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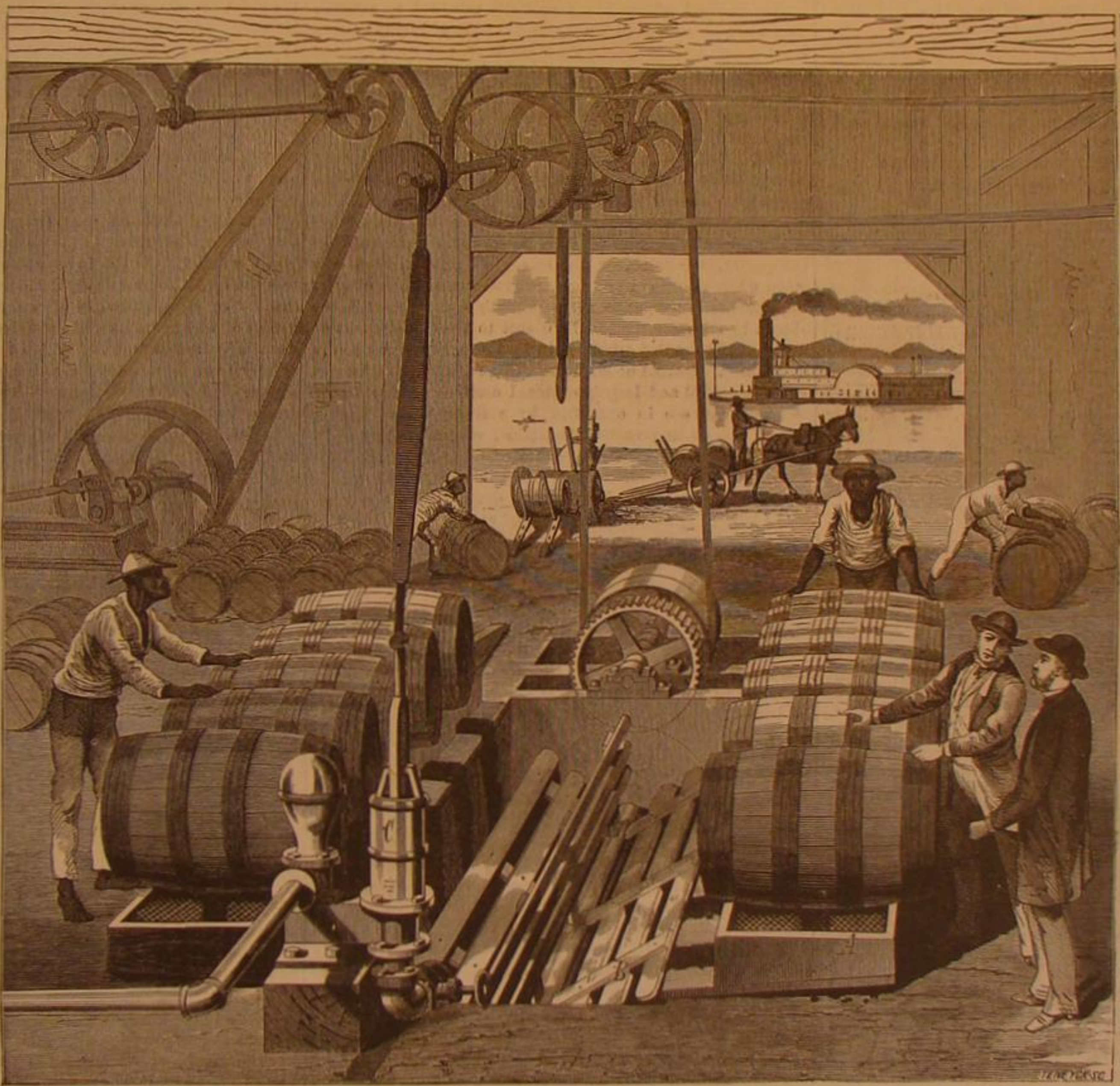
IMPROVED LIQUID MIXER.

Molasses is usually supplied to the markets in four grades—common, fair, prime, and choice—and to obtain these different qualities, it is necessary to mix together large amounts of the liquid at a time. The apparatus represented in the engraving is designed to facilitate this operation. It may also be employed in any other cases where the mingling or equalizing of fluids in bulk, as in refineries, distilleries, etc., is required.

The mixing vessel or vat is conveniently located in the ground, or beneath the floor level. At both sides are arranged boxes provided with strainers, A, through which the liquid escaping from the barrels, which are rolled, bungs downward, upon the tops of the boxes, is filtered. The bottoms of the boxes are inclined so that the fluid runs to an opening at the inside, and thence into the vat. Within the latter, and placed longitudinally, is a stirrer wheel, B, which is revolved by suitable power transmitted from the engine, and by means of which the liquid collected is thoroughly mingled. When the operation is finished, the wheel is stopped, and the contents of the vat are drawn off by the pump, C, operated from the driving shaft, as shown, and through a suction strainer set in a draining box at the bottom of the receptacle.

Large quantities of liquids may thus be handled easily and mixed in a short space of time, while being also strained from any coarse impurities, in the passage to the mixing vat.

Patented through the Scientific American Patent Agency, July 20, 1875. For further information address the inventor, Mr. John B. Meyers, 475 Josephine street New Orleans, La.



MEYERS' LIQUID MIXER.

Prizes for Metallurgical Improvements.

The *Société d'Encouragement pour l'Industrie Nationale* (offices at Paris, rue de Rennes, 44) offers a prize of $600, to be competed for in 1876, for a process of manufacture of cast steel rails from common ores, containing from 0·50 to 1·50 per cent of phosphoric acid. In 1876 will likewise be accorded the D'Argenteuil prize of $2,400 for the discovery or improvement of the greatest consequence to French industry; and in 1879 the society's own prize, of the same amount for the same object. Other prizes are: (1) $600 (in 1876) for a steam engine of from 25 to 100 horse power, burning 1·54 lbs. of coal per horse power per hour, the engine weighing less than 720 lbs., and costing under $80 per horse power. (2) $200 (in 1878) for a small motor for domestic purposes. (3) $400 (in 1878) for specified improvements in flax and hemp spinning. (4) $400 (in 1879) for cotton carding. (5) $400 (in 1880) for a file cutting machine. (6) $400 (in 1877) for a method of obviating the shock and vibration of heavy machinery, such as steam hammers. (7) $200 (in 1876) for any useful application of the recently discovered metals—calcium, magnesium, strontium, thallium, etc. (8) $200 (in 1876) for a new alloy useful in arts (9) $400 (in 1877) for artificial graphite for drawing pencils. (10) $600 (in 1877) for the artificial preparation of compact black diamond, for obtaining a powerful means of action in working iron, steel, and precious stones. (11) $1,200 (in 1878) for a theory of steel based upon experiment, and having for its object to better regulate the manufacture of steel. (12) $200 (in 1876) for the establishment in France of a workshop for the complete treatment of the ores of nickel, and the preparation of the pure metal, the nickel ores from the Alps, the Pyrenees, and Algeria being at present only treated for smalt, and then sent away, to Germany more especially, for the extraction of the nickel. (13) $200 (in 1880) for means for the economical production of high temperatures. (14) $400 (in 1878) for a means of hindering soot from adhering to the walls of chimneys, so that they may be fully cleansed.

New Allotment of Space at the Centennial.

The Centennial Directors have abandoned their original idea as to allotting space, which by the way was never formally adopted, and, for the very convenient arrangement of placing nations across the building and groups of similar objects longitudinally, have substituted the far less sensible plan of putting each nation's exhibit promiscuously within a certain area. The beauty of the first scheme was that, to inspect the display of any one country, the visitor had only to enter the proper side door and walk across the hall, the whole exhibit being in the zone traversed; or, if he desired to examine, say all the cotton machinery of the world, he would simply begin at that class of mechanism at the end of the building and walk its entire length, in so doing crossing the space of each nation where cotton machinery had been placed. There were plenty of objections to the plan, good as it was, which need not be detailed, since the new one has been definitely adopted. The United States now occupy about one fourth of the floor space, and the areas next in point of size are allotted to England, Germany, and France, the four great nations being grouped together. The other countries are scattered apparently without regard to their geographical position. The areas allotted thus far, according to the new plan, are as follows: United States, 166,351.7 square feet; France and colonies, 43,314; England, 51,776; Germany, 27,705; Austria, 24,070; Canada, 24,070; Australasia, 24,070; Sweden, 15,358; Belgium, 15,358; Japan, 16,566; Netherlands, 8,167; Norway, 6,897; Switzerland, 6,646; and Denmark, 5,647.

The Treatment of Hydrophobia.

The French *Journal des Connaissance Médicales* relates that a man, 43 years of age, having been bitten by a mad dog, was cauterized with a red hot iron four hours later. A month passed without any distressing symptoms, but at the end of that time he began to complain of epigastric and pharyngian constriction, and was very much cast down. Recourse was had to chloral at doses of about sixty grains, which succeeded twice in affording a good night's rest; but the third time it remained without effect. The patient experienced great anguish; his voice was hoarse; he had tetanic contractions in the arms, neck, and breast, and expressed great fear, accompanied with hallucinations. In the morning he was utterly discouraged.

They then administered sixty grains of bromide of potassium, which gave a quiet night, with a great improvement on the following day. Another dose of about seventy-five grains was given with equal success; all convulsive motions had disappeared.

The medicine being suppressed, the convulsions began again a week later, when bromide was again administered to the amount of about ninety grains, which completed the cure. This remedy is readily tried, and we shall be glad to hear of any results that our readers can communicate.

Southern Pacific Railway.

Any one, says the *Los Angeles Herald*, desiring to obtain any idea of the stupendous accomplishments of railroad engineering should spend a few day at Tehachape Pass, investigating the operations of the Southern Pacific Railroad Company. About twenty miles of that road is a succession of cuts, fills, and tunnels. Within this distance there are thirteen tunnels, ranging from 1,100 feet to a few yards in length. For the greater portion of the way the road bed is cut through solid granite. The elevation is so great from the present terminus of the road, at Caliente, to Tehachape Valley, that the first mile and a half out of Caliente is attained by laying down eight miles of track. Higher up in the pass the road runs through a tunnel, encircles the hill, and passes a few feet above the tunnel. After completely encircling the hill, and going half round again, the track doubles on itself like a closely pursued hare, and, after running several miles in the opposite direction, strikes up the cañon. This circling and doubling is for grade. Once the track crosses the pass, and this involves the building of a long and very high bridge. We doubt if a more difficult and expensive piece of engineering was encountered in the building of the Central Pacific over the Sierras than that with which the Southern Pacific is now struggling in Tehachape Pass. Another tremendous piece of work is the San Fernando tunnel, which when completed, will be over a mile and a half in length, and in places over 1,000 feet beneath the surface. Yet the company will accomplish this great work, and run cars through from San Francisco to Los Angeles, by the 1st of next July. All the force that can be used is kept at work on the San Fernando tunnel. In the Tehachape Pass 5,000 men are employed, and the force is being increased at the rate of 1,000 Chinamen per week.

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NEW YORK, SATURDAY, OCTOBER 2, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

A NEW USE FOR CRIMINALS.

Even vermin have their uses, say the pessimists. It is a cheering theory, and one which we should rejoice to see demonstrated, especially with reference to those vermin of society, the criminal classes.

Thus far they certainly have been the reverse of useful. Not only have they been a serious detriment always, to national prosperity through their depredations upon life and property and public peace, but also by their vicious example, and, more effectually still, by the transmission of their vicious traits to after generations.

Our present mode of dealing with them labors under the double disadvantage of being very inefficient and very costly. Every year sees the machinery of justice become more magnificent and burdensome, yet it none the less fails either to cure or to materially lessen the evil. Indeed the law has often more terrors for the good citizen than for the bad: he has a large bill of costs to pay at any rate; whereas the rascal who plunders him has everything to win and very little to lose. If he escapes, which is most likely, he gets the booty: if caught, he simply loses for the moment what is no use to any one—his liberty.

Is it not time for the well disposed, the innocent, and the law-abiding to turn the tables and recoup themselves, if possible, for their numerous losses? The ways in which this can be done are as numerous and varied as the varieties of criminal constitution and character.

Just now the authorities of Massachusetts are puzzled to decide what to do with the murderous Pomeroy boy. Hang him! said the court: and the multitude re-echoes the cry. That is an easy way to get rid of him; but will it pay? What good will it do to kill him? His death will not atone for the damage he has done, nor will it deter another of like mental and moral perversity from the commission of similar crimes. Then why throw away all the possibilities of use and instruction which his peculiar character affords?

In a case of this sort, vindictiveness is folly. The boy is what he is through conditions of heredity and culture which ought to be investigated. He represents a stage of human development or atavism which ought to be understood. What was the antecedent stage, and what will the next one be? His character is likely to change with increasing years; what is the direction of that change? Education and moral training are supposed to have a determining influence upon character; what can they do for him? The boy is a very bundle of scientific problems; why not keep him for investigation? For the solution of many of the problems of culture and civilization, he is worth a dozen ordinary children. He ought not to be thrown away. Make it impossible for him ever to transmit his vicious nature to a future generation, then investigate him, and all others like him, for the good of the race.

Apply the same principle in a different way to a very different character, say the once famous, now infamous, Colonel Valentine Baker, late of the British Army: a man of years and high standing, whose irrepressible impulses led him to make criminal assault upon an unprotected fellow traveler. He has lost his place in the army and in society; he has been fined and nominally imprisoned; but his impulses remain unaltered, and his example—punishment and all—seems to provoke others to similar deeds rather than to deter them; for his unusual offense has been since repeated by several. And when he returns to the world, his term of idle imprisonment ended, he will be simply what he was at first, lacking the restraining influence of his rank and possibilities of usefulness.

This may be justice, but it is not good policy. What was needed in his case was chiefly the extirpation of the cause of his uncontrollable passion—which any surgeon could have done in a few minutes—to destroy the only element of danger in his character.

In a rude state of society, the usefulness of a public offender is necessarily measured by his power to do rude work, in the quarry, the mine, or the like. We have arrived at a stage when a portion of our superabundance of such characters can easily be put to more profitable uses; though we should by no means personally object to the employment of the more able-bodied criminals in that way, especially in the coal mines. Instead of manufacturing for such needful service a degraded and largely criminal class—a process which any one can see in operation by visiting a coal-cracker among the Pennsylvanian mountains, where swarms of ill bred children spend their days at hard labor under the most debasing influences—it would be infinitely better to have the work done by ready made criminals, drafted from the country at large. It would be a saving of virtue, and possibly in the cost of coals. But there are still better uses to which the majority of criminals can be put.

Among the most important problems of civilization are those relating to health and disease. Of very few human maladies can it be said that we know their causes, their natural history, their effects upon the physical and mental organism, or a satisfactory mode of treating them. As little do we know how to prevent or avoid them. Yet of what vital importance is such knowledge to the well being of society!

The limited positive knowledge which Science has acquired of the ills which flesh is heir to has been gained through observation complicated by a thousand unknown conditions, through experiments upon unoffending animals, and by dissection of dead. During the middle ages, the last mentioned source of knowledge was barred. Every scholar knows what sudden and immense advances men made in anatomy and physiology, and in the healing arts which rest on them, when students began to draw their knowledge of man's physical frame directly from human subjects, and not indirectly and incorrectly from the study of animals. A similar advance might be expected in preventive and curative medicine could the action of disease be directly studied in human subjects over which the observer should have absolute control.

Our suggestion would therefore be that such a portion of the criminals convicted from day to day, as might be found available, should be turned over to boards of surgeons and physicians, duly appointed, under whom they might be used for the investigation of sanitary problems, for the good of humanity.

