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TORPEDO LAUNCH WARFARE.

In a recent issue, we gave a description, with illustrations, of Admiral Porter's torpedo boat, the Alarm, a vessel designed for offensive operations wholly, and intended as a type to be copied in equipping a fleet of similar craft. The Alarm is therefore a very excellent representative of our American style of torpedo warfare. There is, however, another class of vessels adaptable to the same service, namely, the swift steam launch, which bears about the same relation to the larger craft as a light flying battery might to an assemblage of heavier though more effective field guns. In the United States service, the launch is of secondary importance beside the large light draft torpedo boat; but in France, if we may judge from the very extended experiments recently made at Cherbourg, the launch is given the first place. The launch accomplishes her object—namely, the explosion of a single torpedo, as near to the enemy's side or bottom as is possible—by sheer audacity, aided by opportune circumstances of weather. It would of course be a useless risk to attempt to run alongside a large vessel in broad daylight or under bright moonlight, for discovery would be certain sufficiently soon to enable a well directed shot to sink the small craft. Her work is to be done in weather when the fog lies low on the water, as it often does during cold days when the sea is warmer than the air, or during driving storms of snow or sleet, when vision a hundred feet from the ship is impossible. Then the launch, with her exhaust carefully muffled, creeps cautiously up to her victim, and with a bold dash gets within point blank of the guns before her presence can be known. It is exceedingly difficult to use depressed guns with any accuracy at a stationary object, much less at one moving at eighteen knots per hour; and in any event, before a shot can be fired the launch will have reached the spar torpedo guards or nettings, if any are out. She then relies on her speed to slide her up on the spars, or to carry her through the netting sufficiently to enable her to push her long torpedo boom up against or very near to the ship. If the launch survives the effects of her own explosion, she endeavors to back off; if she fails, her crew pay for their temerity with their lives. The last is fortune of war, and not to be considered in view of the results.

In Fig. 1 is represented the ironclad vessel to be attacked, which is supposed to have discovered the approaching launch, and flashes the electric light upon her. All movements of the little vessel are now perfectly apparent, and the puff of smoke from the ironclad's side indicates that she has already opened fire. The helmsman on the launch has

[*Continued on page 246.*]

Fig. 1.—TORPEDO EXPERIMENTS AT CHERBOURG, FRANCE.

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DARWIN ON THE EFFECTS OF CROSS AND SELF FERTILIZATION IN PLANTS.

It is impossible to finish the perusal of any of Mr. Charles Darwin's works without a genuine feeling of admiration, not only for the manner in which the investigator pursues every branch of the great principles he has enunciated to its minutest ramification, but for the almost inconceivable patience with which he accumulates grain after grain of proof, until his position is not only firmly established but seems possessed of even a superabundant support. For eleven years he has been conducting the difficult and delicate inquiry of which his recent volume is the record; and yet the result to be adduced, from the great mass of facts so slowly and laboriously gathered, is no strikingly novel discovery, although much is embodied that is new. It is rather a substantiation of opinions already enunciated, leading to their wider generalization. His conclusion is closely connected "with various important physiological problems, such as the benefit derived from slight changes in the conditions of life, and this stands in the closest connection with life itself. It throws light on the origin of the two sexes, and on their separation or union in the same individual, and lastly on the whole subject of hybridism, which is one of the greatest obstacles to the general acceptance and progress of the great principle of evolution."

In briefly reviewing Mr. Darwin's new work, or rather its conclusions, for we cannot attempt the consideration of his countless experiments, it is best to begin by the repetition of his own statement, made to avoid misapprehension, namely, that the term "crossed plant seedling, or seed," means one of crossed parentage, that is, one derived from a flower fertilized with pollen from a distinct plant of the same species. And a self-fertilized plant seedling, or seed, means one of self-fertilized parentage, that is, one derived from a flower fertilized with pollen from the same flower, or sometimes from another flower on the same plant.

From his observations on plants, and guided to a certain extent by the experience of breeders of animals, Mr. Darwin many years ago became convinced that it is a general law of Nature that flowers are adapted to be crossed at least occasionally by pollen from a distinct plant. It often occurred to him that it would be advisable to try whether seedlings from cross-fertilized flowers were in any way superior to those from self-fertilized flowers. It so happened that, without any thought of the above inquiry, he raised close together two large beds of self-fertilized and crossed seedlings from the same plant of *linaria vulgaris*. To his surprise, the crossed plants, when fully grown, were plainly taller and more vigorous than the self-fertilized ones. As it seemed quite incredible that the difference between the two beds of seedlings could have been due to a single act of self-fertilization, Mr. Darwin attributed the fact to some accidental cause; but in order to test the matter, he prepared two more beds from the carnation *dianthus caryophyllus*, which, like the *linaria*, is almost sterile when insects are excluded; and hence the inference may be drawn that the parent plants must have been intercrossed during every, or almost every, previous generation. Nevertheless, the self-fertilized seedlings were plainly inferior in height and vigor to the others. This was the starting point of Mr. Darwin's experiments, conducted with all the refinement and minuteness necessary for the most accurate of observations.

Of the conclusions reached, the first and most important is that cross-fertilization is generally beneficial, and self-fertilization injurious. This is shown by the difference in height, weight, constitutional vigor, and fertility of the offspring from crossed and self-fertilized flowers, and in the number of seeds produced by the parent plants. The advantages of cross-fertilization do not follow from some mysterious virtue in the mere union of two distinct individuals, but from such individuals having been subjected during previous generations to different conditions, or to their having varied in a manner commonly called spontaneous; so that in either case their sexual elements have in some degree differentiated. Again, the injury from self-fertilization follows from the want of such differentiation in the sexual elements. Thus when plants of the *ipomœa* and of the *mimulus*, which had been self-fertilized for the seven previous generations, and had been kept all the time under the same conditions, were intercrossed one with another, the offspring did not profit in the least by the cross. On the other hand, as showing that the benefit of a cross depends on the previous treatment of the progenitors, plants which had been self-fertilized for the eight previous generations were crossed with plants which had been intercrossed for the same number of generations, all having been kept under the same conditions as far as possible. Seedlings from this cross were grown in competition with others derived from the self-fertilized mother-plant crossed by a fresh stock; and the latter seedlings were to the former in height as 100 to 52, and in fertility as 100 to 4.

Under a practical point of view, agriculturists and horticulturists may learn much from the above conclusions. Thus it appears that the injury from the close breeding of animals and from the self-fertilization of plants does not necessarily depend on any tendency to disease or weakness common to the constitution of the related parents, and only indirectly on their relationship, in so far as they are apt to resemble each other in all respects, including their sexual nature; and secondly, that the advantages of cross-fertilization depend on the sexual elements of the parents having become in some degree differentiated by the exposure of their progenitors to different conditions, or from their having intercrossed with individuals thus exposed, or from spontaneous variation. Animals to be paired should therefore be kept under as different conditions as possible, and excellent results have been obtained from the interbreeding of individuals reared on distant and differently situated farms. With all species of plants which freely intercross, by the aid of insects or the wind, the best plan is to secure seeds of the required variety which have been raised for some generations under as different conditions as possible, and sow them in alternate rows with seeds matured in the old garden. The intercrossing of the stocks will yield far more favorable results than any mere exchange of seeds. Florists may learn that they have the power of fixing each fleeting variety of color, if they will fertilize the flowers of the desired kind with their own pollen for half a dozen generations, and from the seedlings under the same conditions. But a cross with any other individual of the same variety must be carefully prevented, as each has its own constitution. After a dozen generations of self-fertilization, the new variety will probably remain constant, even if grown under different conditions; and there is no longer any necessity of guarding against intercrossing.

With respect to mankind, Mr. George Darwin has concluded, from a statistical investigation which has already been reviewed in these columns, that the evidence of any evil due to the intermarriage of first cousins is conflicting, and on the whole points to the same being very small. Our author infers that, with mankind, the marriages of nearly related persons, some of whose parents and ancestors had lived under very different conditions, would be much less injurious than that of persons who had always lived in the same place and followed the same habits of life. He sees no reason to doubt that the widely different habits of life of men and women in civilized nations, especially amongst the upper classes, would tend to counterbalance any evil from marriages between healthy and somewhat closely related persons.

THE TRANSMISSION OF CORRECT TIME.

The public clocks in the city of Vienna, Austria, are at present driven by a pneumatic system, actuated at the Imperial Observatory by an automatic arrangement connected with an astronomical timepiece. The idea originated with an engineer named E. A. Mayihope, who had long experimented with the transmission of time by means of electricity, and at last gave it up in favor of pneumatic transmission, which is free from the drawbacks and uncertainties connected with the use of electric batteries, insulated wires for transmission, delicate contact breakers, and other complicated arrangements. Such annoyances have occurred in the experiments made in this country, where electric arrangements for the transmission of time have thus far never been in use for any considerable period. Some years ago, a time ball in the New York Custom House, intended to be regulated by an electric current from the Dudley Observatory at Albany, soon failed, because of the constant attention required, which could only be expected from persons specially engaged and exclusively interested in electric transmissions. Therefore it is not to be expected that such an enterprise can be successful until telegraph companies take hold of the matter; and only in such case is there possibility of a regular working of electric timepieces.

The method of Mr. Mayrhope consists in originating a wave of compressed air, which is sent through airtight tubes laid along the street gas mains to all the public clocks. This wave is transmitted once every minute, when the minute hands of all the clocks move forward the required distance. It is intended to extend this system until it includes the clocks in all the schools, public institutions, hotels, railroad depots, and the houses of such persons as desire it.

There is no doubt that this method has the enormous advantage of simplicity, especially when applied to a great number of clocks. Such a pneumatic tube may have ever so many branches; and at the end of every branch the impulse must invariably reach the moving lever which, pushed by an elastic membrane, will propel the minute hand. It must, however, be borne in mind that, by this system, the clocks will not move so instantaneously as by the electric current. Electricity is transmitted over a telegraph wire with a velocity of from 4,000 to 12,000 miles per second, according to the perfection of the insulation; therefore the motion of the various clocks will be practically isochronous. But the wave of compressed air, transmitted by the elasticity of the atmosphere, moves only with the velocity of sound, which is, on an average, only 1,100 feet, or little over one fifth of a mile, per second, *minus* the resistance in the narrow tubes, which may reduce it somewhat; so that its velocity of transmission may vary from 25,000 to 70,000 times less than that of electricity. This, however, is of little practical importance, as it would only cause the clocks to be one second behind for every 1,100 feet distance from the central station; and if in some cases seconds had to be counted, the correction would be easily applied. Clocks at a mile distance would be about five seconds behind; and the correct amount having been determined by direct observation, a constant number would have to be added to the time indicated by each clock, in order to find the correct time to within a fraction of a second.

But if we go into such close calculations, the difference in time for difference in longitude ought not to be neglected. At the latitude of Vienna, the degrees of longitude are nearly forty-six miles long: that means that meridians drawn on whole numbers of degrees are nearly forty-six miles apart.

The sun crosses each meridian every four minutes; the time for the meridians to the east from the central station is therefore, for every degree, always four minutes earlier, and for meridians to the west four minutes later, than it is at the central station. Four minutes for 46 miles, or two hundred and forty seconds for 241,040 feet, is at the rate of 1,000 feet for one second: a velocity a little less than that of sound. So that the propulsion of the air wave, when going directly west, would slightly overtake the solar movement; and if sent at noon from the central station, it would arrive at a western station before the sun passed the meridian of such western station. If we make the calculation for the latitude of New York city, we come to the curious result that the wave of compressed air, or the sound wave, travels west at the same rate as the sun does; as, in our latitude, the degrees of longitude have a length of nearly 50 miles, which is passed over by the sun in four minutes, being at the rate of 262,000 feet in two hundred and forty seconds, or very nearly 1,100 feet per second. Therefore, if a pneumatic system of transmitting time were adopted here, the impulse would, in tubes running directly from east to west, be transmitted at the same rate as the solar motion, and a wave sent from Brooklyn at noon would arrive in five seconds in New York, where it would then be exactly noon; and it would arrive in Jersey City in another five seconds, where the sun would then cross the meridian, and so on, traveling west and keeping pace exactly with the solar time.

THE UTILIZATION OF RATS.

Most people have an instinctive aversion to rats, classing them with snakes, bedbugs, mosquitoes, and other evils of this world, allowed to exist by an inscrutable Providence for reasons past human discovery. Beyond having a vague knowledge that the heathen Chinee devours the murine tribe, and deems the unsavory-looking rodent a delicacy, the average thinker on the subject can perceive no utilization for the vagrant denizen of cellars and wharves, save (indirectly) in his furnishing an object to be caught by the multiplicity of ingenious traps which inventors have constructed, and serving as a source of perpetual nervousness to the wiry Scotch terrier who spends his days in searching for him under parlor sofas, behind furniture, and in every other shady corner where the illogical canine mind conceives a rat might possibly shelter himself. The fact of the case is that the rat is in reality a useful animal; and as we showed recently in a discussion on bedbugs, it is a violent assumption for anyone to suppose that any living thing does not serve, or may not be made to serve, a useful purpose. Moreover, it is equally erroneous to assert that a rat is a noxious beast. To be sure, he breeds with astonishing rapidity, and he has the failing of cannibalism toward his progeny. But so has his arch enemy, the well fed tom cat. He is pugnacious, but rarely attacks man save in defence of his life. On the other hand, he is scrupulously neat, even more so than the average male feline. As a scavenger, his labors are of great value in the filthy cities of the Orient; and his tail is a marvel of constructive design and a source of perpetual admiration to the anatomist. Unfortunately he is a pronounced kleptomaniac; and this, with his supposed proclivity to take refuge in the vicinity of female ankles, makes him a pariah and an outcast among four-footed things. Yet mark the inconsistency: On the fair hand of the damsel, who shrilly shrieks at the sight of that wonderfully constructed tail whisking into a friendly hole, may be a glove—or at least the thumb of it—made from that despised creature's skin, and called by courtesy a "kid." On the head of paterfamilias, who ruthlessly pursues the fugitive interloper with the kitchen poker, may be a felt hat made from the rat's fur, which exceeds in delicacy that of the beaver, and which is sought after by a large corporation, expressly organized for the purpose, in Paris. An eccentric Welshman once, in order to show how far the rat might be utilized for clothing, spent three years in collecting enough ratskins to make himself a complete dress, hat, neckerchief, coat, waistcoat, trousers, and even shoes; six hundred and seventy rats were immolated for this purpose, and the six hundred and seventy beautifully organized tails were strung together to form a tippet.

It is in Paris—that home of the utilization of everything—that the rat is turned to the greatest number of uses. He furnishes employment for an army of hunters, who pursue him in his sewer fastnesses for the sake of his skin. In the great abattoirs of the city rats exist by the million. One proprietor, on becoming nearly driven from his premises by the rodents, threw a dead horse in a walled inclosure, and then stopped up all means of escape, so that the rats, attracted by the bait, could not get out. In one night 2,650 rats were caught in the trap and killed by men armed with clubs; in a single month, 16,050 of the animals were thus destroyed. We note this case mainly in connection with a curious utilization of rats, wherein dead animals of all kinds are placed where they can get them as an easy way of disposing of the refuse flesh and securing the valuable bones. A regular pound, surrounded by a massive stone wall, is provided for this purpose by the city authorities of Paris, and it is the regular morning's work of those in charge to remove the beautifully polished skeletons.

Of course, when thus pampered, the rats multiply amazingly, and therefore once in a while a grand *battue* is necessary to reduce their numbers. The way in which this is conducted is curious. Horizontal holes are bored all around, in and at the foot of the inclosing walls, the depth and diameter being respectively the length and thickness of a rat's body. Upon the morning of the *battue*, men armed with tin pans, kettles, drums, and other objects for producing horrible noises, rush in at daybreak. The astonished rats precipitately rush for the nearest openings, which are those in the walls. But these, while large enough to contain their bodies, will not accommodate their tails, and the walls are soon ornamented with a vista of those anatomically superb members, whisking about like animated icicles. Then arrives the rat collector—a scientist in his way—who, with admirable dexterity, seizes the pendent tails, jerks forth the owner attached thereto, and deposits him in a bag worn over the left shoulder. The privilege of catching the rats is farmed out by the authorities, and a profitable business it is. The rats are sleek and fat, and fetch high prices for their fur, skins, and flesh—the latter doubtless appearing in the restaurants where one may have "dinner for one franc with wine, bread at discretion." Rat flesh is not bad eating, at least so say those who have tried it, our knowledge in the matter being limited. It is delicate, white, firm, tastes like chicken, and in China the soup made from it is considered to be equal to our well known oxtail. In the Celestial Kingdom rats are worth two dollars per dozen. In the West Indies the rats exist in enormous numbers on the sugar plantations, and work great damage by gnawing the growing sugar cane. Each plantation has its official ratcatcher, who is paid by piecework, that is, so much a dozen for tails brought in.

The credit of suggesting the most extensive utilization of rats is due to Mr. P. L. Simmonds, who has lately printed an admirable work on these and other undeveloped sources of profit—from which we have drawn many of the curious facts above given. Mr. Simmonds suggests that a profitable venture might be made from Kurrachee to Canton and Hong Kong of salted rats. About 7,000,000 could be cured and packed aboard a 400 ton ship. For the sake of curiosity we quote Mr. Simmond's estimate of profits: 7,000,000 rats at 6 cents per dozen, $35,000; salting, curing, etc., 60 per cent, $21,000; total cost, $76,000; and 7,000,000 rats sold at $2 per dozen, $1,166,666.66, shows a profit of $1,090,666.66. There! No one can charge us—thanks to Mr. Simmonds—with not having done our best to enrich our readers. Few journals can claim the proud laurel which we boldly now grasp, of having pointed out the way for any one to become a millionaire.

A FIFTY THOUSAND DOLLAR BOTCH THAT THE PEOPLE PAID FOR.

There will be found, recounted with much detail, in the recently issued report of the Chief of Ordnance of the United States army, about as glaring and inexcusable an instance of waste of the people's money, through a series of mechanical blunders, as can probably be found in the already long category of expenditures for fruitless tests of military inventions. Fifty thousand dollars have been squandered in an attempt to manufacture one 9 inch cannon according to the plans of Mr. Alonzo Hitchcock. The story of the various botches and mistakes, which we summarize briefly below, would verge upon the laughable, were it not well calculated to render any thoughtful mechanic ashamed of the men who did the work, as well as of those who permitted it to continue in the manner recounted for a period of over two years.

The Hitchcock system of cannon making is based on the welding together of a number of wrought iron rings, which are seated on an anvil located upon the piston of a hydraulic press. The latter is lowered as the rings are added, and a furnace is provided for keeping the rings hot while being hammered. In this way a gun is gradually built. This description is very general, but it will serve to convey a sufficient idea of the invention to appreciate what follows. Early in February, 1873, Mr. Hitchcock was granted an appropriation of $50,000 for the manufacture of his gun at the Springfield armory, and given the supervision of the work; and every opportunity was afforded him for making the most careful studies. But so vague were his plans at the outset that he neglected even to have working drawings made of a part of his plans until the mechanics had actually begun labor thereon. The preparations consisted in blasting a pit 40 feet deep into the solid rock, lining it with concrete, and afterwards with a huge iron tank. Two months later, after a part of the ponderous machinery above this had been erected, Mr. Hitchcock concluded to cut the holes, which received his steam hammer supports, down four feet. This was then a very slow and difficult operation, as blasting, owing to the concrete, could not be resorted to. Finally, in August, 1874, the hammer was built, and steam was let on; but the machine refused to work. The hammer bound against the steam cylinder, and unlimited filing of shafts became necessary. "Had Mr. Hitchcock made a careful inspection of these machines when he visited the ironworks for that purpose," the reporter says, "this would not have happened." Then it was discovered that, through a blunder, the anvil pit was not deep enough, and more alterations had to be made.

By April, 1875, more than two years after the work had begun, the furnaces were furnished, and tested satisfactorily, and preparations were made to heat one of the gun disks. Prior to beginning work, tests were made of the water bottom on which the disks rest in the furnace; but through some stupidity, the exhaust valve of the same was closed, so that steam was generated, which drove back the water in the supply pipe. Thereupon "somebody," in a state of great excitement, opened the valve suddenly, relieved the steam pressure, in poured the cold water, and of course the water bottom cracked. The diary of the ordnance lieutenants engaged upon the work now becomes amusing reading. We quote a few extracts: "April 7. Mr. Hitchcock proposes to make a false bottom of sand." "April 8. Tried to resolve piece in heating furnace through the door with a wrench-shaped tool. Piece stuck on hearth, and gaspipe handle grew soft by heat, and bent. Hammer accidentally dropped on the furnace lid crane, which was standing directly under it. Mr. Hitchcock at the throttle." "3:25 P.M. The top piece" (suspended in hammer furnace) "is lowered; it strikes one of the corners of the cast iron center, melts the corner, and topples the piece over. 3:28 P.M. Fortunately by this time it is too cold to stick. 3:35 P.M. It is decided to draw fires." Mr. Hitchcock decides that a cast iron water bottom is essential; but two days later he changes his mind, and concludes to tinker the old cracked bottom with an iron hoop. This promptly burst on being used, and the inventor set about making a wrought iron water bottom, having a locomotive tire for a rim. This was made and inserted, and operations now progressed to the welding of several disks—not, however, without an interesting variety of accidents which we shall not recapitulate. The sixth piece to be added was accidentally dropped, and the unfortunate water bottom was again damaged, and caused to bulge and leak. The pieces welded were cut up and the welds found bad. More alterations of the machinery followed, and at last, in June, fires were again started; but, to quote the official report again, "Mr. Hitchcock dropped the hammer upon the first ring, and found himself unable to raise it again." The anvil had not been properly adjusted, the hammer fell too hard, and away went the cylinder head. Two weeks later, another attempt was made to weld together two large disks to form the breech of the gun. But "the hook at the end of the chain sustaining the transfer tongs became heated, and straightened out, allowing the upper disk to fall. Before the disk could be placed in proper position, it had become chilled, had to be reheated, and finally a weld was made; but this, on examination, was again found to be exceedingly bad."

