter railway managers from its adoption, it would be a great improvement on the existing means of communication between passengers and guards in traveling trains. The projection of the flag from the side of the carriage in which the bell had been rung was considered to be very valuable, as directing the attention of the guard at once to the spot where his assistance had been called for. Mr. Stewart stated that the probable cost of fitting railway carriages with his apparatus would be about one per cent of the cost of the carriages, which would be $50 for a car costing $5,000.

Correspondence.

An Improved Wash Bottle.

To the Editor of the Scientific American:

I recently noticed at the Stevens Institute of Technology a very handy form of wash bottle, devised by Mr. F. L. Bardeen, of which I inclose a sketch. It may be termed a constant bottle, for it throws a stream as long or longer than is required for most washing purposes. With a globe-shaped flask, holding about a liter (four fifths of a quart), the stream is constant for 45 seconds; and with the hot water bottle of the same size, for 1 minute or more, owing to the expansion of air within. With larger flasks, the time of flowing would of course be lengthened. The length of time, obviously, depends on the size of the jet and amount of air in jected; but for ordinary purposes, the time is about as stated. Globe-shaped flasks should be used. and they should never be more than two thirds full; and as the space for air increases as the water flows out, the stream remains constant for a greater length of time.



The device is made by perforating the cork in three places: the first for the exit tube, which extends to the bottom of the flask, the second for the tube through which the air is forced, and the third for an open tube for stopping the flow by relieving the pressure. On the lower end of tube, A, is a valve, made by slipping a short piece of rubber tubing over the tube, making a slit in the side, at B, and closing the lower end with a piece of glass rod. As this slit opens outwardly, all air forced through it is retained, and the expansion of this produces the jet. At C is the third opening in the cork, in which is a short piece of small tube, left even with the cork at the top and projecting a little way through the cork at the bottom.

The mode of use is as follows: Place the first finger of the hand that holds the bottle over the hole, C, and give a strong blast. If the finger remains over the hole, the water will flow for the space of 1 minute or more. The flow is instantly stopped by removing the finger. By using the movable nozzle, indicated at D, the jet may be directed to any required spot. It is especially convenient, as thus constructed, for washing down the precipitate from an inverted beaker; and as it is frequently desirable not to disturb the latter, in the above device the head is not obliged to follow the bottle into uncomfortable positions and remain so while the washing proceeds. W. KNOWLTON.

New York city.

The Great Engineer for President.

To the Editor of the Scientific American:

"The right man in the right place." This oldfashioned doctrine is revived in your able article nominating James B. Eads for the Presidency.

A statesman, an anti-monopolist, an advocate for the rights of the laborer, a gentleman of the highest scientific attainments and literary culture, James B Eads has rendered more lasting service to the Republic than any man living in the United States.

He is truly a representative of the best type of American citizen. Progressive, energetic, endowed with inventive powers in an extraordinary degree, he has contributed more to the advancement of practical science than any man of the age. Constructing an ironclad navy for the Western waters, he originated many important improvements therefor, which resulted in the building of ironclads of lighter draught than had been deemed possible.

As a civil engineer, James B. Eads occupies an eminent position. There is nothing in scientific history to compare with the St. Louis and Illinois bridge, with its wonderful aisson work. Slender and airy as the masonry of this bridge in its perfect symmetry appears, it contains 103,000 cubic yards of masonry—almost double the amount contained in the piers of any other bridge of equal length. The reports of the projector have been translated into many languages, and form the basis of text books used in schools of engineering in America and Europe

Although yet in the prime of life, James B. Eads has accomplished grand public improvements which might compass a century. The records of the Patent Office exhibit him as the originator of many useful and varied improvements. The Jetty system, now being constructed by this distinguished engineer, at the mouth of the Mississippi river, is one of the grandest works of the nineteenth century. The Mississippi river drains one of the most extensive, fertile, and salubrious valleys on the face of the globe, yet the only outlet to the sea, of this grand region, has always remained blocked by a bar over which commerce has vainly striven to find unfettered passage. The success of this great enterprise is already nearly established.

An honest man, an enlightened gentleman, gifted with administrative abilities of a high order, a statesman of broad, comprehensive views and sound logic, James B. Eads is pre-eminently fitted to fulfil the duties devolving upon the Executive of this great nation.

A PATRON OF HUSBANDRY.

Can We Protect our Bank Vaults?

To the Editor of the Scientific American:

The article in your issue of February 20 on this subject is worth attention; but let me ask how it is that bank safes in London, Paris, and Vienna are not robbed? They certainly keep as much specie and currency generally on hand in London as we do here, yet I cannot call to mind a single case of a bank safe being robbed in that city. When I resided in London, I was informed by a friend who had been employed as clerk in a London bank that, when he first commenced his duties there, he was compelled to sleep on the premises with some three or four other junior clerks, and that it was made obligatory on them that two of them should always remain at home to look after the building, in conjunction with the janitor and his family. Thus a band of burglars could have no opportunity of robbing such a bank, save by collusion with four or five persons. The country banks in England, I am told, are guarded in the same manner. It seems to me that, if we give the burglars full opportunity to work, it is quite useless making strong vaults and safes. Guard the building: that is the true remedy. Our safe deposit institutions have wisely adopted this plan, and so far successfully. DEPOSITOR.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

The computations and some of the observations in the following notes are from students in the astronomical department. The times of risings and settings of planets are approximate, but sufficiently accurate to enable an ordinary observer to find the objects mentioned. M. M.

Position of the Planets for February, 1875.

Mercury.

Mercury, which was seen so beautifully after sunset in the latter part of January, can in March be seen before sunrise. On the 1st of March it rises at 5h. 30m. A. M., and on the 31st at 5h. 15m. A. M. The best time to look at it is on the morning of the 10th.

Venus.

Venus becomes more and more conspicuous in the evening sky, setting on the 1st of March a little before 9 0 P. M., and on the last of March a little after 10 P. M.

As Venus passes the meridian between 2 and 3 in the afternoon all through the month of March, with an increasing apparent diameter and at higher and higher altitude, it can probably be seen with the naked eye at its culmination.

Mars.

Mars rises on the 1st of March at 8h. 33m. A. M., and sets at 10h. 5m. P. M. On the 31st, Mars rises at 7h. 30m.A.M., and sets at 9h. 54m. P. M. The apparent diameter of Mars is now very small, in consequence of its distance, but on the 29th it may be recognized from its nearness to Venus.

Jupiter.

Jupiter continues to be very near to the star β *Scorpii* and its motions can be very nicely followed by comparing its position with that of the star. In the first half of the month of March, Jupiter is seen to be moving away from the star; on the 17th it is stationary, after which its motion becomes retrograde, and on the 31st it is very near the star.

Jupiter is coming into better position for evening observers; on the 31st of March it rises about 10h. 32m. P. M., and comes to meridian at 3h. 10m. the next morning, at which time the star β *Scorpii* is west of Jupiter by about half the diameter of the moon.

Saturn.

Saturn sets before the sun in March, but it rises earlier and earlier through the month, and in the latter part can be well seen in the morning. On the 31st, Saturn rises at 4h. 28m. A. M., and sets at 3h. 5m. P. M. Mercury and Saturn are in conjunction on the morning of the 18th.

Uranus.

On the 1st of March Uranus rises at 3h. 36m. P. M. On the 31st, Uranus rises at 1h. 34m. P. M. Uranus can be found at meridian passage, which on the 1st is at 10h. 37m. P. M., at an altitude (in this latitude) of about 58°. On the 31st, Uranus passes the meridian at 8h. 36m., at an altitude of 58¼°

Sun Spots.

The report is from January 19 to February 20, inclusive. The photographs of January 20 and January 21 show a large spot (followed by a very small one) coming on, a small group near the center, and another on the western limb.

Clouds prevented photographing till January 25, when the group seen going off on January 21 had disappeared; the group then near the center was now on the western limb, and the large spot had separated into a group, composed of one large and several small ones.

From January 26 to February 12, when observations could be made, the sun's disk appeared free from spots. On February 12 a large spot, measuring nearly $\frac{1}{48}$ of the sun's diameter, with very marked penumbra and followed by faculæ, was observed. On February 16 this spot was seen to have broken up into a chain of small ones, which measured when last seen, February 20, nearly $\frac{1}{16}$ of the diameter of the sun. Observers should look for the return of this spot about March 9.

PRACTICAL MECHANISM.

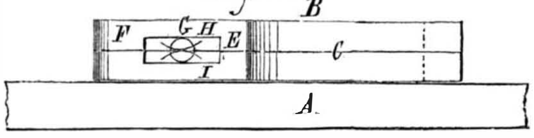
BY JOSHUA ROSE.

NUMBER XLIII.

MARKING OUT A CONNECTING ROD.

Our next operation is to mark out the keyway, which is performed after the butt end of the rod and the inside and outside of the strap have been planed. We first, with a pair of compass callipers, which are better for the purpose than compasses, mark the center of the strap edgeways, and then, laying it with its broad surface on the marking-off plate, we mark off the keyway as follows: In Fig. 213, A represents

Fig. 213

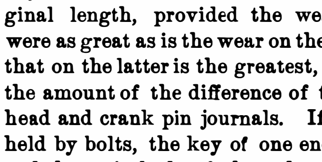


the table, and B the connecting rod strap. C is the center line of the strap, and therefore of the keyway; the end, E, of the keyway should be drawn the necessary distance from the inside crown of the strap, as denoted by the dotted line, because it is that distance upon which the thickness of the brasses depends. Hence the line, E, is the first one to be drawn; then, from the line, E, we mark the length of the keyway, and strike the line, F; the breadth of the keyway we mark by setting the compasses to the radius of a circle whose diameter will be equal to the required breadth of keyway. Then using the center line as a center, we mark the circle, G, and (parallel with its diameter, the center line) the lines, H and I, thus completing the marking of the keyway on the strap. Our next operation is to mark the oil hole of the strap, which should be placed exactly in its proper position, for the following reasons:

A connecting rod whose crosshead end has a strap with a gib and key (or, what is better, two gibs and a key to hold it, the crank pin end having its strap held by bolts, and the key between the bolts and the brass) would maintain its original length, provided the wear on the crosshead brasses were as great as is the wear on the crank pin brasses; but since that on the latter is the greatest, the rod wears longer to half the amount of the difference of the wear between the crosshead and crank pin journals. If both the straps of a rod are held by bolts, the key of one end being between the brasses and the main body of the rod, and the key of the other end between the brasses and the crown of the strap, it would maintain its original length if the wear on both ends was equal; but this not being so, it wears longer, as above stated. The oil hole of a strap, for either a connecting or side rod, should therefore be in the exact center of the space intended to be filled by the brasses. It will thus be central with the joint of the brasses, and from center to center of the oil holes, and will, therefore, represent the proper length of the rod. When, therefore, the brasses of a rod end, whose strap is held by a gib and key, have worn so that the key is let down, the brasses must be lined up to bring the key back to its original position, the back brass being lined up so that its joint face comes even to the center of the oil hole, and the other brass being lined up sufficiently to bring the key back to its original position; then the rod is sure to be of the proper length. But if the strap is held by the bolts (in which case it does not move when the brasses are let together and the key further through), lining the back brass up to the center of the oil hole at once insures the rod being of its correct length, without any reference as to what thickness of liner is put on the other brass, or how far the key may come through. In either case it will be observed that the center of the oil hole, when placed as described, forms a gage to keep the rod its proper length.

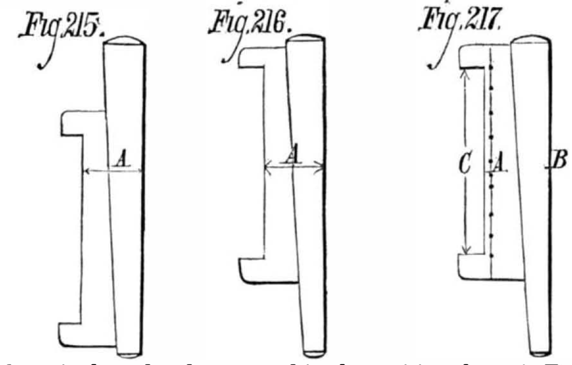
To mark off the oil hole, we lay the strap on its side face, as shown in Fig. 214, and, placing a straight edge along the inside crown face of the strap, we mark a line even with it and across the jaw of the strap, as shown at A, in Fig. 214, and from that we mark with the compasses the line, B, the distance between the two being half the total depth of the brasses, or, what is the same thing, the thickness of the crown brass (when new) from its joint face to its bedding crown. We then, with a square and scriber, carry the line, B, over to the center line of the edges of the strap (C in Fig. 213), and the junction of the two is the center of the oil hole. In centerpunching the center for the oil hole to be drilled, make a deep centerpunch mark to prevent the drill from running to one side and thus deceiving the machinist (who may have to line up the brasses when they become worn) as to thickness of the liner to be placed behind the back brass to keep the rod to its original length.

Fig. 214.



The marking of the keyway in the butt or stub end of the rod is performed in the same manner as that of the keyway in the strap, care being taken to make the edge of the keyway nearest to the end of the rod at the exact proper distance from that end: otherwise the amount of space left, when the strap is in its place, between the end of the rod and the crown of the strap (which regulates the thickness of the brasses), will not be correct, and the oil hole will not stand in its correct position on the strap, unless the key and gib are made to suit the inaccuracy of the position of the keyway in the rod end. For example: Suppose the keyway of the rod to approach too near the rod end; then the strap will, if the gib and key are made of the proper width (when placed together, as shown in Fig. 215) across, as at A, not pass sufficiently along the block end, and there will be too much space allowed for the brasses, and the oil hole will stand too near the crown of the strap. The only method of correcting this defect is to make the width of the key and gib, at A, Fig. 215, wider to the necessary amount, and to cut the keyways, both in the strap and the rod end, wider, by cutting out the metal on the edge of the keyway furthest from the rod end, and the metal on the edge of the keyway in the strap at the end nearest to the crown of the strap. If the keyway of the block end errs in the opposite direction, the keyways must of course be made wider, the metal being cut out in the exact opposite to the above direction. By marking out the two keyways as above described, we have no occasion to take any account of the draw, since that will come right of itself when the brasses are put in their places in the strap, and the strap is put in its place upon the rod end. In marking off the rod end from keyways already cut in the strap, the following plan must be adopted: Place the strap upon the rod end, leaving the space between the rod end and the crown of the strap narrower than is required to receive the brasses (when the latter are new) by an amount equal to the amount of taper there is in the full length of the key, and mark the keyway in the rod end even with the strap, taking no account of the draw required on the keyway, which is provided for in the position in which the strap is placed on the rod end, as will be perceived when we consider that the length of a keyway is always the width of the key and gib, at A, when placed together, as shown in Fig. 216. Hence, by marking off the keyway in the rod end with the keyway in the strap, the latter is in the position in which it will stand when the key and gib are in the position shown in Fig. 216. Supposing then the gib and key to be in their

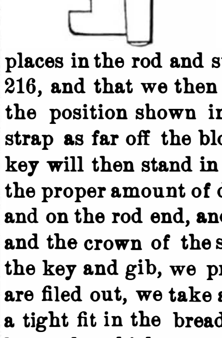
Fig. 215. Fig. 216. Fig. 217.



places in the rod and strap, and in the position shown in Fig. 216, and that we then lift the key up so that it will stand in the position shown in Fig. 215, and that we then pull the strap as far off the block end of the rod as it will come, the key will then stand in its correct position, and there will be the proper amount of draw in the keyway, both in the strap and on the rod end, and the space between the end of the rod and the crown of the strap will also be correct. To mark off the key and gib, we proceed as follows: After the keyways are filed out, we take a piece of thin sheet iron and fit it to a tight fit in the breadth or thickness of the keyway, and have the thickness of the key and gib planed, using the piece of sheet iron as a gage; we then mark off the key on both edges to the proper width at top and bottom, and hence give it the correct amount of taper. We also have the plain or straight edge (that is, the edge opposite to the jaws) of the jib planed straight; we then place the jib and key in the position shown in Fig. 217, and mark off (from the edge face, B, of the key) the line, A, on the gib, using the compass callipers set to the full width of the keyway in the strap or rod end, taking no account of the draw. Hence the key and gib will, when in the position shown, just fill the keyway. The width between the jaws of the gib, as denoted by C, should be marked a trifle less than is the extreme outside width of the jaws of the strap, so as to allow for the metal taken off in filing up the outsides of the jaws of the strap and off the inside of the jaws of the gib.