For example, men convicted of capital crimes, instead of being uselessly hanged, might be employed in the study of diseases usually fatal, or of other diseases whose effects in their various stages would need to be studied anatomically. Especially atrocious murderers might be reserved for cases involving vivisection. Criminals of lower grades could be utilized in the study of diseases of minor severity, according to their physical adaptation and the nature of their crime. Having their subjects under absolute control from the inception of a disease to its termination, the investigator could not fail in time to arrive at certain knowledge both as to its prevention and mitigation, if not its cure. Medicine is full of problems whose solution might be greatly hastened by such means.

The same may be said of other departments of social science. How far, for example, is the criminal diathesis curable, and under what conditions? What is the comparative influence of the different sorts of mental and moral training? How can the taint of hereditary crime be averted? How are the various grades of criminality affected by surgical operations, especially those calculated to make the perpetuation of hereditary crime impossible? And how far may the subjects of such treatment be safely allowed at large?

But the field of investigation is limitless. The possible advantages of its systematic prosecution are correspondingly great. The right of society to defend itself against its internal enemies, even to the taking of life, is unquestioned. To attempt it by means of punishment has proved unavailing and costly. It is time that a different plan be tried. Suppose we sink the idea of retribution—if need be, of reformation also—and seek to make all human vermin first harmless, then useful, either by their productive labor or by their subjective contributions to human knowledge for the protection of health and the saving of life.

As for its deterrent effect, such a passionless, unvindictive, business-like treatment of all violaters of the common weal certainly could not be less efficient than the jumble of uncertainty, vengeance, softness, retribution, sentimentality, and uselessness, which constitutes our present judicial and correctional systems. We are disposed to think that the possibility of being made a subject for the study of small pox, cholera, typhoid fever, or even a bout at measles or the mumps, would restrain a pickpocket or a burglar quite as efficiently as the chance of a few weeks on the Island, or a few months at Sing Sing. At least the knowledge gained by means of him and others like him would go far to recompense society for all it might suffer from his depredations.

HOW FAR WILL BODIES SINK IN THE OCEAN?

The often repeated inquiries which we receive, as to the depth in the ocean at which heavy bodies will float, prove the great prevalence of the error that water is so compressible as to become at certain great depths considerably heavier, by its own superincumbent weight. The fact is that, on the contrary, water is one of the least compressible bodies, so that, under a pressure of 7,200 lbs. per square inch, corresponding to a depth of 16,800 feet, or 3 miles, its bulk is only diminished from 1,000 to 978 parts, and its weight or specific gravity increased from 1·000 to 1·022. At double this pressure, or 33,600 lbs. per square inch, at 6 miles in depth, the compression is double that amount.

Oerstedt of Copenhagen, who in 1819 discovered the relation between electricity and magnetism, a discovery which was the first step in the invention of the modern telegraph, was the first who practically demonstrated and measured the amount of compressibility of water and other liquids, by means of an apparatus still named after him. It consists of a small hydraulic press, of which the piston is pressed powerfully down by means of a screw, so as readily to produce pressures of 500, 1,000, and even 5,000 and more pounds per square inch. The walls, being of extremely strong glass, give opportunity to observe the instruments of measurement enclosed. Experiments with this apparatus show data which may be tabulated thus:

TABLE OF THE DEPTH AND CORRESPONDING PRESSURE AND DENSITY UNDER THE OCEAN'S SURFACE.

Depth below surface.	Pressure of water column in lbs.	Pressure of water column in atmospheres.	Density of the water.	Bulk of equal weights of water.
0	0	0	0·0000	1·000000
32 feet	15	1	0·0990	1·000048
160 "	75	5	0·9997	1·00023
1,000 "	750	50	0 9977	1 0023
½ mile	1200	80	0 9963	1·0037
1 "	2400	160	0 9926	1·0074
1 ½ miles	3600	240	0·9892	1·0111
2 "	4800	320	0·9854	1·0148
3 "	7200	480	0·9782	1·0222
4 "	9600	640	0·9718	1·0296
5 "	12000	800	0 9652	1 036
6 "	144000	960	0·9578	1·044

It will be seen from this table, of which the data are perfectly reliable, having been verified over and over again by various experimenters, that when water is submitted to a pressure of 144,000 lbs. to the square inch, corresponding to a depth of 6 miles, a bulk of 1,000 cubic inches will only be compressed to a space of 957 cubic inches, and the specific gravity increased to 1·044, water being 1 000.

Therefore, if a body be capable of floating at such a depth, it must satisfy two conditions: 1. Its specific gravity must be between 1·000 and 1·044. If the specific gravity is not more than 1·000, it will not sink at all; and if it be 1·044 or above, it will sink to any bottom less than 6 miles deep. 2. The sinking body must be less compressible than water; if it is more compressible, it will grow comparatively heavier all the time it is descending, and can never find a stratum of the same weight, in which it might float in equilibrium. Now all the bodies known to be less compressible than water are much heavier than the limit given; such are stones, metals, etc.; and the amount of their compressibility, as compared with that of water, is still problematic. But they will certainly all sink to the very bottom of an ocean, be it ever so deep. In regard to the bodies of which the specific gravity surpasses that of water slightly, so as to come within the range under discussion, they are all very compressible. All kinds of wood, when submitted to great pressure, so that all pores are filled, attain the specific gravity of the primitive wood fiber, the lignin, of which the specific gravity is 1·400; and they will thus sink to the very bottom, like water-logged wood. So it is with all similar substances; and the theory that there is a certain depth in which all or many bodies may float in the ocean must be modified to a statement that there are various depths at which certain various bodies may be kept floating; but that the cases are extremely rare, exceptional, and perhaps only temporary, so that all bodies will finally either sink or float. In the latter case, the destructive power of the elements will soon dispose of them; in the former they are usually preserved, as is seen in observing the structure of the diatoms, those delicate beings the details of which serve now to test our best microscopes, and which the depth of the ocean has preserved, in the mud deposited there, for thousands of years.

THE PROPOSED RAILWAY TUNNEL UNDER THE ENGLISH CHANNEL.

The preliminary arrangements for the commencement of this great work are progressing favorably, and there appear to be good prospects for its execution under the combined auspices of the English and French governments. Preliminary surveys of the best routes have been made by eminent engineers, who have become satisfied thereupon that no especial difficulties are likely to be encountered. The length of the tunnel will be about twenty-two miles.

The subject came up for discussion recently before the British Association, when Sir John Hawkshaw, who is one of the engineers of the work proposed, gave a variety of interesting particulars:

The channel waters, he said, were a mere fish pond. They were only 180 feet deep. Borings have been made to a depth of 600 feet on each side of the Channel, and also in the Channel bottom at many points on the line, and it has been experimentally ascertained that the tunnel would pass through a chalk formation for nearly the whole distance. The tunnel would be 230 feet below the bottom of the Channel; and with this large amount of material existing between the bed of the tunnel and the ocean above, there was little danger of any trouble from the ingress of water.

Some people seemed to assume that the tunnel would be so badly ventilated that nobody would dare to go into it. When the tunnel came to be constructed the great difficulty would be to get in and out of it. There would be a vast number of workmen and an enormous amount of building material to be carried in and out. There would be a drift way tunnel; and in order to facilitate the men and the material going in and out, it would be desirable to put on each side of the tunnel a pneumatic tube—in fact, they would be almost essential for the mere construction of the tunnel. When the tunnel was finished, he would suggest that these tubes remain. All that was necessary would be to make apertures on one side of the tunnel, and by pumping the air which flowed in at each end of the tubes into the tunnel the ventilation would be practically easy and not very expensive. He had been silent as to this point because engineers were generally silent about works until they were executed. When the work was accomplished, the way in which it was executed would be patent to everybody.

SCIENCE PUGNACIOUS.

"The battle ground of Science" has hitherto been but a metaphor. Not that Science has not waged conflicts, and won victories: that, indeed, is her constant course against error and superstition: but such warfare has been of mind to mind, not hand to hand, and Science, exemplifying truth, prevails, as truth against falsehood always will. For once in history, however, Science has had a genuine battle ground, and a genuine combat. Not the antagonism of two learned pundits, who wax wrathful, and resort to personalities, and hurl jaw-pulverizing epithets across a debating room at each other; but a "square" fight, between Science, as exemplified by the Hayden surveying party, and Error, or stupidity, or dirt, or any other antithesis, in the form of a band of thieving redskins. And Science prevailed as usual, and got herself out of a bad scrape.

The army of Science consisted of seven men, commanded by Geographer Gardner. The army of Error, etc., numbered several times as many souls. Science was peaceably cracking stones, and chasing butterflies, and pulling up plants and measuring lines. She had some of her latest devised firearms along, firearms which could shoot several times to Error's once, but they had nothing to do with the stone-cracking, etc.; they were auxiliary to the theodolites and the hammers. Error met Science smilingly, and requested fire water and plug tobacco. Science had a large store of valuable information to impart about these delusive materials, but no fire water, save such as was improved by the presence of pickled toads, and not even a chew of the nicotian weed. Error departed disgusted and opened fire as soon as Science's back was turned. Then came hot work; if Science stood still, starvation and thirst would result; to proceed was to face the enemy in rocky and precipitous cañons. It was voted to press on. Science exhibited splendid marksmanship at 1,000 yards, with redskins for bulls-eyes. Twenty-four hours' continuous running fire followed, Error being dislodged from every stronghold as fast as gained, until, finally, open country was reached; and Error, having no more rocks to hide among, ran away, *minus* several of her numbers.

It was a good fight, bravely fought, and as bravely won, against heavy odds. The world will benefit by the contemplation of the valor of the scientist, in defense of his country, his flag, and his—specimens.

GAS FROM NIGHT SOIL AND DEAD ANIMALS.

Some time ago an improved method of making illuminating gas from night soil and dead animals was invented by A. Sinderman, of Breslau, Germany, and was very favorably reported upon by a committee selected by the authorities of that city. Subsequently the system has been put into practice under the supervision of the Director of Gas Works, Professor Troschel, who submitted it to a scrupulous examination in regard to quality of the gas produced and the cost of production. Recently the results have been published, and they are mainly as follows:

1. The quantity of gas obtained from a certain mass of material is considerably less than that obtained from an equal quantity of coal; so much so that, to obtain the same quantity of gas, the works required would have to be of double the dimensions sufficient for the coal.

2. The expense of production is, contrary to the expectation of the inventor and the report of the committee, double that of making gas from coal.

3. The method is objectionable. Ten per cent of the material used for gas-making must be heated in ninety per cent of water; and the aqueous vapors of this ninety per cent of water must be condensed in an enormous cooling apparatus.

4. When making gas from such material, the fuel must be bought; while when making gas from coal, forty-five per cent of the coke obtained is abundantly sufficient for fuel.

5. The enormous amount of various impurities, such as nitrogen, sulphur, and phosphorus, and their compounds, such as ammonia, sulphuretted hydrogen, and phosphoretted hydrogen, are present in this gas in much larger quantity than in coal gas; and the purification of the same requires, by reason of this abundance, arrangements of so complex a nature as to become utterly impracticable in working on a large scale.

It is proved thus that the utilization of these materials for the purpose of illumination is not as profitable as transforming them into fertilizers of the soil.

LIGHTNING RODS.

To the Editor of the Scientific American:

In the issue of the SCIENTIFIC AMERICAN dated September 18, in an article on lightning rods, you say, in speaking of the terminal: "This terminal may consist of an iron water pipe, * * * * or a very considerable extension of the rod into wet or damp earth; or a trench filled with iron ore or charcoal may be made available."

Now, I have a lightning rod on my house, the end of which was inserted to the depth of six feet in the earth upon the southerly side of it, at the time the rod was put up. Would the earth be sufficiently damp (the house is on a hill) at that depth? In the country, but few dwellings would be likely to have iron water pipes with which to connect lightning rods; there are none in this vicinity.

In the sentence quoted, you say: "Or a trench, filled with iron ore or charcoal, may be made available;" and, in the concluding sentence of the article: "We repeat, the golden rule for safety is to have the bottom of the rod placed in connection with a large mass of conducting material in the ground."

Now, the query is: How large should the trench be that is filled with iron ore, to afford protection to the building? Scrap cast or wrought iron, I suppose, will do as well (as ore is not found on Long Island), or charcoal, which is easily obtained. Definite information is wanted as to quantity.

Glen Cove, L. I. ISAAC COLES.

REPLY.—A test with the galvanometer would doubtless show that our correspondent's lightning rod is unsafe—that its bottom is sealed up or insulated so that the bulk of an ordinary discharge of lightning would be more likely to go through the dwelling than through the rod. Situated as his house is, the earth would ordinarily be dry, and a length of six feet of rod, say ½ inch square, in the ground, furnishes less than one square foot of conducting surface, which is insufficient as a terminal.

This correspondent, and also several others, request definite information as to the quantity of conducting material that the rod terminal should have in order to ensure safety. This can only be measurably determined by a test in each case, with the galvanometer, because the requirements vary with almost every building and with the hygroscopic condition of the ground. But an approximately safe rule has been suggested by Mr. David Brooks, the electrician, of Philadelphia, which is to the effect that, in dry soils, the terminal of the lightning rod (which may be composed of any of the conducting materials mentioned by our correspondent) should have a conducting surface, in contact with the ground, equal in area to that of the roof surface of the building. For example: If the roof surface is 30x40 feet, or 1,200 square feet, then the rod terminal should have 1,200 square feet of conducting surface in contact with the earth. Now this is only a suggestion of Mr. Brooks, intended for extreme cases of dryness in the soil; and if it errs, it is probably on the side of safety.

In our paper of September 11, we gave an account of a lightning rod test, made at the instance of Mr. George B. Prescott, Chief Electrician of the Western Union Telegraph Company. In that case the rod was arranged substantially like that of our present correspondent, had less than one square foot of conducting surface in the ground, and the galvanometer test showed it to be very unsafe; but the instrument also showed that the rod would be rendered a safe conductor, if put into connection with the house water pipe as a terminal, and this was accordingly recommended. This pipe, of iron, was half a mile long; and allowing it to be one inch in diameter, it presented a conducting surface, in contact partly with the earth and partly with water, of not far from 1,200 square feet.

THE FAIR OF THE AMERICAN INSTITUTE.

Owing to the fact that manufacturers throughout the country are now busily completing their preparations for the coming Centennial, we have been inclined to the belief that the local fairs held this fall would not receive their usual amount of attention, and hence, in point of novelty and variety of exhibits, would fall somewhat below the standard hitherto maintained. We have, however, been agreeably disappointed; for, judging from the reports which reach us from Cincinnati, from Newark, and other localities where industrial exhibitions are now in progress, the displays have never been better, and perhaps never so good. It is certain that, in the case of the Fair of the American Institute, the present show is far superior to any that has been held during the last five years. It is larger, and the exhibits, as a rule, are more elaborately prepared, while there is a goodly variety of new inventions, well calculated to interest as well as instruct the public.

So far as the interior aspect of the building is concerned, there are not many changes from last year, to note. The general arrangement is about the same, and a better and more refined taste has evidently been exercised on the decoration. We note with pleasure the abolition of the Fourth-of-July festoons which were a standing menace of conflagration to the dry wooden arches from which they hung. In place of this, a neatly painted strip of canvas has been carried around the building, so as to resemble a gallery, with very good effect. A number of large paintings, representing scenes in different sections of the country, very fairly executed, are suspended in frames in front of the imitation gallery rail, and agreeably break its monotony. The old pictures on the main arches remain as hitherto; and as there have been no further attempts made toward ornamentation, it will be seen that the same, as it should be, is very simple, and in no wise detracts from the display of articles on the floor.