We have given the above in some detail in order to exhibit to the reader the placid effrontery with which Mr. Hitchcock, in his letter dated June 24, 1875, declining to proceed further with his gun, explains the reasons for this grand series of botches and blunders. We quote *verbatim:* "Notwithstanding the machinery, all works satisfactorily; I find that, by practical operation, there is great danger of uncertainty about the old reverberatory furnaces, which we now have in the works. This was, however, well understood by the Ordnance Board; and all practical furnace men knew that there are better furnaces in use, as, for instance, the gas or Siemens' regenerative furnace; but simply for prudential motives, it was deemed sufficient to test my mechanical mode of welding up guns as I proposed, leaving the furnaces to future consideration if the machinery would do the work, as was promised. We are trying to make impossible things possible, and going squarely in the face of all known facts in science and practical knowledge that have been developed within the last ten or twelve years."

Mr. Hitchcock makes these statements after two years and nine months' experiment, and after the $50,000 of the people's money is all but exhausted. With reference to them, Colonel Benton says: "All parts of his gun machinery, including the furnaces, were designed by Mr. Hitchcock, and were constructed under his immediate supervision and without limitation in the selection of the nature of the furnace." Further comment is needless.

Explosive Compounds.

Two more instances of unexpected decomposition, accompanied with some degree of violence, have lately been brought to our notice. The first happened with iodide of strychnia: a bottle, in which some of the salt had been long kept, was held near the fire, to warm the glass and loosen the stopper. An explosion suddenly occurred, scattering the glass and badly wounding the hand. The other accident was related by Mr. B. F. McIntyre, at a meeting of the Alumni Association of the New York College of Pharmacy. On distilling essential oil of bitter almonds over nitrate of silver, to free it from prussic acid, toward the end of the operation the material in the retort violently exploded, breaking all the glass apparatus in the proximity, but doing no further damage. Neither explosion can be very easily explained; in fact, few explosions can, except in a general way. In regard to the iodide of strychnia, it is supposed that the substitution compound had formed, on decomposition, some iodide of nitrogen, in a somewhat similar manner to the production of that substance when iodine is treated with an excess of ammonia. As to the reaction which occurred between oil of bitter almonds and argentic nitrate, it may be said not to be altogether extraordinary, as the silver is known to readily form explosive compounds with a number of organic substances. The only wonder is that no mention has been made of it before this time, for the rectification of the essential oil over nitrate of silver is not an unfrequent operation, while it seldoms happens that one has occasion to heat old iodide of strychnia.

To Protect Molten Lead from Explosion.

Molten lead, when poured around a damp or wet joint, will often convert the water into steam so suddenly as to cause an explosion, scattering the hot metal in every direction. This trouble may, it is said, be avoided by putting into the ladle a bit of rosin the size of a man's thumb, and melting it before pouring.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

NEW SERIES—NO. XXIV.

PATTERN MAKING.—BENCH WORK.

Round columns are either plain, fluted, or of a mixed design to agree with the square columns in the same building. Fig. 180 represents a plain round column; but it must be remembered that, even though the shaft be plain, the design of the base and cap may be modified according to taste. In the case of so simple a one as we have illustrated, it would probably be cast solid as represented; though if of very large size, as those in the crypts of churches, perhaps 18 inches in diameter, a great deal of metal would be saved by simply casting a plain round shaft with the mouldings, N and O, upon it, and of a length measured from the lower part of the base to the top of the cap. This casting takes the weight of the building. The base, B, with its moulding, B M, and the cap, C, with its moulding, C M, are thin castings fixed to the column by screws. P P are the core prints. Little need be said as to the method of preparing a pattern of this description. If small, it will be turned from the solid wood; and if large, it will be lagged or staved up, as we have described on page 101 of our current volume. In any case, the pattern must be made in halves. Some foundries require a half-core box; while in others, the core is struck up in the manner described on page 229, volume XXXV. We may now pass to the consideration of the fluted column shown in Fig. 181. D is a plan of the peculiar cap required for this kind of column; it is neither square nor round, but of a shape which harmonizes beautifully with the carved work below, all of which, including the cap, is added afterwards, the column being cast a plain round above the member marked N, and also below that marked O. The extension, A, is the part which passes between the joists of the flooring; it is often flattened to admit of this, as shown at C, Fig. 182. B is a section of the column through the fluted part. It is not thought necessary to show the prints, as they would be similar to those shown in Fig. 180, the lower one being flattened if the extension, A, were required.

Fig. 180.

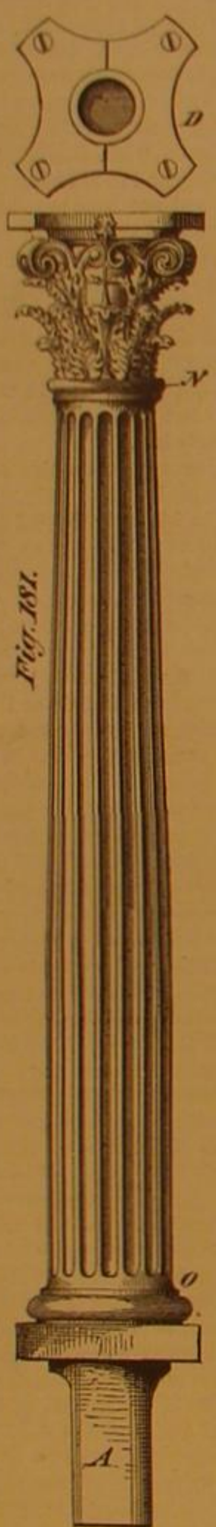
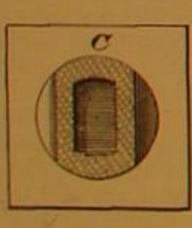


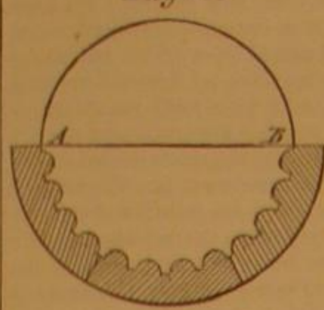
Fig. 181.

Fig. 182.



We have now arrived at the most important part of this branch of our subject, and that is, how to make the fluted pattern column so that it may be extracted with facility from the mould; for, by referring to Fig. 181, it will be seen that the rammed sand, by entering the flutes, would lock the pattern down unless this difficulty were provided for. To overcome this difficulty, we refer the reader to Figs. 183, 184, 185. Fig. 183 is a sectional view of a column, turned extra large at the part intended to be fluted so as to form a plain core print all around the column. A convenient number, divisible by 3 or 4, of flutes must be taken; we have taken 12 flutes in the half column. A suitable core box must be constructed with, say, four flutes; these cores, when packed around the mould, will core out the flutes in the column. This method is only given because there may be special cases where it would be most suitable; but it is not that generally adopted.

Fig. 183.



In Fig. 184, each half of the column is formed of three pieces, which are held together by taper dovetails; in this case the middle piece is first drawn from the mould and then the side pieces. This method will accommodate any even number of flutes, and is quite practicable; the objection to it, however, is that the dovetails are liable to stick, and also that, when the middle piece is drawn out, the side pieces sometimes fall into the mould, to its irretrievable injury.

Fig. 184.

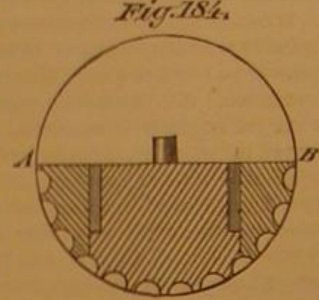
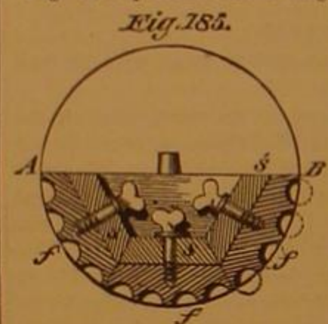


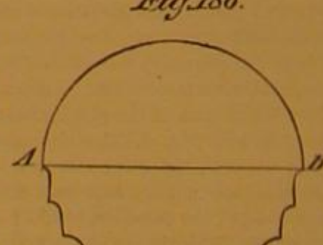
Fig. 185 represents the arrangement in most general use; it is not nearly so expensive as that shown in Fig. 183, nor is it open to the objections mentioned in connection with Fig. 184. The three pieces marked S are the main staves of the column pattern, but the number is not arbitrary. We may take four or any other number, depending on the size of the column; it is advisable, however, to have as few pieces as possible. What we have to do is to notice the direction taken by the pieces as they are drawn out, and if it appears that the flutes do not escape properly, then a larger number of divisions must be made. The pieces marked *f* are the supplementary staves in which the flutes are cut; they are attached to the inner staves by screws, which are removed by the moulder, who is then able to extract the pattern. The side pieces, *f f*, are then drawn out, and lastly the lower pieces, the process being, it will be noticed, the reverse of that shown in Fig. 183. In each case, the line, A B, is the parting line of the pattern, which must always occur in the middle of a ridge and not in a flute. The flutes should be cut out to a half circle, and eased off slightly towards the ridges with sand paper. They must not be in the least undercut, because of the draft in the mould. The pattern should be made as smooth as possible by alternately sand-papering and varnishing, using well worn sand paper to insure smoothness.

Fig. 185.



In Fig. 186 are shown what are called bastard flutes. Their use gives a cheap but not beautiful style, and they are sometimes employed on lamp posts and columns in the cheaper class of tenement houses. The flutes, it will be noted, are made shallow and of a shape to permit the whole half pattern to be removed from the sand. The flutes are cut out of the solid, the front ones being the deepest and the side ones so shallow that many of them are scarcely distinguishable.

Fig. 186.



In columns whose designs are of a mixed character, the methods illustrated for fluting are equally suitable for cableing, as shown in Fig. 185, where the cableing is shown in dotted lines; while rosettes, rope mouldings, and the like, are either attached by wires, as shown in the illustration of square columns, or they must be cast separately and afterwards affixed by screws, as are many other ornaments whose shapes preclude their being moulded solid with the columns.

Diamond Cutting by Girls.

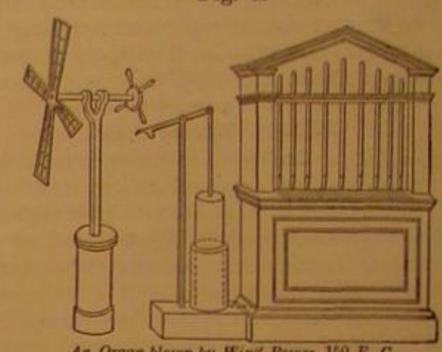
Messrs. H. Cohenno & Co., of New York city and Boston, Mass., write to say that the Dutch Israelites have never refused to instruct American boys, but have consented to do so if paid a proper remuneration, such as they themselves had to incur to learn the business; and further, Mr. Morse's men were not discharged, but left voluntarily. They also say that they are not able to discover where Mr. Morse's girls are at work.

ORGANS, OLD AND NEW.

In the organ the notes are produced by pipes of different lengths, shapes, and materials, supplied with air by bellows and operated by keys which admit or cut off the supply.

The dimension of the instrument is designated by the number of feet of length that its largest pipe measures, forming the lowest note of the key board. Thus we speak of an organ of 32, 16, or 8 feet. An instrument which possesses open flutes of 32, 16, 8, and 4 feet, and a principal an octave above the latter, has a compass of 8 octaves. Large organs sometimes have five key boards, one above another. The first, nearest to the organist, is that of the choir organ. The second, that of the great organ. The third, the swell key board. The fourth, the recitative key board. The fifth, the echo key board. Below these is the pedal key board, played by the feet. The music of the organ is sometimes written on three lines, the two upper ones for the hands and the under one for the pedal key board.

Fig. 1.



An Organ blown by Wind-Power, 150 B. C.

In the "Spiritalia" of Hero of Alexandria, who flourished 150 B.C., we find a description of an organ blown by the agency of a windmill which works the piston of the air pump. Its invention is, perhaps, to be credited to Ctesibus of Alexandria, though it is likely that it was the result of the gradual improvement by various parties through the centuries. The reconstruction of it, given in Fig. 1, is taken, with other engravings presented, from Knight's "New Mechanical Dictionary."* The descriptions of it by Athenæus, Vitruvius, and Claudian render it certain that the pipes were musical, and blown by the force of water, instead of expansible air bellows.

Fig. 2.

Fig. 2 shows several old methods adopted for supplying wind to the organ; the arrangement of the keys and the manner of manipulating them are also illustrated.

A is a representation by Father Kircher of a very primitive form of Hebrew organ, the "Macraphe d'Aruchin." In this, as in other of the earlier organs, a leathern bag served the purpose of the wind chest.

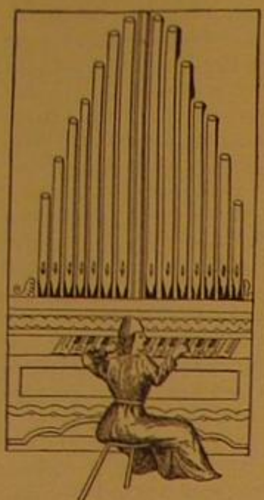
B is copied from the sculptures on an obelisk at Constantinople, erected by Theodosius, who died A.D. 395.

C is a pneumatic organ of the tenth century; it is taken from an ancient psalter in the library of Trinity College, Cambridge.

* Published in numbers by Messrs. Hurd & Houghton, New York city.

D, from Gori's "Thesaurus Diptychorum," is said to have been taken from a manuscript of the time of Charlemagne. It represents King David seated on his throne, his scepter in one hand and a lyre in the other, on which he appears to be playing, accompanied by several instruments, including the organ.

Fig. 3.



Old-Time Organs.

Fig. 3 is from an engraving in the "Theorea Musica" of Franchinus Gaffurius, printed at Milan, 1492.

F. Fig. 4, shows the ancient method of blowing. On each bellows is fixed a wooden shoe; the men who work them hold on to a horizontal bar, and, inserting their feet into a pair of the shoes, alternately raise one and depress the other.

G is what was formerly known as the "positive," in contradistinction to the "portative" organ. The latter, as its name implies, was portable, being carried in processions by one person and played by an other; it was also called the "regal" or "rigol." The former was fixed in position, and, when carried in a procession, it and its stand were placed on a car. An organ of this kind was afterwards placed before the great organ in churches, the two constituting a single instrument, the "positive" being the origin of what has since been designated the choir organ.

Fig. 4.

F

G

Old-Time Organs.

The devices required in order to make a pipe sound or speak are: the bellows for supplying condensed air; a channel for conducting it to the pipe; a valve or other contrivance for admitting and cutting it off; and and a lever for opening and closing the valve.

The pipes are of two descriptions: the mouth or flute pipe (technically called flue pipe) and the reed pipe, which are each further divided into several varieties. Mouth pipes, so-called from having a mouth and lips similar to those of the flageolet, are either of wood or metal. The latter are those observable at the front of the organ case, and are cylindrical in cross section. The wooden pipes are rectangular in section, the sides being in the proportion of 5 to 4; the interior is usually sized with glue. The upper end is open, or is closed by a tompion made airtight by a leather covering. The other end is closed by a block to which three of the sides are glued, a narrow aperture being formed between the block and the front side, by beveling this side so as to have its sharp edge on the interior; this is called the upper lip or windcutter. Another block is arranged so as to leave a narrow space between it and the block. The hollow cylinder, through which air from the bellows is supplied, is let into this block. A mahogany cap, hollowed out on the inner side so as to leave the aperture free, is fastened to the front of the pipe below the mouth. The aperture between the cap and the block, called the plate of wind, admits the compressed air from the bellows in a thin stream, which, being forced against the mouthpiece or windcutter, produces a musical note determined in pitch by the length of the column of air set in motion. In order to voice the pipe—that is, improve the tone—the edge of the block opposite the upper lip is slightly pared away and serrated so as to divide the plate of wind and direct it against the inner edge of the lip. The pitch of a note depends on the length of the pipe, while the tone or timbre depends on its diameter, its shape, or on the kind of wood employed; that yielded by pipes of hard woods, as mahogany, being more clear, while the softer woods yield a mellower sound.

The chimney-top pipe has a small open tube in the top plate for the purpose of sharpening a note: a similar effect is sometimes produced by a hole in the tompion. Metallic mouthpipes are made conical at their lower termination, and where this cone and the cylindrical portion unite is an aperture occupied by a thick plate of soft metal, called the languette, nearly closing the tube, but leaving a small opening for the wind plate, formed with the upper lip.

The thickness of the stream of air admitted to the pipe may be diminished by turning down a projecting exterior lip on the plate. The reed pipe is closed near the bottom by a solid plug, having apertures for the passage of the reed and its adjusting wire. The reed is a cylindrical or slightly tapering tube of brass, having a narrow longitudinal slit in front, covered by a thin plate of metal called the tongue, which is made fast to the reed at its upper part, but is free at the lower end. The back part of the reed is cut off slanting at its lower termination, over which a piece of metal is soldered. The pitch of the reed pipe depends on the length of the tongue, which is adjusted by means of the tuning wire above mentioned; the quality of tone depends on the pipe.

A stop consists of a series of pipes agreeing in quality of tone, or timbre, but differing in pitch. When any particular stop is drawn the keys will play on the corresponding set of pipes. The stops are designated by figures or by words intended to be descriptive of the quality of sound, as *flute*, *oboe*, *vox humana*, etc.

Two or more key boards are required to enable the performer to produce all the notes in an organ of more than one stop. In a large organ the different series of stops are so arranged as to form three or four separate instruments, each having its own set of keys, wind trunk, wind chest, sound board, etc. These have been distinguished by different names, as the great organ, the choir organ, and the swell; also the pedal organ or foot keys which act on the larger pipes.

Couplers are also brought into action at will, which connect the keys on different banks so as to make them act together when one is played. The effects are also varied by tremolo and swell, which give respectively quavering and rising and falling force of sound. The feet of the pipes are inserted in the upper or stock boards, above the bearers and supported on racks—thin boards mounted on pillars. The pipes of the larger stops, however, take up so much space that they cannot be placed immediately over their proper groove, but they may be placed in any convenient position, even outside of the case, and air conveyed to them by means of grooves cut in the upper boards and covered with parchment, forming closed channels.

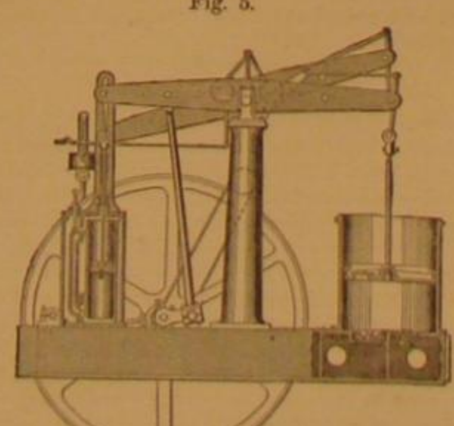
The key movement, in its simplest form, comprises: the key, a pivoted lever, which being pressed down at one end causes the other end to raise the sticker, a small wooden rod depending from the end of a second lever above, which is thus depressed at its opposite end, drawing down the pull wire and opening the valve.

The foregoing description will give an idea of the general principles governing the construction of organs, though there are many mechanical details and improvements introduced into modern construction to which we have not space to refer.

The bellows communicate with the wind chests, which act as reservoirs and distribute the air to the different pipes, as the finger or foot keys are pressed down. The pressure of air is regulated by a weight on the upper part of the reservoir, usually about 15 lbs. to the square foot. The different parts of the organ are now commonly supplied with air under different pressures, separate bellows being used for each pressure.

The wind chest is an airtight box communicating above with the sound board, an oblong frame or box of wood divided by parallel strips into channels or compartments completely separated from each other. Holes corresponding with the number of ranks of pipes are bored through the upper part of the sound board into each channel. Its lower side is covered with parchment or leather, except on that part where the channels communicate with the wind chest and are closed by clack valves opened by means of pull-down wires operated by lever connection with the keys and brought back by a spring. On the upper side of the sound board, at right angles to these channels, a set of grooves, corresponding in number to the number of stops, is formed by screwing down thin pieces of hard wood, termed bearers. These communicate through holes with each of the channels below, and each has a register or slide, a little thinner than

Fig. 5.



Blowing-Engine for the Organ Royal Albert, Hall of Art and Sciences, South Kensington, London.

the bearers, but exactly fitting the groove in length and width. The slides are pierced with holes corresponding in number and size with those of the sound board, so that, by drawing out or pushing in any particular slide, it is caused to open or close the holes in the sound board, and supply or cut off the air from the range of pipes above it.

In organs of the largest class as formerly constructed the operation of the keys was a work requiring, in addition to musical skill, a large amount of hard bodily labor. It is said that the performer on the great Haarlem organ was obliged to strip preparatory to commencing his work, and retired covered with perspiration at the end of the hour's performance. This is one of the largest instruments in Europe, having 60 stops and 8,000 pipes. One at Seville has 5,300 pipes. The expenditure of wind varying greatly, according to the series of notes produced, the tension of the air supply was very different at different times, causing a variation in the purity of the tone and difficulty in opening the valves when under high pressure. These difficulties were remedied by the pneumatic lever of Barker, in which small subsidiary bellows operated by the movement of the key are employed to depress the wires by which the valves are opened.

Where an extraordinary large supply of air is required, it may be furnished by blowers or bellows operated by hydraulic or steam power. Fig. 5 illustrates the blowing engine employed for the great organ at the Albert Hall, South Kensington, London, England. It is a vertical beam engine having two steam cylinders of 7 inches diameter and 24

Fig. 6.