When the rod is fitted up and ready to mark off the brasses, to bore them out by, we proceed as follows: We take the top brass and mark on its outside face two lines level with the faces which fit against the inside jaws of the strap, as shown in Fig. 218, A and B being the lines referred to. We then key up the brasses in their places in the rod and fasten a center piece in the brasses at each end of the rod. Upon these centerpieces we first mark a line parallel with and central between the lines, A B, and then a line across the joint of the brasses if the joint faces meet, and in the center of the space between them if they do not meet, and in either case to the center of the oil hole, if the rods have been correctly made; and the distance between the junction

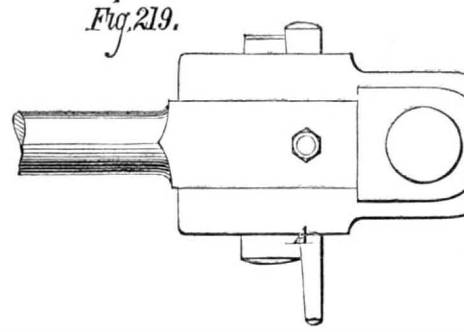
Fig. 218



of the lines so obtained will, from one to the other, be the length of the rod. The rod should, however, always be tested with a pair of trammels set to the necessary distance between the brasses from center to center of their bores, care being taken to stand the rod, while trying the trammels, in the position in which it works, for all rods deflect by their weight, the amount of such deflection depending upon the position in which the rod is suspended. The trammels also deflect, it is true, but their deflection is allowed for in setting them, whereas the deflection of the rod will not be accounted for unless it is trammeled when standing or lying in the position in which it works.

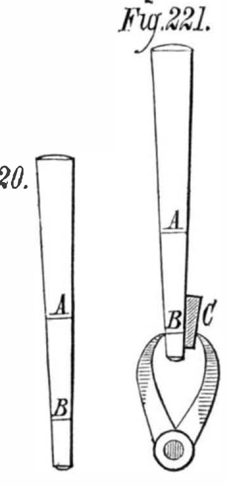
We now come to ascertaining what thickness of liner it is necessary to insert on the back of each brass, when such is necessary on account of the wear of the brasses and on account of the key having passed through the keyway so that its head is level with the top of the jib, and hence requires to be set back. Beginning with the back or bottom brass, which beds against the crown of the strap, we find that the brass at each end of the rod furthest from its key will, no matter what the construction of the rod may be, require lining up so that the center of its bore is even with the center of the oil hole in the strap, that is, providing the oil hole has been marked off as directed. The thickness of liner

Fig. 219.



necessary to place behind the brass nearest to the key should be ascertained as follows: The brass furthest from the key having been lined up, we put the rod end, together with the brasses and keys, in position, and key the rod up properly, when, as shown in Fig. 219, the key will pass too far through the rod end. Then we mark across the face of the key a line, A, even with the edge face of the strap; we then put the key back to its proper position, and mark another line B, even with the edge face of the strap; and taking the key out, we shall find the two marks shown in Fig. 220, A being the first and B the second line struck upon the face of the key; and the difference between the width of the key at A and its width at B will be the thickness of the liner necessary to be placed behind the brass nearest to the key. To ascertain the precise amount of this difference (because a very small error as to this amount causes a great deal of extra labor), we set a pair of outside callipers to the width at A; and then passing the calliper points down to B, we keep one of the points even with the line, B, and insert a wedge until it just fills the space between the other point and the side of the key, as shown in Fig. 221, C being the wedge, which should be chalked along its surface so that, when inserted (as shown) until it touches against the calliper point, the latter will leave a mark on the wedge, denoting exactly how far the wedge entered and hence the exact required thickness of liner.

Fig. 220. Fig. 221.



Bicycle vs. Horse.

A ten mile race, between a fast horse named Happy Jack and a velocipede rider named Stanton, recently took place at Lillie Bridge, England, for $250. For the first three miles the horse kept level with the bicyclist. The ground was rather sticky—owing to late rains—for both, and Stanton seemed laboring, but this is his peculiar way of riding. Stanton was the favorite at as much as 3 to 1, for the start allowed him was generally considered too much. For three miles the horse went easily; where he lost at the corners he made up in the straight. This style he kept up until the sixth mile, when his stride began to falter, not being ridden so well as on the last occasion, combined with the effect of the extra weight he was carrying. Stanton from this point gradually went ahead, and in the next mile he had gained fifty yards. The horse was now beaten, and after going another lap was pulled up at eight miles. Stanton went on and finished the distance, ten miles less 764 yards, in 34 minutes 34 seconds, being at an average velocity of nearly eighteen miles an hour. He rode a 58 inch machine made by Keen, weighing 40 lbs. He seemed to have a good deal more in him had it been required.

A correspondent says: For kitchen and pantry floors there is nothing better than a coat of hard paint; the cracks should be filled with putty before it is applied, and the paint allowed to dry at least two weeks before using. Then it is easily kept clean by washing (not scrubbing) with milk and water; soap should never be allowed to touch it. "Red lead and yellow ocher I prefer for coloring; the former makes a hard paint that wears well."

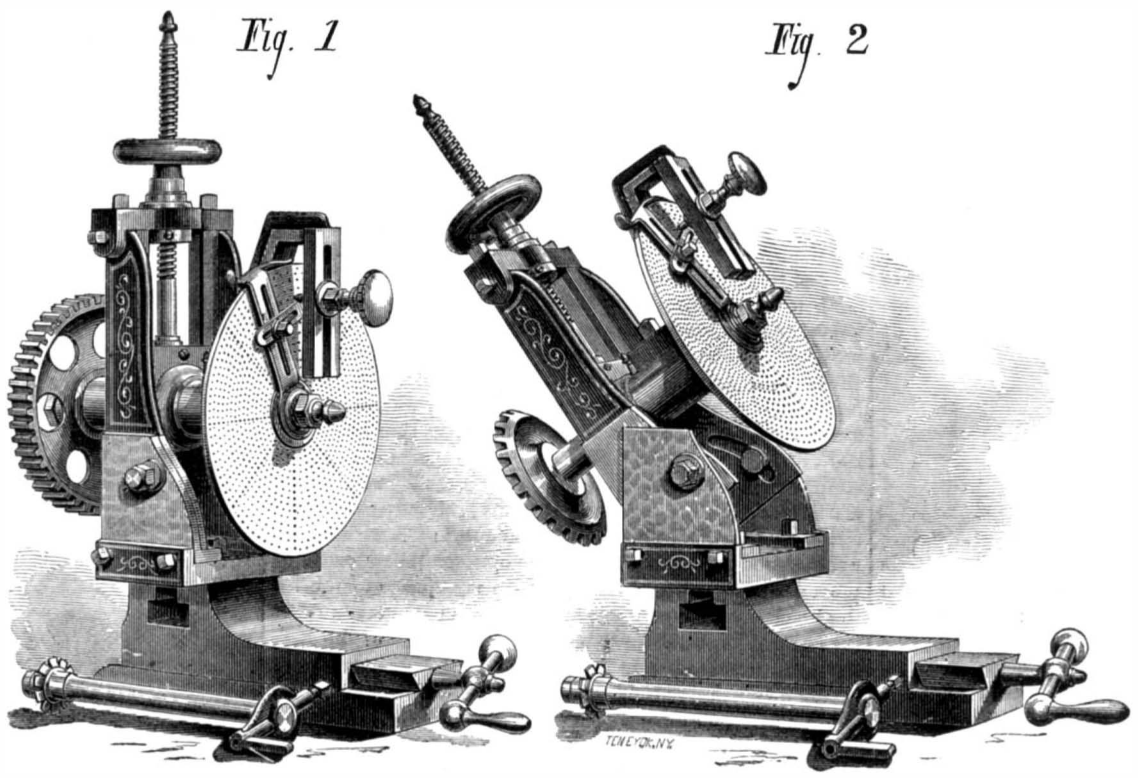
PATENT GEAR-CUTTING ATTACHMENT FOR LATHES.

We illustrate herewith a new and powerful device designed for the use of machinists who require a gear-cutting machine, but who have not sufficient work for an apparatus of that description to warrant their purchasing one of the larger and more expensive appliances now in the market. The present invention is claimed to be able to perform all the work peculiar to it that is necessitated by the average machine shop; and through its low cost, the advantages which it offers are brought within the reach of mechanics generally.

This machine will cut all kinds of gearing—spur, bevel, miter, spiral, and worm—and also taps, reamers, and indexed milling. It is 24 inches in hight, weighs 96 lbs., and its index plate is 12 inches in diameter, and has 38 circles of holes, dividing every number up to 75, and every even number up to 150, or 112 different numbers. Attached to the index is a counter which prevents the possibility of making mistakes.

The general construction will be clearly understood from the engravings. The apparatus is shown on the tool post slide of an ordinary engine lathe as arranged for cutting spur gearing, Fig. 1, and for bevel gearing, Fig. 2. The cutter mandrel is represented separately, beside the machine.

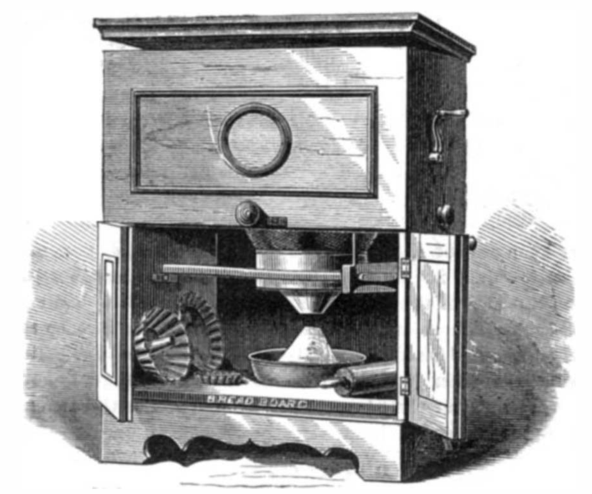
Patented to Mr. Thomas O. Mills, and manufactured under his supervision by the Michigan Manufacturing Company, of Kalamazoo, Mich., to whom inquiries for further information may be addressed.



MILLS' GEAR-CUTTING ATTACHMENT FOR LATHES.

SMITH'S FLOUR AND MEAL CHEST.

The annexed engraving represents a handy receptacle for flour and meal, which protects its contents from inroads by rats and mice, and allows of the withdrawal of the exact quantity of material required in a sifted state ready for immediate use. The upper portion of the device is separated into two compartments, one of which serves for flour, the other for meal, the partition being immediately over a bottom orifice. A separate canvas spout, as represented, leads from each compartment to a sieve beneath, which is sustained in a simple holder, which is vibrated and the sieve so shaken by suitable mechanism operated by the crank shown. Slides



are provided to shut off or admit meal or flour to the chutes and are controlled by the knobs shown respectively in front of the chest and beneath the crank. The lower compartment receives the vessel into which the meal or flour is sifted, and also answers as a convenient closet for storing bread, tray, rolling pin, bread board (which last, with a sieve, is provided with the chest), biscuit cutters, and baking utensils generally. Each compartment may be made to hold a bushel of meal and one hundred pounds of flour, or it may be constructed smaller.

The inventor points out that, with this device, no material is wasted in removing it from the receptacle in which it is kept, and moreover that the same is kept from becoming stale and wormy, as is often the case. No old flour remains at the bottom, as that at the bottom is used first, and every time the slide is drawn the bulk is disturbed and fresh air admitted. In this way the contents of the chest are always kept in a fresh state. The hinged lid at the top admits of ready access to the upper compartments; and when the doors below are closed, the device becomes a neat piece of furniture, fit to be located in the dining room if desired.

Patented January 5, 1875. For further particulars regarding sale of rights, etc., address the inventor, Mr. A. W. Smith, Lexington, Mo.

KEROSENE flames are readily extinguished by throwing a rug or cloth over them. But cloth is not always in the kitchen, where kerosene accidents are most likely to occur. Flour is recommended as a substitute. Thrown upon the flames, it quickly absorbs the fluid and deadens the flame.

CORNELL'S IMPROVED LIFTING JACK.

The new jack herewith illustrated offers the advantage of a continuous lift or press from bottom to top, while its mechanical construction is such as to apply the power with great effect. It is thus well adapted to situations where the jack screw cannot be used. It is always ready for operation, is claimed to be perfectly safe under a load, and admits of lowering the weight gradually when desired.

Between projecting flanges, Fig. 2, upon the two vertical metal bars which form the body, is pivoted the hand lever. On the side nearest said lever, of the wooden standard which plays in the hollow body, is secured a metal rack bar. The lever near its inner end is provided with two pawls, one of which works upon the lever bolt between the prongs of the

Fig. 1.