It is difficult, at the time we write, to form any fair idea of the future contents of the machinery department, owing to many of the exhibits not yet having arrived. The most remarkable features are the

FOUR DRIVING ENGINES.

These consist of an 80 horse power Wheelock, 14 x 42; a 60 horse power Wright, 16 x 36; a 60 horse power Hampson & Whitehill, same dimensions, and a 60 horse power Harris-Corliss, 14 x 36. In the Wheelock machine we note several improvements, tending to simplify the working parts. The dash pots have been raised above the floor, and there is a new and ingenious form of cylinder oil cup, into one portion of which the steam condenses, and then, flowing in the shape of water into a larger portion, lifts the oil to proper hight for entering the cylinder. The Wright engine has a new way of attaching the governor to the cut off valve. Instead of the governor acting directly on the valve, it merely determines the fall or closing of the same by controlling a lug, which throws a spring catch off a cam. The cam is actuated by the engine itself, and the catch connects with the valve. It is of course impossible to convey a very clear idea of this or other devices in the brief terms here necessary, but, the attention of the reader being directed to the novel features, he may perhaps find it interesting and profitable to examine for himself. In

MACHINE TOOLS,

the machinery department will have an unusually fine display—to which, in our future reports, we shall take occasion to allude in detail. Woodworking machinery is also well represented. We notice several portable engines for farm use, and one especially, of English make (Ransome, Sims, & Head, Ipswich), which has a furnace fitted to burn straw and similar fuel. Two heavy drop hammers are in position, and there is a prospect of a good show of pumps. Any further comment on the contents of this department must, for the reason already given, be reserved for the future.

THE MAIN BUILDING.

About the most prominent object on the main floor is a Jardine organ, a fine instrument of very powerful tone. Advantage is taken of that well known experiment in physics, the hydrostatic paradox, to drive the bellows. Water is pumped up into a barrel on the roof, and thence it descends, through a two inch pipe, a distance of 50 feet, moving a piston 4 inches in diameter over an 8 inch stroke. Near the organ, the visitor will find a handsomely built cottage or summer house, covered entirely inside and out with wood papering. This last is merely thin sheets or veneers of wood attached to paper and applied to the wall in the same manner as paper hangings. The effect is that of solid planks, or of fine inlaid work. Almost every kind of wood is employed, and the results, when several varieties are contrasted, are very striking and elegant.

There is another house in the fair, made entirely of packages of Hecker's flour. It encloses an area large enough for the exhibitor to manipulate his cooking utensils over gas stoves, and use up his building material in the manufacture of excellent griddle cakes and waffles, which are freely distributed to visitors. This is a practical way of showing up articles of food, which, to our minds, is far better than loading people down with circulars setting forth long schedules of "advantages." Why do not the other "cereal" exhibitors follow the same plan?

The fair is especially rich this year in

HOUSEKEEPING ARTICLES,

a fact which will ensure its popularity. There is an ingenious grindstone which may be adapted to hold a polishing wheel for plate, for knives, or for stair rods, and will save a world of hard rubbing. The stone is horizontal and has beveled edges (adapting it excellently for sharpening mowing machine knives), and its spindle is surrounded by a spiral into which a pawl, on a traveling slide actuated by a spring treadle, engages. The pawl on its downward motion only acts upon the thread, and thus rotates the stone very swiftly. The silver plate manufacturers as usual show several cases of fine ware; and the china dealers have a remarkably large exhibit, including some specimens, from celebrated European factories, which will greatly interest lovers of rare porcelain. The visitor will find a table covered with pails, dishes, bowls, in fact every kind of vessel, made from paper. These are very light and strong, and for many uses will be preferred to tin or wood.

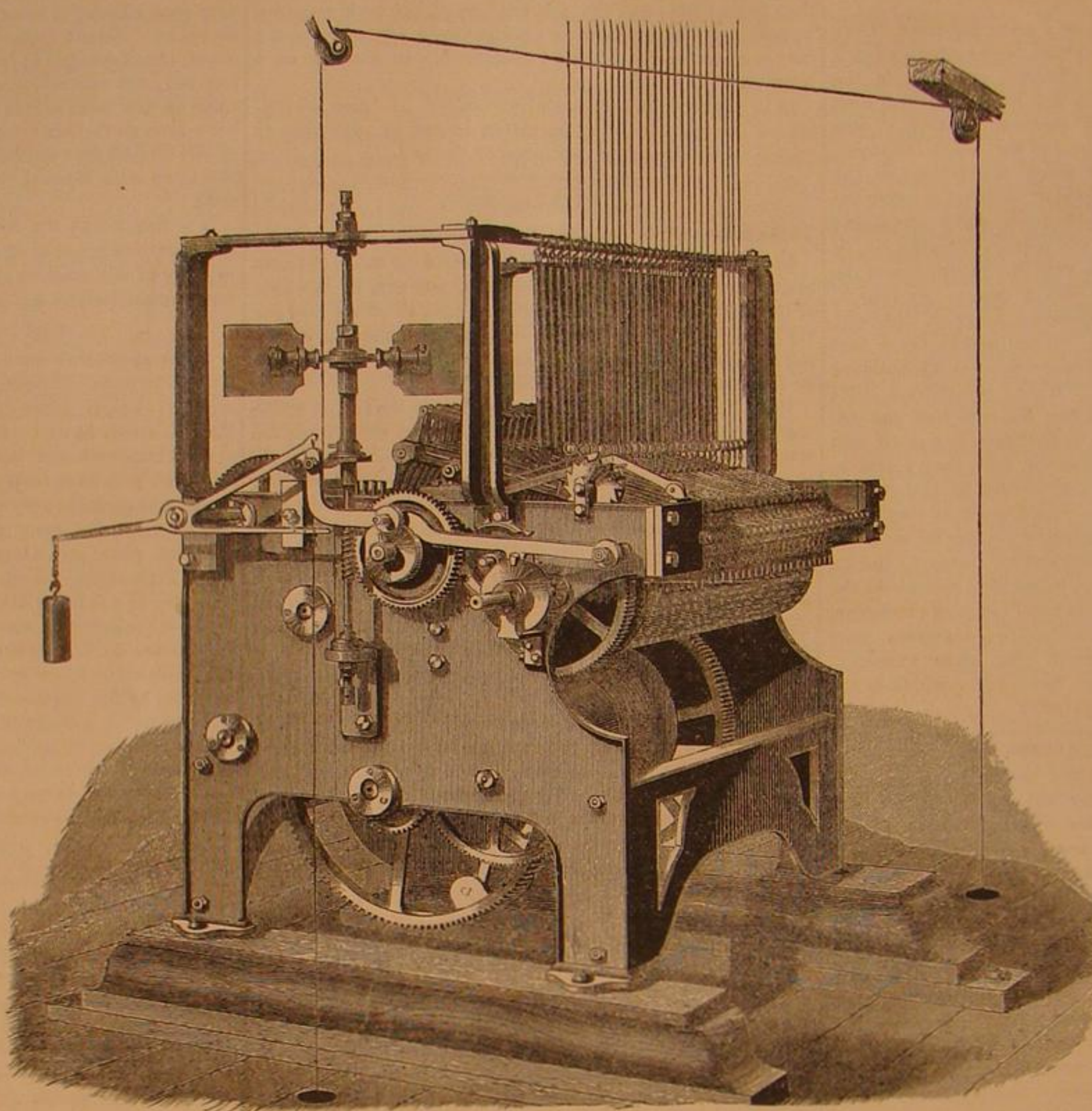
CARILLON MACHINES.

Most of our readers have heard church bells play tunes. At one period such an arrangement was very common, and on the Continent of Europe the system is brought to considerable perfection; but in England it is only within a recent period that the employment of machinery for the production of airs from church bells has become popular.

As the method of producing tunes from church bells is but little understood, it will be well to preface our description of the machine we illustrate by a few words of explanation.

Church bells are caused to sound in two ways—either, that is to say, by swinging them, and so causing the clappers to strike them; or by the aid of hammers of various weights, according to the size of the bell, caused to rise and suffered to fall on the bell. Peals are rung by hand, the bells being swung; clocks always strike the bell with a hammer, the bell being at rest. The hammer is raised by a wire, which pulls down the hammer tail, the wire being worked by a lever, the end of which is caught by a cam on a revolving barrel in the clock below. It is obvious that if a number of bells are all fitted with hammers, and the number of cams is sufficiently great, and the cams are properly arranged, that a tune can be played by a mere multiplication of the device by which a clock is made to strike the hours on a single bell.

The carillon machine embodies this arrangement, only, instead of cams, a number of short pins are set in a revolving barrel, and these pins catch the toes of levers connected by wires with the hammer tails in the bell chamber above. The pins are set or pricked in precisely in the same way as the little points in the barrel of a musical box. If our readers will bear the musical box in mind, and fancy that the whole is enormously enlarged, and that the toes of the levers take the place of the springs, the arrangement will be quite clear. Such is the old fashioned, or, as we may term it, positive carillon machine: and its defects are very serious.



GILLETT AND BLAND'S CARILLON MACHINE.

The hammer, after it has fallen, can only be lifted by the rotation of the barrel; and as the time of dropping the hammer depends entirely on the rotation of the barrel, it is obvious that the barrel can only revolve at a slow speed, and much time is lost in lifting the hammer. The result is that a rapid musical passage cannot possibly be performed. Another result is that, when the small bells, the high notes, come to be played, the barrel meets with less resistance, and revolves faster than when it has to deal with the deep notes and large bells. It follows that the air is played out of time.

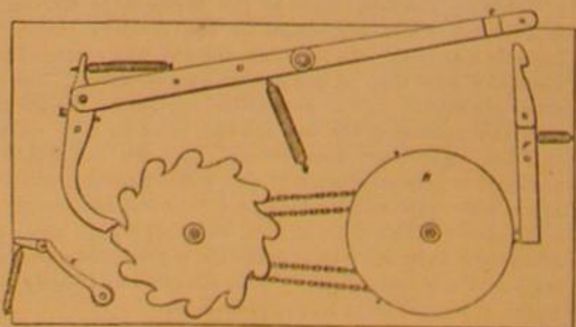
These difficulties are overcome by the invention of Messrs. Gillett and Bland illustrated in the engraving—which explains a principle, and not details. This principle we may call negative. The hammers are always kept raised, and are only allowed to drop by the agency of the musical barrel. The instant they fall they are lifted again; and so long as the lifting is accomplished quickly enough, the time of lifting has nothing to do with the production of the air. That is determined solely by the musical barrel, which, being relieved of the work of lifting, has little or no strain on it, can be made small and light, and will always revolve at the same rate, and so insure that the tune shall be played in perfect time. It also follows that the most rapid passages can be played with the greatest ease and precision.

The second engraving is intended to show the gear for working one hammer. It must be multiplied in proportion to the number of hammers, but the parts are all repetitions of each other. It will be understood that this engraving does not show details, but simply illustrates a principle.

The musical barrel, B, is set with pins in the usual way. A is a cam wheel of very peculiar construction, operating a lever, C, by what is, to all intents and purposes, a new mechanical motion, the peculiarity of which is that, however fast the cam wheel revolves, the tripping of the lever is avoided. In all cases the outer end must be lifted to its full hight before the swinging piece, D, quits the cam. The little spring roller, E, directs the tail, D, of the lever into the cam space, and when there it is prevented from coming out again by a very simple and elegant little device, by which certainty of action is secured. At the other end of the lever, C, is a trip lever, F. This lever is pulled toward C by a spring, and whenever C is thrown up by the cam wheel, F seizes it and holds it up; but the wire to the bell hammer in the tower above it is secured to the eye, G, so that, when D is lifted, the eye, G, being pulled down, the hammer is lifted. The pins in the musical barrel, B, come against a step in F; and as they pass by, they push F outwards and release C, which immediately drops, and with it the hammer, so that the instant a pin passes the step, F, a note is sounded. But the moment D drops, it engages with A, which last revolves at a very high speed, and D is incontinently flung up again, and the hammer raised, and raised it remains until the next pin, B, passes the step on F, and again a note is struck. It will be seen, therefore, that, if we may use the phrase, B has nothing to do but let off traps set continually by A; and so long as A sets the traps fast enough, B will let them off in correct time. But A revolves so fast and acts so powerfully that it makes nothing of even a 3 cwt. hammer, much less the little ones; and thus is obtained a facility of execution heretofore unknown in carillon machinery. We venture to think that our readers will agree with us that such a carillon machine as we illustrate is about as ingenious a combination of mechanism as is to be met with in the range of the arts.

Our large engraving shows a machine on this principle recently put up in the parish church at Shoreditch, London, by Messrs. Gillett and Bland. This plays fourteen tunes on twelve bells—one of the finest peals in London, the tenor weighing no less than 34 cwt. Two barrels are used, which can be changed by hand. The peal ranges from CC to G.

Fig. 2.



There are twenty-four levers, two to each bell, to insure facility in playing rapid passages without driving the cam barrel too fast. The motive power is supplied by a weight of 9 cwt., allowed to fall 72 feet, and wound up every twenty-four hours. The performance of the machine leaves nothing to be desired.

The corporation of Manchester have decided upon having a great clock and carillon for their magnificent new town hall. The clock is to strike the hours upon a bell of seven tuns, and to chime the four quarters on eight bells, the time to be shown upon four 16 feet illuminated dials. An automatic gas apparatus will be fitted to the clock for turning the gas up and down, and so constructed as to suit all seasons of the year. The clock will also have an electric connection with the Royal Observatory at Greenwich. The carillon machine is to play thirty-one tunes—a fresh tune for every day in the month—on seventeen bells weighing altogether about thirty tuns, and wi l also have barrels for changes similar to ringing a peal, and an ivory key board, the same as a pianoforte, attached to the machine, so that any musician can play tunes upon the bells with the fingers as easily as playing a pianoforte or organ. Taken altogether, this will be the largest work of the kind in the United Kingdom, and will cost over $35,000.

Mound Explorations.

Dr. W. W. Ranney, of Lansing, Iowa, communicates to the *Journal*, of that place, an interesting account of an examination, recently made by himself and other parties, of an ancient mound in Union City township, Iowa.

The mound is not in the form of the burial mounds or *tumuli*, but forms a circle, the circumference of which is 700 feet. The ridge or elevation averages about 25 feet in width, leaving a circular inclosure 210 feet in diameter. The hight of the ridge or mound is about three or four feet from the surface of the ground. On opening it, pieces of broken pottery, made of a bluish clay and partially pulverized mussel shells, were discovered; stones, showing evidence of having been used for hearths or supports for the earthen vessels while being used for cooking food; collections of fish scales, bones of buffalo, deer, badger, bear, fish, and birds; but no evidence of human bones. The long or marrow bones of all animals were found broken or split, supposed to have been done for the purpose of extracting the marrow for food, which circumstance is also noted in the *Kjokenmöddings*, or kitchen middens, of Denmark. One peculiarity noticed was that in different localities the ornamentation of the pottery was dissimilar. For instance, all found on one spot was ornamented with horizontal circular rings; all found in another place was ornamented with zigzag lines, and at another, near by, they had the same zigzag lines with dots in the angles. This was accounted for by the supposition that each family had its own particular method of ornamentation, by which they recognized their property. These vessels were quite capacious, the diameter of one having been fourteen inches at the mouth. About one and three quarter inches below the mouth they abruptly widened out six inches all around, making the largest diameter twenty-six inches. The bottoms had been rounded in such a manner that they never tipped over; but let them be set down as they might, they oscillated till they finally, when still, sat in an upright position. For the purpose of handling, the vessels were provided with handles on two opposite sides.