Lascell's Organ-Blowing Apparatus (Dr. Partridge's Church, Brooklyn, N. Y.).

inches stroke, and two blowing cylinders of 24 inches diameter and 24 inches stroke. Its principal duty is to compress and attenuate air for blowing and for mechanical purposes, such as opening and closing the stops. The valves of the blowing cylinder are of india rubber. The upward stroke exhausts the air from vacuum receivers, to which it is connected by zinc piping, and the down stroke exhausts the pressure receivers to which it is similarly connected. In addition to the ordinary governor, it has two throttle valves connected respectively with the pressure and vacuum receivers: so that when the former is filled with air at 1¼ lbs. pressure above, and the latter with air at 1¼ lbs. pressure below, that of the atmosphere, both throttles are closed and the engine stops, thus regulating the supply according to the ever-varying requirements of the organ.

A horizontal engine of 13 horse power, driving a crank to which six large bellows are connected, furnishes compressed air to the reservoirs which supply the pipes.

The giant organ is 60 feet wide and 70 feet high; the four center pipes, which are over 40 feet long, weighing nearly a ton each. The instrument was erected by Mr. H. Willis, and, according to the *English Mechanic*, is the finest in the world, having five claviers (four manuals, extending from C C to C in altissimo, and one pedal from C C C to G). The pedal organ consists of 21 stops; the first manual clavier, or choir organ, including the echo organ, comprises 20 stops, all the pipes in which are of metal. The second clavier, or great organ, contains 25 stops, only two of which have wooden pipes in the bass notes. The third clavier, or swell organ, comprises 25 stops, and these are all, with the exception of the basses of two stops, of metal. The fourth clavier, or solo organ, has 20 stops, making in all 111 stops; then there are 14 couplers and 32 combinations. The total number of pipes is close upon 9,000, and these range from 30 inches diameter down to the size of a straw, and from 40 feet in length down to 6 inches.

Fig. 6 illustrates an organ provided with the hydraulic blowing apparatus designed by G. W. Lascell, Brooklyn, N. Y.; *a* is the cylinder, the piston rod of which *b* is attached to the crosshead of a reciprocating frame, *c*, by which the movable diaphragm, *d*, of the double-acting bellows is operated, alternately forcing the air through the pipes, *e*, *e*, into the wind chest, *f*, from which it is distributed by the trunk, *g*, to the organ bellows, *h*. The wheel, *i*, is connected with a wire that controls the lever, *k*, of the governing valve of the water supply pipe. As the bellows, *h*, becomes inflated, the block on its upper lid strikes against the lever, *m*, closing partially or entirely the valve, and automatically regulating the supply of air to the demand. By means of a hand wheel, *i*, which can be conveniently reached by the organist, a valve, *k*, is opened or closed for admitting or cutting off the water supply. In this engine the crank is dispensed with, and the valve gear so arranged as to prevent stoppage on the dead centers.

Communications.

Danger of Galvanized Cooking Utensils, Water Pipes, Etc.

To the Editor of the Scientific American:

I notice in your issue of March 31 an item from the *Deutsche Industrie Zeitung* on the deleterious effects of zinc oxide in toys, etc., and from the remarks preceding judge that you agree with what follows. I have always in the practice of my profession (analytical chemistry) strongly deprecated the use of galvanized articles, water pipes, culinary utensils, tanks, etc.; but am well aware that this is a point on which the doctors disagree. I would like exceedingly to have the matter argued, in your excellent paper, by disinterested parties, for I have somewhat myself to say on the subject.

I know that the water boards of certain cities hold certificates from practical chemists to the effect that galvanized pipe is harmless and the best for general use, and that citizens are advised to employ it. I consider the use of zinc-coated pipes or vessels for culinary purposes both filthy and dangerous to the public health, whether they are used cautiously and intelligently, or rashly, like the farmer who purposed to boil down cider and sour apples in a galvanized tank.

In large houses, where there are great lengths of galvanized piping, much zinc goes into the systems of the inmates, producing more or less ill health and discomfort; I have heard complaints of milky drinking water on the breakfast table, etc., proving that the servants draw water for use directly from the pipes without allowing any to run to waste.

That zinc-lined pipes contaminate water flowing through them for very long periods is plain from the following: The water for my hothouses flows through 190 feet of inch galvanized pipe from the street main; the water is from Wenham Lake and proverbially pure; the pipe has been in position and daily use for seven years; even now the first water drawn from this pipe in the morning is quite opalescent from hydrated oxide of zinc. I would be loth to drink such water; and believing that what is unfit for animals' use from metallic contamination cannot benefit plants, I have given directions that at least ten gallons shall run to waste before the water is used. Such precautions are rare in dwelling houses, I am sorry to say.

If we can have this matter discussed in your journal, and perhaps settled one way or the other, much good may accrue. I feel convinced that zinc misused is doing great mischief to publis health. DAVID M. BALCH.

Salem, Mass., March, 1877.

[We shall be pleased to receive such information as any of our readers may have to offer on this subject. But we are inclined to think that there is not room for lengthened argument as to whether galvanized pipes are or are not a safe and desirable medium for the conveyance of drinking water. They are unquestionably dangerous; and if further evidence than that above offered by our esteemed correspondent is desired, it can readily be had by consulting the back numbers of the SCIENTIFIC AMERICAN. In fact, in our present number, under the head of Answers to Correspondents, in the correction of a reply given to W. D., we republish a few facts bearing upon the matter.—EDS.]

A Woman's Success with Bees.

To the Editor of the Scientific American:

I am a reader of the SCIENTIFIC AMERICAN, from which I obtain much valuable information. I am wintering fifty swarms of bees on their summer stands, some of them being nearly buried in snow. They are doing finely. I have of my own a system of management entirely original. My hives are so constructed and arranged that I have the swarming propensities of bees as completely under my control as does the stock raiser an increase of his cattle, sheep, or swine. I have no increase by bees swarming unless I desire it; I turn the whole force of bees to storing honey in the boxes connected with the hive. Ample room is given in the boxes for storing honey, so that the bees will fill thirty boxes as quickly as they would three in an ordinary hive. The boxes are so easy of access that the bees enter and commence work without the least hesitation. When I want an increase of swarms, I do not divide or make artificial swarms. But after a close study of the habits and instincts of bees, I am able to have them swarm out naturally, at any designated date in the swarming season, which I may arrange in early spring. My bees average me a clear profit of over fifty dollars a year for each hive I keep, by sale of surplus honey in glass boxes. I am satisfied that bee-keeping is profitable, even in our cold New England climate, where the honey season is short.

I have the Italian bees, and find them greatly superior to the common bee in many points. They will collect double the amount of honey in the same locality. Their vigor in withstanding our cold climate is a strong point in their favor. They also resolutely protect themselves from the ravages of the bee moth, while the common bee often falls a prey to its ravages. Then their beautiful color and large size render them objects of admiration. Then they seldom sting, or show any signs of anger. I have furnished several of my friends with full swarms of Italian bees in my hive, and they have in each case been highly pleased with them. My Italians are beauties; nearly the entire body of the bee is a light straw color. If bee keepers would study more closely the habits of bees, the profits would be greatly increased.

West Gorham, Me. L. E. COTTON.

On Color and Disease.

To the Editor of the Scientific American:

There is something in the color of animals, especially of the feet of animals; but I think your correspondent (page 200, current volume) is mistaken in regard to the pigs eating a poisonous plant, which caused their white hoofs to drop off.

During the war I was in the artillery service, and it was a noted fact that a horse's white foot would get sore when others would not. "Scratches," some called it; and at one time every white foot in a battery of 156 horses was sore, and with few exceptions the rest were all well. They did not graze, but only got the regular rations of oats, corn, and hay, sent from the North and West, and could not have eaten any poisonous plants. We attributed the sore feet to standing in wet and mud, making it impossible to keep the hoofs clean during a Virginia winter with the poor facilities at hand. But how it was that the white feet only were affected we never could explain.

Baltimore, Md. FRED. W. WILD.

How Safes are Blown Open.

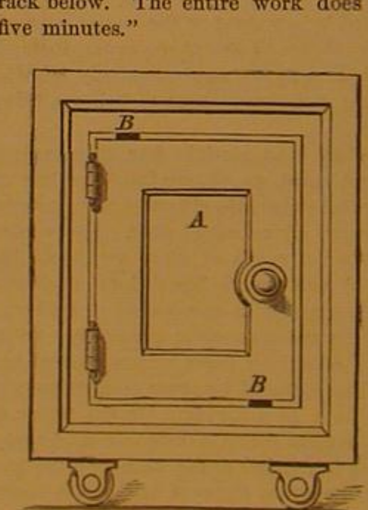
A criminal lately gave to a reporter of the New York *Herald* the following mode of introducing powder within a safe for the purpose of blowing open the doors.

"What tools did you use in drilling the holes?" asked the reporter.

"Good cracksmen don't use tools," answered the burglar. "I'll show you how to blow open any safe in New York without any tools. Just take me to a safe."

There happened to be a safe in Judge Kilbreth's private room, and the writer acquainted the magistrate with the prisoner's proposal. "By all means," said he, "let us learn;" and in a moment the room was filled with spectators.

The prisoner knelt beside the safe, which was locked. "Look," said he, "at this door. Its fits so tightly that no instrument can be introduced in the cracks and powder cannot be inserted. So far so good. The burglar," continued he, "simply sticks putty all along the cracks except in two places, one at the top of the door and one at the bottom, where he leaves about an inch of space uncovered by the putty. At the lower place he puts a quantity of powder and he sucks out the air from the upper place, either by a suction pump, which is the better way, or by his mouth. The vacuum created in the safe draws in the powder through the small crack below. The entire work does not occupy more than five minutes."



The above diagram illustrates the method described. D is the safe door; E E are points left uncovered by the putty. The powder is placed at the lower point, the suction pump at the upper one.

Borax as an Antiseptic.

At a recent meeting of the Pharmaceutical Society, London, Mr. Robottom made some very interesting remarks on the discovery of borax in Southern California, and related a very remarkable and somewhat romantic incident. Traveling on one occasion, weary and unwell, across the bed of what had been at some former period a vast salt lake, and from which some hundreds of tons of native borax are now dug out and obtained, he saw in his pathway the dead body of a horse, and upon it, with but little hesitation, sat himself down to rest. The sun was shining fiercely, and the water he was carrying was hot and unfit to drink. He, however, bathed his temples from the vessel containing it and felt refreshed. Then, with his mind bent on discovery, he commenced a *post mortem* on the body of the horse. To his astonishment, though the temperature around him was almost too high for endurance, he found that no decomposition had taken place, but that, on the contrary, the flesh, as such, was in a perfectly sound and good condition. On inquiry, he was told that the carcase had been lying on the bed of borax, which was immediately underneath it, during the whole of the previous six months. Thereupon Mr. Robottom arrived at the conclusion, and very naturally so, that the borax had been instrumental in preserving the flesh, and in entirely preventing those putrefactive changes which under ordinary circumstances would inevitably have set in. Now if this were really the case, says Mr. W. Willmott, in the *Pharmaceutical Journal*, the discovery would be of much value. "For an account of some excellent experiments, showing the effect of borax on substances readily capable of fermentation and putrefaction, I would refer to a paper by J. B. Schnetzler, inserted in the 'Year Book of Pharmacy' for 1875, page 332. Though, in these experiments, beef, veal, and portions of sheep's brain, were wholly immersed in a concentrated solution of borax, the result was not completely successful. There was no putrefaction, but the meat had an odor *sui generis*. In the case, however, of the dead horse, not only had the borax kept intact the part with which it was immediately in contact, but, inferentially, the whole carcase had been brought successfully under its preservative influence. It is difficult to acquiesce in a conclusion such as this. Borax, in fact, possesses no such power. As an antiseptic it is inferior to boracic acid, whilst boracic acid must yield in turn to carbolic and benzoic acids. And yet meat will putrefy in an atmosphere of the latter though entirely cut off from contact with the outer air. How then, in the present instance, is the preservation of the body of the horse under a burning sun to be accounted for? Presuming the statement of Mr. Robottom's informant to be correct, it would seem to point to the probable truth of the germ theory. It is not impossible that in the wild and untrodden regions of Southern California, beyond and around the Sierra Nevada, the atmosphere, from its extreme and almost optical purity, together with its excessive dryness, causing particles of saline matter from the surface deposits to diffuse themselves through it, might be found incapable of propagating germ life. In an atmosphere such as this, decomposition would be slow, and even the experiments of Dr. Bastian might be reduced to *nil*. But, be this as it may, borax can scarcely exercise its antiseptic power except under the condition of actual contact. If it were otherwise, the grand problem of bringing animal food from the distant shores of Australia would be immediately solved. We might well wish for such a result, and it may be ours in time. In the meanwhile, it is instructive to learn the many and various uses to which borax may be advantageously applied, and at the same time deeply interesting to know that, henceforward, it will come to us in comparative purity, and without stint or limit, direct from the newly discovered saline deposits of the Far West."

Opposition to Machinery.

We are informed, says *Capital and Labor*, that in an eminent coach-building establishment, a short time ago, the principals desired to introduce an American machine for making the wheels. These, of course, have to be prepared and fitted together with the utmost accuracy; and the machine in question secured this so that any number of wheels could be turned out strictly to gauge. Some of the men engaged in this department were ready enough to work the machine, by which their own labor was lightened, and higher wages were secured to them. But as the use of the machine was contrary to the trade union rules, the men were ordered to desist. The machinery was therefore put aside. Since that time wheels made by similar mechanism have been imported from America, this being the only way by which the public requirements for light and strong wheels could be met. It is a curious fact that some of the English carriages exhibited at Philadelphia last year were mounted upon American wheels, which had been sent over from the United States to England, painted, and then returned with the body of the carriages for exhibition. We understand that large numbers of wheels are thus imported, which might have been made in England but for the insensate opposition to the use of machinery.

Cotton and its Spindles.

An eminent cotton firm, in an annual report of the cotton trade during 1875–76, gives the following as the number of spindles in Europe and America, and the average annual consumption of cotton:

	No. of spindles.	Cotton per spindle lbs.	Annual estimated consumption. lbs.
United States	9,600,000	63	600,000,000
Great Britain	39,000,000	33½	1,297,000,000
France	5,000,000	42	—
Germany	4,650,000	55	—
Russia and Poland	2,500,000	[illegible]	—
Switzerland	1,850,000	25	—
Spain	1,750,000	46	—
Austria	1,580,000	67	—
Belgium	800,000	50	—
Italy	800,000	56	—
Sweden and Norway	300,000	65	—
Holland	230,000	60	—
Total spindles	68,060,000		2,906,000,000

or upwards of 6,000,000 bales of the average weight of an American bale.

Ring Sickness.

This is not dissimilar from sea sickness; it requires long experience in a ring to overcome the nausea consequent upon going round and round in one direction. One of the most difficult things for a circus rider to overcome is this sickness. Clowns and ringmasters suffer from it greatly, at first, from merely seeing the horses go round and round; but even after years of experience, a ringmaster (whose principal business in the ring is to keep the horses up to a certain gait, and not merely to give cues to the clown), if a horse balks or gets behind time, and he is obliged to keep close upon him, is very likely to suffer from a pronounced fit of sickness at the stomach after he leaves the ring.

The Patent Office.

The new Commissioner of Patents, having been called upon for a report of the condition of his department by the new Secretary of the Interior, makes an elaborate statement in which important information and suggestions in regard to his bureau are given. General Spear informs the Secretary of many things which some of our readers know; but a few extracts from the somewhat lengthy letter will, we think, be read with interest.

"The force," states the Commissioner, referring to his department, "consists of two distinct classes, the examining and the clerical, with the usual auxiliaries of laborers and messengers.

"The examining corps consists of 22 principal examiners, each having a first, second, and third asssistant; of an examiner of interferences, and an examiner of trade marks. Each principal examiner has charge of a class relating to some one or more kindred subjects matter. Each one of these principal examiners, with the aid of his assistants, examines all applications in his class as to patentability, and decides all questions relating thereto, both of law and fact. His favorable decision is practically final, and the patent issued upon his order. In case of his adverse decision, appeal may be taken to the Board of Examiners-in-Chief. This board consists of three equal members appointed by the President and confirmed by the Senate. Their legal duty is to hear appeals from the adverse decisions of the principal examiners and from the examiner of interferences, to review the decisions of those examiners, and they may affirm or reverse them. From their adverse decision appeal may be taken to the Commissioner in person, or to the Assistant Commissioner acting as Commissioner. * * *

"The duties of the examining corps are partly scientific and partly judicial. They require general intelligence, mechanical aptitude, scientific training, familiarity with the state of the art for each particular class, a knowledge of the law and the decisions of the courts relating to patent matters, a judicial turn of mind, willingness to hear arguments and receive infermation, and firmness to decide adversely to eager applicants. The examiner, in the performance of his duties, is required to make laborious researches in order to ascertain the novelty or the lack of novelty of applications submitted to him. In making the search, he acts the part of prosecuting attorney at the same time. When the search is completed, it is his duty to decide questions, nice and perplexing, as to differences between the processes or machines sought to be patented and those already shown in references in his class. I need hardly add that this duty requires of the examiner an amount of patience, fairness, intelligence, and fidelity not often to be found. And, further, that on the one hand he shall be so sustained that he can act honestly and intelligently, without fear and without favor; and on the other hand, that he shall not be so sustained that he can in security act carelessly or unwisely."

According to the Commissioner's statement, some of the few "fossil" examiners have been removed, and others reduced in rank, which evinces his determination to improve the working force of the Office, which we fully commend. He states as follows:

"A few of the older examiners and assistant examiners were, in my judgment, incompetent for the positions they held, and some have been reduced in grade or discharged since I came into office. In respect to others, I propose to submit recommendations. Many of the older and most of the examining corps appointed since 1869 are able and faithful officers. With respect to them I have but few recommendations to make. In the performance of their difficult executive and judicial duties they need only the incentive that faithful official services will be appreciated. The standard of the examining corps may, and undeniably should be, raised. It is possible on the pay allowed by law (although that pay has not been enough to retain some of the best and most experienced men) as it now stands to elevate the standard of the corps in point of ability, but it is a work which needs to be done gradually. Some of the less able officers have acquired long experience, considerable knowledge of the business, and in some respects render better service than inexperienced though abler men. But they have long since reached their maximum, and their maximum is small. On the other hand, great care is required in the selection of new men."

The clerical force of the Office, which consists largely of ladies who have usually been appointed on personal solicitation, the Commissioner also proposes to sift out, and he will retain only such as are competent to perform the duties required of them. Referring to this force, says the Commissioner:

"Its efficiencies are not up to the standard required by the public interests, nor that which the salaries paid ought to command. The renovation of this force and the elevation of the character of it require time and patience. By carefully sifting out the incompetent and inattentive, I am confident that the Office may be benefited both by the addition of better elements and by better services from those who are retained.

"In respect to reductions, I am of the opinion that the examining corps should be kept up to the maximum allowed by law. The clerical force, I think, may be reduced, when improved in the manner heretofore indicated, and when the method of carrying on the clerical business is changed as I shall hereinafter suggest."

The most important feature, to the greatest number of persons having dealings with the Patent Office, is the examination of applications and promptitude in decisions; and we hope to see the Commissioner more exacting than most of his predecessors have been, requiring the examiner in charge of each class to keep his work up so closely that not more than a fortnight shall intervene in any case, after the application is completed, before a decision is rendered. The long delay in some instances before a decision is made by the examiner is annoying to the solicitor, discouraging to the inventor, and demoralizing to the examining corps itself; and we hope for a reformation in this respect.

"The method of conducting the receipt of applications, examination of cases, and issue of patents," adds the Commissioner, "appears to have been carefully thought out at a very early period in the history of the Office. It works well, is as simple as is consistent with the proper safeguards and checks, and needs no change."

After some suggestions *tending* to facilitate the furnishing of copies of patents, assignments, and abstracts, and a recommendation of the competitive system of examination of applicants for positions, the Commissioner closes his communication as follows:

"There is no need of going far outside the business of the Office to find matter for examination in order to test the fitness of applicants for appointment. I have found by an experience of nearly three years that an examination in matters pertaining to official business, or pertaining to matters intimately connected therewith, is all that is required, not only to test the knowledge of an applicant, but the quality of his mind and mental habits."

Professor Gray's Telephone in New York.

The first puolic exhibition of Professor Gray's musical telephone recently took place at Steinway Hall in this city. This instrument is altogether a different invention from Professor Bell's speaking telephone, which we recently described, as it is adapted only for the transmission of musical sounds. At the concert in which the telephone took part, the operator was located in Philadelphia, over 90 miles from New York, and was in telegraphic communication with Professor Gray on the platform of the hall in this city. Professor Gray made a short introductory speech, in which he said: "We don't exhibit the telephone merely as a musical instrument, but as something wonderful in the science of electricity. It cannot produce as fine music as has been heard here to-night from the other performers, but it can be heard further. It should be explained that this is bad weather for the telephone. It has been raining all day, and the wires are wet, and we shall not get as loud sounds as we might under more favorable circumstances." Mr. Gray proceeded to explain that a good deal of the volume of sound produced in Philadelphia would leak out in its passage through the State of New Jersey, and that those who had bought a ticket of Mr. Strakosch, expecting to be entertained with the music of a full brass band, would be equally disappointed with those who had come expecting to be humbugged. The music was quite audible throughout the room, and sounded like a distant organ, with the difference, however, that the low notes were heard much more distinctly than the upper ones.

The sound of the instrument was rather feeble, but occasionally fine and clear tones were produced. The noise made by the instrument was about as loud as that produced by blowing through a comb covered with tissue paper. It was, however, very distinct and clear, and the tunes it performed were distinguishable. The dampness of the atmosphere decidedly interfered with the clearness of the intonation.