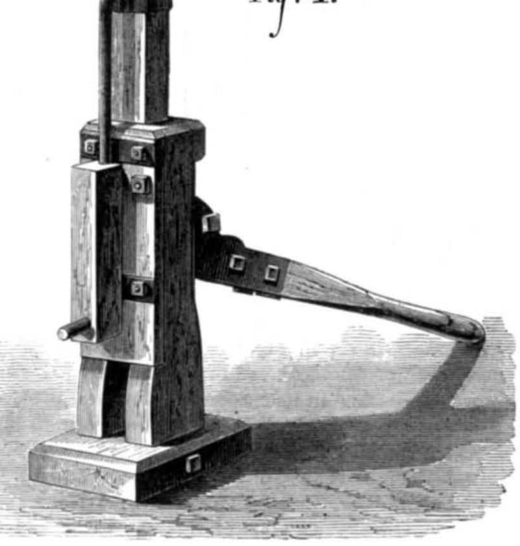
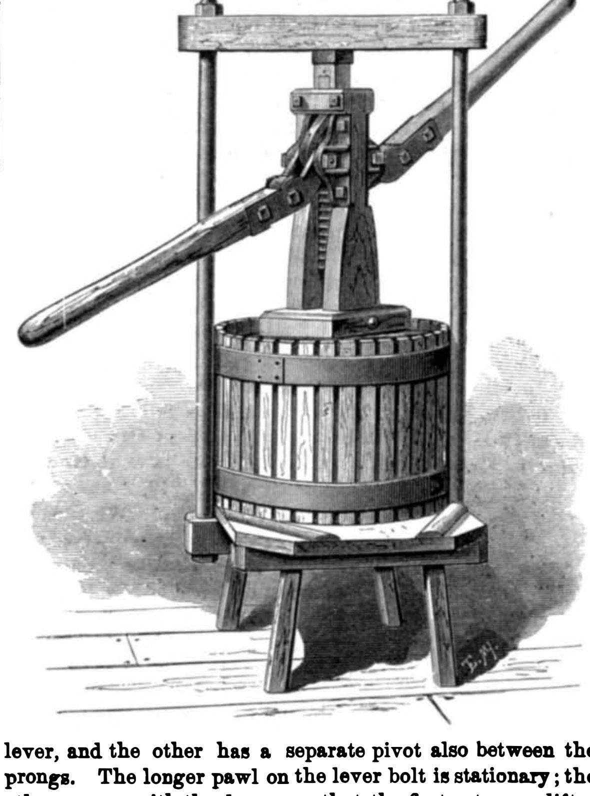


Fig 2



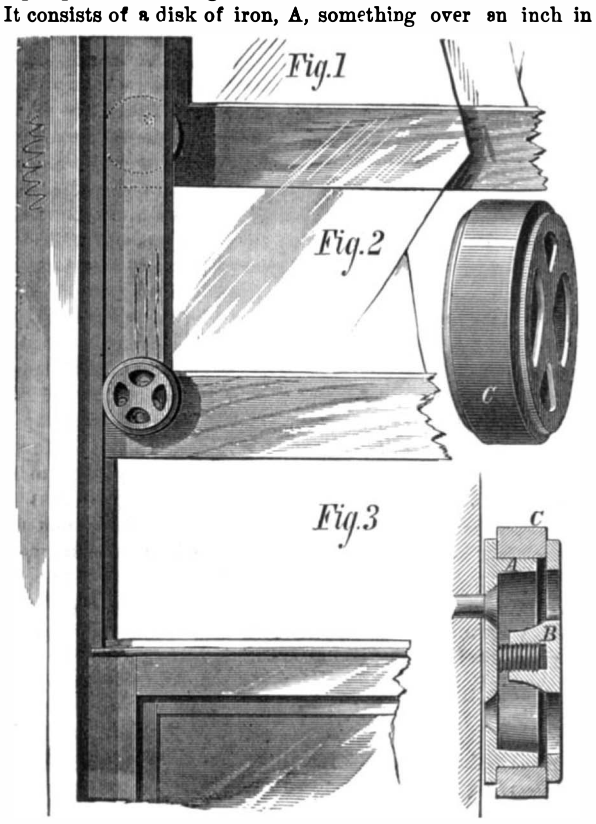
lever, and the other has a separate pivot also between the prongs. The longer pawl on the lever bolt is stationary; the other moves with the lever, so that the first acts as a lifter and the second as a detent. By operating the lever, these pawls are so caused to catch into the rock bar as to lift the standard upward. On the back of the body are attached metallic plates, which form the bearings for metal friction rollers. The latter play through slots in the body and rest against the standard, so that, in lifting heavy weights, the lever and pawl press upon one side of the standard while the rollers relieve the friction on the other. Also at the rear of the machine is a metallic bar, Fig. 1, which has its ends bent at right angles to its length, but in opposite directions. A pin passes through the upper bent extremity and into the top of the standard, so as to keep the bar in place and secure it to the latter. The lower arm of the bar is used to hook under objects which are lower than the top of the jack. A wooden block may also may be added, as shown, for loads to rest upon, so that the machine can easily be adjusted to objects of any hight. The bar is detachable by simply lifting it from its resting place.

In Fig. 2 the application of the jack to a cider press is represented. Here there are two levers, each with its pawls acting on standards on each side of the standard, so that a greater amount of power can be applied. As regards this especial adaptation of the jack, the inventor points out that the iron in a cider or wine press comes in contact with the acid of the fruit, and soon becomes corroded; and this does not happen in the present case. It will be seen that the invention is useful as a wagon jack, fence or timber lifter, and a press for a large variety of purposes. Patented February 1, 1876. For further particulars address Munsell & Dexter, 165 Greenwich street, or 49 Courtland street, New York city.

STELLER'S IMPROVED SASH HOLDER.

We illustrate herewith a simple and effective little device for sustaining window sashes in any position in which they may be placed. In addition to this, it may also be employed as a sash lock, on sashes which are supported when raised or lowered by cords and weights or like means.

Fig. 1 shows the holder as applied to sashes, and Fig. 2 is a perspective, and Fig. 3 a sectional, view of the invention. It consists of a disk of iron, A, something over an inch in



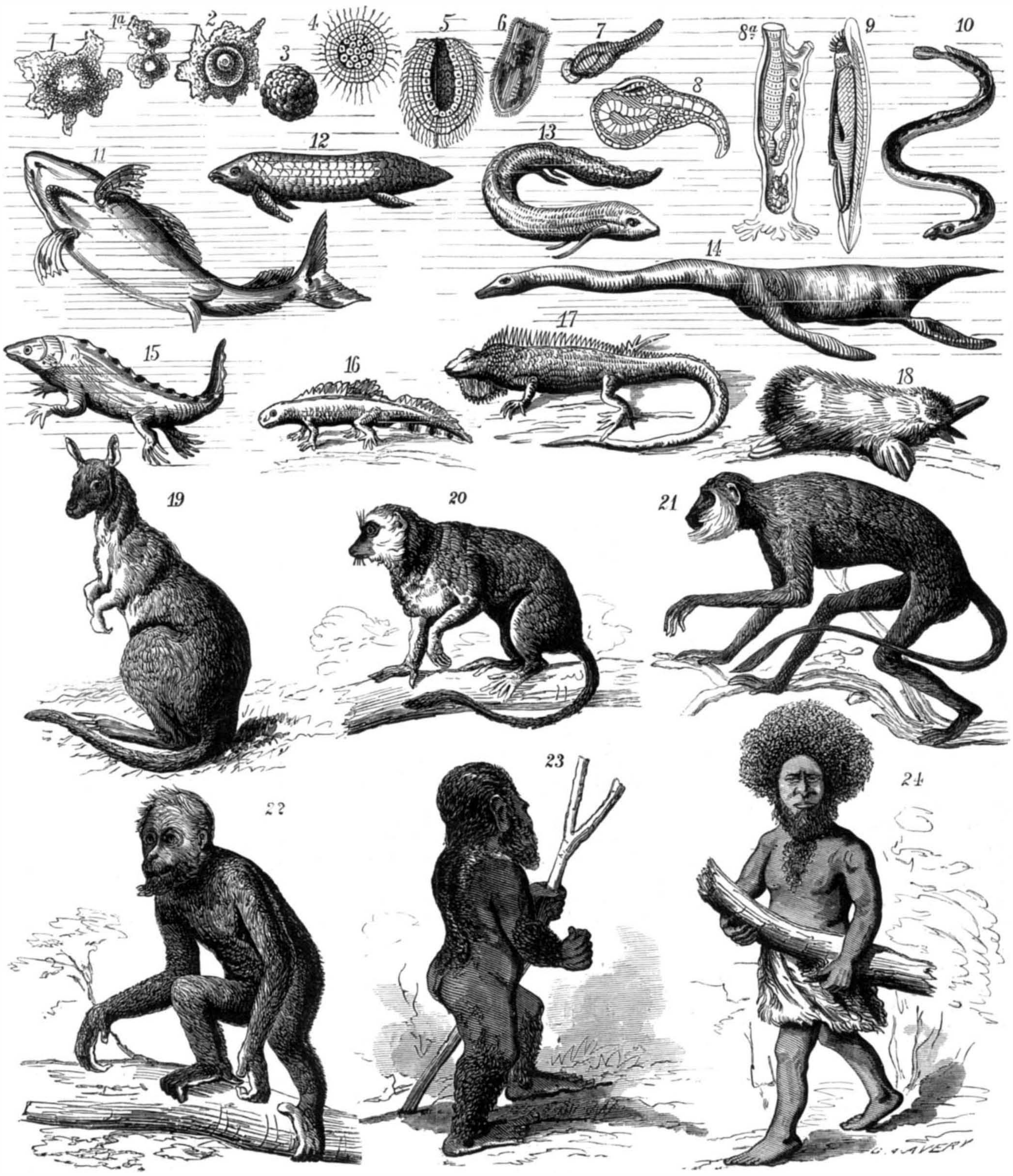
diameter, having a broad flanged portion, and pierced with holes for the reception of the fastening screw. In the center of the disk is a threaded projection, upon which screws another disk, B. The whole thus forms a grooved wheel, of which the flange constitutes the periphery. Around the latter is slipped a rubber ring, C. To apply the device the disk, C, is removed, and the remainder attached by a single screw to the window sash. It thus is secured eccentrically; and consequently, when the rubber covering takes against the casing, the holder becomes jammed through the downward pressure of the sash, so that the latter cannot possibly descend further. This is clearly shown by the dotted lines on the upper sash in Fig. 1. It will easily be seen that, by turning the holder so that its greater portion is above instead of hanging below the screw, the jamming will then take place when the sash is sought to be lifted, and thus the apparatus becomes a simple, self adjusting, and very efficient lock. The invention is neat, tasteful in appearance, and cheap, and doubtless will meet a ready welcome from carpenters and the hardware trade generally. Patent now pending through the Scientific American Patent Agency. For further particulars address the inventor, Mr. C. E. Steller, 352 East Water street, Milwaukee, Wis.

HAECKEL ON THE HUMAN PEDIGREE.

The "Schöpfungsgeschichte" of Professor Ernest Haeckel, of the University of Jena, has recently been translated into English and published under the title of "The History of Creation." The work is a greatly condensed epitome of the thoughts of one who has probably reached the *ultima thule* of scientific rationalism; but the admirable clearness with which the great theories which are dividing the scientific world into two hostile camps, and which are constantly widening the breach between scientific thought on one hand and theological dogma on the other, are here presented and amplified will command for the treatise the attentive study even of those to whom the doctrine of man's origin and development, as here enunciated, is most repugnant.

Dr. Haeckel's theory includes both that of Lamarck and that of Darwin. With Lamarck, he holds that all animal and vegetable species are descended from common, most simple, and spontaneously generated prototypes; and then he adopts Darwin's conclusions in showing us why a progressive transformation of organic forms took place, and what causes, acting mechanically, effected the uninterrupted production of new forms and the ever-increasing variety of animals and men. Dr. Haeckel, however, sets before himself the task of establishing, in the light of the above theories, a probable scheme of the genealogical relationship of organisms. And to this he brings the ripe fruits of extended research, and of a vast store of knowledge in biology and kindred sciences, a knowledge in which he is unexcelled. He thus deals with the descent of man in a directly practical sense, while Darwin only treats it in a general way; and at the very outset he disagrees wholly with Darwin in the latter's final conclusion relative to the descent of all organic beings "from some primordial form, into which life was first breathed by the Creator." In a word, Haeckel sets about constructing a genealogy for the race—and indeed for all animated nature—with the same coolness with which an antiquary would hunt for a family pedigree or a lawyer prepare an abstract of a title to a piece of real estate. And in this work he uses three powerful aids: first, the study of the development of the individual, which he declares to be a short, quick repetition of the development of the tribe or chain of ancestors to which it belongs, determined by the laws of adaptation and inheritance;" second, the study of the development of the tribe from palæontological and geological records; and third, the study of comparative anatomy, or the investigation of the chain of different, but related and connected, forms which exist side by side at any one period of the earth's history. Regarding all these, he affirms that the laws of inheritance and adaptation known to us are completely sufficient to explain the perfect parallelism of the three developments.

In the beginning was the fire mist, thinks our author, adopting the theory of a gaseous chaos which formed the basis of Kant's "Cosmogony." By a universal rotary movement in this nebulous Universe, portions aggregated, and these aggregations, by refrigeration, changed into masses of fiery fluid. The latter, cooling and condensing, became as molten metal. An outer crust formed on the new worlds, and thus, "by the inherent forces of eternal matter, entirely without supernatural interference, the solar and planetary systems came into being. When our earth's crust had so far cooled that the water, present hitherto as a gas, could condense into liquid form, then came into existence the primordial germs of life.



THE MODERN THEORY OF THE DESCENT OF MAN.

In the narrow limits of this article it would be impossible to trace every link of the chain which, from this point, Haeckel forges with infinite care; but we may note the stages into which he divides the pedigree of man, and, by the aid of the accompanying engravings (which are not drawn to relative scale), convey an idea of the being which forms or formed a near or exact type of each stage of development.

We are now able to produce in the laboratory certain combinations of carbon, oxygen, nitrogen, and hydrogen, which are similar, in the complexity of their constitutions, to the combination entering into the mere lump of albumen which forms the body of the still existing moneron (1). This is the simplest of all organisms—as simple as any crystal which consists of a single inorganic combination. "Now," says Dr. Haeckel, "there is absolutely no reason for supposing that there are not conditions in free nature, also, in which such combinations could take place;" and he inclines to the view that such conditions existed at the early epoch of the earth's history, following the formation of liquid water. This combination, taking place, produced a primeval mucus or plasma, capable of life; and this plasma simply needed to individualize itself, in the same way as the mother liquor of crystals individualizes itself, in crystallization, to produce crystals. Thus in the Laurentian period arose the earliest progenitor of life—a mere lump of protoplasm, but capable of nutrition, and of multiplying its species by self division (1 *a*).

By the process of segregation, taking place in the homogeneous viscid body, a kernel was formed within, differentiated from the surrounding plasma, and producing thus the simple cell, of which the low organism, still existent and known as the amœba (2), is a type. By self-division, the cell fell into a mass of simple and equiformal amœba-like cells, each exactly similar to the other, and each containing a kernel. These groups of cells are termed synamœbæ (3), and the conformation of the organism reminds one of a mulberry. But as development progressed, the cells lying on the surface extended hair-like processes, which, by striking against the water of the primeval ocean in which the creature existed, kept the body rotating; and so another differentiation occurred, the external cells covered with cilia differing from the non-ciliated internal cells. These organisms are called ciliated larva or planeads (4). From the planeads arose the primeval stomach animals, the gastræads (5), possessing a simple oval or globular body, which enclosed a simple cavity having a mouth.