Besides the beforementioned articles, copper ornaments, one inch wide at the base and one and a half inches from base to apex, were found, the form being the same as a perforated flat iron, as if to attach some additional ornament or a string to fasten in the ear.

The conclusion was that the mound was once the habitation of a community of families; that huts or wigwams were built in a circle, and the piles of burnt stone unearthed represented a hearth in a hut, on which the pottery sat while cooking, and around each of which a separate family warmed and fed themselves, and that each family had a separate distinct mark on their vessels by which they were known from their neighbors in the next hut or wigwam.

The central inclosure was used for their games, dancing, and pleasure, and perhaps, in case of attack from wild beasts or their fellow men, as a place for the aged, the young, and the women to flee to while the warriors met their encroachments outside the circle of dwellings. Forty rods south were found some 83 burial mounds or *tumuli*, out of which were procured parts of human skeletons.

Preserving Photo Sensitive Paper.

Prepare a number of sheets of cheap blotting paper by immersing them in a solution of bicarbonate of soda and letting them dry. These may be used over and over again. Then sensitise as much paper as is likely to be wanted during the next three or four weeks, interleave it with the blotting paper, and place the whole under a weight.

Sensitive paper thus treated may be preserved ready for use for a long time.

Rats detest chloride of lime and coal tar

DEEP SEA SOUNDING BY PIANOFORTE WIRE.

The use of piano wire for deep sea sounding was first successfully carried out by the celebrated physicist and electrician, Sir William Thomson, to whom belongs the merit of its introduction.

Since that first attempt, the pianoforte wire has done excellent service on submarine cable expeditions in various parts of the world; among other places, across the Atlantic, across the Pacific—where Captain Belknap, U.S N., found depths exceeding 500 fathoms—and in South American waters, from Cuba to the River Plate.

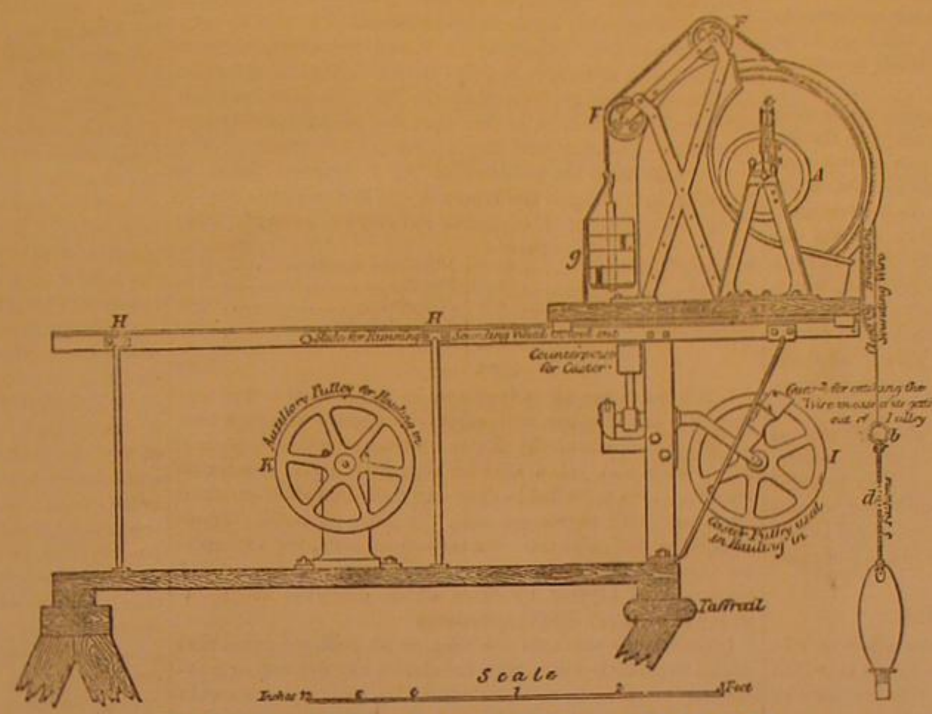
The sounding apparatus, as it is now finished and sent out by Mr. White, of Glasgow, Scotland, and as it is has been used by the steamer Faraday on the Direct United States (Messrs. Siemens') Cable expedition, is represented in the accompanying engraving, which we extract from *Engineering*. It consists of a large light drum, A, of galvanized sheet iron, on which the wire is carefully coiled. The free end of this wire terminates in a stout galvanized iron ring, *b*, and to this ring the sinker, *c*, is attached by a hemp line, *d*, several fathoms long. The interposition of the line between the wire and sinker prevents the wire from reaching the bottom, and the ring is heavy enough to keep the wire tight—thus kinking of the wire is avoided. The circumference of the drum is one fathom, and an indicator, *e*, is fixed to the axle to indicate the number of revolutions of the drum. A slight correction, due to the thickness of wire on the drum, has therefore only to be applied to the indicated number of turns in order to give the amount of wire paid out, or depth of the sounding in fathoms.

In order to stop the drum immediately on the sinker reaching the bottom, the brake, F F, is employed. It consists of a friction cord attached at one end to the framework of the apparatus, and passing over a secondary groove on the circumference of the drum, A, the other end being weighted at *g*. By means of this break the increased pull on the wire, due to the amount of it paid out, is to be more than counteracted, so that the drum will revolve by a pull on the wire due to something less than the weight of the sinker. For, in this case, when the sinker is supported by the bottom, there will be a friction on the drum, bringing it to rest. The weights, *g*, have, therefore, to be applied gradually, as the wire runs out. The rule adopted in practice is to apply resistance, always exceeding by 10 lbs. the weight of the wire out. Then, the sinker being 34 lbs., we have 24 lbs. weight left for the moving force. This is amply sufficient to give a very rapid descent, so that in the course of half an hour the bottom will be reached at a depth of 2,000 or 3,000 fathoms. The person in charge watches a counter (the indicator, *e*), and for every 250 fathoms (that is, every 250 turns of the wheel) he adds such weight to the brake cord as shall add 3 lbs. to the force with which the sounding wheel resists the egress of the wire. That makes 12 lbs. added to the brake resistance for every 1,000 fathoms of wire run out. The weight of every 1,000 fathoms of wire in air is 14½ lbs.

In water, therefore, the weight is about 12 lbs.; so that if the weight is added at the rate indicated, the rule will be fulfilled. So it is arranged that, when the 34 lbs. weight reaches the bottom, instead of there being a pull, or a moving force of 24 lbs. on the wire, tending to draw it through the water, there will suddenly come to be a resistance of 10 lbs. against the motion. A turn or two and the drum comes to rest. The instantaneous perception of the bottom, even at so great a depth as 4,000 fathoms, when this rule is followed, is very remarkable. The sounding apparatus is best fixed so as to project beyond the bow or stern taffrail. In order to take a sounding, the drum, A, is run out to the end of the rails, H H, where it admits of the sinker dropping sheer into the sea. The sinker is then gently lowered by turning the handle of the drum until it touches the water, when the indicator is set at zero. Everything being ready and the ship at rest, the handles of the drum are then unshipped, the check pawl of the drum is unlocked, and the wire runs rapidly out. When bottom is reached, the indicator is read off, and the hauling up is set about at once. The wire is first supported from the framework by a yarn stopper, or is held by a couple of men with canvas or leather protection for their hands. The drum is then run inboard again, and the wire is led over ¼ circumference of the caster pulley, I, then passed over the auxiliary hauling-in pulley, K, so as to make ¾ or 1¾ turns before it is coiled on the drum.

The tube in the end of the sinker, if fitted with a valve door, brings up a specimen of the bottom. As the wire comes in, it may be partially dried by rubbing it with a piece of canvas; and as it is being coiled on the drum, to preserve it from rusting it is drenched occasionally with oil. When not in use the drum is kept in a bath of oil. It was formerly the custom to apply a solution of caustic soda in the same way, but the oil has superseded it.

This is the complete apparatus for deep sea sounding, but a simpler affair will suffice for soundings of even 1,000 fathoms, and especially for flying soundings from telegraph or mail steamers approaching land. With the wire three men can do the work in a small fraction of the time; the sounding is surer, for the wire goes down very sheer; and difficult manœuvering of the ship in rough tides, to keep her over the line, is avoided during hauling in, because the lateral friction of the wire to its passage through the water is so small compared to that of the hempen line. A sounding in 2,500 fathoms, which would engage several men and a donkey engine, require very alert handling of the ship, and occupy from four to five hours, can now be done by three men in the space of about forty minutes.



WHITE'S DEEP SEA SOUNDING APPARATUS.

Breaking of a Fire Ladder.

By the breaking of a patent fireman's ladder machine in this city, during a recent drill of the fire department, three men lost their lives. The machine consists of a combination of ladders, which, by the turning of winches, are quickly elevated to an angular or perpendicular position, the ladders sliding out one beyond the other. The unfortunate men were on the upper ladder, ninety feet from the ground, when one of the lower ladders gave way, and they were precipitated to the pavement. Cause—bad material and bad workmanship.

Dietetic Effects of Water.

Certain experiments made by a French *savan*, with the view of ascertaining how far the phosphate of lime in bone may be replaced by other phosphates, have been used by Mr. W. J. Cooper to illustrate how profoundly the bodies of animals are influenced by the waters they drink. This is an aspect of the water question which will be new to most people; but there is no doubt that the composition of the body is materially influenced by the mineral constituents of the fluids we habitually drink. The active effects of several mineral waters upon the functions are well known; it is not so generally known that water from artesian wells, so pure from organic pollution, sometimes contains sulphate of magnesia and other salts to such a degree as to be positively injurious. On the other hand, in some districts in Holland where there is only rain water to be obtained for drinking purposes, softening and distortion of the bones are frequent. That, as shown by the experiments referred to by Mr. Cooper, the use of natural waters may tend to alter the structure of our bodies, introduces another element into the much vexed question as to the proper source whence to draw the supplies of potable water for towns, by showing that the inorganic impurities of water are of more importance to health than they have been usually considered; while it lends support to the opinion that the same conditions have something to do with the goitre and other glandular affections endemic over certain regions.

ENGINEERING IN NEW ZEALAND.

We publish herewith a view of a bridge, designed by Mr. J. Millar, of Dunedin, New Zealand, to carry the Otago Great Northern Trunk Railway over the Waitaki, a river of great width, and liable to considerable variation in depth of water. The bridge consists of 28 bays, each of 132 feet from center to center of piers. On one side an extra span of 45 feet leads the general road traffic upon the bridge, as shown, the rail level being on the top, and the road level at the bottom, of the Warren girders, which compose the long structure. The river, which is, in times of low water, reduced so much in volume that the bed is exposed in banks of shingle, as shown in the engraving, is greatly flooded at the season when the snow melts from the mountains, and passes down in torrents. At such times the width of the river is increased to a mile, and the water rises to a level within 5 feet of the level of the bridge.

HAIR should never be put in mortar until a few days before the material is used, as the lime will soon destroy it

BRIDGE OVER THE WAITAKI NEW ZEALAND.

Nitro-Glycerin Explosives.

Nitro-glycerin is the most powerful explosive in use. In difficult blasting, where very violent effects are required, it surpasses all others. In spite of the many accidents that have occurred with it, it has been found to be so valuable that its use has steadily and largely increased.

Its liquid form is a disadvantage, except under favorable circumstances, as when made at the place where it is to be employed. It, however, forms the essential ingredient in a number of solid mixtures, which will be taken up farther on. When used in blasting or similar work, it is usually put in tin cans or cartridge cases.

Since nitro-glycerin is so readily detonated, it has the advantage of not requiring strong confinement. Even when freely exposed, it will exert violent effects, such as breaking masses of rock or blocks of iron. So, in blasting, it requires but little tamping. Loose sand or water is entirely sufficient.

The relative force of nitro-glycerin is not easily estimated, since the effect produced depends greatly on the circumstances. Thus, a charge of nitro-glycerin in wet sand or any soft material will exercise but a slight effect, while the same charge will shatter many tuns of the hardest rock In the former case much more sand would be thrown out by a slower explosion, which would gradually move it, than by the sudden violent shock of the nitro-glycerin, which would only compress the material immediately about it. But in the hard rock, the sudden explosion is much more effective than the same amount of force more slowly applied. Roughly, it may be said that nitro glycerin is eight times as powerful as gunpowder, weight for weight.

Products of decomposition: On explosion, nitro-glycerin is resolved entirely into the gases carbonic anhydride, water, nitrogen, and oxygen, the last named appearing only in small quantity. If explosion is imperfectly accomplished, oxides of nitrogen are formed, and the total quantity of gas is lessened. If fully exploded, no disagreeable or poisonous gases are given off.

NITRO-GLYCERIN PREPARATIONS.

The explosive preparations containing nitro-glycerin will be taken up in this place, since they are but forms in which nitro-glycerin itself is presented for use. Their explosive power is derived from the nitro-glycerin in them; so that they are not explosive mixtures in the sense in which that term has been employed in these pages.

In all of them nitro-glycerin is present as nitro-glycerin, but it is mixed with some absorbent substance or vehicle. In this way a solid or semi-solid substance is obtained, which is much more convenient and safer to use than the liquid itself.

DYNAMITE.

In dynamite, the absorbent is usually a natural silicious earth. Deposits of this silicious earth are found in many places, notably in Hanover. From the Hanover earth, the original dynamite was made. This silicious earth, or *Kieselguhr*, is a fine white powder, composed of the skeletons of microscopic animals (infusoria). It has a high absorptive power, being capable of taking up from two to three times its weight of nitro-glycerin without becoming pasty.

Artificially prepared silica has been proposed by the writer as a substitute for the natural earth, and has been used at Newport with good results. This silica is prepared by precipitating it from a solution of sodium silicate (water-glass) by sulphuric acid, washing, and drying. Its absorbent power is a little less than that of the natural earth, but it retains the nitro-glycerin very well.

The process of making dynamite is very simple. The nitro-glycerin is mixed with the dry, fine powder in a leaden vessel with wooden spatulas.

Dynamite has a brown color, and resembles in appearance moist brown sugar. It usually contains from sixty to seventy-five per cent of nitro-glycerin. In this country, dynamite is made and sold under the name of giant powder.

The explosive properties of dynamite are those of the nitro-glycerin contained in it, as the absorbent is an inert body. It freezes at the same temperature as its nitro-glycerin, to a white mass. If solidly frozen, it cannot be fired; but if loose and pulverulent, it can be exploded, although with diminished violence. It can be thawed by placing the vessel containing it in hot water.

The keeping qualities of dynamite are those of the nitro-glycerin it is made from. It is safer because it avoids the liquid condition, and from its softness it will bear blows much better. Exudation must be guarded against. Therefore, it must not contain too much nitro-glycerin, especially if it is liable to be exposed to comparatively high temperatures, which tend to make the nitro-glycerin more fluid, and consequently less easily retained.

The firing point of dynamite is the same as of its nitro-glycerin. If flame is applied to it, it takes fire and burns with a strong flame, leaving a residue of silica. It is not sensitive to friction or moderate percussion.

Mode of firing: Dynamite is fired by a fulminate fuse. Gunpowder will fire it, but not with certainty, and the effect obtained is much less than when the stronger agent is employed.

Use and relative force: Dynamite is the best of the nitro-glycerin preparations, and is indeed the best form in which nitro-glycerin can be used. It has earned a good reputation for safety, in spite of the horror usually excited by nitro-glycerin, or anything connected with it. It contains more of the explosive agent than the other nitro-glycerin preparations, and is therefore stronger. Safer than the liquid nitro-glycerin, from its mechanical condition, it is not complicated by the admixture of substances which may exercise injurious effects.