A full description of the Gray telephone, with illustrations, was published in the SCIENTIFIC AMERICAN SUPPLEMENT No. 6; and others showing the scene and the instrument in Steinway Hall, during the recent exhibition, will be published in these columns, in our next issue. The construction of the apparatus is briefly as follows: A tongue of metal is arranged to vibrate automatically between two electromagnets, when the electric current passes. Of course the number of vibrations per second of the tongue is dependent upon its length, and consequently two tongues of different lengths will have a different number of vibrations, which, when translated into sound, will produce different notes. If we have sixteen tongues, then it it evident we may produce all the notes of two octaves. With each tongue, connection is established from a different key on a keyboard, so that, by pressing any key, the current passes and the corresponding tongue vibrates, and in so doing breaks and closes the circuit of the main telegraph wire. Therefore the latter is caused to transmit vibrations perfectly synchronous with those of the tongue; and these pass to an electromagnet at the receiving station, which, instead of an armature, has a steel ribbon stretched on a metallic frame. This ribbon is tuned to vibrate as a particular pitch; and hence if the vibrations which pass over the main wire are in accord with it, it will then and then only be thrown into vibration, and will produce sound. As there are as many receiving instruments as sending ones, it follows that the vibrations of any one tongue may be imagined as searching through all the receiving ribbons until one is found which vibrates correspondingly. In this way any note produced at the sending station is reproduced at the place of reception; and whether one or a dozen or more notes are sounded at once, the vibrations will all disentangle themselves, and each set will affect its correspondingly pitched ribbon. This is a very general description of an exceedingly beautiful invention, the practical value of which lies especially in its adaptation to the purposes of multiple telegraphy.

The Orang-Outang.

"The Zöological Society, London, have again been very fortunate in obtaining two orang-outangs. These interesting beasts are now accommodated with apartments in the keeper's room adjoining the monkey house. They are very funny and about as big as a human baby just beginning to walk. They sit in their box surrounded with flannels, and nestle one against each other like the babes in the wood. Their features are exceedingly human: in fact, I have seen many human faces that are much less human in appearance than these infantine catarrhines, or apes of the old continent. They are covered with hair, long and scanty, and of a deep chestnut red. The ears are very small and well shaped. The orbits of the eyes prominent; the eyes very bright and observant; no eyelashes, but the eyelids are surrounded by a few stiff hairs. The forearms are much longer than the legs; all the hairs of the forearm point towards the elbow, where they unite with those of the humerus, and end in a point. The fingers are very long; in fact, the hand is more like a foot. The thumb is placed parallel with the fingers, and is not of the same service to the animal as the human thumb. All the fingers have nails of a blackish color and oval form, but I believe some have no nail on the thumb.

"It is very funny to see the orang try to walk upright. When he is put on the floor he manages to progress by placing his bent fists upon the ground and drawing his body between his arms. When moving in this manner, he strongly resembles a cripple walking on crutches. In a state of nature, he probably seldom moves along the ground; his whole configuration showing his fitness for climbing trees and clinging to their branches. The length and pliability of his fingers and toes enable him to grasp with facility and steadiness; and the force of his muscles empowers him to support his body for a great length of time by one hand or foot. He can thus pass from one fixed object to another, at the distance of his reach from each other, and can obviously pass from one branch of a tree to another, through a much greater interval. In sitting on a flat surface, this animal turns his legs under him. In sitting on the branch of a tree, or on a rope, he rests on his heels, his body leaning forward against his thigh. This animal uses his hands like others of the monkey tribe.

"The orangs, as they sit in their box, look exceedingly grave and sedate. They have somewhat the physiognomy of an eastern prince who has no end of riches and nothing particular to do, yet fond of being amused by other people. I expect their intelligence is very great. It is a very old story that monkeys can talk if they like, but won't because they would be made to work. It would indeed be a wonderful thing if we could get one of these orangs to articulate even a single word; and I should much like the opinion of one of the clever professors who teach the deaf and dumb people to articulate words.

"It is a curious fact that the adult animals are never taken, or I believe even seen, while the young ones are comparatively common. The parents are, I believe, immense fellows, growing between five and six feet. In the 'Asiatic Researches,' Dr. Abel gives an account of a large orang having been killed by the officers of the brig Mary Ann Sophia, who had landed to procure water at a place called Ramboon, near Touramar, on the northwest coast of Sumatra. This apparition, 'when moving, had the appearance of a tall man-like figure, covered with shining brown hair, walking erect, with a waddling gait.' They managed to hunt him to a place where there were few trees, and they were obliged to cut down the trees before they could drive him to fight on the ground. It is stated by those who aided in his death that the human-like expression of his countenance, and the piteous manner of placing his hands over his wounds, distressed their feelings, and almost made them question the nature of the act they were committing. When dead, both natives and Europeans contemplated his figure with amazement. His stature at the very smallest computation was six feet. He was said to be a full head taller than any man on board, measuring seven feet in what might be called his ordinary standing posture, and eight feet when suspended for the purpose of being skinned.

"It seems probable that the animal had traveled from some distance to the place where he was found, as his legs were covered with mud up to the knees, and he was considered as great a prodigy by the natives as by the Europeans. They had never before met with an animal like him, although they lived within two days' journey of one of the vast and almost impenetrable forests of Sumatra. They seemed to think that his appearance accounted for many strange noises resembling screams and shouts and various sounds, which they could neither attribute to the roar of the tiger nor the voice of any other beast with which they were familiar."—*Frank Buckland, in Land and Water.*

Lime in Agriculture.

Pure lime, where it is not mingled with clay, sand, and other organic and inorganic substances, consists of the oxide of the metallic element calcium, and, entering into the composition of all plants, must occupy a large place in Nature's laboratory. It has an affinity for water and carbonic acid; when applied to the land it absords water, forming hydrate of lime; this hydrate then absorbs carbonic acid, so that lime, although applied to the land in the caustic state, really exists, shortly after its application, in the form of carbonate, along with a little sulphate and phosphate, as previously mentioned. Lime has for a long time been used as a fertilizer; when land previously unworked is brought into cultivation, or when worn-out pasture land is broken up, lime is generally applied. It affects chiefly the vegetable matter contained in the soil, promoting its decomposition, and thus rendering it available as plant food. We, however, find its action important on some of the mineral constituents—decomposing insoluble silicates, the result being soluble.

The Contagion of Typhoid Fever.

The question of the contagion of typhoid fever has been examined by M. Guerin by the experimental method. He injected into a number of rabbits fecal matter from typhoid subjects, and he finds it has a poisonous principle, at leaving the system, capable of causing death. Various other excrementitious products of persons in typhoid fever, such as urine, blood, mesenteric liquids, etc., have likewise this poisonous property, which is retained for several months. It is absent from the fecal matter of healthy subjects.

[*Continued from first page.*]

jammed his helm hard a-starboard, showing that the boat is going about, and thus abandoning the attack until some time when her huge antagonist shall be less wide-awake.

Fig. 2 shows one of the new French torpedo launches, recently built by Thorneycroft in England. She is of steel; and although only 64 feet in length, has attained a speed of 18·85 knots per hour. Her engine is capable of developing 200 horse power. The torpedo employed is charged with 66 lbs. of gun cotton, and its effects are shown in Fig. 3, which represents the stern of an old frigate used in Cherbourg for the experiments. The Paris correspondent of the London *Times* writes concerning these experiments as follows: "This was the first occasion of testing in French waters whether a torpedo could be launched against a ship in full sail. Accordingly Admiral Jaurez, who commands the squadron, ordered a disabled ship, the Bayonnaise, during a rather rough sea, to be towed out by a steamer belonging to the navy. A second lieutenant, M. Lemoinne, was sent for, and informed that he had been selected to make the experiment of launching the Thorneycroft against the Bayonnaise while both were in full sail. He accepted the mission without hesitation, picked out two enginemen and a pilot, and went down with them into the interior of the Thorneycroft, of which only a small part was above water, this visible portion being painted of a grayish color, so as to be easily confused with the sea. The torpedo was placed so as to project from the bow of the vessel, at the extremity of which were two lateen sailyards about 10 feet in length. The towing steamer then took up its position in front of the squadron, and the Thorneycroft also assumed the position assigned for it, an interval of three or four marine miles separating the torpedo and the Bayonnaise.

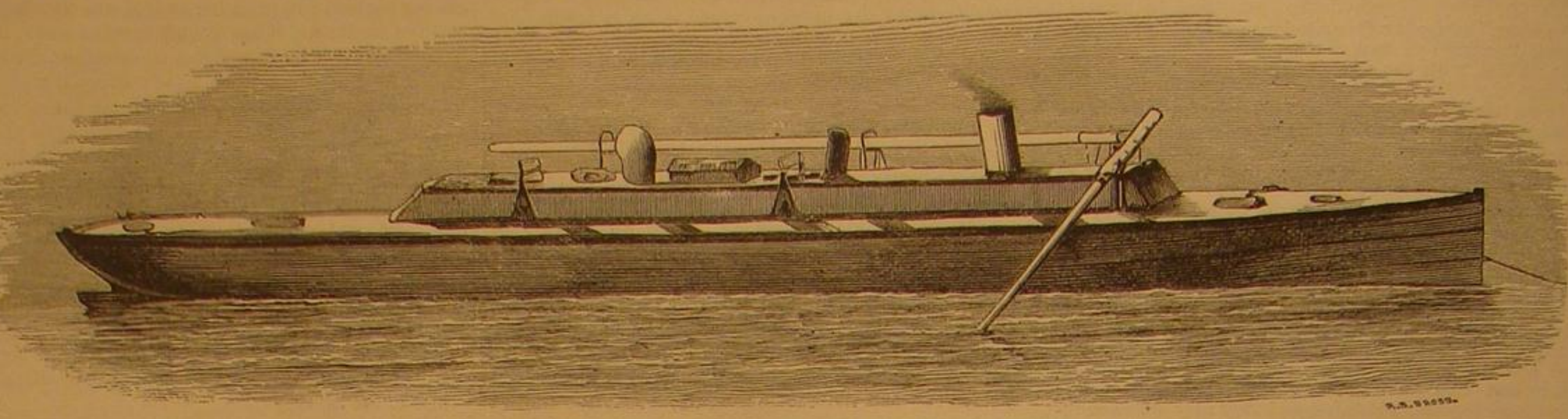


Fig. 2.—THE THORNEYCROFT TORPEDO LAUNCH.

"On a signal being given, both were set in motion, the steamer advancing in a straight line, and the Thorneycroft obliquely, so as to take the Bayonnaise in flank. The steam tug went at fourteen knots an hour, going at full speed in order to escape the Thorneycroft. The latter went at nineteen knots an hour, a rate not attained by any vessel in the squadron. The chase lasted about an hour, the squadron keeping in the rear so as to witness the operations. At the end of that time the distance between the Thorneycroft and the Bayonnaise had sensibly diminished, and at a given moment the former, in order to come up with the latter at the requisite distance, had to slacken speed to eight knots an hour. The whole squadron watched this last phase of the struggle with breathless interest, and people asked themselves whether the shock of the torpedo would not infallibly destroy the little vessel that bore it. It was feared that the lives of the second lieutenant, Lemoinne, and his three companions were absolutely sacrificed. However, the two vessels got visibly nearer.

"All at once the Thorneycroft put on a last spurt, and struck the Bayonnaise with its whole force on the starboard bow. The sea was terribly agitated, a deafening report was heard, and the Bayonnaise, with a rent as big as a house, sank with wonderful rapidity. As for the Thorneycroft, rebounding by the shock about 50 feet, even before the explosion occurred, it went round and round for a few moments, and then quietly resumed the direction of the squadron. No trace remained of the Bayonnaise; it was literally swallowed up by the sea."

The best mode of defence against torpedo launches lies in the electric light, which renders them visible when approaching at night, even at quite a long distance away. Our engravings are selected from the pages of *L'Illustration*.

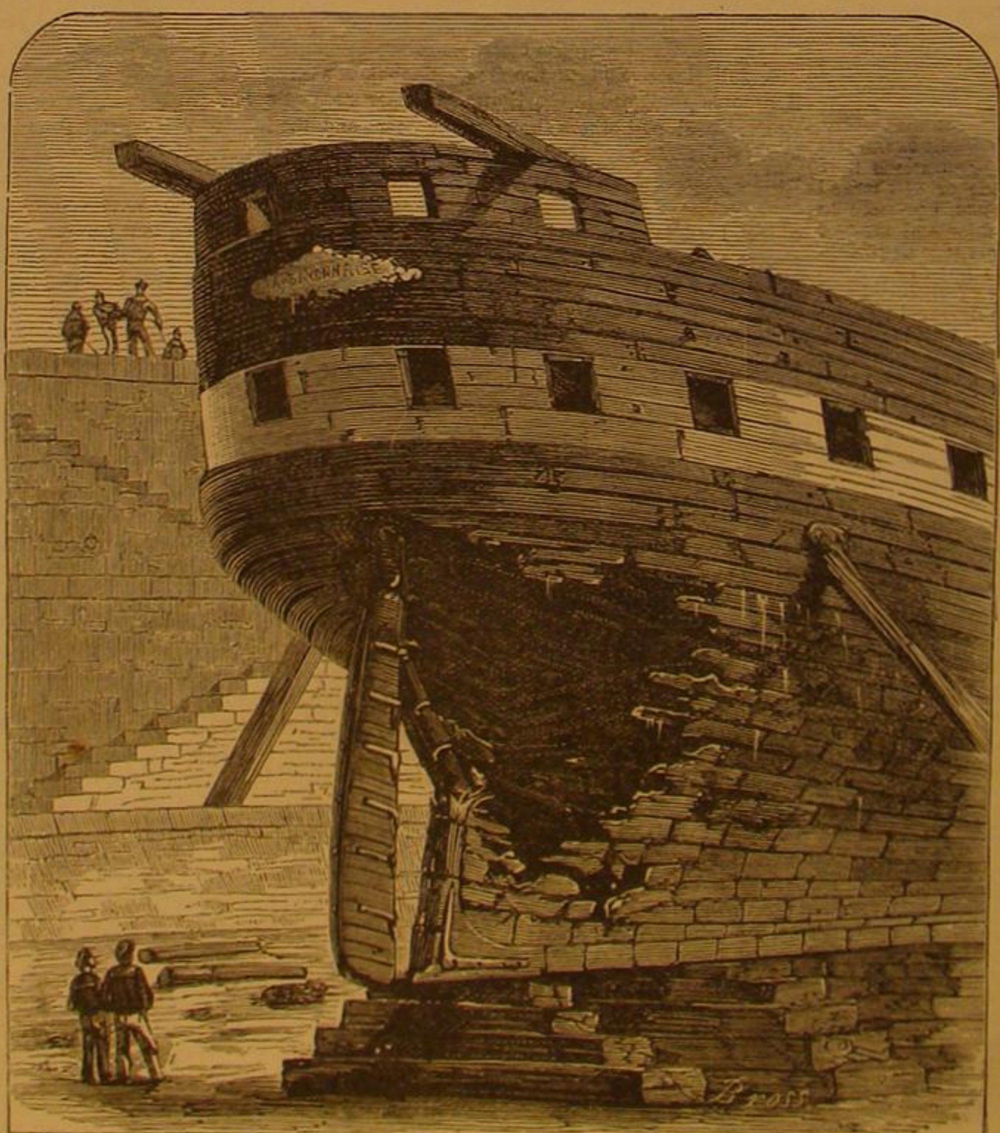


Fig. 3.—EFFECT PRODUCED BY A TORPEDO.

Preservation of Milk.

If milk is kept in ice water at 33·8° to 35·6° Fah., it will continue sweet and unaltered, M. Soxhlet states, 14 days. In one experiment it began, after 17 days, to taste a little rancid; this taste increased till, after 28 days, the milk became coagulable with boiling, and even coagulated in ice water.

Considerable quantities of volatile fatty acids were formed through oxidation of milk fat in the air. This acid formation is completely different from the lactic acid formation which occurs through decomposition of the milk sugar by an organized ferment at high temperature, but is prevented by the low temperature of the Schwartz process, while the oxidation through cold is not hindered, but takes place, though slowly.

Air Suspended in Water.

Some curious experiments with regard to the suspension of water in air have been brought before the French Academy by M. de Romilly. For example, take a bell jar and cover the mouth with net. Place the mouth horizontally in water, and suck up some water into the jar by means of a tube inserted in the upper part, and furnished with a stopcock. If you now close the stopcock and raise the jar, the water will remain in the latter, a meniscus being formed at each mesh of the net, along with a large general meniscus. In a similar arrangement, M. de Romilly succeeds in even boiling this suspended water, by placing a flame under the net (which in this case is metallic). The jar is here made to communicate with another jar placed in a vessel, the suction tube acting through this second jar.

Improved Method of Laying Concrete under Water.

BY JOHN C. GOODRIDGE, JR., OF NEW YORK CITY.

In the ordinary method employed in laying concrete under water it has been considered necessary to use broken stone and coarse gravel with cement. This material thus mixed has been thrown directly on the water, which was inclosed to prevent washing away the cement, or has been dumped from boxes prepared for the purpose.

I have found, by repeated experiment, that it is impossible to obtain a good result from such a mixture. The varying velocity with which bodies fall through water is owing to their different specific gravities. If stone of a specific gravity of 2·5 is used with a cement of 1·4, the stone is in its descent washed entirely free from the cement, and is deposited on the bottom, while the cement, held in partial suspension, and moved by every new addition of the mixture, is finally deposited above the stone and gravel, after being rendered inert by the washing of the water.

My improvement consists, first, in rendering the water (which is inclosed in water-tight compartments or coffer dams, to prevent any motion or current that may allow the escape of the concrete) strongly alkaline by the addition of a sufficient quantity of air-slaked lime. This renders the water less apt to hold the cement in suspension, and causes a more immediate precipitation of the cement. It also causes the concrete to attach itself the more firmly to adjoining masonry; second, sand, clean, sharp, and of fine grain, is selected, and as near as possible of the same specific gravity as the cement, which is about 1·4, and weighing about 88 lbs. to the cubic foot, and carefully mixed with cement.

A good proportion for general use is three parts of sand to one of cement. The proportion may be varied, depending on the strength required of the concrete. In this proportion it requires 4·25 cubic feet of dry cement and 12·75 cubic feet of dry sand to make 10 cubic feet of concrete, measured after being laid in place. The sand and cement are then mixed with water. Sufficient is added to make it thinner than is used in the plastic bétons, yet not watery or thin enough to run, as used in ordinary concrete. A quantity of this mixture should then be placed on an incline, where it should be allowed to lie for a short time until the cement has formed a slight bond with the sand —five or ten minutes—varying with the quickness of the setting of the cement, and then the whole mass should be allowed to slide slowly down the incline or inclines, the bottom of which should be placed in the water, and the concrete evenly distributed by any suitable means.

A large mass should be collected before depositing, in which case the greater portion of the concrete does not come in contact with the water. Succeeding batches are prepared and deposited in the same way, and the process is continued until the space to be occupied by concrete is entirely filled.

Béton so deposited under water needs no ramming. The grains of sand close together with their irregular interstitial spaces filled with concrete. We have then a homogeneous compact mass, weighing about 144 lbs. to the cubic foot, and a specific gravity of about 2·3, and capable of having a crushing strain of over 6,000 lbs. per square inch, and a tensile strength of over 300 lbs. per square inch.

An iron wash for woodwork can be made by taking fine iron filings 1 part, brickdust 1 part, and ashes 1 part. Put them in glue water, warm, and stir well together. Use two coats.

CENTRAL AFRICAN HABITATIONS.

Commander Cameron, R.N, whose famous journey across Africa has proved so rich in valuable additions to our geographical knowledge of a little-known portion of that continent, gives, in the record of his travels, the sketches from which the annexed illustrations are made. Both represent discoveries which will afford an excellent idea of the ethnological importance of a study of the people of Central Africa and their habits.

Fig. 1 represents the curious village of Manyuema, where the explorer found the houses arranged in regular streets, and the latter kept scrupulously neat and clean. The inhabitants, although cannibals, are much more civilized than their neighbors, and appear to be a conquering race which has enslaved the tribes of the vicinity. They are skillful iron workers, and erect furnaces which show considerable inventive ability.

Fig. 1.—THE VILLAGE OF MANYUEMA.

It is well known that, in prehistoric times, whole villages were often constructed on piles, above lakes. Relics of these dwellings have been abundantly found, belonging to extinct peoples representing all stages of civilization, from the age of stone down to the dawn of the iron age. It is not understood why the ancients adopted this form of habitation. Protection from hostile tribes, safety from wild beasts, and convenience in fishing, have all been suggested; but there are reasons which go to show that none of these explanations are entirely satisfactory. Commander Cameron has found the same species of dwellings in use on Lake Mohyra, in Central Africa, and in Fig. 2 one of the huts is represented. The inhabitants are excellent swimmers, and, although provided with boats, frequently take to the water in preference to using them.

The lake dwellings of which our engraving gives a specimen are to be found in all parts of the world. The oldest known are in Switzerland, and in that country they have been thoroughly explored. They are of two kinds, those built of fascines and those built on piles. Those of fascines were commonly used on the smaller lakes of Switzerland, and wherever the bottom was too soft to hold a mass of piles firmly; those of piles were built in deeper water, where the waves would sweep away a foundation of fascines. Lake dwellings as old as the stone age are found in some parts of Russia, and in Borneo and the Malay archipelago, as well as in Africa. Herodotus mentions them on Lake Prasias, in Thrace; and as these were connected with the shore only by a single narrow bridge, the inhabitants were enabled to defy the troops of Darius. Each family occupied one hut, and caught fish by letting a basket down through a trap door.