At this point we reach two divergent lines: One branch of gastræads gave up free locomotion, adhered to the bottom of the sea, and developed into zoöphytes or animal plants; the other branch retained free locomotion and developed into the primary form of worms. In these last appeared the first formation of a nervous system, the simplest organs of sense, secretion, and generation. The nearest akin to these primeval forms are the ciliated gliding worms (*turbellaria*), of which one is represented at 6 Through the formation of a true body cavity and blood, within the gliding worms, arose the soft worms, which include very many different intermediate stages. A type of one of these links is shown at 7. Next, by the formation of a dorsal nerve marrow, and of the spinal rod which lies below it, were produced the sack worms (8 and 8 *a*). It is just the position of this axial skeleton (8), between the dorsal marrow on the dorsal side and the intestinal canal on the ventral side, which is most characteristic of all vertebrate animals, including man, and also of the larvæ of the ascidiæ here represented. Now followed the formation of body segments, the further differentiation of the organs, a more perfect development of dorsal marrow and spinal rod, and probably the separation of the two sexes—producing the acrania or skull-less animals, of which the still living lancelet (9) affords a faint dea

We next meet the development of the first brain. It was formed out of the anterior end of the dorsal marrow, while the anterior end of the dorsal chord developed into a skull. The first animal possessing a brain was similar to the lamprey (10), a single nostriled creature. This single nostril divided into two lateral halves; a sympathetic nervous system, a jaw skeleton, a swimming bladder, and breast and ventral fins appeared, and so, in the Silurian period, originated the shark-like ancestors (11) of all fish. By adaptation to life on land, by the transformation of the swimming bladder into an air-breathing lung and of the nasal cavity into air passages, arose the mud fish, to which the still living ceratodus or grass-eating fish (12), the lepidosiren (13), bear a near resemblance. At the same time originated the now extinct sea dragons, like the plesiosaurus (14). Out of the mud fish, by the transformation of the paddling fins into five-toed legs, and also by the more perfect differentiation of various organs, came the most ancient amphibians, which, like the axolotl (15) of the present day, besides possessing lungs, retained throughout life regular gills. From these arose the tailed amphibians, which, like the newts or salamanders (16) lost the gills which they had possessed in early life, but retained the tail. They originated by accustoming themselves to breathe only through gills in early life, and later in life only through lungs. In the mesolithic or secondary period, the tailed amphibian, through loss of gills, by the formation of the amnion, of the cochlea, of the round window of the auditory organ, and of the organs of tears, produced the primeval amniota, of which the true lizard (16) may be taken as a type. Here we meet another branching, for on one hand the amniota developed into reptiles and thence into birds, and on the other into mammalia. Following the second branch, we find that, by the transformation of scales into hair, and by the formation of a mammary gland, were next evolved the promammalia, closely related to the beaked animals, such as the ornithorincus (18) Now comes the transition to placental animals, by the promammalia and the evolution of the marsupials, such as the kangaroo (19).

Out of the rat-like marsupials, by the formation of the placenta, development of the commissures of the brain, etc., come the semi-apes, of which the lemur (20) is an existing type. From the semi-apes, by the transformation of the jaw, and by claws on the toes becoming nails, arose the narrow-nosed tailed ape (21). Then the tail disappeared, the hairy covering partially departed, and the brain above the facial portion of the skull developed, producing the orang-outang (22), or the chimpanzee, or the gorilla—the human apes of the miocene period. These apes gradually became accustomed to an upright walk, and the separate pairs of legs differentiated. The fore hand became a human hand, the hind one, a foot. Thus was produced the ape man, the pithecanthropus (23), who existed toward the end of the tertiary period. Genuine man developed out of the ape-like man by the gradual development of the animal language of sounds into a connected and articulate language of words. These went hand in hand with the higher differentiation of the larynx and the brain. Primæval man, Haeckel divides into the straight haired and the wooly-haired. From the last arose the Papuans (24), the oldest of all still living human species, and nearest related to the original primary form of wooly-haired men. Next come the Hottentots, belonging to the same branch as the Papuans. To the other branch belong the Negroes and the Kaffirs.

The straight-haired men generated the Australians and Pro-Malays, the latter, the Mongols and the Malays. The Mongols produced the eighth and ninth species, the Americans and the Arctic Men, and the last produced the Esquimaux. The Malays have developed into no other distinct species. A third branch of the Pro-Malays, however, produced the Dravidas, from whom sprang the Cingalese, the Nubians, and the Mediterranese, thus completing the series of twelve species and thirty-six races.

Tracing, lastly, the history of nations or historic tribes, the Mediterranese gave rise to four races, the Semites and Basques in one branch, the Indo-Germans and Caucasians in another. From the Indo-Germans, in regular progression, came Sclavo-Germans, the primeval Germans, the Germans, Low Germans, Saxons, and. lastly, Anglo Saxons. And here our chronicle ends, for thus over a lapse of thousands of millions of years—ages, according to Haeckel, countless and incalculable save by mere approximation—we have traced the development of man from the clot of albumen to the race which now populates these United States.

The Heat of Slags and Economy of Furnaces.

From two recent papers of Professor Grüner we obtain the following interesting data: The experiments on which they are based were made with a water calorimeter of 18 kilogrammes (nearly 40 lbs.) weight, and upon quantities of molten material varying from 50 to 100 grammes (1·6 to 3 2 ozs.). The heat is given in French calories, or centigrade units.

The less fusible slags of the blast furnace (accompanying gray pig) possess, on issuing from the furnace, 450 to 500 units. Those proceeding from non-fusible ores, and most frequently associated with white pig, have 400 to 450; white glass (70 per cent silica) heated to the temperature for glass-blowing, 415 to 420; bottle glass under the same circumstances, 380 to 400. The ferruginous and manganiferous scoriæ from the Martin process (54 to 55 per cent silica) require for smelting 410 to 415 units; porphyroidal copper slags from Swansea (60 per cent silica and quartz), 405 to 410; bisilicate protoxide of iron slags (45 per cent silica), 380 to 400; puddling or reheating cinder (30 to 35 per cent silica), 320 to 330; monosilicate slags from lead and copper furnaces (28 per cent silica), 275 to 300. Pure, well carburized pig requires for melting 225 to 230 units; gray silicious pig (3 per cent carbon), 250 red copper, which, like the foregoing, has its melting point at about 1,200° C. (2,192° Fah.) may be brought to that temperature with 160 to 165 units of heat. Iron copper matte requires 230 to 240; iron lead matte, 200. Lead, which has, like platinum, a very low specific heat, can be brought to clear orange redness with 45 to 50 units.

From the foregoing figures, and other researches which he has previously made public, Professor Grüner has deducted the following interesting statements:

In the wind furnace, which is from this point of view the most imperfect apparatus, there is utilized, in the fusion of steel in crucibles, but 1 7 of the total heat capacity of the fuel, or at most 3 per cent of the heat generated. In the reverberatory, when steel is melted in crucibles, the useful effect is 2 per cent of the total heat, or 2 per cent of the heat generated. In the Siemens crucible furnaces, 3 to 3·5 per cent; in Siemens glass furnaces, operating on a large scale, 5·5 to 6 per cent; in ordinary glass furnaces, 3 per cent; in fusion upon the open hearth of a reverberatory, of glass, 7 per cent; of iron, 8 per cent; in well arranged Siemens and Ponsard furnaces, up to 15, 18, and even 20 per cent of the total heat is utilized.

The caloric effect is much greater when the fuel is mixed with the material to be fused. In old cupolas, 29 to 30 per cent; and in modern cupolas, higher, more rapid in working, and narrower in zone of fusion, upwards of 50 per cent is realized. Large iron blast furnaces utilize, according to their working, 70 to 80 per cent of the heat generated, or 34 to 36 per cent of the total heat which the complete combustion of the fuel would set free.—*Engineering and Mining Journal.*

Cat Racing.

Since the siege of Paris a great deal of interest in the breeding and training of homing pigeons has been created by the admirable service rendered by these swift-flying messengers from the besieged inhabitants of that city to friends outside. The birds in which the homing powers were found to be most strongly developed were of a breed of Belgian pigeons now pretty generally known as Antwerps. This homing faculty, it seems, a Belgian society is now endeavoring to develope in the domestic felines of that country by inaugurating cat races, on much the same principles as pigeon-flying matches. A cat race was very recently instituted in Liége. There were thirty-seven competitors, all of which were liberated some distance from the town, and the prize was awarded to the animal which reached its home in that town first. They were started at 2 P. M., but the distance they had to traverse is not stated; suffice it to say, the first prize animal won in a canter, as he arrived at home at 6:48 P. M. the same evening, the second cat not appearing until 2:24 A M., the following morning.

DECISIONS OF THE COURTS.

United States Circuit Court---District of Massachusetts.

R. C. ANTHONY *et al.* *vs.* JOHN CARROLL.—ASSIGNMENT OF CLAIMS FOR PATENT DAMAGES.

[In equity.—Before SHEPLEY, J.—Decided October, 1875.]

SHEPLEY, J.:

This bill in equity, filed July 27 1874, alleges the grant of letters patent of the United States to Marie Amédée Charles Mellier for a new and useful improvement in making paper pulp; the assignment, by Mellier, to one Buchanan, June 19, 1857, of all Mellier's right and title to the invention secured by the letters patent; the assignment by Buchanan to Buffam, trustee of the American Wood Paper Company, October 14, 1863; and the assignment by Buffam to that company, June 16, 1865, of his legal estate in the patent. The infringement by the defendant, and consequent profit to defendant, and damage to the American Wood Paper Company, is alleged from October 14, 1863, to August 19, 1867.

The bill alleges an assignment, August 19, 1867, from that company to Gardner Harland of "all their claims against the said defendant for the said damages and profits for the said infringement during the said period," and an assignment by Harland to R. C. Anthony, one of complainants, October 4, 1873, of all said claims. The bill is brought by R. C. Anthony, a citizen of New York, and the American Wood Paper Company, a corporation created by the Legislature of the State of Rhode Island and located at Providence in said State, against the defendant, a citizen of Massachusetts, for a discovery and account of profits, and for damages and other relief.

The defendant has demurred generally to this bill, and in support of his demurrer relies upon the bar of the statute of limitations of the Commonwealth of Massachusetts, and also upon the character of the claim alleged in the bill. The limitation in cases of tort in this Commonwealth is six years. (Gen. Stat. of Mass., Ch. 155, Sec. 1.)

As a general rule, the laws of the State in which a national court sits must be the rules of decision in such court. The thirty-fourth section of the judiciary act provided that "the laws of the several States, except when the Constitution, treaties, or statutes of the United States shall otherwise require or provide, shall be regarded as the rules of decision in trials at common law in the courts of the United States in cases where they apply." It is too well settled to require the citation of authorities that, in ordinary actions at common law, the statutes of limitation of the State where the suit is brought may be pleaded in bar under this provision of the judiciary act.

Whenever the cause of action is one cognizable by a court of common law, a court of equity, in accordance with the general rules of equity jurisprudence, follows the law in relation to the limitation of actions. The question presented is whether this rule applies to actions, the subject matter of which is under the exclusive control of the national legislature and judiciary.

Mr. Justice Swayne held, in the case of Collins *vs.* Peebles (2 Fisher, 541), that the State statutes could not limit the time within which actions for the infringement of letters patent might be brought in the courts of the United States; that Congress having failed to legislate upon this subject, there was no limit to the time for bringing such actions; and Mr. Justice Grier is reported, in a note to the above case (2 Fisher, 543), to have so decided in the case of Parker *vs.* Halleck. To the same effect is the decision in Read *vs.* Miller (3 Fisher, 310).

In the case of Parker *vs.* Hawk (2 Fisher, 58), the learned Judge of the Southern District of Ohio decided that the limitation act of Ohio applied to an action on the case in the Circuit Court of the United States for an infringement of a patent. It is stated, in a note to that, that the decision was affirmed by Mr. Justice McLean. Parker *vs.* Hawk was decided on the authority of McCluny *vs.* Silliman (3 Peters, 270). But McCluny *vs.* Silliman is by no means decisive of the question. That was an action on the case against the defendant as register of a land office in Ohio for non-feasance, in refusing at the request of the plaintiff to enter his application for the purchase of certain government lands, as required by an act of Congress. Such an action against an officer for non-feasance could have been prosecuted in the State as well as in the federal courts. The cause of action was one over which the national and State courts had concurrent jurisdiction. Such a case clearly falls within the provisions of section thirty-four of the judiciary act. It is one of the cases where the laws of the State apply. But how it can be contended that the laws of the States apply to an action for the infringement of a patent, when the right of action is exclusively under the Constitution and laws of the United States, when the form of the remedy is prescribed by the acts of Congress, and when the Circuit Courts of the United States are clothed by statute with exclusive jurisdiction over the whole subject matter?

Should the legislature of a State pass an act in express terms limiting the time for bringing an action in the federal courts for infringement of patent rights, there can be no reasonable doubt that such a statute would be unconstitutional and void. The policy of the government to provide a uniform system of rights and remedies throughout the United States upon the whole subject matter of patents for new and useful inventions and discoveries, by placing it under the control of Congress and the federal courts, would be frustrated if such State legislation could directly, or indirectly limit, restrict, or take away the remedy. For these reasons, I think no State statute of limitation can be pleaded in bar of this action.

It is contended in support of the demurrer that a court of equity will not entertain a suit for the benefit of an assignee of a right of action for a tort. The question whether a court of equity would entertain this bill, if brought only in the name of an assignee, of a right of action for a tort, does not necessarily arise in this case, as this bill is brought by the assignor, who is also the owner of the patent, and who, under the rules of equity pleading, joins with him, the assignee, he being beneficially interested therein. The better opinion seems to be that, if the claim be for an injury to one's estate or property, and not to a mere solatium for an injury done to the person or personal feelings of the assignor, the claim may be assigned. (The People *vs.* Tioga, Common Pleas, 19, Wendell, 73; McKee *vs.* Judd, 2 Kernan, 622; Milnor *vs.* Metz, 16 Pet., 221.)

The demurrer of defendants is not sustained.

[*Francis C. Nye* and *L. C. Ashley* for complainants.
Browne & Holmes for defendant.]

United States Circuit Court--- District of Massachusetts.

JOHM KENDRICK *vs.* THOMAS A. EMMONS.—WEAVING APPARATUS.

In equity.—Before SHEPLEY, J.—Decided October, 1875.

An English patent, taken out surreptitiously by any person, who, without the knowledge of the American inventor, and without authority from him, endeavored to appropriate the benefits of his invention, would not thereby deprive the real inventor of any of his rights.

SHEPLEY, J.:

The principal questions presented in this case were fully heard and argued upon the motion for an injunction *pendente lite*. Upon a careful revision of the case and of all the new evidence now before the court, no good reason appears for any modification of the views expressed upon the hearing of the motion. The reasons are fully stated in the opinion upon that motion, and it is not necessary to repeat them. The conclusion is that the bifurcated plate in the English machine, constructed substantially according to the patent to Ellis and Sladdin, sealed July 12, 1864, and sometimes described as the retainer or fork, as well as the contrivance substituted for it in the Sladdin machines in evidence, which perform the same office, are infringements of the third and fourth claims of the reissued patent No. 5,282 to Joseph Winsor, for an improvement in machines for making weaver's harness.