It is used for blasting and other purposes instead of nitro-glycerin. It is now extensively employed in mining and quarrying with excellent results, and its use is constantly increasing. Much more effective than powder, it is practically safer, since it is not liable to explosion by sparks or flames. Carelessness is therefore less likely to be followed by accident. For military purposes, also, it is largely employed. The explosive force of dynamite is, of course, that of the nitro-glycerin contained in it. If it contains seventy-five per cent, its comparative force may then be approximately stated at six times that of gunpowder, weight for weight.

DYNAMITE NO. 2.

Dynamite proper contains only nitro-glycerin and the silicious absorbent. Mixtures containing other substances are sometimes included under the same name. The true dynamite is often called dynamite No. 1, and the others dynamite No. 2, etc., or receive fanciful names. All these mixtures contain less nitro-glycerin than the No. 1, so that they cost less per pound, but of course they are proportionately less powerful. Possibly they may sometimes be of use.

The following are varieties of No. 2 dynamite made in England, according to the report of the Select Committee of House of Commons on explosive substances, June 26, 1874:

	Per cent.		Per cent.
Nitrate of soda	69·00	Nitrate of potash	71·00
Paraffin	7·00	Paraffin	1·00
Charcoal or coal dust	4·00	Charcoal	10·00
Nitro-glycerin	20·00	Nitro-glycerin	18·00
	100·00		100·00

It is hard to see any advantage in these mixtures except that they are cheaper, and might be applied to uses where the great violence of the larger amount of nitro-glycerin is not needed, and yet a sharper explosive than powder is wanted. It is improbable that any useful effect is obtained from any other ingredient than the nitro-glycerin. Those containing deliquescent salts (nitrate of soda, for example) are objectionable from their liability to exudation. All of them will be injured by water, which dissolves the salts, which are the principal ingredients.

It is easy to see that the number of such mixtures that might be made is very great, for almost any dry salt or powder may be taken as an absorbent.* No special value would attach to any of them. The only requisites would be that the absorbents should not exert any injurious action, and that no more nitro-glycerin should be present than could be perfectly retained at the highest temperature that would probably be experienced.

Many of these mixtures have been proposed and made, but it is undesirable at the present time to touch upon more than a few of the most prominent, which will serve as examples.

LITHOFRACTEUR.

Lithofracteur is a mixture which, according to Trauzl, has the composition:

	Per cent.
Nitro-glycerin	52·00
Infusorial earth	30·00
Coal	12·00
Soda saltpeter	4·00
Sulphur	2·00—100

Sometimes, instead of the sodium nitrate, the potassium or barium salt is used, and variations made in the quantity of nitro-glycerin present. Like all the nitro-glycerin preparations, lithofracteur has no necessarily definite composition, being merely a mixture made according to the caprice of the manufacturers, as shown by experiments with lithofracteur in England by a special committee. Experiments in 1872 with a lithofracteur containing 66·7 per cent of nitro-glycerin showed great liability to exudation. In 1873 the manufacturers submitted another sample of 47·5 per cent, which, of course, retained the nitro-glycerin much better.

This preparation is made by Krebs Brothers & Co., in Cologne, and has been used to some extent in Europe. It is claimed by the makers that the other substances (coal, saltpeter, and sulphur), mixed with the nitro-glycerin, increase the quantity of gas delivered, and, therefore, the explosive force. This is not, however, correct. Nitro-glycerin is so sudden in its explosion that nothing can be added to it from the slower burning of any of the other combustible ingredients, which are present in comparatively small amount, and in bad proportions. Neither does the presence of these substances add anything to the safety of the mixture. They tend to lower its firing point, and render it more easily exploded.

Lithofracteur must be regarded as inferior to dynamite proper, especially for military purposes. It is much more liable to exudation.

The mixtures known in this country as giant powder No. 2, rend-rock, etc, and those already spoken of under the head of dynamite No. 2, are similar to lithofracteur; but in them the silicious earth is generally omitted.

DUALIN.

Dualin is a mixture made by Carl Dittmar, a Prussian, of nitro-glycerin, sawdust, and saltpeter, in about the proportions:

	Per cent.
Nitro-glycerin	50·00
Fine sawdust	30·00
Saltpeter	20·00
	100·00 (Trauzl.)

* During the siege of Paris, in 1870, nitro-glycerin and dynamite were made in the city in considerable quantity for military purposes. The glycerin was obtained from the candle factories, but of course the silicious earth was unattainable. Many experiments were made to discover a good absorbent. Pulverized brick, tripoli, charcoal, magnesia, chalk, lampblack, and others were rejected as not possessing sufficient absorptive powers. Finally, the ash of the coal used for gas-making was hit upon. This was a white powder mainly composed of aluminum silicate, and capable of taking up twice its weight of nitro-glycerin, without becoming plastic. The mixture so made was called dynamite.

This preparation is also inferior to dynamite. The sawdust and saltpeter have much less absorptive power than the silicious earth, and retain the nitro-glycerin comparatively feebly. Its firing point is said to be considerably lower than that of dynamite. Also, its lower specific gravity is a drawback.—*Professor Hill's "Notes."*

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

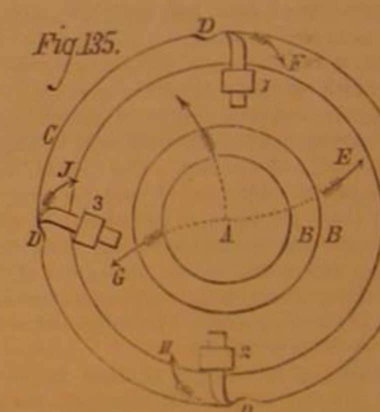
NUMBER XXXII.

BORING BARS AND TOOLS.

A very important consideration with reference to boring bars is the position which the cutters should occupy towards the head or the body of the bar. We have already been over the same ground with reference to parting or grooving tools for lathe work, cutting tools for planing work, and cutters for cutting out holes of a large diameter in boiler plates; but there are so many principles involved in the shape and holding position of cutting tools, so many variations, and so many instances in which the reasons for the adoption or variation of a principle are not obvious, that it is of vital importance to specify, in the case of each tool, its precise shape and position of application, together with the reasons therefor the field of application being so extensive that the memory can hardly be relied upon.

A careful survey of all the tools thus far treated upon will disclose that, in each case wherein the cutting edge stands in advance (in the direction in which the tool is moving or, if the work move, in the direction of the metal to be cut) of the fulcrum upon which the tool is held, the springing of the tool causes it to dig into the work, deepening the cut, and in most cases causing the tool point or cutting edge to break; while in every instance this defect has been cured (upon tools liable to spring) by so bending or placing the tool that the fulcrum upon which it was held stood in advance of the cutting edge; and these rules are so universal that it may be said that pushing a tool renders it liable to spring into the work, and pulling it or dragging it enables it to take a greater cut and to spring away from excessive duty; and thus the latter prevents breakage and excessive spring, because, when the spring deepens the cut, it increases proportionally the causes of the spring, and creates a contention between the strength of the tool and the driving power of the machine, resulting in a victory for the one or the other, unless the work itself should give way, either by springing away from the tool and bending, or forcing it from the lathe centers or from the clamps which hold it

For instance, in Fig. 135, is shown A, a boring bar; B B

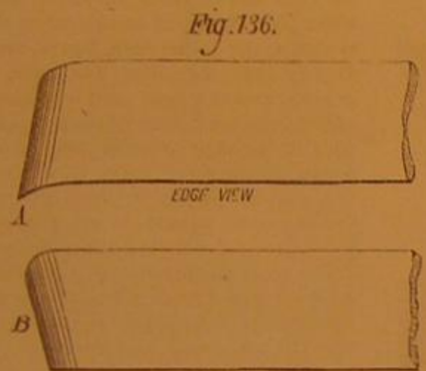


is the sliding head; C C is the bore of the cylinder, and 1, 2, and 3 are tools in the positions shown. D D D are projections in the bore of the cylinder, causing an excessive amount of duty to be placed upon the cutters, as sometimes occurs when a cut of medium depth has been started. Such a cut increases on one side of the bore of the work until, becoming excessive, it causes the bar to tremble and the cutters to chatter. In such a case, tool and position No. 1 would not be relieved of any duty, though it spring to a considerable degree; because the bar would spring in the direction denoted by the dotted line and arrow, E, while the spring of the tool itself would be in the direction of the dotted line, F. The tendency of the spring of the bar is to force the tool deeper into the cut instead of relieving it; while the tendency of the spring of the tool will scarcely affect the depth of the cut. Tool and position No. 2 would cause the bar to spring in the direction of the dotted line and arrow, G, and the tool itself to spring in the direction of H, the spring of the bar being in a direction to increase, and that of the tool to diminish, the cut. Tool and position No. 3 would, however, place the spring of the bar in a direction which would scarcely affect the depth of the cut, while the spring of the tool itself would be in a direction to give decided relief by springing away from its excessive duty. It must be borne in mind that even a stout bar of medium length will spring considerably from an ordinary roughing-out cut, though the latter be of an equal depth all round the bore and from end to end of the work. Position No. 3, in Fig. 135, then, is decidedly preferable for the roughing-out cuts. In the finishing cuts, which should be very light ones, neither the bar nor the tool are so much affected by springing; but even here position No. 3 maintains its superiority, because, the tool being pulled, it operates somewhat as a scraper (though it may be as keen in shape as the other tools), and hence it cuts more smoothly. It possesses, it is true, the defect that the distance from the cutting point stands further out from the holding clamp, and the tool is hence more apt to spring; and in cases where the diameter of the sliding head is much less than that of the hole to be bored, this defect may possess importance, and then position No. 2 may be preferable; but it is an error to employ a bar of small diameter compared to that of the work.

To obtain the very best and most rapid result, there should be but little space between the sliding head and the bore of the work; the bar itself should be as stout as is practicable, leaving the sliding head of sufficient strength: and if the bar revolves in journals, these should be of large diameter and with ample facilities for taking up both the diametrical and end play of the boxes, since the one steadies the bar while it is performing boring duty, and the other while it is facing off end faces, as for cylinder cover joints. The feed of a boring bar, which is slight in comparison to its duty, will range at from 30 to 40 revolutions to an inch of travel; while that of a stout bar, held in large and closely fitting journals, may be about 20 revolutions per inch of tool travel for roughing-out cuts, and 4 revolutions per inch of travel for finishing cuts, which may be made to leave the work very smooth indeed.

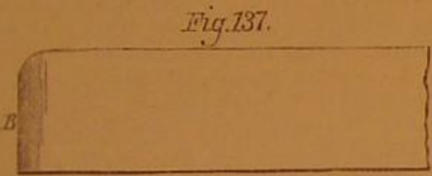
The tools employed for the roughing cuts should not have a broad cutting surface, and should have a little front rake, as shown in Fig. 136, A being the cutting corner. For the

Fig. 136.



finishing cuts, the same tool may be employed, the end being ground to have a broad level cutting surface along the edge, B, as shown in Fig. 137. These tools should be made

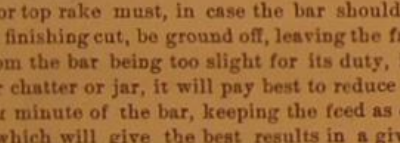
Fig. 137.



of the best quality of steel, and hardened right out, that is to say, not tempered at all.

The lip or top rake must, in case the bar should tremble during the finishing cut, be ground off, leaving the face level; and if, from the bar being too slight for its duty, it should still either chatter or jar, it will pay best to reduce the revolutions per minute of the bar, keeping the feed as coarse as possible, which will give the best results in a given time. In cases where, from the excessive length and smallness of the bar, it is difficult to prevent it from springing, the cutters must be made as in Fig. 138, having no lip, and but a

Fig. 138.



small amount of cutting surface; and the corner, A, should be beveled off as shown. Under these conditions, the tool is the least likely to chatter or to spring into the cut, especially if held in position No. 3, in Fig. 135; for a tool which would jar violently in position No. 1, would cut smoothly and well if held in position No. 3.

The shape of the cutting corner of a cutter depends entirely upon the position of its clearance or rake. If the edge forming the diameter has no clearance upon it, the cutting being performed by the end edges, the cutter may be left with a square, slightly rounded, or beveled corner: but if the cutter have clearance on its outside or diametrical edge, as shown on the cutters in Fig. 135, the cutting corner should be beveled or rounded off, otherwise it will jar in taking a roughing cut, and chatter in taking a moderate cut. The principle is that beveling off the front edge of the cutter, as shown in Fig. 138, tends greatly to counteract a disposition to either jarring or chattering, especially as applied to brass work.

The only other precaution which can be taken to prevent, in exceptional cases, the spring of a boring bar is to provide a bearing at each end of the work, as, for instance, by bolting to the end of the work four iron plates, the ends being hollowed to fit the bar, and being so adjusted as to barely touch it; so that, while the bar will not be sprung by the plates, yet, if it tends to spring out of true, it will be prevented from doing so by contact with the hollow ends of the plates, which latter should have a wide bearing and be kept well lubricated.

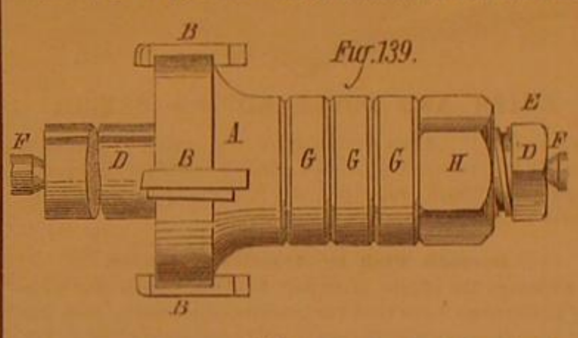
It sometimes happens that, from play in the journals of the machine, or from other causes, a boring bar will jar or chatter at the commencement of a bore, and will gradually cease to do so as the cut proceeds and the cutter gets a broader bearing upon the work. Especially is this liable to occur in using cutters having no clearance on the diametrical edge; because, so soon as such a cutter has entered the bore for a short distance, the diametrical edge (fitting closely to the bore) acts as a guide to steady the cutter. If, however, the cutter has such clearance, the only perceptible reason is that the chattering ceases as soon as the cutting edge of the tool or cutter has lost its fiberous edges. The natural remedy for this would appear to be to apply the oilstone; this, however, will either have no effect or make matters worse. It is, indeed, a far better plan to take the tool (after grinding) and rub the cutting edge into a piece of soft wood, and to apply oil to the tool during its first two or three cutting revolutions. The application of oil will often remedy a slight existing chattering of a boring bar, but it is an expedient to be avoided, if possible, since the diameter or bore cut with oil will vary from that cut dry, the latter being a trifle the larger.

The considerations, therefore, which determine the shape of a cutter to be employed are as follows: Cutters for use on a certain and unvarying size of bore should have no clearance on the diametrical edges, the cutting being performed by the end edge only. Cutters intended to be adjusted to suit bores of varying diameter should have clearance on the end and on the diametrical edges. For use on brass work, the cutting crown should be rounded off, and there should be no lip given to the cutting edge. For wrought iron, the cutter should be lipped, and oil or soapy water should be supplied to it during the operation. A slight lip should be given to cutters for use on cast iron, unless, from slightness in the bar or other causes, there is a tendency to jarring, in which case no lip or front rake should be given.

SMALL BORING BARS.