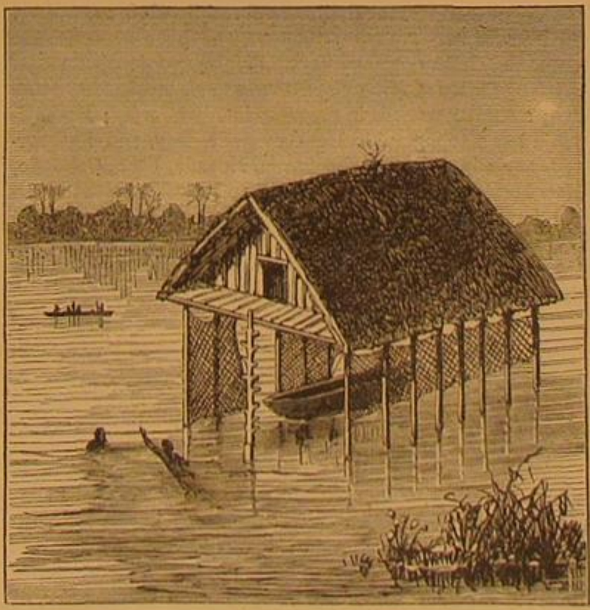


Fig. 2.—AFRICAN LAKE DWELLING.

In Switzerland, large settlements of lake dwellings have been discovered in Lakes Zurich, Constance, Geneva, Neufchatel, and others; and from one in the little lake of Moosseedorf, near Berne, a vast quantity of very interesting relics of the stone age have been found, together with weapons and implements made of teeth and horns of animals, and fragments of pottery. A lake village at Robenhausen, in the Canton of Zurich, contains numerous dwellings, and it has been estimated that 100,000 piles of oak, beech, and fir were used in its construction; and three different sets of piles indicate as many different periods of construction. Wheat, barley, burnt apples and pears, beech nuts, cherry stones, fragments of cordage, and cloth of flax and bast, and stone relics, were found here in great profusion.

Similar structures have been found also in the lakes of Scotland and Ireland.

Shams.

If there is any special curse under which the world at large, and our own country in particular, is laboring, it is that of *sham*. Both directly and indirectly, shams effect an injury; and this injury is both material and moral. It is, however, hardly supposable that the latter aspect of the case will nowadays have much attention paid to it; society seems calloused, and, possibly, the only way in which shamming can be made unpopular is to show that it is unprofitable. To show that shamming and shams are also in very bad taste, as well as being dishonest, would be quite easy; but it seems as though the high road to man's reason lies through the pocket. Shams are uneconomical in most instances. The desire to appear better than facts warrant leads, in nearly every case, to a sacrifice of some cardinal merit. Thus the textile fabric of a given material, weight, and strength may be combed up, or filled in, or highly calendered, until it simulates a nobler material, has a greater weight and bulk, and assumes a more costly appearance; but the first operation weakens the fibre; the second renders it brittle; the third takes the life out of it. The "doctored" fabric neither wears as long, nor looks as well after a short use, as though untampered with. In furniture, the attempt to imitate elaborate carving has lead to, and in fact encouraged, weak and unworkmanlike construction. The present style of building offers a premium on slight in hidden work; and we find houses in which our grandparents lived unpretending lives, outlasting those which we ourselves put up.

Professional and "practical" (?) men, devoid of, and in many cases incapable of receiving, the proper training, have intrusted to them our lives and our property; and by their ignorance endanger them both. Instruction is given, or pretended to be given, and yet where (by some rare chance) solid and practical studies are undertaken, they are slurred over so that when the time comes when we need them, the facts or rules which should be "at hand" are forgotten, if indeed they were ever learned. Vessels are built of poor iron, and commanded by poor officers; they go down, or run ashore and break in the middle, and the account of "profit and loss" has an entry, running more or less into the hundreds of thousands, on the debit side.

Patent attorneys, of more or less enterprise and "cheek," procure patent papers with big red seals thereon, and fob their clients' (or victims') money; and when the time comes to test them, any one can drive a triumphal chariot of infringement through the claims and never ruffle a plume.

Bridges with any amount of ornamental work and stylish paint (in showy places) are thrown across streams or chasms, and over them heavy trains are thundered, until some cold still night a chord snaps and travelers' wives are widowed by the score, and everybody shudders—and goes on shamming and being imposed on just the same as ever.

A theater has a gaudy domed ceiling which shows deep and heavy panelling, frescoed in the highest style of the art —a flash and a blaze and a quick licking of flames, and the whole disgusting sham curls up and drops upon a panic-stricken audience, and the entire tinder-box of a man-trap crackles and falls, and in it are the sickening corpses of a happy unsuspecting throng; all the world is horror-struck, and inspection is rife, and committees rampant for a term of days; and now we all go into sham theaters the same as ever; attend sham churches and pray to be delivered from lying and hypocrisy; as if half the columns and mouldings were not flat and downright lies, and most of the brown stone fronts simply paint and sand or thin veneer. To be sure, the "columns" scale off and look ridiculous, and have to be renewed, and the brown stone fronts get measly if shammed with paint, or if of thin sheets, buckle out and tumble down and kill a passer-by now and then; but then paint can be renewed, and there are plenty more passers-by in the world. A split pin or a key is left out, or insufficiently driven home, and a flaw in a bedplate is filled up and painted over, in a piece of heavy machinery run at a high speed; and some day there is a thud and a crash, and castings are broken, and forgings twisted, and six or eight thousand dollars' worth of damage done; and every one stands round in sham shoes and wonders how it happened. A large percentage of patents granted is for "substitutes," as though there were not sufficient fertility in lying, and enough originality in covering the lies up, without protecting the—the —(well, we might as well say it) the liars.

A prominent Methodist divine once rode from Washington to San Francisco on a free pass granted to his brother, and made out in his brother's name. He afterwards "hoped the Lord would forgive him for *telling a lie three thousand miles long*." But there is not a city in our land in which there are not lies covering acres of ground and towering up stupendously in their magnificent pretension; sheet iron lies, pretending to be granite; cast iron lies passing themselves off for marble; and plastered brick lies, shamming sandstone; and in them merchants are selling cotton velvets, and baryta paints, and fusel oil whiskey, and leaded "tinware," and soap loaded with water, and all kinds of abominable shams; and we (bless our dear unsuspecting, unmindful souls!) enjoy it all immensely, and keep on stealing from our right hand pockets to put into the left, and then boast of our superior acuteness and progress. And the devil, or whoever else it is that gets a share of what we waste and a dividend on all that we cheat ourselves out of, looks on and laughs, and pockets the income brought him by *sham*. And, doubtless, as long as we can stand it, he can. But how long can we stand it?—*Polytechnic Review*.

April Management of Bees.

Mrs. E. S. Tupper tells the readers of the *Bee Keeper's Magazine* how to treat bees during this month (April), to produce the best future results. She says:

In all places near timber, bees find natural pollen now, in average seasons; and if the colony has a prolific queen and they have honey or are fed, the brood should be abundant and young bees appear fast. This state of things should be encouraged, and then you are sure of good working colonies. Where bees are thus doing well, empty combs may be added from time to time, as fast as hatching bees are plenty enough to cover the brood. We have in early seasons and in strong colonies had comb built to some extent in April. Two years ago we gave comb foundations to several colonies in April, feeding them quite liberally with diluted honey, and we had ten full combs completed in the hives in eight days. We found always a great gain in using the comb foundations.

Usually no comb is built until much warmer weather than we have in April, and we attribute our success then to the heat generated by a very large number of bees in hives very tight. We would always take care to have the quilts, blankets, or mats snugly tucked in and the entrances quite small, so that all the heat possible may be maintained.

If there are wild cherry trees near your bees, they should not be allowed to store honey in boxes or frames while the bloom of these trees continued. We have seen honey that was unsalable from wild cherry flower.

If it is intended to multiply colonies this year, by the last of April it is well to begin raising surplus queens to be ready for the season when dividing is in order. Our way to do this is to take combs from the best and most prolific queen we have, with brood in all stages in the cells, and plenty of young adhering bees with them. Two of these combs will do, but three or four are better. Put these in an empty hive (a small one if you have it), and take it to a dark cellar or bee house for a few days, taking care of course to supply it with syrup or diluted honey. You can set it where you please when taking it from the cellar, for the bees will mark their location. They will start a number of cells, and these may be used for forming new colonies, or the cells may be preserved in nucleus hives until fertilized and the queens be used. Young queens are of great value in dividing; and you should begin in season to rear them.

Plants and Insects.

Sir J. Lubbock, M.P., recently delivered a lecture at the Society of Arts, London, on "Certain Relations between Plants and Insects." The lecturer said that he would endeavor to bring before them in a condensed form what was known in regard to the importance of the functions which insects performed for plants, and the attractions which plants provided for the insects. Neither plants nor insects would be what they were but for the influence of the other; indeed, some plants were altogether dependant on the visits of insects. He thought that there was no doubt that, as Sprengel originally suggested, the true use of honey to flowers was to attract bees and other insects. Ants, however, were also very useful to plants in destroying caterpillars and other injurious insects which fed upon them. M. Foret watched from that point of view a large nest of *formica giratensis*, and he found that the ants brought in dead insects—small caterpillars, grasshoppers, etc.—at the rate of 28 per minute, or 16,000 per hour: which, when it was considered that the ants worked all day, and sometimes during summer weather all night, it would be easy to see what important functions they fulfilled in keeping down the number of small insects. Some of the most mischievous of the class of small insects—certain specimens, for instance, of aphis and coccus—had turned the tables on the plants, and converted the ants from enemies to friends, by themselves developing nectaries and secreting honey, which the ants loved. They had all seen the little brown ants running up the stems of plants to milk their curious little cattle, and by the adoption of that ingenious idea not only did the aphides and cocci secure immunity from the attacks of the ants, but even turned them into friends. They were subject to the attacks of a species of ichneumon, and M. Delphine had noticed the ants watching over them with a truly maternal vigilance and driving off the ichneumons whenever they attempted to approach. Certain plants would produce no seeds at all unless they were visited by insects.

In some of our colonies the very useful common red clover will produce no seeds on account of the absence of humble bees. The same remark applied to the non-production of seeds from the scarlet runner in Nicaragua. Even in cases where it was not absolutely necessary, it was better that the plant should be fertilized by the pollen from another flower. Ants if they left one plant generally crept to another of the same kind; but cross-fertilization was wanted for flowers, and hence they required insects which readily flew from one flower to another. Even in the case of many small plants, such as crucifera, composita, saxifragæ, which might well be fertilized by ants, the visits of flying insects were much more advantageous. Moreover, if the plants were visited by ants, not only would they deprive them of their honey, but they would destroy the bees. If an ant was touched with a bristle it would turn round and bite it with its horned jaws; if, then, the delicate proboscis of a bee was bitten by an ant in the same way, its power of procuring honey would be quickly destroyed altogether.

The lecturer gave instances of plants and flowers which were naturally protected from ants by their natural formation, in some cases the stems being covered with bristles, in others being "sticky," thus preventing the ants from creeping up them. That was the case with plants which bore horizontal or upright flowers. In other cases the ants could readily reach the outer leaves of flowers which were pendulous, but could not get at the honey, or if they attempted would generally fall to the ground. Among the former class of plants were the *lamium* and the *carlina vulgaris;* among the latter the snowdrop, the cyclamen, etc.

The lecturer next called attention to several varieties of "sleeping flowers," some of which slept during the day, others during the night, opening and closing at different periods of the day or night, and said that he thought that the explanation was due to the fact that bees and wasps were flying about very early in the morning, while the ants did not come out till the dew was off the grass, and therefore could not get at flowers which were by that time closed.

Passing to the second portion of his lecture, Sir John said that the larvæ of insects taught many instructive lessons. It would, in fact, be a great mistake to regard them merely as preparatory stages in the development of the perfect insect. They were much more than that, for external circumstances acted on the larva as well as on the perfect insect, and both therefore were liable to adaptation. The modification which insect larvæ undergo might be divided into two kinds, namely, "developmental," or those which tended to approximation to the mature form; and "adaptational" or "adaptation," namely, those which tended to suit it to its own mode of life. Some of the larvæ were very dissimilar in their perfect form, others were not much altered in their ultimate shapes. Among the former class were the larvæ of moths, sunflies, and beetles. Among the latter class were the centipede, the weevil, the sitaris, the anthran, etc. The classification of insects founded on larvæ would be quite different from that founded on the perfect insects. It would puzzle a very good naturalist to determine the species of ant larva; while the larva of butterflies and moths was as easy to distinguish as the difference in the perfect insect was palpable. The lecturer proceeded to explain the different species of caterpillars: that their outer coatings, varying from dark brown to light green, and spotted and striped specimens with shades of various hues, had in each instance been provided with such colors for the purpose generally of being almost indistinguishable on the flowers and plants which they affected. In one or two cases, indeed, the reverse was the case, inasmuch as a striking contrast was created; but in those instances the insects were unfitted for the food of birds, who could thus easily distinguish and avoid them. Much, however, yet remained to be discovered; but, in conclusion, he might say that in the insect kingdom there was not a hue, or spot, or color which did not serve some purpose or perform some function, or which was not of some use in the economy of Nature."

Surveying the State of New York.

The report of the Board of Commissioners of the State Survey, for the year 1876, has just been issued. In it the necessity for a thorough survey of the whole State is pointed out as a measure of economical value to the people. The report says:

"The officers of the survey found, in intercourse with the people in those sections which were visited, that there were evils growing out of the prevailing ignorance with regard to the topography of our State, which exceeded anything before suspected. We learned that large numbers of our citizens, a great proportion of whom were women; and persons dependent upon small estates had been induced to invest their property in railroad stocks or bonds which had proved to be of little or no value, and that these investments were made upon solicitations and statements which would not have been listened to if the maps and surveys of New York had given any idea of the character of its surface. If these maps had shown our people the relative heights and positions of our hills and valleys, and the natural channels of commerce, they could not have been induced to invest their money in projects so placed that failure was inevitable. Had there been but a fair knowledge of the hills and valleys of our State, these disasters never could have happened. Our citizens would have been protected against reckless or fraudulent enterprises, as the people of England or of Switzerland are protected, by maps and surveys which show at a glance the character of the country, and to which it is their practice to refer whenever they are solicited to invest in this class of public improvements. We have already discovered several instances where roads have been carried over hills at a ruinous cost, not only of construction but of operation, where valleys might have been followed at comparatively small expense, and which would have furnished a larger and more profitable traffic.

"As illustrating the grossness of these errors, we find that on our best map Buffalo is placed about three miles from its true position, Elmira about three miles, Ogdensburgh half a mile, Syracuse a mile and a half, Plattsburgh three miles, and similar misplacements wherever tests have been applied. Lake Champlain is laid down from a survey made before the Revolution. Recent measurements show that, with respect to distances of twenty miles on the lake, the maps are in error as much as three miles. The maps of New York we find to be worse than those of any other civilized country of equal wealth. Even Japan has a rough triangulation of her territory a hundred years ago, and has now a more accurate work of similar character in progress under American officers. Every European government has executed a careful survey of its territory based upon triangulation, not because they are richer than we, for Switzerland and Sweden are poorer, but because they are wiser than we, and have observed the waste that follows bad surveys and false and deficient maps. A triangulation of Massachusetts was made nearly forty years ago; a similar work is in progress in New Jersey; Pennsylvania has a topographical survey under way, and like surveys are advancing in California, Nevada, Utah, Colorado, New Mexico, and Wyoming. When New York attains distinction as the worst mapped wealthy State in the world, it is time to consider whether this marked deficiency has not already produced serious evils, which are generally felt, even though their cause is not understood.

"For these evils we propose the same remedy that other governments have tried with perfect success—a trigonometrical survey. By this means points about ten to fifteen miles apart should be exactly determined in position throughout the State, the work being verified by reference to the surveys of the general government. This system of points, perhaps twelve miles apart, will form the principal triangulation of the State survey, and every effort will be made to have both the courses and distances between stations known with utmost precision, and to have them marked with monuments which will remain for many generations. This is usually done by burying below the frost line an earthen jar of peculiar form and marking, with its center at the point to be preserved, while directly above it is placed a stone squared and marked with the number of the station, and projecting enough above the surface of the ground to be readily found. These principal stations would be placed upon prominent hills overlooking the neighboring country. Where principal stations are too far apart for convenient use in local surveys, secondary and tertiary stations must be fixed by trigonometrical measurements from the principal stations. These secondary and tertiary points would also be preserved by underground marks and surface monuments of cut stone. Their distances apart would be determined by the character of the local surveys to be based upon them, being nearest together where land is most valuable. Those familiar with the subject well know that such points and lines can never be lost. They form an enduring base upon which each county or town can found special surveys of any degree of precision. All property lines or public boundaries measured and referred to the State survey points will be permanently fixed. The use of the magnetic needle will no longer be necessary, since the course of every line will be astronomically determined, and the accuracy of surveys can be tested by connecting with two or more of the State monuments.

"An annual appropriation of $20,000 for ten years will, we think, complete a State trigonometrical survey in such a manner as to furnish accurate bases for local surveys throughout the State in every town where they are needed, and secure the corners of the counties. This estimate is based on careful examinations during the summer, and has been compared with the cost of surveys elsewhere."

Paralysis in the Peas.

The London *Punch*, alluding facetiously to the popular scare on poisonous canned peas, adds a few lines of chemical fact worth remembering. Beware, says the writer, how you try the effect of strychnine, prussic acid, or any other poison, on a rabbit or a guinea pig. Have the fear of the Anti-Vivisection Act before your eyes. If you want to try experiments with poisons on a living animal, try them on yourself. Should you kill yourself, unintentionally, the law will acquit you of suicide, as it does not forbid any donkey to experiment on a donkey. Suppose, for instance, you want to know what is the effect of repeated small doses of copper upon the human system, take a fraction of a grain of the sulphate or acetate of that metal once a day continually till you discover. Ultimately you will find it produce paralysis. You will lose the use of your hands or legs, or one side, or more, of your body. Salts of copper will paralyze you sooner than even salts of mercury. But you must take them in minute quantities. In large doses they mostly rid you of themselves—copper acting like antimony. In order to take your copper pleasantly, your best plan will be to swallow it at dinner time, daily, along with green peas. This you can do all the year round, as peas are always to be had preserved in tins. You can mix your copper with your peas if necessary. If the peas are of a dull, grayish, faded, ugly color, there is probably no copper in them, and you may have to put some. But when their tint is a beautiful bright green, then you may suspect that there is plenty of copper in them to cause paralysis if persevered with sufficiently long. The copper is mingled with the peas to make them look pretty; and few people seem to be deterred by the fear of poison from preferring pretty-looking peas to plain ones. It is possible, however, that it may become rather less easy than it has been heretofore to procure tinned peas, which besides being tinned are also coppered. Several foreign provision dealers have lately been summoned before Mr. Knox, and, on medical evidence, fined for selling tinned peas containing copper in dangerous quantities. As they sold them in ignorance, they have been let off with nominal fines, but in future venders of coppered peas may expect to incur a penalty of $250 for each offence—and have to pay. Of course the multitude ignorantly eating peas greened with copper must be, all of them, greener than any peas. Bright green tinned peas may always be suspected of containing copper. If there is any question on that point, it may be summarily settled by pouring on the peas a little strong liquid ammonia, which, if copper is present, will make them turn bluer than even their seller will look when he is fined $250. So also with pickles, only the vinegar of the pickles will require a large excess of ammonia. In case there is no ammonia or other means at hand of determining whether the greenness of peas or pickles is owing to copper or no, a philosopher would give copper the credit of the color, and himself the benefit of the doubt.

A New Photo-Sculpture Process.

In the United States Army Department at the Centennial, there was exhibited a handsome model of the Rock Island Arsenal. It is to be regretted that this work of art did not bear some description as to the manner in which it was produced—an explanation of which we find for the first time in the recently issued report of the Chief of Ordnance of the United States army. From the various buildings, it appears, positive photographs were obtained, representing all their different sides. Each view was then exposed over a thick film of sensitized gelatin covering a glass plate, and afterwards the soluble, opaque portions of the gelatin were washed out. The film was then swelled by a peculiar process, so as to magnify its differences of level, until a suitable relief was obtained; and a plaster cast being taken of the film, it gave a permanent mould from which many repetitions could be made. A successive series of these plaster views, taken from the different sides of a house, were mitered together at their edges; and when roofed in, they formed a perfect reproduction of the house itself, every stone and crevice being represented. In one building, the slats of a lattice work around the piazza were plainly exhibited, in lines not over 0·006 inch in width. The model was made by Baron F. Von Egloffstein, of this city.

Evaporation of Nitroglycerin in Dynamite.

According to recent investigations of Captain Hero, of Vienna, it appears that a specimen of dynamite made in 1871 lost in five years 2·2 per cent of its nitroglycerin, and another sample manufactured in 1872 lost in four years 1·52 per cent, through evaporation. The conclusions are that regular times should be fixed as limits for the employment of dynamite supplies, and that, when the material is kept beyond these periods, it should be replaced by fresh. It is also suggested that, to allow for this loss, a larger proportion of nitroglycerin than the percentage now employed (ranging from 71 to 78) should be introduced in dynamite.

The Niagara Railway Suspension Bridge.

Messrs. W. Milnor Roberts, Chief Engineer N. P. R. R., T. E. Sickels, Chief Engineer U. P. R. R., and W. H. Paine, Assistant Engineer New York and Brooklyn Bridge, who were lately employed to examine the Niagara Railway Suspension Bridge, and to report upon its state and stability, have concluded their labors. They report that they first examined carefully those portions of the bridge supposed to be defective, and found, at the anchorages where the strands are separated and pass to and around the shoes, some of the outer wires somewhat corroded with rust: particularly at the first anchorage opened, where eight or ten wires were corroded quite through.