Additional evidence and elaborate opinions of experts have been introduced at the final hearing upon the disputed point, whether in the machines of the Sladdin type the size of the loop is gaged by the needle or by the retainer and its substitutes. Question is also made whether the fingers in the Winsor machine, in fact, gage and determine the size of the loops. The theories of the defendant's experts upon this subject are ingenious and elaborate; but upon a close examination of the two machines, when operating to make heddles, one cannot fail to discover that, as a practical result, the length of the loop in the heddle is limited in the Winsor machine by the fingers W1 and W3, and in the Sladdin machine by the bifurcated plate or retainer. Each of these devices determines the size of the eye or loop by a gage outside of the eye itself, and this operation constituted one of the prominent features of Winsor's invention. This feature of his invention enables him to dispense with the use of the laying bar, around which the eye of the heddle had before been formed, and thus to dispose of one of the great obstacles in the way of making a loom harness automatically, which Winsor was first to accomplish. This office of determining the distance from each other of the two extremities of the eye by a limiting device outside of the eye itself, the retainer of the English machine performs for the same and in substantially the same manner as the fingers in the Winsor machine.

The mistake in copying the specifications in the re-issued patent, by which the hooks are supposed to be described as gaging the length of the eyes, is so obviously a mistake in description, and so easily corrected by reference to the other parts of the patent and the machine described, that it does not impair the rights of the patentee. The word "they," when used in that clause of the specifications for the second time, evidently refers to the fingers and not the hooks, as determining or gaging the size of the eye.

It is contended that, as letters patent had been granted on the invention in England in April, 1854, for the term of fourteen years from their date, prior to the application for letters patent of the United States, the letters patent of the United States expired with the English patent, and could not be legally extended after the expiration of the patent.

The English patent was not sealed previous to the 15th of June, 1854. It was taken out surreptitiously by some one who, without the knowledge of the American inventor and without authority from him, endeavored to appropriate the benefits of his invention. If a person had thus surreptitiously taken out letters patent in this country for the invention of another who was diligently perfecting his invention, he would not thereby have deprived the real inventor of any rights. It is not believed that, by taking out in advance an English patent, he could accomplish more than he could have done by taking out letters patent in this country. Moreover, as the English patent was not sealed prior to June 15, 1854, it was not more than six months prior to the application for letters patent in this country; and under the act of 1836, he had a right to take out his patent in this country for the full term, although he had taken out one in a foreign country, the same having been published at any time within six months next preceding the filing of his specifications and drawings. The act of 1839 was not intended to limit the inventor's rights under the act of 1836, but to enlarge them. He still had the right to take out his patent for the full term, notwithstanding that he had obtained and published a foreign patent within six months. But after the six months he had, for a further specified time, a right to take out his patent, subject to the conditions and specifications specified in the act of 1839. But the provision in the act of 1839, with reference to the effect of his invention, having been patented in a foreign country more than six months prior to his application, evidently refers to the fact of its having been patented by him, the applicant for the American patent.

In the interlocutory decree made on the motion for a preliminary injunction, and in what has hereinbefore been stated upon the subject of infringement, reference has been had solely to the infringement of the third and fourth claims of the reissued patent. The question of infringement of the eighth claim remains to be considered.

The eighth claim is for—

"8. The combination of the sliding bar, or its equivalent, and the rods acting together, substantially as described, whereby the leese is preserved after it is formed, and the heddles are drawn away from the locality where they are formed on the stationary slats, and the movement of the sliding bar, or its equivalent, and the band attached thereto, to which heddles are tied in the process of formation."

Winsor's rights under this claim also are to be considered in the light of the fact that, prior to the date of his invention, there had never been a machine constructed in which was organized any apparatus for making the difficult side of a weaver's harness, combined with a sliding bar, or its equivalent, for drawing away the heddles, nor had there, prior to the invention of Winsor, been any machine having any combination of the sliding bar, or any equivalents of any such rods as are described in the Winsor patent, for receiving and preserving the leese of the heddles. The evidence in the record proves that the Winsor invention antedates any devices which are relied upon as anticipating this portion of the Winsor invention.

In the Ellis and Sladdin machine we find the same sliding bar for removing the heddles from the locality where they are formed, combined with automatic arrangements for making the heddles. We find, also, slats securing and preserving the leese supported by one end only, as in the Winsor machine, so as to afford the facility of securing the twine at one of their sides or the other by passing them by the end, and by receiving them as they are formed upon the free end, in combination, as in the Winsor machine, with the screws and yoke for moving the heddles along. The Ellis and Sladdin devices appear to be equivalent devices acting in the same combinations to accomplish the same result of preserving the leese after it is formed; and although they, by assisting to form the leese, do more than similar devices do in the Winsor patent, that does not relieve them from liability to the charge of infringement.

The defendants must, therefore, be held to have infringed the third, fourth, and eighth claims of the reissued patent.

Decree for injunction and account as prayed for in the bill.

[*Chauncey Smith*, *Benjamin F. Thurston*, and *William W. Swan*, for complainant.
Benjamin F. Butler and *A. K. P. Joy*, for defendant.]

NEW BOOKS AND PUBLICATIONS.

THE ELEMENTS OF PHYSICAL GEOGRAPHY, for the Use of Schools, Academies, and Colleges. By Edwin J. Houston, A.M., Professor of Physical Geography and Natural Philosophy in the Central High School of Philadelphia. Price $1.75. Philadelphia, Pa.: Eldredge and Brother, 17 North Seventh street.

This is one of the best school books that we have lately received. It is full of information, which has been thoroughly condensed without losing any of its clearness of explanation; and it is written in a style to interest the young reader, and to induce him to give proper attention to every branch of the subject. The maps and other illustrations are excellent, and the book is evidently the work of a writer who knows how to teach,

THE ECONOMY OF WORKSHOP MANIPULATION, a Logical Method of Learning Constructive Mechanics. Arranged with Questions for the Use of Apprentice Engineers and Students. By J. Richards, Author of a "Treatise on Woodworking Machines," etc. New York city: E. & F. N. Spon, 446 Broome street

Mr. Richards' works on the economy of the mechanical arts are well known, and his new book will enhance his reputation as a fluent and pleasing writer. His views are always sound and enlightened, and his precepts deserve to be learnt by heart by every young mechanic. The chapter on mechanical drawing in the book now before us is an excellent piece of instruction.

THE POLYTECHNIC REVIEW, Devoted to Science as Applied to the Useful Arts. Published Monthly. Subscription $3 a year, payable in advance. Philadelphia, Pa.: Drs. Wahl & Grimshaw, 119 South Fourth street.

This publication is intended to occupy some portion of the extensive field in which we are diligently laboring, and to present to its readers, monthly, all the current information on the many subjects included under the generic name of Science. Its first number has a creditable appearance.

PAPERS RELATING TO THE FOREIGN RELATIONS OF THE UNITED STATES, transmitted to Congress with the Annual Message of the President, December 6, 1875. In Two Volumes.

NOTES ON THE YUCCA BORER. By Charles V. Riley, Ph.D. St. Louis, Mo.: R. P. Studley Company, 221 North Main street.

SCRIBNER'S MONTHLY for March offers its usual attractive table of contents. The number opens with an excellent description of the new buildings of Trinity College, Hartford, Conn., with illustrations. The architecture of these proposed edifices is altogether different from that of any other college buildings in the country, and will attract considerable popular interest. The kindergarten system of instructing very young children is clearly expounded by Dr. Eggleston. Mr. Dorsey Gardner writes upon the struggles and successes of Wilson, the celebrated ornithologist. The editor has some thoughtful essays on "Public Halls" and "Common Schools." Mr. P. T. Quinn contributes some timely directions about laying out small places and suggestions relating to rural topics, and there is a goodly variety of entertaining serial and short stories. Subscription price $4 a year. Scribner & Co., publishers, 743 Broadway, New York.

ST. NICHOLAS for March is, as usual, preternaturally good. If the editress would occasionally introduce something poor within its covers, we should be half inclined to welcome it as a pleasing variety, just as a discord in music often adds to the beauty of the surrounding harmony. Mr. Whittier sends a new and beautiful poem, Mrs. Oliphant the beginning of a series of interesting papers on Windsor Castle, Mr. Charles Dudley Warner and Mr. Bayard Taylor contribute interesting sketches of foreign countries, Miss Alcott continues her pleasant talks; in fact, we cannot pretend to tell half the good things with which the youngsters are provided. The illustrations are as charming in subject and variety as they are artistic, and that is saying a great deal. Subscription price $3 a year. Scribner & Co., publishers, 473 Broadway, New York.

The ATLANTIC MONTHLY for March begins with Mr. T. B. Aldrich's new poem "the Legend of Ara Coeli;" Mr. John Fiske concludes his papers on the "Unseen World," imparting results of modern scientific religious thought; Mr. Charles Francis Adams publishes the first chapter of his excellent essay on the "State and the Railroads," one of the most valuable and thoughtful contributions to the literature of the railway that we have ever read. The beauty of inflation and the advantages of a paper currency Mr. Henry Carey Baird attempts to show in an article, none the less well written and interesting, even if its writer, in the opinion of most people, is on the wrong side of the present important financial controversy. Mrs. Fanny Kemble continues her pleasant "Gossip," Mr. E. W. Jones tells us some new facts about the Welsh in America; and besides a variety of short poems by Dr. Holmes and other well known writers, the editor contributes his usual careful and critical reviews of current literature. Hurd & Houghton, publishers, New York and Boston. $4 per year.

THE ALDINE.—The Aldine Company, 18 and 20 Vesey street, New York, have issued, of this year's numbers, Parts 1, 2, 3, and 4. The engravings, letterpress, and paper are all of the highest standard of art work. Published fortnightly at 50 cents a number, and sold only to subscribers. The publishers announced it as their intention to make it the leading art journal of America. They are fulfilling their promise.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]
From January 7 to February 8, 1876, inclusive.

BOAT DETACHER.—R. F. Hyde, Springfield, Mass.
BOILER, ETC.—B. T. Babbitt, New York city.
CAR AXLE.—T. S. E. Dixon, Chicago, Ill.
CASTING COPPER, ETC.—J. Turner, Bridgewater, Mass.
CONCRETE BLOCK PRESS.—T. Cook, Sing Sing, N. Y.
COP TUBE.—G. H. Simmons, Bennington, Vt., *et al.*
COP TUBE.—J. Essex, North Bennington, Vt.
CUTTING OIL CAKE.—A. B. Lawther (of Chicago, Ill.), Liverpool, Eng.
ELECTRIC REGULATOR.—J. Sangster *et al.*, Buffalo, N. Y.
EXTINGUISHING FIRES.—J. L. Hastings *et al.*, Pittsburgh, Pa.
FLANGING MACHINE.—R. C. Nugent, Dayton, Ohio. Two patents.
FRICTION CLUTCH.—W. F. Holske *et al.*, New York city.
FURNACE.—E. Savage, West Meriden, Conn.
GLOVE FASTENING.—F. G. Farnham, Hawley, Pa.
HARVESTER SHOE.—Johnston Harvester Co., Brockport, N. Y.
HORSESHOE.—E. L. Tevis, Philadelphia, Pa.
HOT WATER SUPPLY.—J. Archer, Denver, Col.
LAMP.—A. Burbank, Rochester, N. Y.
LIQUID METER.—D. W. Huntington *et al.*, South Coventry, Conn.
LOCK WASHER.—S. E. Gee, New York city.
LUBRICANT.—H. V. P. Draper *et al.*, Hannibal, Mo.
MAKING CIGARS, ETC.—J. T. Hannaman *et al.*, Baltimore, Md.
MAKING CONCRETE BLOCKS.—T. Cook, Sing Sing, N. Y.
MAKING GAS, ETC.—J. P. Gill, Newark, N. J.
MAKING SACKS.—H. P. Garland (of San Francisco, Cal.), Dundee, Scotland.
MAKING STEEL.—J. Baur (of Brooklyn, N. Y.), London, Eng. Two patents.
MAKING STEEL RODS, ETC.—C. P. Haughian, Brooklyn, N. Y.
METAL-TURNING LATHE.—H. M. Quackenbush, Herkimer, N. Y.
PRINTING AND CUTTING MACHINE.—R. M. Hoe *et al.*, New York city.
PROPELLER.—J. Ellis, Freeport, N. Y.
RAILWAY GATE, ETC.—S. A. Jenks, Lincoln, R. I.
RAILWAY WHEELS, ETC.—J. Bowron, Senr., Philadelphia, Pa., *et al.*
REEFING SAILS.—P. C. Marsh, Northampton, Mass.
REFRIGERATOR.—J. J. Bate, Brooklyn, N. Y.
REVOLVING PISTOL.—E. P. Boardman, Lawrence, Mass.
ROCK DRILL.—M. D. Converse, New York city.
ROLLER SKATE.—S. O. Brown (of San Francisco, Cal.), London, England.
ROWLOCK.—F. A. Gower, Providence, R. I.
SCREWING MACHINE.—F. P. Sheldon, Providence, R. I.
SEWING MACHINE, ETC.—R. H. St. John, Springfield, Ohio.
SEWING MACHINE.—Howe Machine Company, Bridgeport, Conn.
SEWING MACHINE.—J. E. A. Gibbs, Steele's Tavern, Va.
SEWING NEEDLE.—H. M. Jenkins, New York city.
SHARPENING SAWS.—W. L. Covel, Providence, R. I.
STEAM ENGINE.—W. C. Wilcox *et al.*, San Francisco, Cal.
TREATING OIL SEEDS.—A. B. Lawther (of Chicago, Ill.), Liverpool, Eng.
TYPE WRITER, ETC.—G. H. Morgan, Alexandria, Va.
WOOD SCREWS, ETC.—T. J. Sloan, New York city.

Recent American and Foreign Patents.

NEW AGRICULTURAL INVENTIONS.

IMPROVED BUTTER PACKAGE.

Andrew Jackson Dibble, Franklin, N. Y.—This is a new package containing butter, so constructed that the cover may be readily attached and detached, and will when attached will be held securely and airtight in place, and will prevent the tub from spreading. It combines a novel arrangement of grooved catch blocks on the side and cover of a tub, together with a locking latch.

IMPROVED MILK PAN COVER.

Alfred F. Morgan, Mason City, Iowa.—This is a cover for milk pans, made of wire gauze for the top, tin or other sheet metal for the rim and for the flange which shuts down the sides of the pan.

IMPROVED HARVESTER RAKE.

Samuel M. Morrison, Fairfield, Iowa.—This is an improved attachment to harvesters that raise the cut grain to the binders' table by the action of vibrating rakes, so as to cause the grain to be delivered to the binders straight and even, without regard to its condition. The invention consists in the combination of the upper rakes and their crank shafts with the lower angular rakes and their crank shafts. There is a slight variation of speed of the rakes during a portion of their revolution, and the consequent jostling of the grain has a tendency to cause tangled grain to become parallel with the teeth, which are set in horizontal lines. The upper rakes are so set that their teeth may slightly overlap the teeth of the lower rakes, while leaving sufficient space between the rake bars, so that light and heavy grain will be carried up with the same facility.