In boring work chucked and revolved in the lathe, such, for instance, as axle boxes for locomotives, the boring shown in Fig. 139 is an excellent tool. A represents a cutter head, which slides along, at a close working fit, upon the bar, D D, and is provided with the cutters, B B B, which are

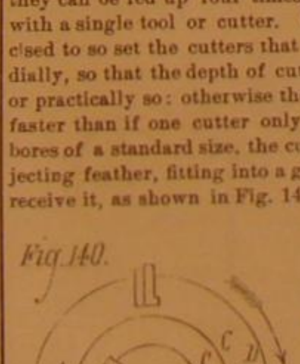
Fig. 139.



fastened into slots provided in the head, A, by the keys shown. The bar, D D, has a thread cut upon part of its length, the remainder being plain, to fit the sliding head. One end is squared to receive a wrench, which, resting against the bed of the lathe, prevents the bar from revolving upon the lathe center, F F, by which the bar is held in the lathe. G G G are plain washers, provided to make up the distance between the thread and plain part of the bar, in cases where the sliding head, A, requires considerable lateral movement, there being more or fewer washers employed according to the distance along which the sliding head is required to move. The edges of these washers are chamfered off to prevent them from burring easil_. To feed the cutters, the nut, H, is screwed up with a wrench.

The cutter head, A, is provided in its bore with two feathers, which slide in grooves provided in the bar, D D, thus preventing the head from revolving upon the bar. It is obvious that this bar will, in consequence of its rigidity, take out a much heavier cut than would be possible with any boring tool, and furthermore that, there being four cutters, they can be fed up four times as fast as would be possible with a single tool or cutter. Care must, however, be exercised to so set the cutters that they will all project true radially, so that the depth of cut taken by each will be equal, or practically so: otherwise the feeding cannot progress any faster than if one cutter only were employed. For use on bores of a standard size, the cutters may be made with a projecting feather, fitting into a groove provided in the head to receive it, as shown in Fig. 140, which shows the boring bar and head, the nuts and washers being removed. A A A A represent the cutters, B the bar, C C the sliding head, and D D D D the keys which fasten the cutters in the head. The cutters should be fitted to their places, and each marked to its place; so that, if the keyways should vary a little in their radius from the center of the bar, they will nevertheless be true when in use, if always placed in the slot in which they were turned up when made. By fitting in several sets of cutters and turning them up to standard sizes, correctness in the size of bore may be at all times insured, and the feeding may be performed very fast indeed.

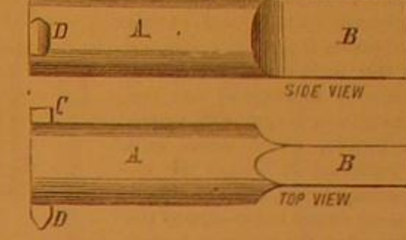
Fig. 140.



BORING TOOL HOLDERS.

For use on holes too small to admit of a bar having a sliding head, which are usually bored with a slide rest tool, a boring tool holder may be employed to great advantage. Such an appliance is shown in Fig. 141, A representing a round bar shaped at the end, B, to fit into the tool post of the slide rest, and having a groove across the diameter of the end, C D, to receive a short tool. The slot and tool may be either square or V-shaped, the tool being locked by a wedge. It is obvious that, instead of shaping the end, B, as shown, the bar may be held (if the slide rest head is provided with clamp instead of a tool post) by two diametrically opposite flat faces. For use in holes of from two to eight inches bore, such an appliance is invaluable, especially if the hole to be bored is of unusual depth; because the bar may be made very stout in proportion to the size of the hole, and will, therefore, stand a depth of cut and a rate of feed totally impracticable with an ordinary boring tool, and will not spring away towards the back end of the hole, as boring

Fig. 141.

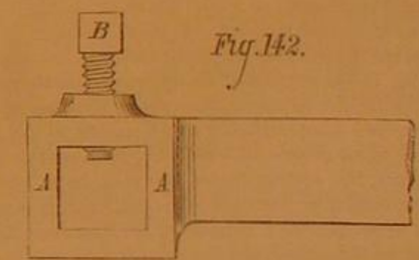


tools are apt to do. Furthermore, the cutting tools, being small, are easily forged, ground up, and renewed when worn out; and the bar maintains its original length, which may be made to suit the depth of hole required to be bored: while a boring tool becomes shorter each time it requires reforging.

The shape of the cutting tool may be as shown at D, Fig. 141, or such other as the nature of the duty may require. For truing out broad recesses in large work, the slot in the end, C D, may be made large enough to receive two tools, one to turn the inside and the other the outside of the recess.

For use upon holes of a large bore, or upon outside work, in which the tool requires to stand out far from the slide rest, the tool holder shown in Fig. 142 should be employed,

Fig. 142.



the tool box, A A, being long enough to receive two of the set screws, B.

The Value of Vivisection.

While the practice of vivisection cannot be defended when the torture is inflicted on lower animals, simply to exhibit truths already fully settled and demonstrated, its utility in original investigation cannot be contradicted. This is amply proved by the results to which it has lead. In summing up the benefits to practical medicine accruing from vivisection, in a speech recently delivered before the British Medical Association, the president of that body, Sir Robert Christison, noted among others the following:

By means of the most extended series of vivisection on record, Orfila placed toxicology on a scientific basis, and gave to the world a knowledge of the action of poisons which has been directly instrumental in saving thousands of lives. To experimentation on animals as to the nutritive value of non-nitrogenous substances, the goodly fellowship of anti-vivisectionists who have a tendency to gout or gravel owe the accurate dietetic treatment of their ailments. Sir Robert himself discovered through vivisections the mode in which oxalic acid poisons, and the means of counteracting its effects; determined the rapidity of action of prussic acid; ascertained by experiment, first upon himself and subsequently upon animals, the physiological and toxic effects of Calabar bean, now largely and usefully employed in medicine; in an important medico-legal case he established the guilt of the accused by proving upon animals the fatal action of laburnum bark, the substance administered, the effects of which had not previously been investigated.

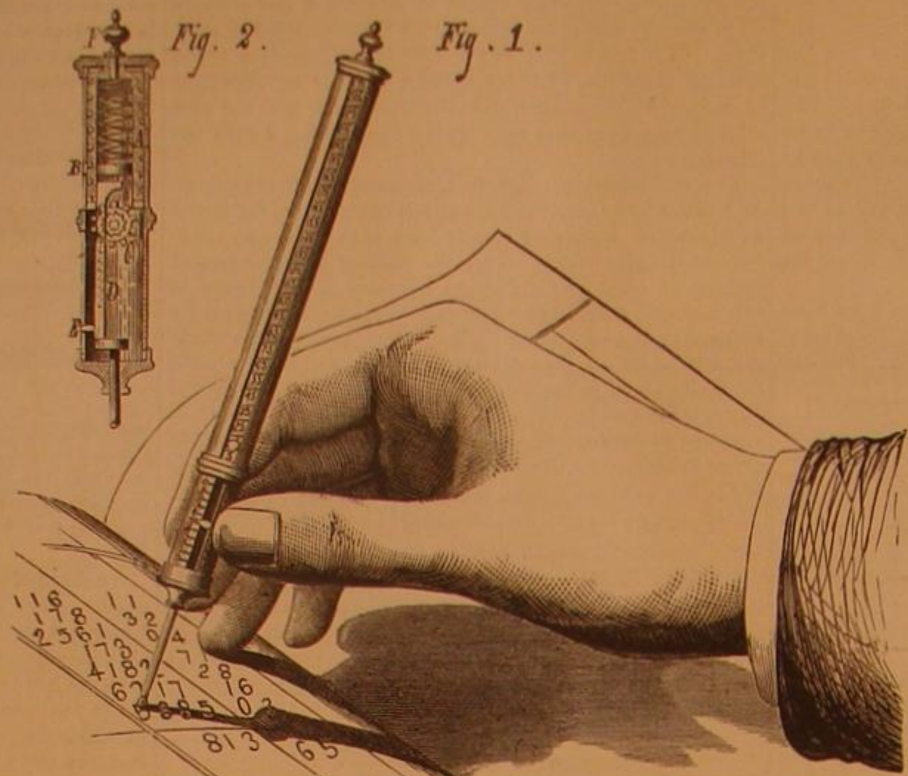
To Sportsmen and Hunters.

The editor of the *Forest and Stream* announces the establishment of a most interesting exhibition at the Centennial Exposition, to be held in Philadelphia next year, where he intends to show a genuine camp in the forest, with a running stream—shelter tents, a veritable Indian birch wigwam, canoes, etc., etc. Every department will be complete, and genuine Indians and trappers have already been engaged to superintend each one. Anything that comes within the province of his interesting journal will be welcome to a place, whether old relics or new inventions, things useful or ornamental, boats, guns, rods, dog collars, camp utensils, life preservers, bear traps, snow shoes, lariats, wigwams, buckskin suits, wampum belts, portable stoves, Indian scalps, pelts and horns, jack lamps, moccasins, tents, rubber goods, stable furniture, rare birds and animals, fruits and plants, trolling tackle, bats and balls, billiard tables, aquariums, and cartridge belts.

RECENTLY, off Wicklow, Ireland, the British ironclad Iron Duke ran into and sunk the ironclad Vanguard. Cause, fog. Both ships were of 6,000 tuns burden, plated with 6-inch iron, and carried 14 guns each. No lives were lost.

IMPROVED ADDING PENCIL.

We illustrate herewith an ingenious and quite useful invention, the object of which is to facilitate the labor of accountants in adding up long columns of figures. It is a miniature calculating machine, which performs its work with unfailing accuracy and without requiring any thought on the part of the operator, other than that involved in noting that a pointer points to the proper figure to be added. In shape it resembles a pencil, being no larger, and as easily manipulated.



SMITH AND POTTS' ADDING PENCIL.

As shown in the hand in the engraving, the device has a metal case which is provided with a longitudinal slot. Within the case, represented in section in Fig. 2, is a cylinder, A, grooved spirally, and having figures, marked beside the grooves, ranging from 1 to 700, this last number being considered as probably as large as any one column of figures in a ledger will aggregate. In the groove, which serves as a guide, is an indicator, B. Below the cylinder is a pinion, C, the teeth of which enter similar teeth on the lower edge of the cylinder, so that when the pinion is turned the cylinder rotates within the case. The pointer of the pencil is connected, inside the case, with a rack, D, upon which is an indicator, E, working in a separate slot and ranging along a scale marked with the digits. The teeth of the rack engage with a wheel attached to the pinion when the rack is pushed up, but not when the rack is forced down by the reaction of the spiral spring within the cylinder.

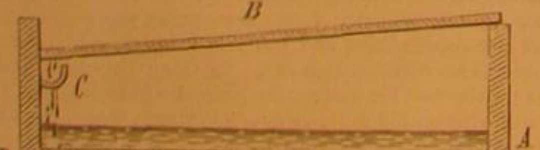
In adding a column of figures, the operator presses the point upon the first number until a corresponding number is noted by the digit indicator, E; thus, in the engraving, the point is pressing on 5, and the indicator shows the same number. This, of course, involves the pushing up of the rack and the turning of the pinion, the revolution of the cylinder, and the consequent guiding of the indicator, B, a short distance up the spiral groove, said distance being in proportion to the total length of the spiral groove, as 5 to 700. The operator then raises his point, the spring forces the rack back, without turning the cylinder, so that the digit indicator returns to 0, while the upper indicator remains at 5. The next figure, 6, in the column is touched, and the digit indicator is carried to 6, the upper indicator is carried forward as before, but starts from its present location, namely, 5, so that at the end of its movement it will have traversed a total distance of 11, denoted by the numbers placed on the cylinder. This operation is repeated for every figure of the column; and when all have been touched, their sum is shown by the position of the indicator, B. By turning the piece, F, and rotating the cylinder in the opposite direction, the indicator, B, is now carried back to zero, ready to begin a new column; or if there be any number to carry from one column to another, instead of being set back to zero, it is adjusted to that number, so that that is added in, as it should be, with the next sum.

It will be seen that there is simply no possibility of error in the operation, unless the user deliberately sets the digit indicator, E, to the wrong number. A little practice will enable him to cause that indicator, however, to stop at the right figure almost instantly, so that the column will be cast up nearly as quickly as he can touch the separate figures, and, as claimed by the inventor, much quicker than the average arithmetician can perform the same mentally. Interruption during the computation is no annoyance, and, indeed, the motion may proceed almost mechanically while engaged in conversation. Or he may stop work in the middle of a column, attend to other matters, and resume it after any period of time. So long as the pencil is not altered in the interval, the results will be absolutely correct.

Patent pending through the Scientific American Patent Agency, to Messrs. Marshall M. Smith and Fletcher W. Potts, of Verdi, Washoe county, Nevada. Patents are also being secured in foreign countries. For exclusive right for United States, State rights, and other particulars, the inventors may be addressed as above stated.

CHANGING SALT WATER TO FRESH.

A simple device is described in *Les Mondes* for changing sea water into drinkable water, which deserves to be widely known, and which might be the means of saving an immense



amount of suffering to people wrecked at sea. The necessary portions could easily be got together before abandoning a ship and taking to a raft. The engraving given herewith, prepared from the description, will render the latter more clear. A shallow box, A, is made, 14 feet long, 2 feet broad, and about 6 inches deep. The sides are an inch or more thick and well caulked. Into this, salt water is poured to an inch in depth, and glass, B, is laid over the top at an inclination of an inch and a half. A channel, C, is added below the lower edge of the glass. Window sashes, such as are used for cabin windows or skylights, will answer the purpose as well as sheets of glass, care being taken to cut away the framing, so as to make wood and glass, on the underside, level.

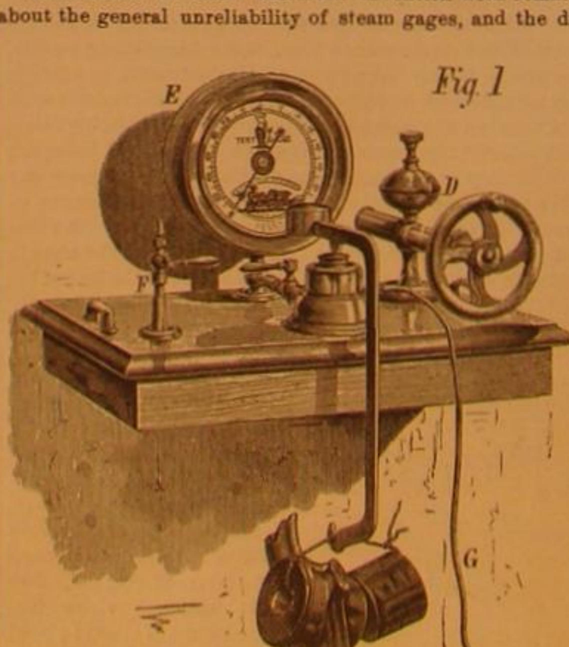
The device is exposed to the sun, and the effect of the rays is to evaporate the water, which condenses on the under side of the glass, flows down into the channel, and is caught by a vessel, D. After condensation the water of course is fresh. It is stated that, with a glass 3 feet 2 inches square, 2 gallons of fresh water per day may easily be condensed, under a hot sun, from salt water.

German Fish in American Waters.

Although the efforts to import shad eggs from this country to Germany have thus far proved unsuccessful, such has not been the case with the attempts to transport German fish hither. The North German Lloyds steamer Hermann recently brought to this port sixty carp and forty golden tench, in fine condition, only one fish having died on the voyage. The travelers were met at the wharf by Professor Baird, of the United States Fish Commission, who placed them in tanks of fresh water and sent them to Druid Hill Park, in Baltimore, Md., where they now are. The fish are mostly yearlings, and it is intended to keep them in their present location, using them for breeding and distributing them throughout the warmer waters of the Southern States. The experiment is one which pisciculturists are watching with the liveliest interest, since the carp especially is a very valuable fish for the table. The first distribution will be made, it is expected, in about a year.

WOOD'S PATENT SQUARE-INCH TEST VALVE.