All of the badly rusted portions of the several wires have been removed until perfectly sound wires were found underneath. The portions removed have now been replaced by splicing a new piece to each individual wire under the strain due to the weight of the bridge.

The state of the strands now at this anchorage, and the general condition of the strands at the other anchorages, lead them to the opinion that there is at none of them a diminution of strength from corrosion of half of one per cent, which is as little as might be expected in any iron bridge structure standing the length of time this has stood; and it is to be noted that the oxidation of the wires has not taken place in the main cables between the towers, but at the extreme shore ends near the shoes where the strain is less than it is elsewhere.

Careful tests have proved conclusively that the wire has lost none of its original strength from the strains to which it has been subjected, and there is no reason to believe that the bridge is now less capable of carrying the usual trains or the test load which was at first imposed upon it.

During the examinations they carefully noted that the action of the bridge under passing loads is normal; and as the heaviest locomotives and trains of eight or more loaded freight cars during this period were constantly using the bridge, they had excellent opportunities of observing their effect.

A further report, accompanied with drawings, is to be submitted at an early day, in which will be stated in detail the examinations that have been made and the results of numerous tests of the strength of wire from the cables.

Effect of Sunlight on Flour.

It is maintained, says *The Millstone*, that the inferior quality of certain kinds of wheat and rye flour is frequently due to the action of sunlight on the flour; even when in bags or barrels the gluten experiences a change similar to that occasioned by heating in the mill. The tendency thus imparted to it, to become lumpy, and to form dough without toughness, is similar to that of most grain, or of flour when it is too fresh, or made from grain ground too early, or when adulterated with cheaper barley meal. Such flour can be improved by keeping some weeks.

Recent American and Foreign Patents.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED HAME FASTENER.

Tunis H. Poland, Farmersville, Collin County, Tex.—This hame fastener comprises a pair of plates and a set of gradulated links. Upon one end of the strap is formed an eye or hook to receive the hame loop. Upon the other end is a hook, to be hooked into one or another of the links. This fastening can be readily fastened and unfastened without taking off the gloves, and with cold and benumbed fingers, and when fastened will hold the hames securely. This invention is for sale. For terms, etc., address the inventor as above.

IMPROVED BRUSH.

Lewis Uitz, Nora Springs, Iowa.—This consists of a brush head, with a recessed bottom and side lugs, in connection with a broom whisk fastening wire, that is wound around the head and the whisk ends, and retained by lugs and suitable end fastening.

IMPROVED SLATE.

George S. Velez, New York city.—The object of this invention is to provide an improved device for facilitating and expediting the multiplication of larger and smaller numbers by the assistance of mechanical means. It consists of a slate with a sliding slate rule, guided in a slot or recess of the slate, and worked in connection with the graduated or subdivided edges or the adjoining slate sections.

IMPROVED BAG FASTENER.

Constantin Lazarevitch, Brooklyn, N. Y.—This invention consists in a rectangular frame of metal sewed to the mouth of the bag at one side. It is shorter than the width of the bag, and is provided with buckle-shaped catches at its lower side near each end, which are each provided with a number of bars. A bar of metal having formed upon it two hooks capable of engaging with the bars of the buckle-shaped catches is sewed on the side opposite the rectangular frame. The parts are so arranged that the loose sides of the mouth of the bag may be folded in upon its contents, and the rectangular frame closed over the loose sides of the mouth. The bar having the hooks is closed over all in such a manner as to draw the side against the rectangular frame, and is then hooked to the buckle-shaped catches.

IMPROVED BALE HOOK.

Henry Hauschildt, New York city.—The object is to provide for the handling of bales an improved hook that is rigidly connected to the handle without working loose therein, or injuring the hand of the workman using it. A cross pin is passed through a longitudinal hole of the handle, and an eye of the shank end of the hook. The shank end may be threaded and screwed into a screw socket of the handle, the key being also threaded at the end and screwed into the wood of the handle at the side opposite to the longitudinal entrance hole of the key.

IMPROVED COMBINED COLLAR AND HAME.

Ezra Strood, Riceford, Minn.—This relates to an improved collar and hame combined, which may be fitted in flexible and easy manner to any size of neck of a horse, and which admits the adjustment of the draft on the hame, and the convenient opening and closing of the collar and hame for putting the same on or off the neck.

IMPROVED HEATER.

José Guardiola, Chocolá, Guatemala.—This consists of a heating furnace of new and improved construction, for heating air for drying purposes, and for heating buildings, etc., having an inner and outer cylindrical shell inclosing an annular air space, and a central air pipe and radial pipes, that connects the same with the annular air space, and a firegrate and fireplace. The device also consists of a cold air pipe leading from the blower pipe to the hot air pipe beyond the heater, for the purpose of introducing cold air in the place of hot air into the *drying* apartment when desired. This invention was described and illustrated on p. 82, vol. 36.

IMPROVED HARNESS TRIMMING.

Isaac N. Just, Belding, Mich.—This consists in the combination of the swinging wedge block, having its bottom concaved, and provided with a flange along its rear edge, and an extension having the inner side of its bottom bar concaved or flat with the terret. In using the device the free end of the tie-strap is passed through the cavity of the extension and is drawn back for a suitable distance. It is then drawn forward and draws the wedge block into the cavity of the extension, and clamps the said tie-strap securely between the lower edge of the said block and the bottom bar of the extension.

IMPROVED GLAZIER'S DIAMOND HOLDER.

Jacques E. Karelsen, New York city.—The object is to simplify the construction of glaziers' diamond holders in common use in such a manner that they can be made cheaper, and also so as to take up less room in the pocket. The invention consists of the breaker being secured to the handle directly and in line with the axis of the handle and of the swiveled diamond holder. The present ferrule construction is thus dispensed with.

IMPROVED TRACE BUCKLE.

Lyman D. Hubbard, Hume, N. Y., assignor to himself and Henry C. Brown, of same place.—This trace buckle is provided with a swinging tongue section provided with wedge-shaped sides, that slides in horizontal slots of the buckle frame. It is readily opened to detach the trace by pulling the same forward and swinging the lateral tongue section into open position.

IMPROVED COMBINED DRYER AND SMOKE HOUSE.

Ransom Sabin, Shelby, Mich.—This is a building made of sheet metal and angle iron, having a fireplace, and a flue running around its interior and out at the roof. It also consists in a circle provided with hooks, upon which to hang meat and other articles, and in the arrangement of swinging shelves for supporting fruit and vegetables.

IMPROVED OILER.

William H. Harrison, Livermore, Cal.—This oiler is so constructed as to catch and hold any oil that may run down the stem, while at the same time it keeps the outside of the can free from oil, and the caught oil free from dust.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED ORE SEPARATOR.

William M. Courtis, Wyandotte, Mich.—The tailings are received from the tail-race by a chute, and are projected between blocks and upon the grating with sufficient force to carry the larger particles over the end of the grating into a vertical chute. By the action of currents of water the heavier of the particles that pass through the grating fall toward the pipe leading to the settling tank, while the lighter of such particles are carried upward and discharged with the tailings.

IMPROVED RAILROAD SWITCH.

William H. Cooke, Wilton, Conn.—This switch is operated by the passing locomotive. A notched bar is connected with the movable switch rails, and a locking lever engages with notches of said bar. By means of a T lever, the locking lever is disengaged, and the notched bar and rails are moved. Levers, which are moved by the locomotive, are placed each side of and remote from the notched bar, and connected with the T lever by means of rods.

IMPROVED BOAT-DETACHING APPARATUS.

William McK. Bell, Collingwood, Ontario, Canada.—This invention consists of a detaching device applied to the boat, and made of a supporting frame with a pivoted tumbling bar and swinging tongue, locking by its toothed or serrated end to a correspondingly toothed projection or catch of the supporting plate, until the pressure on the tongue is released, and thereby the same detached.

IMPROVED TURNSTILE.

Alfred F. Swan, Hoboken, N. J.—This consists of parallel guide rails, with central pivoted side standards, having rigid horizontal arms, of which one set extends parallel to the other at an oblique angle to the longitudinal axis of the stile. The side standards and arms are revolved and locked by hinged and spring-acted platforms, which are jointly worked by the weight of the person passing through the turnstile. One platform operates the standards by ring-shaped sleeves, with pins entering spiral recesses of the same. The second platform locks the standards by recesses binding on stop pins, jointly with the first platform or singly, to prevent the return of the person.

IMPROVED MILLSTONE CURB.

William L. Taggart, Niles, Mich., assignor to himself and William R. Taggart, of same place.—This invention consists in a double walled curb for stones of flouring-mills, the inner wall being provided with openings and deflectors, which receive the air from the interior of the curb, and deliver it to the space between the double walls. Apertures are provided in the top of the curb for the admission of air between the walls of the curb. A tube that connects the space between the walls with an exhaust fan, the object being to provide efficient means for ventilating burr stones, so that the capacity of the stones may be increased and the quality of flour improved.

IMPROVED WATER WHEEL.

Andrew Jamison, Taylorstown, Pa.—This invention consists in a water wheel provided with semi-cylindrical or wedge-shaped buckets, placed in a channel in the middle parts of said wheel. Holes lead from the ring channel in said wheel at the ends of the buckets, out through the ends of the wheel. By this construction the water, as it enters the wheel, impinges upon the buckets, and by its force gives motion to the wheel. At the same time the rapid motion of the wheel keeps the buckets and holes in the lower part of the wheel full of water, so that the wheel will be driven by both the force and the weight of the water.

IMPROVED POST AND PILE DRIVER.

William A. Newton, Pappinville, Mo.—This machine is mounted on wheels so as to be moved from place to place as desired. Its standards may be adjusted into a vertical position when the surface of the ground into which the posts are to be driven is inclined. The standards also serve as ways for the hammer, which may be made in parts securely bolted together, so that its weight may be increased or diminished as required.

IMPROVED CAR COUPLING.

John B. P. Mohan, Dryden, Minn., assignor of one third his right to Thomas D. M. Mohan, of same place.—The mode of operation is as follows: The link passes into the drawhead under and against the rear of a lever, lifting the latter against the spring until its recess receives a spring bolt, which then holds the lever in a horizontal position against the tension of a spring. As soon as the shaft or key is turned sufficiently to force back the bolt, the spring forces down the rear and up the front end of the lever, thus uncoupling the cars.

IMPROVED CAR AXLE BOX.

Joseph A. Picard, North Platte, Neb.—This consists in the arrangement, on the upper side of a journal box, of a reservoir for containing oil, provided with split tubes, having screw caps for controlling the flow of oil. The said tubes communicate with a series of holes in the back of the "brass" or bearing surface of the box through grooves cut in the brass for that purpose. The device also consists in backing the said brass by a plate of iron and a heavy sheet of rubber.

IMPROVED CROSS TIE FOR RAILWAYS.

Henry S. Wilson, *Fernandina*, Fla.—This consists of an iron beam having wide flanges formed on its upper and lower sides, and provided with fixed and removable clips for clamping the rail flange. The advantages claimed are, that the cross tie is practically indestructible, and that a track laid upon ties of this description is more durable and less liable to accidents than those laid upon ordinary wooden ties.

IMPROVED STEAM ROCK DRILL.

Joseph C. Githens, New York city.—This rock drill is so constructed as to avoid the necessity of a large steam chest upon the outside of the steam cylinder to enable the drill to be used close to the top of the cutting. The middle part of the piston is made smaller and is surrounded with a sleeve, the space between the said middle part and the said sleeve serving as a steam chest. The steam is introduced through guide pins screwed into the opposite sides of the cylinder, the inner ends of which enter curved slots in the sides of the sleeve so that the said sleeve may be turned to admit and exhaust the steam by the longitudinal movement of the piston.

NEW AGRICULTURAL INVENTIONS.

IMPROVED BRUSH AND CANE CUTTER.

Oliver Pickering, Needham, Mass., assignor to himself and Charles E. Keith, of same place.—This consists in a ferrule provided with the three hooks, a pivoted button, and a bolt, in combination with the handle, to receive and hold the shank of the cutter. By this construction the cutter will be held securely in place while in use, and may be readily detached by removing the bolt.

IMPROVED GRAIN SEPARATOR.

Theophilus Harrison and William C. Buchanan, Belleville, Ill.—From thrashers the straw comes to the separator from six inches to three feet in depth, and the shaking packs the straw, so that it requires to be pulled apart by some instrumentality. This is accomplished by rakes mounted on crank shafts, so that they are alternately oscillated and carried forward over the straw, then down into it and back with it, thus pulling apart the straw at the point of juncture of the sections of the shaker.

IMPROVED CRANBERRY SEPARATOR.

Joseph C. Hinchman, Medford, N. J.—In using this machine, as the berries drop through the space between boards they strike the forward part of the upper side of an upper roller, and the perfect berries bound over the upper edge of the inclined board and pass down from one to another of the boards until they are received in a box placed beneath the forward lower part of the case. The perfect berries that were prevented from bounding, and those that struck against the inner side of the board, pass down between another set of boards to the next roller, where the same operation is repeated, and so on to the last, when the bad berries drop into a suitable receptacle.

NEW HOUSEHOLD INVENTIONS.

IMPROVED LAMP BURNER.

Charles A. Ferron, Paris, France, assignor to George R. Tuttle, New York city.—This consists of an interior fixed, and an exterior detachable, guide tube for the wick, to which the air is supplied from the outside through the base of the dome, and the inside through a radial air channel of the conical base, arranged around the stem of the wick-adjusting spur wheels. The wick is evenly adjusted by intermeshing double spur wheels in connection with flat side springs of the base part. The upper part of the wick is closed, while the lower part is open, the closed part being arrested in its downward motion by a radial top plate or partition of the base section. The chimney, globe, and dome holder are supported on a collar of the base section, and by a guide ring on the outer wick tube.

IMPROVED LINE FASTENER.

Andrew S. Goodrich, New York city, assignor to himself and Henry Goodrich, of same place.—This invention consists of a clothes-line supporter consisting of a supporting plate, which is attached to the window casing outside of the lower sash, and provided with a fixed horizontal arm, carrying an upright standard and outer hook. On the inclined collar of the standard swings a lever arm that supports the pulley line, the arm being, at the end swinging on the post, inclined in similar manner as the collar, and secured by set-screw in inward or outward position thereon.

IMPROVED SPICE BOX.

Orvill M. Brock, Monroeton, Pa.—This consists in the combination of a pepper box and salt cellar, the latter being screwed on or otherwise attached to the former, so that it may be readily detached when salt is used.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED SHEET METAL ROOFING.

Henry W. Smith, Waynesburg, O., assignor to himself and Thomas C. Snyder, of same place.—This consists in the use of flanged sheets and anchors. The roofing is held securely without driving nails through the sheets of metal composing the same. The peculiar form of the seam permits of expansion or contraction without injury to the roof.

IMPROVED MACHINE FOR PLANING WOOD.

Frederic Godeau, Paris, France, assignor to Pierre Ferdinand Arbey, of same place.—The knife rests on the front bearing or cheek of a lower plate. The top plate bears by its front part or face on the knife, and is curved to be raised a short distance above the main part of the knife for the same purpose of leaving the knife free of pressure at the rear part. The lower plate is secured by fastening screws passing down through the plate into the cutter-head, or from below, through the cutter-head, into the plate. The top plate is secured to the cutter-head by fastening screws near the center of the plate, or to the lower plate, as described. For the purpose of sharpening the cutting knives a grinding attachment is arranged at the top of the frame. The side plates of the frame carry a lateral revolving shaft, on which is placed a laterally sliding but axially revolving emery wheel, that is adjusted to the knife to be sharpened by means of a hand lever, connected with suitable mechanism. By moving the lever handle to either side, the ready following of the revolving emery wheel is caused.

NEW TEXTILE INVENTION.

IMPROVED SHUTTLE BOX LOOM.

James Hyde, Stottville, N. Y.—This is an improved fancy loom, so constructed that it may be run at greater speed and at less expense than ordinary fancy looms; and that may be worked without pickers or spindles. The construction cannot be explained without the aid of detailed drawings. It is, however, exceedingly ingenious, and forms an improvement in weaving which is well worthy of careful examination.

Business and Personal.

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

Notes & Queries

T. F. D., Jr., will find on p. 315, vol. 29, directions for tempering edge tools. Back numbers of this journal are sold for 10 cents each. See publishers' notice on the second page of this issue.—E. R. does not send sufficient data as to his boat, engine, and boiler.—S. W. H. will find directions for coloring brickwork on pp. 235, 236, vol. 36.—T. P. P. will find something on changing the color of the hair on p. 220, vol. 35.—E. will find a recipe for cologne on p. 75, vol. 31.—C. P. G. will find a full description of the Great Eastern steamship on p. 346, vol. 31.—A. S. will find directions for making crucibles on p. 330, vol. 32.—O. A. P. will find directions for recovering tin from tinned plate scrap on p. 319, vol. 31.—F. W. J. will find a recipe for a gold-plating solution on p. 116, vol. 33.—W. H. H. will find a recipe for a silver-plating solution on p. 299, vol. 31.—W. C. will find a recipe for a stain to imitate black walnut on p. 90, vol. 32.—L. G. L. will find on p. 379, vol. 31, a good recipe for a paint for smoke stacks, boilers, etc.—J. H. B. will find on p. 130, vol. 35, directions for making imitation marble.—C. M. can drill glass by following the directions on p. 218, vol. 31. A cement for fastening glass to wood is described on p. 143, vol. 33.—E. F. M. will find a recipe for Vienna bread on p. 185, vol. 33.—N. E. L. will find an article on sending the time by telegraph on p. 358, vol. 30.—M. G. will find directions for ridding fruit trees of insects on p. 200, vol. 36.—G. H. P. will find an answer to his query as to the surface of a brake on p. 273, vol. 31.—W. R. W. can make his glass windows opaque by following the directions on p. 264, vol. 30.—E. H. will find something on parhelia and halos on pp. 132, 171, vol. 28.—C. W. B. will find a recipe for a liquid dressing for shoes on p. 107, vol. 36. For a recipe for writing fluid, see p. 92, vol. 33.—S. A. S. will find directions for dyeing crimson on p. 235, vol. 36.—J. A. will find directions for mending rubber boots on p. 203, vol. 30.—H. J. M. will find directions for making potato starch on p. 315, vol. 30.—J. R. will find directions for making rubber hand stamps on p. 156, vol. 31.—E. P. will find descriptions of emery wheels and their uses on p. 22, vol. 29.—E. W. will find directions for ridding a house of cockroaches on p. 43, vol. 31. As to bedbugs, see p. 378, vol. 24.—R. H. M. will find directions for glazing earthenware on p. 353, vol. 35.—W. H. T. can fasten rubber rollers to their spindles with glue. For wringing machines, marine glue would be best. See p. 43, vol. 32.—L. S. B. will find something on endurance of life in an airtight place on p. 202, vol. 32. To make oxygen, see p. 299, vol. 33.—L. C. will find a recipe for cement for stopping leaks in boilers on p. 202, vol. 34.—E. H. P. will find a recipe for invisible ink on p. 267, vol. 34.—J. A. T. can calculate the power of his engine by the rules given on p. 33, vol. 33.—W. C. J. will find directions for removing freckles on p. 187, vol. 32.—J. H. will find on p. 298, vol. 30, a recipe for cement that will fasten metals to glass.—J. A. McC. can blue his gun barrels by the process described on p. 123, vol. 31.—J. C. K. should trap his moles. See p. 223, vol. 26.—J. R. J. will find directions for making an æolian harp on p. 330, vol. 26.—A. M. N. will find directions for drilling holes in glass on p. 218, vol. 31. Hydrofluoric acid will dissolve glass. See p. 203, vol. 33.—C. W. H. will find on p. 171, vol. 36, a recipe for a cement that will fasten paper to stone or iron.—A. S. will find a recipe for waterproof glue on p. 43, vol. 32.—G. I. M. will find a full description of the East River bridge on p. 99, vol. 35.

(1) A. McG. asks: Why do frost crystals form on windows? A. If ice water be introduced into a glass vessel in a warm room, it speedily determines the precipitation of the moisture from the surrounding air, which forms as beads of dew upon the exterior surface of the vessel. If instead of cold water a mixture of pounded ice and salt be introduced, the condensed moisture will be frozen as it forms into hoar-frost, which is composed of minute crystals of ice. This precipitation and congelation is precisely analogous to that which takes place upon window panes in cold weather. All frozen water is crystalline.

(2) J. R. L. asks: How can I give shirt bosoms the polish and stiffness obtained by shirt manufacturers? A. Rub 1 oz. best potato starch up with a little cold water, so as to reduce all the lumps; add a tablespoonful of best loaf sugar, an equal quantity of dextrin, a little soluble indigo, and a lump of pure paraffin about the size of a nutmeg. Then add a pint of boiling water, and boil, with occasional stirring, for half an hour (not less). The starch should be strained through a linen cloth before using.

(3) D. F. H. asks: What is used on the end of magnets to keep the wire in place? Will iron or brass do? A. Brass or bone rubber.

(4) J. A. H. asks: 1. In an electromagnet made of 25 feet of No. 18 copper wire, of what length and size should the core (composed of small soft iron wires) be, to give the greatest inductive effect to a secondary coil? A. Of $7\frac{1}{2}$ or 8 inches length and $\frac{3}{4}$ inch diameter. 2. Which will give the most magnetic power, a single coil 1 foot in length, or 4 layers 3 inches long, and should the iron cores be the same size in each case? A. The single coil, with proper battery? 3. What is the rule regulating the proportionate lengths of helices to their diameters and to the diameter of the iron cam? A. About 8 or 10 to 1 is a good proportion. 4. What rule regulates the size of the wire of which the helix is composed? A. The wire should be of such size that, when filling the proposed space, its resistance about equals that of the battery.