IMPROVED COTTON PLANTER.

Leonidas M. Rhodes, Warrenton, Ga.—This is an improvement upon a machine hitherto patented to same inventor, in which the seed is discharged through a slot in the bottom of the hopper. It is now found that a better result may be attained by constructing the hopper without a slot, and providing the traveling wheel with pins or fingers inclined rearward, so as to draw the seed toward the side of the wheel and deliver it through the space between the hopper and wheel.

IMPROVED STUMP EXTRACTOR.

John Platten, Fort Howard, Wis.—This is a vertical windlass operated by a horizontal sweep, to which the power is applied. The windlass winds the fall of a single purchase, from the moving block of which connection is made to the stump by a series of bars secured together. The lower end of the windlass cylinder revolves in a ring formed in the center of a lower bar, and rests and revolves in a cup-shaped plate connected with and supported from the bar, a space being left between the edge of the cup and the ring of the bar, to enable any sand or dirt that may get into the said cup to be conveniently removed.

IMPROVED GRIT SEPARATOR.

Walter M. Jackson, Augusta, Ga.—This consists of a pair of riddles, which detain and transversely shake the grain until the latter passes through their perforations, while the lighter impurities are eliminated in front of the winnower by a blast from the fan, coming lengthwise. Beneath the lower riddle is placed a pair of conveyers, converging toward each other in a downward direction, and toward the middle of a subjacent grading sieve.

IMPROVED CHURN.

David L. Epperson, Mill Shoals, Ill.—The novel feature here is a dasher geared with a crank shaft, so as to be rapidly revolved, and thus cause the cream to flow continuously into the wheel at the top, through and out of it at the periphery, and back to the top, by which it churns the cream into butter in a short time.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED SHIRT.

Geo. D. Eighmie, Poughkeepsie, N. Y.—This invention relates to certain improvements in shirts, designed to obviate the breaking and rumpling of the bosom produced by the bending of the body and the girding of the suspenders. It consists in a bosom or front attached to the shirt about an inch from the edge, so as to leave a loose edge all round, beneath which the suspenders pass when bending forward. The upper part of the bosom is attached to the neck band below the yoke band, so that the pressure of the suspenders on the shoulders does not cause the top of the bosom to bend or rumple.

IMPROVED HARNESS.

Benjamin H. Cross, Byron, Ga.—In order to connect the trace chain and back strap, this inventor suggests a couple of rings and a buckle tongue suspended from a bar fastened in a loop attached to the back strap, so that the trace chain passes through the rings and is fastened by the tongue.

IMPROVED CARTRIDGE.

Louis T. De Froideville, Paris, France.—This inventor interposes between the powder and the bullet a layer of grease to keep out dampness, to operate as a gas check, and lubricate the gun; and then, to prevent the grease from permeating the powder grains, he places between the grease and the powder two wads, with a metallic plate placed between them to prevent the absorption and penetration of the grease through the wads.

IMPROVED HARNESS SADDLE.

Robert Spencer, Brooklyn, N. Y.—The object of this invention is to increase the flexibility of a harness saddle, so as to cause the same to automatically adjust itself to the horse's back. It consists in the combination, with the bearings and trimmings of a harness saddle, of a thin main plate of elastic steel, securely attached to, and worked up with, the other parts of the saddle. The crupper loop also, being held in place by the crupper, and the water hook, being held in place by its rein, cannot turn.

IMPROVED LOCK FOR TRUNKS, ETC.

Christian H. Stall, Red Falls, N. Y.—This consists of a system of checks to obstruct the turning of the key and prevent the unlocking of the lock, except by one acquainted with the order of operation by which the checks may be displaced or avoided.

NEW HOUSEHOLD ARTICLES.

IMPROVED COMBINED SKIMMER AND FORK.

Emerson E. Flagg, Brattleborough, Vt.—A skimmer and a fork are here connected with each other in such a manner that they may be slid back and forth upon each other, to adapt the instrument to be used as a skimmer or as a fork.

IMPROVED CUPBOARD.

Lewis Spangler, Auburn, Ind.—This is a cupboard constructed to extend through two stories, connecting the kitchen and dining room floor with the cellar floor below. It is set into the dividing wall of the kitchen and dining room, and arranged with doors at both sides to give access from either side. The cupboard is arranged with sinks, hinged tables at both sides, and an elevator that is raised and lowered by hoisting mechanism, to connect with the cellar. A refrigerating and other shelves serve to preserve articles that have to be kept in a cool state.

IMPROVED FLOUR SIEVE.

Ferdinand Blair, Pleasanton, Kas.—This invention relates to supporting the rotating crank shaft of the sifter upon arms which are bent upward at the middle: the object being to provide a space at the center of the concave wire bottom of the sifter for reception of hard particles in the flour, or worms, insects, or other foreign bodies.

IMPROVED LAMP.

George Sherwin and Edmond Hoople, New York city.—In this device the chimney is fitted on guides, with or without friction rollers, to enable it to be raised up and let down for lighting, trimming, filling, etc. The guides control and keep the chimney in place, so that it will not fall when raised up, and will drop into its place with certainty when down.

IMPROVED WEATHER STRIP.

Thomas Walker and Washington A. McCrery, Pleasantville, Md.—The object of this invention is to provide a weather strip for closing the crack between the door sill and the bottom of the door. It consists in the particular construction of a strip of molding having an extensible slide held to the molding by a spring, with a strip of rubber upon its bottom, and the whole so arranged that, when the door is open, the spring holds the slide up and away from the carpet, and out of sight, and when the door is closed the said slide is extended downward, so as to entirely close the crack.

IMPROVED MOTH-PROOF COMPOSITION.

Wm. H. Hall, Jersey City, N. J., and John Kennell, Passaic, N. J.—The invention relates to that class of preventives which have been long employed to deter moths from attacking woolen goods, furs, and pictures, and consists in dissolving purified tar and mixing it with camphor, merbane, citronella, bitter almonds, and extract of cedar. The solution may then be sprinkled on the wrapper or envelope in which the article is to be enclosed.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED TIRE UPSETTER.

Charles H. Reynolds, Brooklyn, N. Y., assignor to himself and William Freudel, same place.—This invention consists of gripper jaws fixed on pivots so as to adjust automatically to tires of any radius; and it also consists of a novel contrivance of the pivots for both the stationary and movable jaws, arranged so that the resistance is taken directly by the supporting blocks instead of being expended on pivot bolts.

IMPROVED THILL COUPLING.

William O. Hanby, Osceola, O.—In this thill coupling, the inventor employs a clip having a perforated block, through which passes the pintle, to which the thill iron is hinged. The invention is a non-rattler, the work and wear being brought upon the coupling bolt, while the knuckle at that point is subject to the pressure of rubber.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED COMBINED BARREL HOOP MACHINE AND COILER.

George C. Skidmore, Grand Rapids, Mich. This invention relates to a novel construction of a machine for making barrel hoops. It consists in the arrangement of devices for feeding the boards to a reciprocating shuttle, carrying a knife which at each stroke cuts off a hoop slip. It also consists in the means for automatically reversing the motion of the reciprocating shuttle, and in the means for trimming the ends of the hoop slip, crimping it into the circular form, and coiling them into bundles for the market.

IMPROVED BELT COUPLING.

James K. P. Shelton, Gaston, Ala.—A series of square holes is made in each end of the belt. On the under side of the latter are placed transverse wires. The lacing is first secured to one end of the belt, passed through the first hole around the wire, then led to the other end of the belt, carried through the opposite hole and around the wire, and so on until all the holes are laced. Notched strips of belting are inserted between the wires and the belt to prevent wear.

IMPROVED CAR COUPLING.

Horace Resley, Cumberland, Md.—This invention relates to certain improvements in that class of automatic car couplings in which a gravity catch is pivoted in the draw bar so as to rise above the entering link and fall through the same to effect the coupling. It consists in the particular construction and arrangement of the said gravity catch, provided with a hole which receives a coupling pin of the ordinary construction, to secure the short links of cars unprovided with the gravity catch, whereby the devices are equally as well adapted to be coupled with the draw bars of the ordinary form.

IMPROVED TREADLE.

Henry Reese, Baltimore, Md.—The object of this invention is to lessen the fatigue of operating sewing machines and other devices run by treadle power by means of a peculiar construction of treadle which permits the movement of the latter to be made without bending the ankles, and enables the operator to run the machine with a very light expenditure of muscular power. This result is accomplished by a peculiar construction of two independent treadles hinged or pivoted upon opposite sides of the fulcrum of the main treadle, held in proper horizontal position by means of springs, and arranged adjustably for either foot foremost.

IMPROVED SCREW-CUTTING DIES.

Shadrach N. Cudworth and George R. Stetson, New Bedford, Mass., assignors to the Morse Twist Drill and Machine Company, same place.—The die consists of two parts, held together by means of a guide, which has holes for screws formed in it, which are elongated to admit of adjustment of the dies to which the guide is connected. The invention also consists of two adjusting screws fitted in the body of one part of the die to secure the die positively after being adjusted, and an improved adjusting die and guide connected with a screw plate.

IMPROVED BELT STRETCHER.

Frederick L Spiess and William Spiess, New York city.—Bars are clamped on the meeting ends of the belt. On the ends of said bars are journaled two or more loose pulleys; also hooks are fastened on two or four of the extremities. To the hooks are attached the standing parts of cords which, passing over the pulleys of the bars, form tackles whereby the ends of the belt may be drawn together.

IMPROVED PUMP PISTON.

Lorenzo D. Hovey, Clinton, Ill.—This piston has tapering base rings, between which an elastic packing ring is secured. The rings are perforated to allow the entrance of guide rods, which are of such a hight that a heavy cylindrical valve may slide vertically within them. Their upper ends are attached to the connecting socket of the pump rod. On ascent of the plunger, the valve's leather-lined packed bottom bears on the interior wedge ring, so as to close the opening through it watertight. The descent of the piston lifts the valve and allows the passage of the water through the base rings.

IMPROVED GIGGING MACHINE.

Carl Gerber, Sr., and Christian Woelfel, Webster, Mass.—This invention consists in combining, with the stretching and guiding rolls of a napping machine, sliding napping cards, arranged between each pair of guide rolls, and adapted to reciprocate in planes at right angles to the cloth. The quick withdrawal of the cards from the cloth gives them, it is claimed, no chance to stick, and overcomes thereby the objectionable rigidity of the rotating wire cards, while doing the dressing in a more perfect and rapid manner than the teasels, but without the expensive and troublesome features of the same.

IMPROVED NAIL MACHINE.

Stephen Butterfield, Boston, Mass.—This invention consists of two sets of dies, arranged like comb teeth and fixed on slides. The latter are caused to move the teeth of one set into the spaces of the other set, in which condition they form dies, which shape rods hanging down from a feeder, so that they are caught between the fingers and shaped into nails by them. Below these fingers the projecting ends of the rods are upset, to form heads, by a header forced up nearly against the dies by the slide which works the dies. The points are formed by the upper margins of the dies, and by cutters immediately above the dies the points of the nails are separated from the rods. The header then moves laterally a little, and opens passages for the escape of the nails when freed by the opening of the dies.

IMPROVED ROTARY ENGINE AND WATER WHEEL.

John Lucas, Hastings, Minn.—This invention consists in the construction of a revolving piston wheel, which is formed of two parts, in diametrical registering slots, in which is arranged a piston plate, the journals of which are seated in recesses made in the parts of the piston wheel. The pivoted piston is arranged to oscillate in a line at right angles to the rotation of the piston wheel, by the action of the water or steam admitted into the engine casing. Said casing is provided with an oblique opening for the passage of the piston-wheel shaft, so as to cause the beveled sides of the piston wheel to bear against the inner sides of the casing. The pivoted piston plate is made in two or more parts, to adapt it to receive and hold packing between said parts.

IMPROVED POST DRIVER.

Isaiah W. Norton, Memphis, Mo.—This is an improved portable post driver, that may be used on sloping ground for the purpose of driving in the posts in perpendicular position with great rapidity. The hammer is raised by bringing one of the cams on the end of a lever, and the post is then placed into position in the guides. The hammer is then adjusted to the hight of the same by raising or lowering its pivoted supporting frame. When the hammer is in the required position, the drum is operated and the cams of the actuating wheel will engage the hammer lever, producing powerful strokes of the hammer in rapid succession, until the post is driven into a level with the hight of the bed frame.

IMPROVED WATER ELEVATOR.

Andrew B. Flowers, Thibodeaux, La.—This consists mainly of an endless bucket chain. The buckets are provided with suitable guards to prevent the escape of water. There are devices for changing the tension of the chain, and also an adjustable spout. The apparatus is suitable for draining marshes, irrigating land, and the like.

IMPROVED CHEESE CUTTER.

Bowne G. Yates, Madelia, Minn.—A hinged section is opened for the purpose of cutting off a portion of the cheese; the knife is then raised and the platform turned till a piece of required size is below the knife, which is then carried down, cutting the pieces in radial direction from the cheese. After the piece is taken out the front section is brought back on the base part, so as to inclose thereby the cheese completely, and keep off flies, etc.

IMPROVED SPRING POWER.

Charles M. Frahm and William Scharnweber, Chicago, Ill.—This is a new arrangement of a series of coiled springs and gears, whereby a large number can be arranged in a small space, and each spring can be wound up independently of the others, and while the machine is running. There is an ingenious regulating apparatus and stop mechanism, the whole forming a machine designed for wherever light power is required.

Business and Personal.

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

Notes & Queries

G. C. will find a recipe for liquid glue on p. 90, vol. 32.—F. G. S. will find a description of the ventilation of the Paris opera house on p. 134, vol. 33.—J. O. M. will find a description of artificial ivory on p. 234, vol. 30. See above for liquid glue.—R. W. E. will find directions for making an æolian harp on p. 315, vol. 33.—J. H. P. will find a recipe for a light metal on p. 347, vol. 32.—N. M. E. will find directions for cleansing water pipes on p. 49, vol. 34.—F. L. J. will find full directions for making paper boats on p. 163, vol. 27. This also answers F. T. H.—E. S. S. will find full directions for constructing a windmill on p. 241, vol. 32. This also answers B. W. S.—N. will find directions for filling black walnut on p. 315, vol. 30.—F. B. M. will find the information he wants, as to condensation on a cold vessel, on p. 43, vol. 31.—A. J. should address the School of Mines, Columbia College, New York city.—J. H. K.'s query as to color of gold, etc., is answered on p. 363, vol. 53.—N. E. F. will find a description of toughened glass on p. 20, vol. 33.—J. W. B. will find a description of a brown stain for wood on this or the next page.—S. B. will find a description of a battery suited for plating on p. 26, vol. 32.—G. H. W. should read Chevreul's book on color, to be obtained through any good bookseller.—A. N. will find directions for gilding on stone or marble on p. 59, vol. 30.—J. B. will find full directions for bending gas pipes on p. 150, vol. 33.