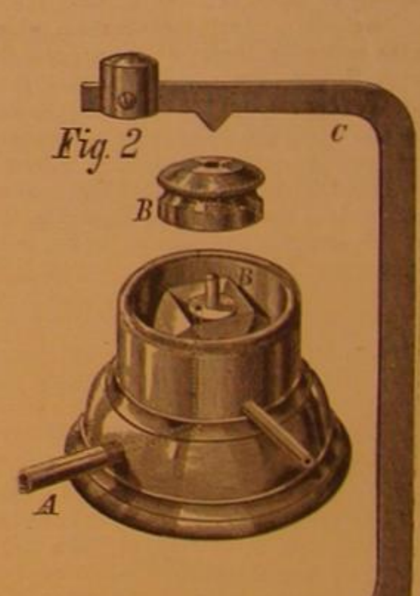
To introduce the below described invention with remarks about the general unreliability of steam gages, and the disastrous consequences attributable to false indications by the same, would only be to rehearse facts with which every engineer and steam user is fully conversant. No man, we believe, has ever had charge of a steam boiler, even for an hour, without thinking that, on the correctness of the needle quivering on the dial before him, the safety of himself, of others, perhaps of millions' worth of property, depended; and if such thoughts should father the desire to know the certainty of the gage, such would be but the result of his natural instinct toward self-preservation. Put into that man's hands, however, a simple device by which, in five minutes, he can assure himself that the instrument is absolutely correct, and one cause, and that perhaps the most prolific of boiler explosions, the false gage, is rendered impossible.



The usual method of testing gages, by means of the test gage and pump, is reliable only so far as the test gage itself is free from error; it is not an absolute trial of the instrument under examination, as is claimed to be the case when the novel device, represented in the annexed engravings, is employed. The principle of the invention is simply that of the safety valve. It is, in fact, a valve which, weighted to a given pressure, lifts when that pressure is applied; being connected with the gage, that latter should indicate the same pressure; if it does not, the amount of error is obvious.

The apparatus, which is shown taken apart in Fig. 2, consists of a brass base, provided with a pipe, A, to be connected to a pump. At B is a hardened steel valve and seat, the latter having knife edges for the valve to rest upon, and being made exactly one square inch in area. There is a guide stem on the seat to enter a hole in the valve and so guide the same; and the water pipe, A, it will be noticed by the direction of the dotted lines, has its aperture directly under the valve. The valve, when in place, makes a tight joint with the knife edges, and the pressure beneath is confined until it exactly balances the combined weight of the valve, yoke, C (which rests by a pointed projection upon the valve), and any extra weight which may be suspended from the lower hook of the yoke.

The mode of operation will be better understood from Fig. 1, which represents the weighted yoke in place, and at the same time the test pump and test gage, which may be purchased from the manufacturers below named, with the test valve. D is the pump, in the reservoir of which water is poured; and by turning the screw, pressure is caused beneath the valve and also in the test gage, E, and in the gage under examination, which is applied at F. The pieces of iron, etc., attached to the lower end of the yoke are previously weighed, so that the valve must lift and the water escape by the overflow pipe, G, the moment such known weight is exceeded by the water pressure. The limit, therefore, cannot be overstepped, and hence the gage under examination and at the same time the test gage should each indicate a pressure equal to the weight attached to the yoke, *plus*, as before stated, the weights of yoke and valve.



The device is simple, easily operated, and reliable. It is sold for $18.

Patented to Edwin A. Wood, through the Scientific American Patent Agency, September 22, 1874. For further information, address the manufacturers, the Utica Steam Gage Company, Utica, N. Y.

New Steel Works.

The new Edgar Thomson Steel Works at Pittsburgh, Pa., were duly opened on September 4, in the presence of several hundred invited guests. The latest improvements are introduced throughout the establishment. For example, red hot ingots of steel, weighing a ton, are transferred from the truck to the rolls by one man. The great saving in manual labor and the superior excellence of the metal produced will enable this concern to distance all foreign competition. One of the tests of the steel at these works is to fix one end of a railroad rail, and by means of a wheel at the other end twist the rail twice, which is done without fracture of the rail.

REMARKABLE SWIMMING.—A girl of fourteen, named Beckwith, daughter of the champion swimmer of England, recently swam from London Bridge to Greenwich, a distance of over five miles, in one hour and eight minutes. This is believed to be the fastest swimming on record.

Mortality among Elephants.

We learn from the Rangoon *Burmah Mail*, a file of which has just reached this office, of a large mortality among elephants in that district; and a more serious loss of the same kind has been experienced by the Moulmein foresters, on the Thoungyeen side. The *Mail* states the value of each elephant is from 800 rupees to 1,500 rupees ($400 to $750) and that the loss to their people in the aggregate is very considerable, greatly enhancing the price of these useful animals, and increasing the difficulty and cost of bringing timber to market.

KNIGHT'S IMPROVED HEALTH LIFT.

Physical culture, in moderation, is unquestionably bene-

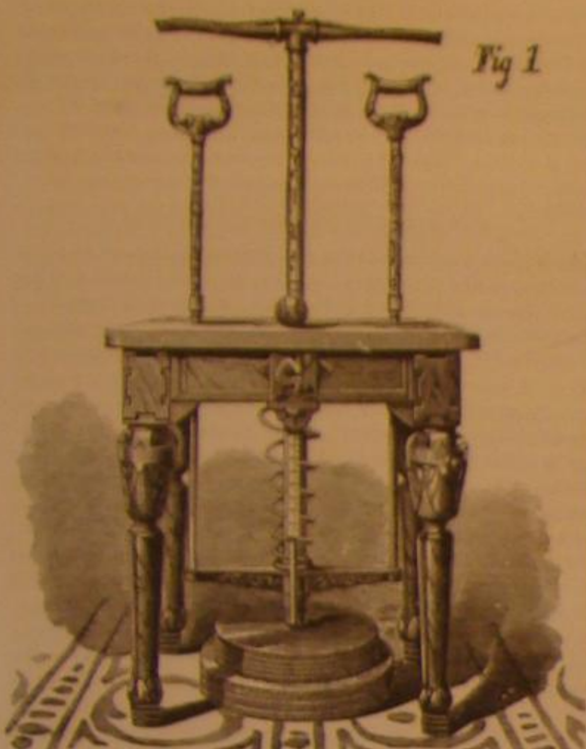


Fig 1

ficial; but physical culture in excess is as certainly baneful and injurious to the system. The present tendency is toward the extreme; and, as exemplified in the repeated failures of overtrained athletes at the moment of trial, the results reached are exactly the reverse of those sought. The reason is undoubtedly to be found in the mistaken theory which impels the development of only those muscles which are to be used in the contest—a theory which neglects the equally important truth that, after all, the human body is but a beautifully organized machine, and, like every other piece of mechanism, its ultimate strength, as a whole, is only equal to the strength in its weakest part. If, therefore, we create an abnormal growth of arm muscles for rowing, or for leg muscles for walking, we do so at the expense of some other part of the machinery, usually the nerve centers. We accelerate the circulation of the blood in the vessels of the chest until the walls of the veins and arteries become thinned and diseased through distension, and the application of undue strain determines their rupture. It would be exactly the same if we were to seek to strengthen an engine by taking away all the metal about the steam conduits until the walls of the same were as thin as paper, and putting it on the connecting rod and crank. The moment a heavy load was put on the machine, an increased strain would break the pipes, and everything would stop. The kind of exercise needed is that which will strengthen all parts of the body equally, producing a uniformly strong structure. Such exercise would be rational, beneficial, and health-giving, resulting in permanent good effects, and not, as is now too frequently the case, in permanent bad ones.

Whether or not such benefit is to be gained from what is known as the lifting system, we are not, from personal knowledge, prepared to state. That the lift exercise is growing in favor is undeniable, and we may add that we have known a number of persons who have derived much good therefrom. The inventor of the machines illustrated herewith, says, in regard to the value of lifting: "I state what I have proved; for in my practice of Swedish movements (applied exercise), I was compelled to devise some way to cultivate the strength and endurance of certain kinds of patients, without at the same time disproportionately taxing their nervous energies. My machine (in use six years in my office) does it better than anything else known to me; and I feel able to say that if oarsmen—*soi disant*, or professionals—would carefully cultivate the nerve centers by lifting in a prescribed manner everyday, they would accomplish more, and with less waste, than without the machine."

The appearance and construction of the machine referred to will be understood from the engravings. Fig. 1 represents the apparatus arranged for complete spring and dead weight combined, with a maximum resistance of from 600 to 1,200 lbs.; and Fig. 2 is the family machine, constructed with spring alone, having a resistance of from 300 to 600 lbs.

The table legs are supported upon springs, in order to give elasticity to the lift when raising a dead weight from the floor. A slotted tubular socket is attached to the under side of the table, and guides an interior tubular piston that is connected with a yoke sliding on the outside of the socket tube, and resting on a collar at the lower end of the same. A second pin connects the lower part of the sliding piston with a slotted and weighted tube which slides between the socket tube and piston, and which may be adjusted higher or lower on the latter, so that the weighted tube may be raised at any desired moment of lifting the piston. The yoke carries a powerful spiral spring which is compressed by raising the handle, and also side arms, having vertical rods and small side handles. The intermediate tube carries on its base collar a number of detachable weights which allow not only of the adjustment of the apparatus to any degree of spring and dead weight action combined, (but also by the higher or lower setting of the weighted tube) the raising of the weight at any desired moment after the spring has been partly compressed.

A well graduated strain is thus obtained, which proceeds from a minimum to a maximum, and thence goes back to the minimum, requiring no considerable effort to overcome the constant or fixed resistance, but admitting, by a gradually increasing exercise, a regular training and development of the muscles.

The machine is very handsomely constructed, and forms a neat and ornamental piece of furniture. Its employment is especially recommended to persons of sedentary habits and those suffering from chronic diseases.

Patented through the Scientific American Patent Agency, May 11, 1875.

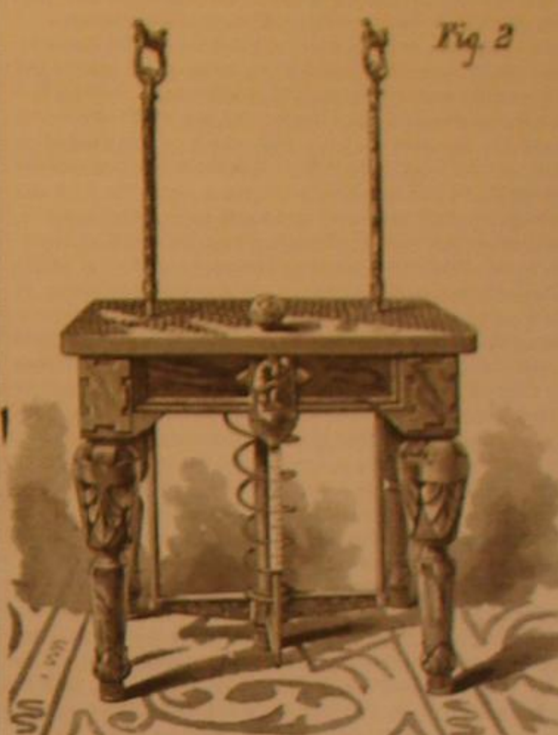


Fig. 2

For further particulars address the inventor Dr W. H. Knight, 61 Pleasant street, Worcester Mass.

A MODEL VILLA.

We have remarked of late a growing tendency on the part of architects and builders to abandon the stiff and ungainly models of rural architecture, and substitute therefor much more tasteful and ornate designs. There are few buildings so severely ugly as those of the conventional types so common in New England towns. We mean, first, the square box, the perfectly cubical shape of which is relieved only by a little cupola perched mathematically in the middle of the roof, looking as useless as it is out of place; second, the innumerable attempts to duplicate the Athenian Parthenon, by


A MODEL COUNTRY RESIDENCE

adding a series of ponderous and palpably wooden pillars to the front of the building, and thus darkening, by the over-hanging roof, all the front windows of the upper stories; and lastly, the aspiring efforts to rival the modern French construction by imitating the iron and stone mansards and lofty towers, in wood and on a much reduced scale, too frequently in entire incongruity with all the surroundings. In constructing larger country dwellings, the same models, enlarged, have been kept in view, so that it is no uncommon sight to find the villa, standing in the midst of its score of acres, duplicated in the cottage, cramped in a twenty-five foot lot, or the cottage repeated on a magnified scale in the more pretentious residence.

So many excellent plans have been published for country homes that we are led to believe that a genuine taste has been awakened for a really rural style of architecture. A city house, with its lofty staircases and its general construction carried skyward, remains a city house, to all intents and purposes, no matter if planted in a wilderness. It suggests cramped space and narrow limits, and not that carelessness as regards the area covered over, which is the distinctive feature of the country dwelling. Let the reader compare the illustration of the beautiful villa, given herewith, with any of the perky, stiff, tall structures which sprang up like mushrooms when the taste for French design became first prevalent here. The edifice is low and broad, suggestive of ample halls and large, cool, airy rooms. It is irregular in shape, as if it were planned for the convenience of the occupants—adjusting itself to their needs, and not at all suggestive of that hermit crab peculiarity of many people who fix on a residence and then adjust themselves to it. There are broad windows shaded by tasteful porches, the heavy effect of which is relieved by the delicate half-Moorish tracery of their supports, and lastly, there are the piazzas, which fill out the details of the bare walls. Add tasteful painting, in a couple of cool shades of brown, for example, and the embowering westeria or other vines which trail over doors and windows, and a dwelling is made which is in itself a picture of comfort.

It is such architecture as this that we hope to see replace the designs so long prevalent. Taste, or rather the gratification of it, is not necessarily expensive; for it costs no more—perhaps not so much—to erect either a cottage or a villa which shall be graceful and pleasing in appearance, than to construct tall towers, and mansard roofs, and elaborate ornamentation, or even the severely plain edifices which, to our minds, serve only by their contrast to enhance the beauty of Nature's handiwork.

It would be an excellent plan, we think, for persons contemplating building to have models of their houses constructed in paper or thin wood. Few people can obtain a perfect idea of the aspect of any proposed edifice from the architect's drawings. Engineers very frequently adopt this plan in building bridges and similar structures; and in theaters, the scenic artist always submits pasteboard models of elaborate set scenes to the manager and playwright before putting brush to canvas. A good model is always preliminary to the construction of a machine—as indeed it is to almost every structure, except a building—and why architects should not also furnish an embodiment of their designs in the same manner has always seemed to us rather anomalous.

BRITISH ASSOCIATION NOTES.

PROPELLING SHIPS BY WAVE MOTION.

Mr. Beauchamp Tower read a paper on "A Machine for Obtaining Motive Power from the Motion of a Ship among Waves." The machine consists in principle of a weight supported on a spring, so that it can oscillate on the spring through a considerable range in a vertical line. The scale of the spring, and consequently the natural period of oscillation of the weight, can be varied at will. When it is so adjusted that it synchronises with the waves, the oscillations become very violent, and a large amount of power can be obtained from them. In practice, the springs consist of highly compressed air pressing on the rims of hydro-pneumatic cylinders, and the arrangement is such that the vessel containing the compressed air forms the moving weight. The author exhibited a design of a machine for working an auxiliary propeller of a sailing ship of 1,800 tuns displacement. The moving weight in this case is 200 tuns, and he showed by calculation that it would give about 30 horse power in the long swell met with in the tropical calms, 260 horse power in average ocean waves, and more than 600 horse power in a heavy head sea. The space occupied by the machine compares favorably with a steam engine of the same power. The author exhibited a model of the machine, which recently, in a moderate sea, had yielded power at the rate of 1¼ horse power per tun of moving weight.