(5) W. S. asks: 1. Please give a description of how a good vibrator is made, and how is it applied on electrical apparatus? A. Connect one end of the coil of an electromagnet to the armature of the same; the other end, to one pole of a battery; and the opposite pole of the battery to an adjustable spring against which the armature presses when not attracted. The points of contact of armature and spring should be made of platinum. 2. Can you mention a good work on experimental electricity and magnetism? A. Read Davis' "Manual of Magnetism," Pynchon's "Chemical Physics," or Tyndall's "Lectures on Electricity."

(6) G. M. F. asks: Will 60 feet silk-covered copper wire, $\frac{1}{16}$ of an inch in diameter, for the primary coil, which is 6 inches long, and 1,200 feet of silk-covered copper wire, $\frac{1}{64}$ of an inch in diameter, for the secondary coil, give a severe shock? A. Yes.

(7) H. F. G. says: 1. I am making a small horizontal steam engine; the cylinder is of brass, cast, with a 1 inch bore and two inches stroke. How large and heavy must I make the balance wheel? A. Make it 9 inches in diameter, to weigh 4 lbs. 2. How large must I make a boiler of sheet copper, and how much pressure will it *stand*? How large must I make a boiler of sheet iron, and also what pressure will it stand? A. Boiler should be 8 inches diameter and 15 inches high. Copper should be $\frac{3}{16}$ thick, iron $\frac{1}{4}$ thick, for a working pressure of from 50 to 60 lbs. per square inch.

(8) H. P. asks: 1. Would steam at low pressure mingled with compressed air at a higher pressure moisten the air and increase the pressure? A. Yes. 2. What thickness shoul' I make my air tank to stand a pressure of 150 lbs., the diameter being 19 inches? A. About $\frac{3}{16}$, if it is wrought iron.

(9) S. A. H. says: 1. I bought a telegraph sounder having about No. 32 wire on it; and I have made another instrument using No. 18 wire—about 175 feet in coil. When working it alone, it works well; but when I attempt to work the two instruments together in a short line, I find only one of them will work, the one which has the fine wire on it. What is the difficulty? A. The resistance of the fine wire is too much for the circuit, both instruments should be wound with the same size wire. 2. Please publish a recipe for a varnish or composition to be used on wire as an insulator in place of the silk covering generally used. A. Shellac and alcohol is sometimes used for the purpose. 3. Can you publish a process for making hard rubber? A. See p. 123, vol. 32.

(10) G. M. G. asks: Has an electromagnet more attraction on an armature approaching directly upon it than it has on one approaching in an oblique direction toward the poles of the magnet? A. Yes.

(11) A. E. T. asks: Of what are the zinc plates made that are used in medical batteries, so that they do not need to be amalgamated, but can be used until they are worn out? I refer to the kind used in a bichromate solution. A. A very small amount of mercury is sometimes put in the molten zinc before casting.

Please give me details of the process of tempering steel springs? A. See pp. 27, 363, vol. 32.

(12) J. D. J. asks: 1. Is there anything that will neutralize the attraction of a lodestone? A. Its attraction can be neutralized by placing an equal magnetic force of the same polarity in juxtaposition with it. 2. Has a lodestone ever been used as a light motor power? A. No.

(13) D. W. L. asks: 1. Will a small magneto-electric machine, such as is used for medical purposes, be sufficient to charge a small magnet? A. No. 2. Has electricity in this form ever been used for telegraphing? A. Yes.

Is the exhaust steam of an ordinary engine heated to above 212° Fah.? A. Yes.

(14) A. S. asks: Does it take more time to send one letter by telegraph over a continuous line of 10,000 miles than over a line of 1,000 miles? A. Yes, one hundred times more.

(15) C. S. M. says: Some time ago I purchased a second hand galvanic battery; and when I added the solution and tried to run it, I could only feel the very slightest current, and that only lasted a few minutes. How can I remedy it? A. We cannot tell you, unless you state what the battery is composed of.

(16) J. F. D. asks: Can I run by foot power a magneto-electric machine capable of heating a $\frac{1}{2}$ inch steel rod to a red heat? A. No.

(17) W. R. B. says: In making vinegar, I use a common German generator containing corncobs soaked in vinegar. When I let a stream of cider flow in, the temperature rose to 110° Fah.; but when it flowed out at the bottom, it was flat, like warm water. I have made strong vinegar in this way before, and with the same apparatus. Can you tell me what is the difficulty? A. Add a little vinegar to the cider and let it ferment a short time before running through the acetifier; or return the liquid to the same, and let it trickle slowly through it a second time, and even a third time, if necessary.

(18) F. W. J. says: Can you give me a recipe for a gold wash for watch chains, etc.? A. Clean the articles perfectly, and wash them in a strong neutral bath of chloride of gold in warm water. Then dip for a moment into moderately strong solution of copperas, dry, and polish. Or use an etherial solution of chloride of gold, dry, and reduce by contact with hydrogen gas (coal gas will answer) in a tight apartment. Or dip in the gold solution first mentioned, and then in a hot solution of caustic alkali.

(19) G. S. says: 1. I wish to make a collection of marine animals, such as sponges, anemones, and algæ. Which is the best time to commence it, spring or summer? A. We believe the latter part of the summer is generally chosen for such collections. 2. Would such animals live in water mixed with common salt in the same proportion as salt or sea water? A. Experience has shown that genuine sea water is best. 3. Do you think it would improve the health of these animals to have the light of the sun filtered through yellow paper or glass? Professor Draper, of New York, says: "The yellow ray of the sunlight is that portion which is the peculiar stimulus of the chemistry of the leaves and plants." I doubt not but that it would have some influence on the *polypi*, but I would like to have your opinion. A. Dim, diffused sunlight is best.

(20) J. B. H. asks: How can I best make a cement that will stand fire and not wash or crumble out? I have a boiler in two parts, and a space between the two has to be stopped with a V-shaped piece of iron. The cement that I have used dries and crumbles out. A. Use a cement made as follows: Cast iron borings 10 lbs., red lead 1 lb., alum $\frac{1}{2}$ lb., lime 5 lbs., sal ammoniac 2 ozs. Dissolve the alum and sal ammoniac in a small quantity of hot water, and mix in the other ingredients.

(21) J. H. H. asks: Can you give me a recipe for cement with which I can fasten thicknesses of paper together, which, on application, will cause no enlargement (expansion or contraction) or alteration in shape or size? A. We do not know of such a preparation.

(22) J. C. C. asks: 1. How can I make stearic acid without an hydraulic press, or the use of costly chemicals? A. It is not practicable. 2. How can beeswax candles be prevented from guttering? A. Add about 10 per cent of stearic acid to the wax. 3. How is paraffin wax made? A. The mode of obtaining paraffin differs according to its being an educt or product: an educt as from petroleum, neft-gil, ozokent, etc., and a product of the dry distillation of brown coal, peat, and bituminous shale. It is usually obtained from petroleum, by distilling the residues after the separation of the lighter oils, with steam at a temperature of from 300° to 400°. It is separated from the liquid distillate by artificial cold and the centrifugal machine, purified by treatment with oil of vitriol and steam, and neutralized with lime water. It is then rapidly redistilled, and treated in the hydraulic press, as in the preparation of stearic acid.

(23) M. J. B. asks: What is an east and west line? Is it a parallel of latitude or a line running at right angles to a meridian? A. It is a parallel of latitude.

(24) E. A. H. says: 1. What is the pressure of water freezing in an airtight cylinder? A. About 30,000 lbs. per square inch. 2. What is the strength of cast iron and sheet iron, of $\frac{3}{4}$ inch and $\frac{1}{4}$ thick respectively, to resist water pressure? A. Cast iron 18,000, and sheet iron 35,000 per square inch. 3. Which plan would be best for strength of resistance to the hammer in riveting, a bar 5 feet in length one end not supported, or a 10 feet bar with both ends supported? A. There might be no difference, if the bars were sufficiently rigid. Steel or wrought iron would answer for the bar.

(25) J. B. O. asks: Is it possible to build an electro-magnetic engine of one-half horse power? A. Yes. 2. If so, what size of magnet will be required? A. It requires a combination of magnets to get continuous work. 3. Will a cast iron magnet answer as well as a wrought iron magnet? A. Wrought iron is best.

(26) G. G. says: A little while ago I made a simple telephone, to be used without the electrical current. I tried a thin sheet of brass in place of a membrane as a cover to the mouthpiece for receiving and for transmitting the vibrations made by the voice to the connecting line. I found that the brass would not answer. If a sheet of iron or other metal is used, what is the shape, and how is it held in position? A. The transmitting instrument consists of a simple electromagnet, in front of which is a tightly stretched membrane of skin; just opposite the poles of the magnet, on the membrane, is a small permanent magnet which vibrates with the former when set in motion by the air. The receiving instrument is a tubular electromagnet formed of a single helix with an external soft iron case, into the top of which is loosely fitted a light iron plate which is thrown into vibrations by the action of the magnetizing helix. 2. Does it require a circuit to transmit the electrical current? A. Yes. The helices of both electromagnets are included in one circuit, which may also include a battery.

(27) J. A. T. says: I have an engine $1\frac{3}{4}$ by 4 inches. What power will it give with a horizontal boiler 18 inches x $12\frac{1}{2}$ inches with tubes $1\frac{1}{2}$ inches in diameter? A. Possibly you may realize $\frac{1}{2}$ a horse power.

(28) J. A. C. asks: What is the easiest method by which a conducting surface can be imparted to cloth, leather, etc., for the purpose of electro-plating? I have tried plumbago, but it will not do for my purpose. A. Try the following: Immerse the object in a solution of nitrate of silver in wood naphtha. When partially dried, treat with ammonia. After being thoroughly dried, the object should be exposed to the vapor of mercury, when its surface will become completely metallized in a few moments; transfer to bath immediately. Great care must be taken not to breathe the mercury fumes.

(29) D. C. W. asks: 1. Which solution in a Bunsen battery requires to be changed, and how often? A. The nitric acid requires to be changed first, but the frequency of change depends upon the work done. The best rule is to change whenever the battery becomes too weak to do the work. 2. How can I make an electrotype of an autograph? A. You must photo-engrave it first. See p. 272, vol. 32.

(30) F. D. H. asks: If I connect one cell of a carbon and one cell of a Leclanché battery, for either quantity or intensity, do I utilize the entire energy of both, or is there a waste owing to the elements being dissimilar? A. It is a bad plan to connect batteries differing in electro-motive force, for quantity; connected in series, the resulting electro-motive force is equal to the sum of all the electro-motive forces of the different cells.

(31) C. E. J. says: Inclosed find sample of battery wire. The wires have been in use in an hotel for two years. About 6 months ago, a portion of the house telegraph ceased working. Upon examination, I found the battery wire corroded and eaten off; since then I have had the same trouble about a dozen times, and in every case was the battery wire eaten off, as in the sample. The floor is double, with cement in between. The wires run in a groove cut in the cement; the battery wire is precisely the same as the room wires, and runs in the same channel. In most cases, the battery wire would be in the middle of the other wires; but I failed to find that any of the other wires were affected. A. If the wires are in a damp place, the action of the battery probably causes the corrosion. Better use kerite covered wire, and be sure the covering is perfect.

(32) T. J. L. asks: Is there such a word in the nomenclature of telegraphy as "telehiro" or "telehiero?" A. No.

(33) E. W. W. asks: What form of battery will be the best to work a set of alarm bells (four large gongs and six small gongs) all controlled by one large vibrator on a circuit of about 500 feet length? The main requisites in the battery are to be strength of action

with permanence and requirement of the least possible care. A. If all are in one circuit, and only used for a few seconds at a time, four or five Leclanché cells will probably be found to give satisfaction.

(34) H. L. C. says: I wish to make some permanent U magnets 8 inches long, of cast steel $\frac{3}{8}$ inch thick and 1 inch wide. If I make an electromagnet of 1 inch round iron of the same size and shape as the steel, and wind it with 150 feet of No. 14 cotton insulated copper wire, and use for battery two Hill cells, will it be sufficient to charge the steel magnets so that they will each support 8 or 10 lbs.? A. Yes, if the plates are so large that the battery resistance is very small. You had better use one or two Grove cells.

(35) E. D. G. asks: Does the latest authorized survey show Gray's Peak to be the highest altitude in Colorado? If not, what is the greatest altitude? A. We believe that the latest information shows that there are several peaks slightly higher than Gray's.

(36) R. B. C. says: 1. I am about to have a propeller wheel made, of 32 inches diameter, and would like to know how much pitch to give it. I have an abundance of power, and would like to get the greatest possible speed? A. Four feet pitch. 2. I have a horseshoe boiler, and would like to know if it would be advisable to heat the feedwater in the back breeding of the boiler by means of pipes, in the form of return bends. If so, where shall I locate the check valves, between the pump and pipes? A. If your boiler steams well at present, there is no necessity for the change.

(37) W. L. asks: In what book can I find how to calculate the times of rising and setting of the sun for each day in a year, for any degree of latitude? A. There are many special methods used by computers which are not given in ordinary treatises on astronomy; but you will find a good discussion of the subject in Norton's "Astronomy."

Which of two horses pulls more on the double tree of a wagon if one is a little ahead of the other? A. Usually the one that is a little ahead.

Why does a gun barrel scatter the shot? A. Generally it is due to the fact that the barrel is not true or is foul, or to the shape of the breech.

(38) T. L. says: How many horse power will be developed by using 100 inches of water (miner's measure) on a 20 feet overshot wheel, and also on an 18 feet wheel? A miner's inch of water is an amount that will run through one inch square aperture under a five inch pressure or head. A. About six and five horse power respectively.

(39) J. H. H. says: 1. I propose making a wrought iron jacket cylinder, $2\frac{1}{2}$ feet in diameter and 6 feet long, with a steam space of $1\frac{1}{4}$ inches, to be run by superheated steam. I understand that steam can be superheated to 1200° Fah. The outside of the cylinder is to be covered with a non-conducting covering. With a cylinder of this construction, how many degrees of heat will be radiated to the interior of the cylinder? We expect to use between 25 and 40 lbs. of steam. A. You do not send sufficient data. 2. Would an elliptical cylinder be as good as a circular one? A. No. 3. How thick would you make the non-conducting coating? A. From $\frac{3}{4}$ to 1 inch.

(40) S. asks: What is the rule by which shipbuilders calculate the carrying capacity of vessels, and find the weight of a ship as she stands in the water? A. The rule is too long for insertion in these columns. You should consult a standard treatise on shipbuilding.

(41) E. M. asks: 1. How can I use and make dipping acid for cleaning gas fixtures? A. Use sulphuric acid diluted with about 5 parts of water. 2. How can I put on the bronze powder used on zinc covering pipe? A. Use boiled oil as a size. 3. How can I make lacquer used after bronzing? Can any kind of clear transparent varnish be used? A. Use shellac in alcohol.

(42) J. K. says: 1. We have an upright tubular boiler of the following dimensions: Shell 8 feet by 3 feet, plates $\frac{3}{8}$ inch thick, single riveted, having 51 tubes each 6 feet long by $2\frac{1}{4}$ inches diameter. Firebox or furnace is 30 inches by 23 inches high. Heads $\frac{3}{8}$ inch thick; and the boiler is made of best iron. The water space around firebox is 2 inches. How many horse power (at 20 feet heating surface per horse power) do you consider this boiler to give? A. About $7\frac{1}{2}$. 2. What pressure per square inch should it be worked up to? A. From 80 to 100 lbs.

(43) A. P. H. says: We have two 60 flue boilers, 14 feet long and 60 inches diameter. They were tested with 100 lbs. cold water pressure and did not leak. But as soon as we started fire under them they began to leak in the seams over the fire on top; where the fire did not strike them they were perfectly dry. We calked them, and that stopped the leaks for a day or two. We tried the calking over again several times, but with the same result. When we had run about four weeks, all the flues in the back end of one of the boilers began to leak. Why did the flues in one boiler leak and not those in the other? A. We judge from your account that the boilers have been badly built, badly managed, or both, the probability being that they are very poorly constructed.

(44) J. H. N. says: I need a 6 horse power steam engine to do my work. Can exhaust steam from an engine be used to warm a house, through pipes, after the manner of heating now in use? If so, what increased capacity of power would be required to warm an ordinary village residence? A. With properly arranged heating apparatus, the increase of steam required will not be more than 10 per cent.

I prepared gummed labels with a solution of gum arabic; these labels rolled up, resembling little pipes. What can I use to prevent this curling up? A. Mix some refined sugar with your gum solution.

I am using an incubator for hatching queen bees' and hens' eggs. I need a temperature governor. What metal or substance in the form of a bar is most susceptible to and expands most by heated air? In liquid form, mercury is most expansive, is it not? If mercury is confined in a cylinder by a close-fitting piston, will it exert considerable power or will it compress like air? A. Mercury inclosed in a tube will answer very well. Zinc and lead are among the most expansible solids.

(45) W. E. N. says: I have a small copper boiler 18 inches high and 12 inches in diameter, made of $\frac{1}{8}$ inch copper. The heads are of $\frac{3}{16}$ inch copper. What size engine will it run? A. You can use an engine $1\frac{1}{2}$ x 3 inches.

(46) J. H. T. asks: 1. I have a 10 horse power engine which ordinarily works well, but when at heavy work it will (while pumping water into boiler) overflow the exhaust pipe in smoke stack, when I have scarcely two gages of water. What is the cause of it? A. We presume, from your account, that the boiler has not sufficient steam room when the engine is working at full capacity. 2. What is the best paint or varnish for boilers? A. A black varnish made from petroleum is sold for that purpose, and answers very well.

What is the rule for finding the number of revolutions per minute of certain pulleys? A. Divide the diameter of the driving pulley by the diameter of the driven pulley, and multiply the quotient by the number of revolutions of the driving pulley.

(47) J. S. W. asks: What number of blades should a propeller wheel have to be used on a small yacht, model and power being able to give the highest speed, and length being from 24 inches to 38 inches? A. Three.

(48) W. N. R. says: 1. Will you explain the process of laying very thin veneers? A. The veneer having been cut to the proper shape, the surface to which it is to be applied is coated uniformly with glue and the veneer is directly placed in position. The exterior surface of the veneer is then sponged over with warm water to prevent its curling. 2. What is the meaning of the word "caul," as applied in this process? A. If the surface to be veneered is a plain one, the caul is simply a plain smooth board, covered with canvas, and clamped on over the veneer to insure its perfect contact in every part with the glued surface until the glue has properly set. If the surface is uneven, the caul is made up of canvas to which thin slats of wood have been previously glued to give it the required shape.

Please give me a recipe for aquarium cement? A. Heat up a small quantity of pure caustic lime in fine powder with a sufficient quantity of white of egg to form a thick paste, and fill the angles of the aquarium with this immediately before it sets. When perfectly set, give the seams a coating of fused paraffin.

(49) W. A. M. says: I have a quantity of nitric acid of 30° Baumé. How can I increase its density to 50° Baumé? A. Distil it with a quantity of strong oil of vitriol in a large glass retort.

(50) W. L. R. asks: How much will eight span of horses pull in one wagon, provided one span will pull 20 cwt., all other things being in proportion? A. Where the horses are accustomed to work together, 8 spans will pull about 8 times as much as 1 span. But if 8 separate spans were hitched to the same wagon, even though they might all pull well when working in single spans, it is doubtful if they would pull more than 5 or 6 times as much as a single span, and the aggregate pull might fall even lower. The same thing may be noticed in the effect produced by gangs of men when pulling, pushing, or lifting.

(51) R. L. H. says: 1. How large should a current wheel be, and what should be the shape of the paddles, to realize 15 horse power in a current running at the rate of about 5 miles per hour? A. Make the wheel 15 feet in diameter, with floats at an angle of 15° to the radius, each float being 3 feet deep and 18 feet long. 2. How should the current wheel be geared to give a speed of about 350 revolutions to a 24 inch corn mill? A. Ordinary bevel gearing and cogwheels will answer.

(52) W. B. P. asks: How is the ribbon for the type writers, and for the ordinary ribbon stamps, made? A. It is saturated with a solution of one of the aniline dyes, alizarine, or alcoholic extract of madder, in glycerin.

(53) C. C. F. asks: How is the so-called French kid, made from goat skins and used in ladies' shoes, worked out and tanned? A. The process is that known as tawing. It is too long for publication in detail here. The skins, having been soaked in water and scraped on the flesh side (the hair being loosened and removed by soaking in lime water and plucking), are passed through singly, and then digested for about 10 minutes in a boiling bath composed of 12 lbs. alum, $2\frac{1}{2}$ lbs. salt, in 12 gallons water: 15 lbs. wheat flour, and the yolks of 50 eggs are then added to the warm alum bath, and the skins are soaked in this for a day or more. The proportions here given are for 100 skins. The skins are then stretched in lofts to dry for a week, when they are soaked in water for a few minutes, softened by stacking, and ironed.

(54) W. D.—Referring to the reply given to W. D. (No. 16, p. 203, vol. 36), who asked about the use of galvanized iron pipes, for conveying spring water, etc. Our Professor was in error in advising the use of galvanized iron pipes. Probably a better material would be pipes of wood. With some waters, the use of galvanized pipes has proved disastrous, and the safer rule is to banish them altogether. Perhaps we cannot do better than to repeat the inquiry and reply we gave on this subject on p. 251 (No. 4), SCIENTIFIC AMERICAN of October 16, 1875:

J. G. W. asks: Will galvanized iron tubing in a bored well be durable? Would the water from such a well be wholesome? A. The use of galvanized iron pipes for family water supply is not desirable. For a short pipe, if the water is pure, and the precaution is taken not to use water that has stood too long in the pipes, perhaps no bad effect would result. But there have been repeated examples of poisoning from the use of galvanized iron conducting pipes. In a case at Portsmouth, N. H., a family of four persons were thus poisoned, and Dr. Jackson found four grains of oxide of zinc in the water. In another case, near Boston, where the house was piped with galvanized iron pipes, one of the young members of the family died, and a *post mortem* examination revealed the presence of oxide of zinc in the stomach and other organs. Death was directly attributed to the use of the above pipes. They are made by heating and dipping the iron pipes in melted zinc.