(1) P. C. says: Please state the number of shots that can be fired from the best kind of mitrailleuse. A. About 400 rounds a minute, we believe.

(2) J. M. R. asks: 1. How much steam will pass through a 2½ inch pipe in 1 minute at a pressure of 60 lbs. to the square inch? A. The question cannot be answered generally, as it depends on the length and arrangement of the pipe, the quality of the steam, etc. As a rough approximation, the amount may be taken as between 1,600 and 1,700 cubic feet a minute. 2. How many cubic feet of steam will 1 cubic foot of water make? A. It will depend upon the pressure of the steam. You will find tables in any good modern treatise on the steam engine. 3. How many cubic feet of water will a boiler (diameter 62 inches, 15 feet long, with 40 three inch tubes) evaporate in one hour, fired externally, to maintain a pressure of 60 lbs. to the square inch? A. Between such boilers in practice, about the following range of results is obtained: Coal burned per square foot of grate per hour, 5 to 15 lbs., water evaporated per lb. of coal, 6 to 10 lbs. Hence you see that it would be tolerably difficult to answer so general a question as you have proposed, in a definite manner. 4. How many cubic feet of steam will pass through an 12 x 14 engine in one hour, running at a speed of 150 revolutions per minute, at 50 lbs. pressure per square inch? A. There is about the same range in engines of this size as there is in the boilers, the amount of water used per horse power per hour varying from 30 to 100 lbs.

(3) W. M. asks: What is the name and what is the mode of drawing the proper curve upon which to turn the points of piles in order to have them sink the deepest with a given blow? A. We imagine that you refer to the so-called antifriction curve, or tractrix. Its equation, referred to rectangular axes, is as follows: $x = h \times \log. \left(\frac{h + \sqrt{h - y^2}}{y}\right) - \sqrt{h^2 - y^2}$

(4) F. T. T. asks: Can you point to a series of experiments upon the resistances to transverse stress on very short bars, the lengths of which are, as a maximum, but little greater than the lines that are the measures of their cross sections? A. If, as we understand you, you refer to a load uniformly distributed over a very short beam, fixed or supported at the ends, we imagine that you might safely proportion the part by a consideration of the shearing resistance. We shall be very glad, however, to receive and publish any experimental data that our readers may have.

(5) A. J. asks: 1. In driving a sawmill, is it practicable to transmit power by a cog wheel on the engine shaft geared to one on the saw mandrel? A. No. 2. How would this compare for safety with the usual method of using a long belt? A. Not well. 3. How many feet of soft timber per hour, with suitable feed, can be sawn with a 52 inch saw driven by a 15 horse power engine? A. This depends on a variety of conditions. 4. Is it true that the bore of a new engine cylinder is always an even number of inches? A. No.

(6) J. W. P. says: I am about making an engine to drive an ordinary skiff. I think that two oscillating cylinders, each about 1½ inches bore by 3 inches stroke, will be about as good a form as any: but I do not know how to build the boiler. I wish you would be so good as to tell me the proper size and form of boiler, also the best kind of fuel to burn, and what degree of power it would be likely to develope. A. Make a boiler from 18 to 20 inches in diameter, and 3½ feet high, with two inch tubes. Use anthracite coal, nut size, for fuel. In regard to the horse power of this or any other boiler, we can give you no information.

(7) B. L. asks: What is meant by sulphuric acid at 50° B.? A. 50° of Beaumé's hydrometer.

What shape of tool is most suitable for turning felt wheels, such as are used for polishing with crocus, etc.? A. A carpenter's chisel.

(8) W. T. says: I am about to put an engine of 1½ horse power, making usually 300 revolutions per minute, into a boat 18 feet long, 5 feet wide, drawing 8 inches forward and the diameter of the propeller aft. What should be the size and pitch of the propeller? A. If you use one propeller, it should have a diameter of at least 18 inches, and about 2½ feet pitch. 2. Should the shaft be placed parallel to the surface of the water or parallel to the keel? A. Make the shaft approximately parallel to the keel. It is difficult to give a general estimate of the slip of small propellers, but for a small boat like yours you will do very well if the slip does not exceed 25 or 30 per cent.

(9) J. E. R. says: Will you please inform me how I can restore edge tools, such as plane bits, chisels, etc., to their original temper, after they have gone through a fire? A. Heat them to a cherry red, and quench them endwise in lukewarm clean water. Then brighten the surface with emery and reheat them slowly over a piece of heated iron until a brown color appears, then quench them in water.

(10) J. B. J. says: I wish to roll sheet brass and crimp the same while hot. The heat softens the metal and takes all of the stiffness out of it. By what process can it again be hardened? A. By rolling it cold.

(11) C. B. asks: 1. Is there any way of making wiped joints on water pipes other than freezing the pipes, in case the water could not be turned off? A. We know of none. 2. What is the use of an air chamber in a force pump? A. To make the supply and delivery of water even. 3. Why does a water pipe burst when frozen? A. Because the water expands in freezing.

(12) D. H. asks: Does the pressure on the valve of a common slide valve engine depend on the area of the valve or the area of port? A. On the area of the valve.

(13) J. S. asks: 1. What temper is required for a butcher's steel? A. The steel may be hardened as hard as fire and water will make it, or tempered to a brown color. 2. Is there a certain quality of steel for sharpening steel? A. Use cast steel.

(14) J. H. says: It is proposed to change the course of a slow, circuitous, and now unhealthy stream. It has a fall of 1 in 700 feet. The bridges are 50 feet wide, and are ample to resist spring freshets. It is proposed to cut through a bank of clay above the town: this cut would be 1,000 feet in length by 22 feet deep, and in it a fall of 10 feet would be obtained, and the water would go clear by the town. With this additional fall, what width would we require to cut to carry off the amount of water mentioned? A. The proposed fall of 10 feet in 1,000 would create a velocity too great for the permanent stability of the bottom and sides of the cut, on account of the scouring effect it would have upon them. This would, therefore, involve the necessity of paving the bottom and sides, to prevent the gradual abrasion of their surfaces and the ultimate caving in and destruction of the cut itself. Considering this necessity and the depth of the excavation required, you will find it more economical to construct a light, brick, cylindrical aqueduct, and to effect your excavation by tunneling, through the 1,000 feet, the neat size of the aqueduct, without disturbing the surface of the ground. The size of the excavation should be 6 feet 8 inches in diameter, cut true to a mold or pattern, and then lined with a brick arch 4 inches thick, carefully laid in cement: this would give a clear section of 10 feet, and would discharge all the water of the stream, even in the season of freshets. In excavating, be gin at the lower end and follow on at once with the brick arch, being careful to pack the earth well over the top of the latter, and behind the sides of it, as fast as a course may be constructed; in this way you will support the earth as you progress, and make all safe. You can secure the proper grade by means of a leveling instrument, having the bottom edge inclined at the gradient of 1 inch in 100 inches, and the top edge level; this can be applied to the bottom of the aqueduct. In removing the excavated material, let it be done upon boards laid upon the bottom to protect the brickwork. If you should strike a vein of sand, this need not prevent your proceeding, as in this case you can use the shield tunnel excavator.

(15) L. M. S. says: I have care of an engine which is 12 x 25 inches, and runs at 130 revolutions per minute. It cuts off at ¾ stroke, and has ⅛ of an inch lead (that is, the port is open ⅛ an inch when the engine is on the center). Is the lead too much? A. The $\frac{1}{16}$ inch lead will be better. You may cut off at ⅞: but if you give steam to the full length of the stroke, your engine will be less powerful for want of a free exhaust.

(16) D. P. P. asks: 1. If a water wheel is attached to a force and lift pump, could the pump throw up as much water as the wheel would require to operate it? A. No. Such a machine would be a perpetual motion, which is absurd. 2. If I fill a small strong chamber with air and compress it sufficiently to drive a small air engine, could I get power enough to operate one or more air pumps to keep up the pressure in the air chamber for any length of time? A. No. This is another version of the idea in your first query.

(17) T. D. W. says: I am about to make a foot lathe to swing 8 inches. Will you give me your opinion as to the bearings for the spindle? I want it to run as light as possible, and to turn solid and not to require setting up very often. I tried a cone on each end of spindle, but found that the spindle ran very hard. It would jamb or shake, no matter what care was used. Were the cones at a wrong angle? They were at 30° from the horizontal. A. Place two broad projecting rings on the first bearing of the lathe spindle, and your lathe will run all right.

(18) I. B. asks: 1. What is the best quantity of grate area in proportion to heating surface in a boiler? A. From 30 to 38 square feet of heating surface per square foot of grate. 2. Does this proportion vary for different kinds of fuel? A. Not essentially. 3. What is the proportion of cross section of area of tubes to grate area? A. From ⅛ to ⅙. 4. What is the proportion of area in the second row of return tubes? A. Generally somewhat smaller; for instance, if ⅕ in first row, ¼ in second. 5. Would you consider it just as economical in fuel to get the same amount of cross section by one row of 5 inch return tubes as by two rows of 3 inch return tubes? A. Generally, there would not be any great difference.

(19) L. G. C. asks: Is there a method to find a true circle if there is not room to put the center? A. Any number of points may be found, in a similar manner to that in which they are determined for a railroad curve. Perhaps some of our readers will be sufficiently interested in the problem to try their hands at a geometrical solution.

(20) H. S. T. asks: How can I make a stain for wood to imitate mahogany? A. A simple way of effecting the object is to brush the wood with aquafortis, and dry it at the fire. This is good for veined birch and beech. The latter may also be stained by putting 2 ozs. dragon's blood into 1 quart rectified spirit; let the bottle stand in a warm place and shake it frequently; and when the gum is dissolved, the stain is fit for use.

(21) J. B. Jr. asks: How can I make lime water? A. Slake 4 ozs. lime with a little distilled water, then add distilled water to make 1 gallon. Cover the vessel and set it aside for 3 hours. Pour off the clear liquor for use.

(22) J. P. M. says: A trough is 12 inches wide, 1 inch deep, and has a fall of 3 inches. How many feet of water will run through the same per minute? A. You do not send sufficient data, as the discharge will depend upon the length of the trough, as well as the other elements. You can make the calculation, approximately, by the following formula: Velocity in feet per second =

$$\sqrt{\left(\frac{\text{area of way in sq. ft.}}{\text{wet perimeter in ft.}} \times 2 \times \text{fall in ft. per mile}\right)}$$

(23) R. R. Z. asks: How high a column of water can air be forced through with a pressure blower? How many lbs. air pressure would it take to force air through a 2 inch pipe and up through a column of water 12 feet high, with no obstruction to the passage of the air on the top of water? A. A question of this kind could best be determined by experiment. If any of our readers have data, we would be pleased to hear from them.

(24) G. B. asks: How can I make impression paper? A. Take the very thinnest writing paper, and smear it with lampblack made into a paste with pure tallow. Let the paste remain on 12 hours, then wipe smooth with a piece of cotton waste. Any colored pigment may be used in place of lamp black, but it must be very finely pulverized.

(25) W. P. C. asks: How can I obtain iron in the form of impalpable dust? A. The iron obtained by hydrogen, commonly kept in the drug stores, answers your description; it can be prepared as follows: Take 30 troy ozs. subcarbonate of iron, and wash thoroughly with water till no traces of sulphate of soda are shown by the appropriate tests; then calcine, in a shallow vessel, till free from moisture. Spread it on a tray made by bending an oblong piece of sheet iron in form of an incomplete cylinder, and introduce into this a wrought iron reduction tube, about 4 inches in diameter. Place the reduction tube in a charcoal furnace; and by means of a self-regulating generator of hydrogen, pass through the mass a stream of that gas, previously purified by bubbling successively through a solution of sub-acetate of lead, diluted with three times its volume of water, and through milk of lime, severally contained in half gallon bottles, about one third filled. Connect, with the further extremity of the reduction tube, a lead tube bent so as to dip into water. Lute all the junctions airtight; and when enough hydrogen has passed to exclude all atmospheric air from the apparatus, light the fire, and bring that part of the reduction tube occupied by the subcarbonate to a dull red heat, which must be kept up as long as the bubbles of hydrogen contain aqueous vapor. When the reduction is complete, remove the fire, allow the whole to cool, and withdraw the product from the reduction tube.

(26) W. S. H. M., of Reading, England, asks: Has it ever been proposed to utilize water and other power, now running to waste, by storing it up for future consumption? A. Yes, very often. The compression of air in strong vessels, for conveyance to where the power is needed, is frequently suggested.

(27) L. L. H. asds: How can I prevent oil paintings from cracking? A. Cracks occur in oil paintings when the colors were ground in oil containing impurity or otherwise unfit for the purpose. Linseed oil is the best, poppy oil the next; but purity is the essential quality of all vehicles for colors.

(28) J. D. R. asks: Is there any remedy for tender fingers? I am a printer, and my fingers get sore and the skin peels off. A. Printers frequently burn paper on an iron surface, and rub the sore place with the resulting oil.

(29) G. H. C. W. asks: 1. Does multiplying the square of the diameter of a circle by 0·7854 give the area in square inches or circular inches? A. In square inches. 2. What is a circular inch? A. A figure the square of the diameter of which multiplied by 0·7854 gives 1 square inch.

(30) A. B. D. says: I am finishing wire work with paint mixed with varnish; it takes too long for it to dry hard. What will dry quickly and not break off easily? A. Boil good linseed oil with enough litharge to make a stiff paint; add 1 part by weight of pigment to every 10 parts of the litharge. Boil for 3 hours over a gentle fire.

(31) G. H. S. asks: Is there anything that will remove the smell of tobacco from old cigar boxes? A. Varnish the box on the interior with a thin covering of shellac in alcohol.

(32) Q. C. asks: 1. How many degrees or what portion of a degree is an ohm according to Oersted's law? A. That depends upon a number of conditions, and consequently varies with different instruments. You will find full information on the subject of testing rods in No. 1 of the SCIENTIFIC AMERICAN SUPPLEMENT. 2. How can I tell if a current of electricity is passing through a lightning rod? A. If occasional tests show little or no appreciable resistance, there is no occasion to trouble oneself further. As a general thing, however, it may be assumed that currents are always traversing the rod. 3. Could a pocket compass be arranged for that purpose? A. See article above referred to.

(33) J. A. asks: 1. Which is the most effective, a glass or a hard rubber plate, for an electrical machine? A. Ebonite plates are recommended as preferable to glass. 2. Is the construction of the machine the same with either plate? A. Yes. 3. Must an amalgam be used on the cushions of a hard rubber plate machine? A. Yes.

(34) E. A. F. asks: Why is it that a circular saw, after being used long enough to require two or three gummings, becomes rim bound, or, in other words, becomes expanded in the center, and the saw becomes dished? A. There exists in the minds of many persons, who are not fully acquainted with the principle upon which circular saws are made, an erroneous opinion that a saw should work the same until worn out, if it is not accidently sprung in use, or strained in gumming. So far as any damage to the saw is concerned, there is no difference between the use of a burr gummer and a file; but if proper care is not exercised in the use of the emery wheel, there is more danger from their use than with the file or the burr. After a few times gumming, the saw will be enlarged on the rim, so that the slightest warmth will cause it to buckle, and there is no remedy left but to send it to a saw maker and have it rehammered. Some, however, entertain the erroneous impression that a saw rehammered will never run as well as when new. Never was there so great an error; on the contrary, a saw rehammered will generally run better than when new, because all the elasticity (or nearly all) is worked out of the saw by using, and it generally works stiffer than when new. A saw must become red hot to change the temper. Inserted toothed saws are not as liable to become expanded on the rim as solid saws.—J. E. E., of Pa.

(35) J. M. H. says: I wish to give a nice finish to the walls of my parlor, and propose to use the recipe on p. 53, vol. 12. Would you recommend it? Is the size spoken of a paste or preparation of glue? Please give me proportions of ingredients, etc.. A. We have not tried the process referred to, and cannot vouch for it. We presume the size intended is the ordinary glue water. You would do well to try experiments with it on a piece of wall that it would not injure.

(36) S. B. Jr. asks: I. Which electro-magnet requires the least number of coils of a given sized wire, one to lift an armature weighing ½ lb. suspended $\frac{1}{16}$ of an inch from its poles, or one where the distance is $\frac{1}{32}$ of an inch and the weight 1 lb.? A. Electro-magnets, such as are used for telegraph sounders, having three or four ohms resistance, will answer for either case. 2. How many cells of Callaud battery are required to enable such an electro-magnet, through the medium of ½ mile of ordinary line wire, to lift the armature as above? A. Six or eight cells of Callaud battery will answer, provided the resistance of the circuit does not exceed 30 ohms.

(37) C. F. S. says: I want to make a magnetizing coil that will take a core ¼ inch in diameter and 6 inches long, and magnetize it to saturation. Will you please tell me what size of wire, number of layers, and battery power will serve my purpose? A. A couple of sounder coils like those to be seen in any telegraph office, with two or three cells of battery, will charge a soft iron core highly.

(38) N. Y. S. asks: Is the compound used in charging fire extinguishers a secret? A. No. Carbonates of the alkalies or alkaline earths are commonly employed for this purpose, such as carbonate or bicarbonate of soda, carbonate of lime, etc, etc. These are placed in the lower part of a suitable vessel; and immediately over it is placed a vessel containing a strong acid, such as muriatic or sulphuric, so arranged that, when the instrument is required for use, the vessel containing the acid may be inverted, thus emptying its contents upon the carbonate below. A violent action immediately ensues, and carbonic acid gas is liberated in great quantity. This gas is the fire extinguisher. Various modifications of this instrument, in the method of placing and manipulating the reagents, etc., have been invented since the value of carbonic acid gas as a fire extinguisher was first recognized; but the principle is the same in all.

(39) J. H. P. asks: How is prepared rubber made? A. We do not recognize any material by this name. Do you mean ordinary vulcanized rubber, vulcanite, or ebonite?

(40) J.H.P. says: A lady in the N. Y. *Times* says that ¼ lb. saltpeter dissolved in 1 pint alcohol is an excellent remedy for swollen joints caused by rheumatism. I attempted to dissolve some niter in alcohol of 95 per cent, and it would not dissolve. What is the matter? A. Niter is almost absolutely insoluble in strong alcohol. Dissolve the saltpeter in the smallest quantity of cold water possible, and add the alcohol in small quantities at a time, with constant stirring. The addition of too much of the alcohol will precipitate the salt.

(41) P. L. & Co. ask: How can we make sensitive cards, which, when placed upon the hand, immediately curl up with the heat? A. By passing a good quality of gelatin, previously softened by hot water, between oiled rollers set so as to produce a film of the required thickness.

(42) H. F. B. says: In constructing a grinding mill, the grinding being done by cast iron rings, it is very desirable to have them of the hardest metal. I believe that an extremely hard metal can be obtained by mixing cast iron with spiegeleisen. Am I correct? A. Yes. According to the percentage of spiegeleisen employed, the percentage of carbon may be changed in the pig produced, with a similar change in properties.

(43) P. S. B. says: 1. I have in my possession an oriental ruby of great hardness, weighing about ⅛ lb. What is it worth? A. A ruby of extremely fine color, brilliancy, etc., is said to be even more highly valued than a diamond of the same weight. The exact value of your ruby could not be given without seeing it. 2. What book or books must I consult in order to obtain the most the most exhaustive knowledge of the finer metals and precious stones? A. Consult Emanuel on "Diamonds and Precious Stones," and Jones on "The Treasures of the Earth."

(44) D. L. asks: Would it be possible to restore vision in an eye of which the lens is destroyed, by putting in an artificial lens? A. Theoretically, yes; but the science of surgery has not, as yet, become sufficiently skilled to attempt such an operation on this most delicate and susceptible organ.

(45) S. R. asks: 1. Can sulphuric acid be concentrated to sufficient strength in lead kettles to treat the refractory silver ores of Colorado and Nevada? A. Concentrated sulphuric acid must be employed, and for this lead vessels are not adequate. Instead of making the ore digesters of platinum, the practice of late in Europe has been to employ digesters of cast iron, white or mottled iron being preferred. It has been found that these vessels are unacted upon by the strong acid, since the surface becomes coated with a thin layer of metallic silver. 2. In using iron pyrites and ores heavily charged with sulphur, what fuel would be the best? A. Such ores should first be calcined, either in a special furnace or in heaps in the open air; the ignition of the sulphur in the ore being effected by placing the latter upon a layer of brushwood. The roasting must not be carried too far, but sufficient sulphur must be left to produce a proper regulus. The roasted ore may then be reduced with coal, etc.

(46) S. C. P. asks: What is the origin of the symbols used in apothecaries' weight? A. These symbols are supposed to have been derived from inscriptions on the ancient monuments of Egypt. This supposition is made more probable by the recent discovery of a papyrus concealed between the bones of a mummy in a tomb of the Necropolis at Thebes. This papyrus contained a treatise on medicine, written about 1552 B. C., and is consequently more than 3400 years old. In it the volumes are indicated by special signs, and figures with dots above them represent weights. The unit of volume is thought to be the *tenat*, which is equivalent to $\frac{6}{10}$ of a liter. The sign for a half *tenat* bears a striking resemblance to our sign for a drachm.

(47) D. D. asks: Can you inform me how white wine or whisky vinegar is made? A. Obtain a large cask, and about a foot above the bottom construct a false perforated bottom. Above this fill the cask with good, well burnt charcoal in coarse lumps, over which pour first a sufficient quantity of good vinegar to thoroughly moisten it. Let the whole stand for a short time, when it will be ready for the introduction of the alcoholic liquors This should be introduced in small quantities at a time, and the apparatus kept in a moderately cool place to prevent too energetic an action. This method will give you a pure vinegar, which will suffer considerable dilution. Use a very small quantity of annatto as coloring matter.

(48) E. G. A. says: A glass globe has two yellow spots marked on the opposite sides. The globe holds five gallons, and is placed close to the wall on a table directly between two windows. The light from the windows passes through the water in the globe and strikes the opposite side. The spots are of a soft, slimy nature, easily rubbed off. Can you tell me what they are composed of? A. The spots may consist of several substances. Send some of the material, and we will tell you what it is and the mode of formation. It is not improbable that the water held bicarbonate of iron in solution, which gradually became decomposed on standing in a warm room, and, from some peculiarity in the currents generated in the vessel, deposited hydrated sesquioxide of iron in the manner indicated.

(49) W. C. says: Please give me a recipe for dyeing veneers green. A. Put the veneers in a box or trough with clean water, and let them remain immersed for 3 or 4 days, changing the water once or twice as occasion may require. Let them dry for about 12 hours before they are put into the dye: by observing this the color will strike quicker, and be of a brighter hue. Prepare the dye as follows: To 1 gallon of strong vinegar add 1 lb. of the best verdigris finely ground, 2 ozs. sap green, and 2 ozs. indigo. Place this in an iron or copper vessel, with as many of the veneers as the liquor will cover, and boil for several hours or until the requisite intensity of color is obtained.

(50) J. M. says: I am building a small engine. The boiler is 5 feet long x 16 inches in diameter, without flues; it is made of ⅛ inch iron. Could this boiler afford steam enough to run a drag saw requiring 2 horse power, and what pressure could it stand to the square inch with safety? A. We do not think the boiler would be large enough to do the work satisfactorily. You could maintain a working pressure of about 50 lbs. per square inch.

(51) A. J. H. asks: 1. What preparation will produce a good sensitive surface? A. A collodion film holding iodide and bromide of silver. 2. Can the camera obscura be utilized for photography? A. Yes, but not so conveniently as the ordinary camera. 3. Does any number of the SCIENTIFIC AMERICAN contain directions for photography? A. No complete treatise, but valuable suggestions will be found in almost every number.

What is the enclosed substance? A. Caramel and salt.

(52) C. L. asks: What effect (if any) do the many steam mills, locomotives, and steam vessels have upon the humidity of the atmosphere? A. We do not know of any observations especially relating to this point: but we imagine that the effect, if any, is very slight and strictly local.

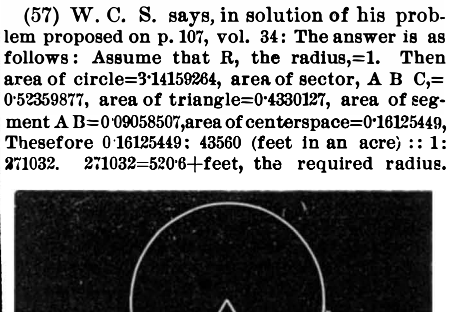
(53) F. G. W. says: The Boston and Albany Railway Company has some 240 locomotives, most of which have no steam domes; and if you ask the men who handle these engines how they carry their water, they will tell you that no engines work drier steam or less water than they do, under all circumstances. It is well known that much of the track of this line, on the mountain slope between Westfield and Washington, lays on a grade of 83 feet per mile. Steam domes are not only expensive, but are a decided injury to a boiler, and if locomotives work as well, they are certainly much better without them. This company is continually building locomotives without domes, which seems to be the best evidence possible that they are as useless as a steeple to a church. A. There are many locomotives which have no steam domes. The celebrated Crampton engines, made in 1847, had none, and gave excellent results. It is usually considered, however, that drier steam is obtained from the top of the dome than from the shell of the boiler.

(54) W. H. B. asks: Where was the first railroad located? A. Railroads or tramways, used in mines, worked by horses, are very old. The first mining road worked by steam was at Killingworth, England; the first passenger road worked by steam was the Stockton and Darlington Railway, England.

(55) I. L. asks: 1. How can I construct a float, to use in a steam boiler to indicate the water level or to operate a valve? Can it be made sufficiently light and yet stand the external pressure of 100 lbs. per inch? A. Make your float of copper. 3. I have thought that a float made of common tin, made airtight, with a small quantity of water in it, would answer, as the water inside the plate would be converted to steam from the heat of the steam outside the float, the quantity of water used to be equal to that required to fill the float with steam at the required pressure. Would this be practicable? A. Your plan of a tin float is impracticable. 3. Is the fusing point of common tinner's solder sufficiently high that 100 lbs. of steam would not fuse it? A. Yes.

(56) R. W. R. says, in answer to W. H., who asks as to preserving a cotton rope used in the open air: We are carrying 20 horse power by a cotton rope 1 inch diameter and 800 feet long, over V-shaped pulleys 5 feet in diameter. To protect it from wear and the weather, it is slushed occasionally with ⅓ black lead and ⅔ tallow.

(57) W. C. S. says, in solution of his problem proposed on p. 107, vol. 34: The answer is as follows: Assume that R, the radius,=1. Then area of circle=3·14159264, area of sector, A B C,= 0·52359877, area of triangle=0·4330127, area of segment A B=0·09058507, area of centerspace=0·16125449, Thesefore 0·16125449: 43560 (feet in an acre) :: 1: 271032. 271032=520·6+feet, the required radius.



J. E. N., F. L. R., M. B., F. E. B., D. E. Q., J. H. B., C. J. T., J. W. I., C. A., E. L. W., M. R., P. J. D. S., J. E. N., A. W. F., Dr. B., J. R. D., E. I. T., T. S. M., S. N. M., J. M. G., F. W. W., G. W. C., A. G. F., M. C., P. M., R. F., A. F. C. & Co., and K. Q. X. send answers which, like the above, are approximately correct. J. S. W., C. H. B., G. D. T., E. McC., L.B., N. M. B., V. P. B., F. G. G., I. D. S., H. M. A., G. D. T., R. C., R. J. McL., W. J. McG., and G. H. O. send erroneous answers; and L. S. W. sends different solutions with no results stated. C. W.M.'s answer is incomplete. C. says: " One curious fact I notice is that the division of the 160 rods by the exact figure, which is a trifle less than 0·162, gives the following regular arrangement of numerals, the root of which we extract for the answer: $\sqrt{987654321}$=31·4269."

(58) H. S. says, in answer to F. H. D.'s query as to cast iron and steel sleigh shoes: Wrought steel sleigh shoes are not tempered, as it would crook them out of shape; and cast iron shoes, if they are what they ought to be, are made of quite hard iron, that cannot be drilled or filed, and shows a white crystaline fracture when broken.

(59) G. G. W. says, in reply to several correspondents who ask for recipes for casehardening: To caseharden wrought iron, take wood soot and urine, mix and work them up into a dry mastic, and cover the article to be hardened with it: heat to a red heat slowly in a charcoal fire, so as to heat through. Take out and knock off the soot, and plunge in cold water; then draw the temper, as done with steel.

E. M. M. asks: How can I make and use a good oil finish, similar to that used on parlor organs?—A. S. B. asks: Can you give me information as to the actual number of miles of railroad laid in England, Ireland, and Scotland?—E. P. asks: How is printing in gold or bronze done, to produce a smooth surface and a clear, sharp, outline?—J. J. T. asks: How is wall paper varnished after it has been hung?

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 Resources of Georgia. By M. E. C.
On the Angora Goat. By H. G. O.
On Magic Squares. By J. S.
On the Epicycloid. By L. F.
On Spontaneous Combustion. By J. S. W.
On a First Class Tool Maker. By D.
On the Power of Figures. By G. B. M.
On a Singular Medical Case. By R. W. B.
On Spirit Photography. By C. M.
On Head Work. By J. K.
On Bank Vaults. By S. K.
On Food. By C. S. P.

Also inquiries and answers from the following:
S. G. H.—J. M. S.—Z. S.—J. G. McC.—H. J. M.—E. J. P.—T. G.—J, N.—J. H. M.—G. M.—J. K.—C.K—B. L.—W. B.—R. N.—T. W.—W. M.—M. H.

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 makes rake teeth? Who publishes works on pottery and porcelain? Who makes phosphorus in large quantities? Who buys bone dust? Why do not makers of microscopes advertise in the SCIENTIFIC AMERICAN?" 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.

[OFFICIAL.]

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