See also the letter of Mr. Balch given on another page of this issue.

(55) W. A. E.—The temperature of ignition of dry pine is about 800° Fah., of oak 900°. The temperature of ignition of charred wood, if perfectly dry, is not sensibly different from the above. Wood or charcoal, perfectly dry, generally requires the actual contact of a spark to produce ignition.

(56) C. G. D. says: I read the following: "Venus is twice as near the sun as the earth is, and consequently receives four times as much light and heat as we do, and the average temperature of the earth being 77° Fah., the average temperature of Venus would be four times 77°, or 308° Fah., etc. Now as the zero point is not at the true zero—the point of absolute cold—heat cannot be multiplied except by indicating it, as five or ten times as much, never expressing the amount in degrees. This can be proved by comparing the results of the temperature of Venus by the two most common scales, the Fahrenheit and the centigrade. The result given by Fahrenheit is 308°; on the centigrade scale 25° corresponds to 77° Fah.; so, by that scale, the temperature would be 100°, or that of boiling water, which is 96 Fah. degrees lower than the first result, a considerable difference. By means of freezing mixtures, an artificial cold of —220° Fah. has been reached; placing this as the zero point of a new scale (and it is unquestionably nearer the true zero than the zeros now in use), the temperature of Venus would be 968° Fah., a much greater difference than ever. So, we see, the result varies with each scale with a different zero; Réaumur and centigrade, starting from the freezing point of water, give the same result. If my reasoning is incorrect, what is the temperature of Venus, our temperature being 0° Fah.? or —10° Fah.? A. Your reasoning is based on correct principles; and the absolute zero, which must be taken to obtain the same results when multiplying temperatures on different scales, is fixed by theory at about —219·2° Réaumur, — 275° centigrade, and —461·2° Fahrenheit.

(57) N. L. R. asks: 1. How much water will I have to turn on an overshot wheel, 20 feet in diameter, to get six horse power? The water will flow on the wheel from a trough. I will not have any head of water at all. A. About 230 cubic feet a minute. 2. Will it take less water if I have a head of five cubic feet above the wheel, that is, just over the wheel? A. Yes.

(58) J. A. B. asks: 1. Is 18 inches too long a beam for an engine whose stroke is $4\frac{1}{2}$ inches? A. It will answer very well. 2. In a parallel motion, does the cylinder require to be under the ends or the center of the arc described by the end of the beam? A. Under the ends of the arc. 3. What power can be obtained from two engines, $3\frac{1}{2}$ by $4\frac{1}{2}$ inches, making 300 revolutions, with steam at 120 lbs. in boiler? A. Between 8 and 9 horse power. 4. Would one of them give half the power? A. Yes.

How will an ice boat make 60 miles per hour, the wind having a velocity of 15 miles per hour only? A. This matter has been frequently referred to in recent back numbers.

(59) E. B. K. asks: What pressure does a column of mercury, of 1 inch area, give in ascending 1 inch in the tube? A. About $\frac{1}{2}$ lb.

Is there not an expeditious method of cutting firebricks other than by chipping them with a hammer? Are there not saws made for the purpose? A. We are not sure. If there are such tools, some of our readers will, we hope, send us word.

(60) G. A. R. asks: Is a pine log lighter when it is frozen than when it is thawed, or not? A. There is little or no difference in the weight of timber under such conditions. Ice is lighter than water, volume for volume, but 1 lb. water when converted into ice will weigh neither more nor less than 1 lb.

(61) R. C. says: 1. I wish to make an incubator heated by horse manure. I filled a box three feet square with fresh manure; it heated in about a week, and in two weeks it was as cold as when I put it in the box. How can I retain the heat for three weeks? A. Moisten the manure with a little molasses water, and keep covered with sawdust. 2. Will quicksilver placed in a glass tube work a stopper in the tube resting on the quicksilver, as a regulator of heat? A. If the tube is provided with a proportionately large reservoir or bulb at the lower extremity, it will answer well enough for the purpose, but it will be necessary to make a table for it by comparing the indications with those of a good thermometer.

(62) N. R. asks: What is the best preparation for restoring hair to its natural growth? A. Make a strong aqueous solution of Liebig's extract of beef, and add about 2 per cent of neutral citrate of iron, and a little wine. Take a few spoonfuls of this every day.

(63) W. C. M. says: Please give me a cheap process for clarifying vinegar, either before or after acetification has taken place? A. It is usually purified by distillation in large tinned iron vessels. This is the cheapest method.

(64) G. S. says: 1. I have heard of a newly discovered light, besides the electric and the calcium, the latter of which I am in the habit of using for the magic lantern. Is there something new in this line? A. A. The lime or calcium light, the magnesium light, and the argand gas and oil lamps, are the only sources of illumination that have thus far proved of any practical value for projection with the magic lantern. 2. Can the zoötrope be used in connection with the magic lantern or the wonder camera, so as to throw the motion of figures on the screen? A. Modifications of the instrument you name have been used in the magic lantern. The pictures are painted or photographed on glass disks, which are rotated before the condenser with the interposition of a similar opaque disk, bearing the slits, which is simultaneously rotated in the contrary direction.

(65) A. B. G. says: I have a quantity of oxide of zinc. How can I convert it to the metallic state again? A. Mix with an excess of powdered charcoal and a little molasses, pack into black lead crucibles, cover with a luting of fire clay, and heat strongly. Consult Bloxam's "Handbook of Metallurgical Operations."

(66) T. J. M. says: I have an engine $\frac{1}{2}$ x 1 inch bore, with 2 flywheels $5\frac{1}{2}$ inches in diameter, weighing together about $1\frac{1}{2}$ lbs. Boiler is upright, 5 x 8 inches inside, with two $1\frac{3}{4}$ inches copper flues. Boiler heads are cast, $\frac{1}{4}$ inch thick, and shell is of $\frac{1}{16}$ inch iron, riveted. How can I steam it? A. We think you can use a lamp with two burners, one for each flue. The best forms of lamps used for heating purposes are patented, and we advise you to purchase one in preference to making it.

(67) R. A. J. says: 1. Our town is situated on a river. At the back of the town and about one mile from the river is a bluff, on which is a cemetery. I wish to know whether the close proximity of the cemetery will injure the water in the wells in that part of the town which is close to the cemetery? The water in the wells runs in a direction from the cemetery to the river. The cemetery has been there for over twenty years. A. It is improbable that this will, in any way, affect the quality of the water. 2. How can I test for impurities in the water? A. Make a dilute solution of permanganate of potassa in water, and add to a sample of the well water a little of this solution, just enough to impart to it a perceptible tint. If the color thus imparted disappears, even after an hour's standing, the water may be considered unfit for drinking purposes.

(68) P. A. T. asks: What size of boiler of the firebox locomotive kind and what size of engine do you recommend for a boat 65 feet long by 18 feet beam, and $3\frac{1}{2}$ feet depth of hold? The said boat is to be a high pressure sternwheel and the engine double. A. Make a boiler 4 feet in diameter and 12 feet long, cylinders 10 x 20 inches, with a steam pipe 3 inches in diameter. Feed pump 3 x 20 inches, pipes 1 inch. 2. How many cords of wood ought said boat to be able to carry? A. Capacity of boat, 60 to 70 cords of dry wood.

(69) T. C. B. says: 1. I would like to build a model locomotive of the following dimensions: Cylinders $1\frac{1}{4}$ inches in diameter, stroke $1\frac{1}{2}$ inches, steam ports $\frac{1}{4}$ x $\frac{1}{4}$ inch, and exhaust ports $\frac{1}{4}$ x $\frac{1}{4}$ inch, with a plain D slide valve. Drivers are to be of 4 inches diameter, and four in number, coupled. Front or swing truck is double with 4 wheels. Boiler is of $\frac{1}{4}$ inch copper, diameter $4\frac{1}{2}$ inch, and length, including smoke box, 15 inches. Firebox has a height of 4 inches, length of $4\frac{1}{2}$ inches, and width of 4 inches. Pump has a bore of $\frac{1}{4}$ inch connected to crosshead. Injector has a discharge diameter of $\frac{1}{4}$ inch. Will these proportions do? A. We think your proportions are generally very good, and we are glad to publish this letter for the guidance of others. 2. What would be the best for fuel, charcoal or cannel coal, a blower being conducted to stack? A. It will be best, on several accounts, to use charcoal for fuel.

(70) C. S. says: 1. I wish to build a cider press. I intend to use a single cast iron screw, of about 4 feet in length. What should be the diameter of the screw to support a pressure of 100 tons? A. Make the screw large enough to have the area of the thread in the nut equal to 25 square inches at least. 2. What would be the friction, supposing the nut to be placed in the upper end of the screw, and the lower end of the screw to turn on a flat metal surface? The screw will, of course, be well lubricated. A. Friction will probably not exceed 10 per cent of the force applied to the screw.

(71) J. F. says: 1. We have not got enough natural draught for our stationary boiler. We propose putting on a fan blower. Would it do as well to let it blow up through the stack as under the grates? Our exhaust goes into the stack, but our engine does not run continually, and we see that the exhaust has but very little effect on the draught or fire. A. The arrangement of blower which you suggest will answer very well. 2. We have also a $\frac{3}{4}$ steam pipe running into the stack, which, when steam is let through it, creates a terrible roaring fire. It uses a great deal of steam, but it is a long way ahead of the exhaust. Will not our exhaust create more draught if the nozzle was closed to the top of the stack? A. We do not think any gain will be realized by carrying the exhaust pipe as proposed.

(72) D. M. M. says: 1. I have an iron tank for supplying water to a steam boiler 4 feet long by 20 inches diameter. The shell is of $\frac{1}{4}$ inch boiler plate, and the ends are cast iron, having a rod passing through the center. Can I insert 40 two-inch tubes by drilling holes through the cast iron ends of sufficient size for the tubes without weakening the strength of the tank? The tank is guaranteed to stand a pressure of 60 lbs. per inch, or will it be better to have the ends replaced with boiler plate? A. It will be better to use wrought iron heads. 2. What is the comparative power for water and air to absorb heat, both being of the same temperature? A. The amount of heat that will raise the temperature of 1 lb. of water 1°, will do the same for about 4 lbs. of air.

(73) R. J. asks: 1. How can I dissolve rosin in large quantities in something that will evaporate and leave the rosin hard? A. Turpentine, naphtha, benzole, etc., are solvents for rosin, and will deposit the same upon evaporation. 2. How can I dissolve rubber? A. Use bisulphide of carbon mixed with 6 or 8 per cent of best alcohol. 3. Can old rubber shoes be dissolved? A. Vulcanized rubber may be dissolved in the above mixture by heat, pressure, and agitation, in strong vessels of boiler iron. The solution, however, is somewhat difficult, and, owing to the volatility and inflammability of the solvents, not without danger when the operation is conducted by inexperienced hands.

(74) T. J. C. asks: Will a circular saw with 16 teeth cut better and more easily in hard wood generally than one with 24 teeth, each saw being 54 inches in diameter? A. This depends upon the thickness of the saw and the amount of feed to each revolution. For a 54 inch saw of No. 8 gauge, cutting 1 inch at each revolution in hard wood, I should say that, if the teeth were spread at the points in place of bending each alternate tooth for the set, 16 teeth would be better than 24. All of the conditions should be given in order to permit a definite decision to be arrived at.—J. E. E., of Pa.

(75) C. D. R. asks: What is the reason that tubes in an upright boiler do not burn out at the top

where there is no water? A. The steam in the boiler ordinarily reduces the temperature of the products of combustion to a point where they will do no damage to the iron.

(76) E. C. asks: 1. Will a portable engine rated at 6 horse power do more work in a day than 6 horses? A. Yes. 2. Is an upright boiler as durable as a horizontal one? A. Ordinarily, yes.

How many revolutions should the cylinder of a thrashing machine make, the diameter being 13 and length 30 inches? A. This depends on the construction of the machine. You should address the manufacturer.

(77) B. A. W. says: Given a propeller with a 24 foot keel and 7½ feet beam, rather flat on the bottom at midship, with an upright boiler, with two inch tubes and shell 2 feet by 4 feet; which is best, an engine 3¼ x 6 or 3½ x 5 inches? or is there a better size than either? A. Use one 3 x 5 inches. 2. What size and pitch of wheel, and how many blades are necessary? A. Use a propeller of 3 blades, 24 inches diameter, of 3 feet pitch. 3. Where should the boiler be placed to allow a cabin to be built in front, projecting at the sides on the guards 5 inches each side, the roof covering the whole boat? A. You do not send sufficient data to enable us to determine the position of the boiler; but probably it can be placed 12 or 14 feet from the bow. 4. What speed would such a boat make? A. Probably 6 miles an hour.

(78) S. L. S. says: I have a forebay or penstock to a mill; it is 8 by 10 feet, and the water is 6 feet deep. In the center of the forebay I wish to place a wheel, with a gate 17 by 18 inches. How many lbs. pressure of water will thus be on the gate at the bottom of the forebay? A. About 2½ lbs. per square inch, as we understand the question.

(79) G. W. R. says: A man is using a hydraulic pipe, with a 22 inch pipe at the head or penstock. He takes out the 22 inch pipe at the head, and puts in a 36 inch pipe. Will the pipe throw the water further from the nozzle, and will the pipe take more water than before? A. Your question is rather incomplete; but, as we understand it, the change will make no material difference in the discharge.

(80) A. W. F. asks: 1. How many lbs. of anthracite coal would an upright tubular boiler, measuring, say, 4 feet high by 34 inches diameter, with ordinary grate surface and draft, consume? Boiler carries from 30 to 110 lbs. steam, and engine runs at 300 revolutions per minute. A. Such a boiler would probably burn from 40 to 50 lbs. per hour. 2. What should be the proportionate depth of a steam yacht to its length, and how high should a boat of 30 feet long rise out of water at its bow, the boat being used where the water is oftentimes quite rough? A. Draft, from $\frac{1}{12}$ to $\frac{1}{15}$ length. The boat in question might rise from 24 to 30 inches at the bow.

(81) L. M. C. asks: How can I prepare color, such as red, blue, green, etc., to mix with a glue size, to be used on cotton cloth, which, when stretched on a frame and dry, will look clear and transparent, and be smooth and free from streaks on the flat surface? A. The aniline colors will give the best satisfaction. You can obtain them with instructions from almost any druggist. They are brilliant and economical. Some of the vegetable dyes would answer; but it would require too much space to give you the various methods for their extraction here.

(82) D. W. says: A very singular phenomena recently occurred in a mill, run by an eight horse power steam engine. The upper stone is stationary, the lower stone standing on a 1¾ inch spindle, resting on a step. This step is movable, so as to gauge the rate of feed. The spindle is of hardened steel, resting immediately on a steel plate, ⅜ of an inch in thickness and 2 inches square, resting on a cast foot, in a square bed, secured against revolving. Above this bedplate is a loose collar of cast iron resting in the step plate surrounding the spindle in a manner to secure stability of motion to the spindle. The foot plate is of hardened steel, its upper surface being flat, and the point of the spindle resting on this plate is slightly oval. A few days ago, while the mill was running at its usual velocity with a full head of steam, the stones stopped instantly, the belt sliding in the pulley until steam was shut off. The miller supposed that something had got between the stones, and at once set to work to raise the upper stone from its bed, but only the ordinary amount of grain was found between the stones. The lower stone was then lifted from its bed, and the spindle was found firmly attached to the steel foot plate in the step. An attempt was made to drive this foot plate off, the corners projecting sufficient to give a full blow with a heavy hand hammer, such as blacksmiths usually use. The corners of this plate were bent down by repeated blows, without any effect on the attachment to the spindle. The spindle was then taken to a smith's forge, heated and cut off above the step plate, so as to leave a small portion of the spindle attached to the step plate. On close inspection, a small portion of the outer surface of the end of the spindle was found not attached to this step plate. Oil was found above the step plate and collar around the spindle, in sufficient quantity, and no evidence of heat or unusual friction could be found. And yet the spindle was firmly welded to the step plate. This process of welding must have been instantaneous, as no abatement of speed was noticed by those standing about. All the above facts can be verified by testimony. Can anyone explain this fact? A. We prefer to throw this open for general discussion. If our correspondent can conveniently forward the corroborative testimony of which he speaks, we would be glad to see it.

(83) W. H. says: 1. Why is it that, in winter or spring, when it is warm enough to cause slush ice to break up and follow the current of the streams, at night some of the lightest of this slush will sink to the bottom of the stream and freeze to rocks, etc.? A. Your account is not sufficiently detailed to enable us to answer your question. 2. A pump used for pumping water from a river often refuses to take water on account of this slush freezing to the strainer of the suction pipe, but it is only at night; and as soon as the sun rises we do nor have any trouble with it. A. Probably the trouble is caused by the manner in which the strainer is located. In general, stoppages of this kind are more influenced by atmospheric conditions than by the time of day.

(84) W. D. P. asks: If I were to put a piece of vulcanized rubber (such as combs are made of), 10 inches wide, 32 inches long, and ½ inch thick, into a hydraulic press (the box of the press fitting the rubber), how much pressure would it stand without breaking or altering its shape? A. It would probably stand several tons; but we have no data on this subject.

(85) A. L. E. asks: Do you know of any chemical compound or method by which the hair on the head can be turned permanently gray or white without injury to the scalp or skin? A. We do not know of anything of this nature that we care to recommend. All such agents are more or less injurious.

(86) R. L. D. asks: How can I harden the shell of a hen's egg without impairing the egg? A. We do not know of any practicable method of accomplishing this.

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

J. W. B.—They are small, well formed garnets.—C. C.—If the colors constituting the pattern of your carpet are not affected by the solvents, the green stain may be removed by means of a little warm alcohol and ammonia (aqua ammonia). Otherwise it is not advisable to attempt the removal of the stain.—W. H. H.—It is a sand consisting of iron pyrites. See p. 7, vol. 36.—W. L. W.—It is a small fragment of quartzose rock, containing bright specks of iron pyrites. See p. 7, vol. 36.—E. P. C.—No. 1 contains lime, magnesia, alumina, silica, sesquioxide of iron, and iron pyrites. The cubes of No. 2 are crystals of sulphide of iron—pyrites. See p. 7, vol. 36.

It has been our custom for thirty years past to devote a considerable space to the answering of questions by correspondents; so useful have these labors proved that the SCIENTIFIC AMERICAN office has become the factotum, or headquarters, to which everybody sends, who wants special information upon any particular subject. So large is the number of our correspondents, so wide the range of their inquiries, so desirous are we to meet their wants and supply correct information, that we are obliged to employ the constant assistance of a considerable staff of experienced writers, who have the requisite knowledge or access to the latest and best sources of information. For example, questions relating to steam engines, boilers, boats, locomotives, railways, etc., are considered and answered by a professional engineer of distinguished ability and extensive practical experience. Inquiries relating to electricity are answered by one of the most able and prominent practical electricians in this country. Astronomical queries by a practical astronomer. Chemical inquiries by one of our most eminent and experienced professors of chemistry; and so on through all the various departments. In this way we are enabled to answer the thousands of questions and furnish the large mass of information which these correspondence columns present. The large number of questions sent—they pour in upon us from all parts of the world—renders it impossible for us to publish all. The editor selects from the mass those that he thinks most likely to be of general interest to the readers of the SCIENTIFIC AMERICAN. These, with the replies, are printed; the remainder go into the waste basket. Many of the rejected questions are of a primitive or personal nature, which should be answered by mail; in fact, hundreds of correspondents desire a special reply by post, but very few of them are thoughtful enough to inclose so much as a postage stamp. We could in many cases send a brief reply by mail if the writer were to inclose a small fee, a dollar or more, according to the nature or importance of the case. When we cannot furnish the information, the money is promptly returned to the sender.

J. C. R. asks: What is the greatest depth ever attained by a diving bell?—G. G. asks: How can I mend a stiff hat with a tear in it?—B. A. F. asks: Can you give me information concerning the dark day said to have occurred in New England at the commencement of this century? It was not occasioned by an eclipse or any other explainable cause.

COMMUNICATIONS RECEIVED.

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

On a Demand for a New Business. By H. D. R.
On Patent Rights and Wrongs. By J. R. R.
On Diphtheria. By S. S. S.
On Perpetual Motion. By D. H. M.
On the Bourdon Gauge. By A. B. W.
On Cartesian Physics.
On Trisecting an Angle. By H. C.
On Theories of Light. By P. S.

Also inquiries and answers from the following:

M. C.—M. A. F.—S.—J. B.—A. C.—W. M. K.—H. P.—W. P. E.

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.

Inquiries 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: "Whose is the best generator, for the manufacture of vinegar? Who are the largest steel manufacturers in the United States? Who makes cast cast-steel? Who sells stamped tissue paper? Who makes machines, actuated by weights or springs, for raising water? Who lays narrow gage railroads, and what is the cost per mile? Who sells electro-plating materials?" 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.

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

March 13, 1877,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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9,848.—GLASSWARE.—D. Barker, Pittsburgh, Pa.
9,849.—STOVES.—C. H. Castle, Quincy, Ill.
9,850.—SPOONS, FORKS, ETC.—J. M. Culver, Wallingford, Conn.
9,851, 9,852.—CARPETS.—E. D. Daniels, Paris, France.
9,853.—CARPET.—T. J. Stearns, Boston, Mass.
9,854.—KNIFE HANDLE, ETC.—J. Seymour, Syracuse, N.Y.
9,855.—TRIMMING.—A. Sturm, New York city.
9,856.—TOWEL BORDER, ETC.—T. Webb, Randallstown, Ireland.

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