WAVE MOTION

Professor Guthrie read a paper on the measurement of wave motion. He said his endeavor in various inquiries was to determine the rate of wave progress. The rate at which the wave moved along depended very little indeed upon the hight of the wave, nothing at all upon the breadth of the wave, nothing upon the density of specific gravity of the liquid, but almost entirely upon the wave length—that was, the distance from crest to crest. The learned professor demonstrated by means of experiments that, in circular troughs, the smaller the diameter the more rapid was the pulsation, and that the rate in different sized troughs varied inversely as the square root of the diameter. It was also found that in a circular trough a wave 39·4 inches in length traveled in one minute over 270 feet.

UNDERGROUND TEMPERATURE COMMITTEE.

Professor Everett presented the report of the Underground Temperature Committee. He said the committee had been in existence for eight years, and during that time had been engaged in trying to determine the rate of increase of temperature of the rock as they went deeper into the ground. The observations had generally been made by means of artesian wells and mines, and he gave interesting particular, of investigations recently made in the St. Gothard tunnels at Chiswick, and at Swinderly, near Lincoln. Mr. Galloway, mining engineer, narrated the result of some observations in mines in regard to the temperature, and Professor Everett said he did not think that in old mines, where good ventilation had been obtained for many years, any reliable data with reference to the temperature of the rock could be obtained without boring to a very great extent.

THE ATMOSPHERE AND SOUND.

Professor Osborne Reynolds read a paper on the refraction of sound by the atmosphere, and related the effect of experiments which he had recently made, with a view of throwing light on the subject. He had confirmed his hypothesis that, when sound proceeded in a direction contrary to that of the wind, it was not destroyed or stopped by the wind, but that it was lifted, and that at sufficiently high elevations it could be heard at as great distances as in other directions, or as when there was no wind. An upward diminution of temperature had been proved by M. Glaisher's balloon ascents, and he showed, by experiments with the sounds of firing of rockets and guns, that the upward variation of temperature had a great effect on the distance at which sounds could be heard. By other observations he found that, when the sky was cloudy and there was no dew, the sound could invariably be heard much farther with than against the wind; but that, when the sky was clear and there was a heavy dew, the sound could be heard as far against a light wind as with it. Professor Everett remarked that Professor Reynolds had given the most important contribution to the subject that had been given for very many years.

SUN SPOTS AND ATMOSPHERIC FORCES.

Professor Barrett read a paper prepared by Mr. T. Moffat, on the apparent connection between sun spots, atmospheric ozone, rain, and force of wind. The author stated that from 1850 to 1869 he discovered that the maximum and minimum of atmospheric ozone occurred in cycles of years. He had compared the number of new groups of sun spots, in each year of these cycles, with the quantity of ozone, and the results showed that in each cycle of maximum of ozone there was an increase in the number of new groups of sun spots. He also showed that there is an increase in the quantity of rain and the force of wind with the maximum quantity of ozone and sun spots, and a decrease in these with the minimum of ozone and sun spots.

CONSTITUTION OF THE SUN.

Professor Balfour Stewart, in an address on this subject, said: Several new metals have been added to the list of those previously detected in the solar atmosphere, and it is now certain that the vapors of hydrogen, potassium, sodium, rubidium, barium, strontium, calcium, magnesium, aluminum, iron, manganese, chromium, cobalt, nickel, titanium, lead, copper, cadmium, zinc, uranium, cerium, vanadium, and palladium occur in our luminary.

If we have learned to be independent of total eclipses as far as the lower portions of the solar atmosphere are concerned, it must be confessed that as yet the upper portions—the outworks of the sun—can only be successfully approached on these rare and precious occasions. Thanks to the various government expeditions despatched by Great Britain, by the United States, and by several Continental nations—thanks, also, to the exertions of Lord Lindsay and other astronomers—we are in the possession of definite information regarding the solar corona.

In the first place, we are now absolutely certain that a large part of this appendage unmistakably belongs to our luminary, and in the next place, we know that it consists, in part at least, of an ignited gas giving a peculiar spectrum, which we have not yet been able to identify with that of any known element. The temptation is great to associate this spectrum with the presence of something lighter than hydrogen, of the nature of which we are yet totally ignorant.

A peculiar physical structure of the corona has likewise been suspected. On the whole, we may say that this is the least known, while it is perhaps the most interesting, region of solar research: most assuredly it is well worthy of further investigation.

THE TRIALS OF SCREW STEAMSHIPS.

Mr. William Denny (Dumbarton) read a paper on "The Trials of Screw Steamships." A considerable part of his paper was taken up in proving the fallacy of the cube of the speed theory, of which "arbitrary and misleading dogma" he hoped there would soon be an end. The system of progressive trials exploded this idea, and if the late Professor Rankine had had the advantage of progressive trials his work would have been more valuable. In making progressive trials, perfect accuracy should be obtained, and they would be worthless if they fell below Admiralty standard, which the majority of private trials, he was sorry to say, did almost invariably. A perfectly calm day was necessary, as the wind told enormously on the slow speed. The great aim was to equalize the development of power on the two runs. They would gain literally nothing from single model trials. Mr. Thorneycroft (Chiswick) having observed that, in a ship with a very large surface, the resistance increased in a slower ratio than in a bluff vessel, Professor Kennedy said that shipbuilders had not at present got anything like so far to adopting progressive trials as Mr. Denny seemed to have gone. But one thing they might at least look for was tolerably complete results. They continually had to work at results which looked very complete, and had a great many figures in them, but frequently happened to leave out one or two matters which were absolutely essential to coming to anything like conclusions from them. It was very easy indeed, on a trial ship, with a moderate amount of care, to get to know a great deal of the commoner particulars, which, if put together and collated, would help them to come to something like a conclusion. They wanted especially particulars of the size of the vessel, her general form, the exact draft, and the exact speed. Mr. W. Smith (London) agreed with Professor Kennedy in his remarks. He said that the very systematic mode of setting about to deceive had been too thoroughly followed, and had been a practice quite recognized in connection with steamship builders, marine engineers, and even the persons associated with them. It was impossible to conceive of anything more fallacious than the records that had been sent to the British Association on this matter. Mr. Denny heartily agreed with what Professor Kennedy and Mr. Smith had said, and added that he had seen glaringly careless trials, which were as bad as dishonest trials.

THE STEERING OF SCREW STEAMERS.

In a paper read before the mechanical section of the British Association, Professor Osborne Reynolds says: 1. That when the screw is going ahead, the steamer will turn as if she were going ahead, although she may have stern way on. 2. That when the screw is going reversed, the rudder will act as if the vessel were going astern, although she may be moving ahead. 3. That the more rapidly the boat is moving in the opposite direction to that in which the screw is acting to drive it, the more nearly will the two effects on the rudder neutralize each other, and the less powerful will be its action. In reference to the effect of the screw to turn the boat independently of the rudder, the author states the following law: 4. That, when not breaking the surface, the screw has no considerable tendency to turn the ship as long as the rudder is straight. On the subject of racing, the author stated that his experiments had enabled him to establish the following laws: 5. That when the screw is frothing the water, or only partially immersed, it will have a tendency to turn the stern in the opposite direction to that in which the tips of the lower blades are moving. 6. That when the boat is going ahead, its effects will be easily counteracted by the rudder; but when starting suddenly either forward or backward, at first the effect of the screw will be greater than that of the rudder, and the ship will go accordingly. 7. That if, when the boat is going fast ahead, the screw is reversed, at first it almost destroys the action of the rudder, what little effect it has being in the reverse direction to that in which it usually acts. If then the screw draws air or breaks the surface, it will exert a powerful influence to turn the ship.

New Photo Dry Process.

M. E. Quiquerez furnishes the details of his rapid dry process, which, he claims, combines the quality of results belonging to the albumen processes with a sensitiveness hitherto unapproached. The plates first receive a preliminary coating of albumen (one in forty) to be filtered immediately before use. M. Quiquerez insists upon the use of ammonia rather than acetic acid for preserving the albumen from decomposition, as the acid causes the growth of a species of fungus which destroys the clearness of the liquid. Any good commercial collodion may be used, but one containing a large proportion of bromide is to be preferred. The silver bath consists of: Nitrate of silver 40 to 50 grains, glacial acetic acid, 2½ to 10 minims, according to temperature, rain water 1 oz., to be saturated with iodide of silver. The plate is allowed to remain in the bath at least four or five minutes, after which it is well washed, first in rain and then in ordinary water, until the whole of the free silver is removed. The preservative, in which the novelty of the process lies, is as follows:

SOLUTION No. 1.—Roasted and finely ground coffee, 3½ ozs.; Caramel, 1½ ozs.; boiling rain water, 40 ozs.

SOLUTION No. 2.—Gum arabic, 1 oz.; albumen (beaten and decanted), 1 oz.; pyrogallic acid, 120 grains; cold rain water, 26 ozs.

When No. 1 has become cold, it is filtered and added to No. 2, the whole being well agitated, when it is ready for use. M. Quiquerez attributes the great sensitiveness of this process to the large quantity of pyrogallic acid employed, the albumen, though present in very small proportion, giving great solidity to the sensitive film. The gum and caramel lessen a slight tendency to harshness noticeable with coffee and albumen alone, and also render the film more permeable during development. The pyrogallic acid facilitates the action of the alkaline developer. The preservative is applied in the usual way by pouring it on and off the plate (previously well drained) three or four times.

The development is performed in a dish, by means of a plain solution of carbonate of ammonia, the plate being plunged direct into the developer without previous washing. If the exposure has been well timed, the details will be brought out without further treatment, when the film is carefully washed and intensified with pyro and silver. If, on the contrary, the exposure has been too short, the development must be continued by means of the ordinary alkaline pyro developer. An eighty-grain solution of sulphocyanide of ammonium is recommended for fixing, as it does not destroy the half tones. The color of the image is a rich red brown: but for those who prefer a black tone, M. Quiquerez recommends the use of chloride of gold.

New Theory of the Resistances of Ships and other Moving Bodies in Water.

The following is an abstract of the address of Mr. W. Froude, C.E., F.R.S., as president of section G (Mechanical Science), British Association:

"I propose," he said, "to treat of certain of the fundamental principles which govern the behavior of fluid, and this with special reference to the resistance of ships. By the term "resistance" I mean the opposing force which a ship experiences in its progress through the water. Considering the immense aggregate amount of power expended in the propulsion of ships, or, in other words, in overcoming the resistance of ships, I trust you will look favorably on an attempt to elucidate the causes of this resistance. It is true that improved results in shipbuilding have been obtained through accumulated experience; but it unfortunately happens that many of the theories, by which this experience is commonly interpreted, are interwoven with fundamental fallacies, which, passing for principles, lead to mischievous results when again applied beyond the limits of actual experience. The resistance experienced by ships is but a branch of the general question of the forces which act on a body moving through a fluid, and has within a comparatively recent period been placed in an entirely new light by what is commonly called the theory of stream lines. The theory as a whole involves mathematics of the highest order, reaching alike beyond my ken and my purpose; but I believe that, so far it concerns the resistance of ships, it can be sufficiently understood without the help of technical mathematics; and I will endeavor to explain the course which I have myself found most conducive to its easy apprehension. It is convenient to consider first the case of a completely submerged body moving in a straight line with uniform speed through an unlimited ocean of fluid. A fish in deep water, a submarine motive torpedo, a sounding lead while descending through water, if moving at uniform speed, are all examples of the case I am dealing with. It is a common but erroneous belief that a body thus moving experiences resistance to its onward motion by an increase of pressure on its head end, and a diminution of pressure on its tail end. It is thus supposed that the entire head end of the body has to keep exerting pressure to drive the fluid out of the way, to force a passage for the body, and that the entire tail end has to keep on exerting a kind of suction on the fluid to induce it to close in again--that there is, in fact, what is termed *plus* pressure throughout the head end of the body and *minus* pressure or partial vacuum throughout the tail end. This is not so: the resistance to the progress of the body is not due to these causes. The theory of stream lines discloses to us the startling but true proposition that a submerged body, if moving at a uniform speed through a perfect fluid, would encounter no resistance whatever. By a perfect fluid I mean a fluid which is free from viscosity, or quasi-solidity, and in which no friction is caused by the sliding of the particles of the fluid past one another, or past the surface of the body. The property which I describe as 'quasi-solidity' must not be confused with that which persons have in their minds when they use the term 'solid water.' When people in this sense speak of water as being 'solid,' they refer to the sensation of solidity experienced on striking the water surface with the hand, or to the reaction encountered by an car blade or propeller. What I mean by 'quasi-solidity' is the sort of stiffness which is conspicuous in tar or liquid mud; and this property undoubtedly exists in water, though in a very small degree. But the sensation of solid reaction which is encountered by the hand or the oar blade is not in any way due to this property, but to the inertia of the water. It is in effect this inertia which is erroneously termed solidity; and this inertia is possessed by the perfect fluid, with which we are going to deal, as fully as by water. Nevertheless it is true, as I am presently going to show you, that the perfect fluid would offer no resistance to a submerged body moving through it at a steady speed.

It will be seen that the apparent contradiction in terms which I have just advanced is cleared up by the circumstance that in the one case we are dealing with steady motion, and in the other case with the initiation of motion. In the case of a completely submerged body in the midst of an ocean of perfect fluid, unlimited in every direction, I need hardly argue that it is immaterial whether we consider the body as moving uniformly through the ocean of fluid, or the ocean of fluid as moving uniformly past the body. The proposition that the motion of a body through a perfect fluid is unresisted, or, what is the same thing, that the motion of a of a perfect fluid past a body has no tendency to push it in the direction in which the fluid is flowing, is a novel one to many persons; and to such it must seem extremely startling. It arises from a general principle of fluid motion, which I shall presently put before you in detail—namely, that to cause a perfect fluid to change its condition of flow in any manner whatever, and ultimately to return to its original condition of flow, does not require, nay does not admit of, the expenditure of any power, whether the fluid be caused to flow in a curved path, as it must do in order to get round a stationary body which stands in its way, or to flow with altered speed as it must do in order to get through the local construction of a channel which the presence of the stationary body practically creates. Power, it may indeed be said, is first expended, and force exerted to communicate certain motions to the fluid; but that same power will ultimately be given back, and the force counterbalanced, when the fluid yields up the motion which has been communicated to it, and returns to its original condition." He illustrated this portion of his address with several interesting experiments, in one of which he was assisted by Sir William Thomson, showing that, if a chain be set rotating at a very high velocity over a pulley, the centrifugal forces did not tend to disturb the path of the running chain, and that a stream of fluid in a tortuous flexible pipe would behave in a strictly antagonistic manner. He also introduced an experiment to show that, in a pipe of varying diameter, the pressure of a running stream is greater in the wider part. He then pointed out that the causes of resistance to the motion of a ship through the water are: First, surface friction; secondly, mutual friction of the particles of water (and this is only practically felt when there are features sufficiently abrupt to cause eddies); and thirdly, wave genesis; and that these are the only causes of resistance. He also showed that a ship at the surface experiences no resistance in addition to that due to surface friction and the action of eddies, except that due to the waves she makes.

He then said: "I have done my best to make this clear; but there is an idea that there exists a form of resistance, a something expressed by the term 'direct head resistance', which is independent of the abovementioned causes. This idea is so largely prevalent, of such long standing, and at first sight so plausible, that I am anxious not to leave any misunderstanding on that point. The notion of head resistance, in the ordinary sense of the word, or the notion of any opposing force due to the inertia of the water on the area of the ship's way, a force acted upon and measured by the area of midship section, is, from beginning to end, an entire delusion. No such force acts at all, or can act. No doubt, if two ships are of precisely similar design, the area of midship section may be used as a measure of the resistance, because it is a measure of the size of the ship; and if the ships were similar in every respect, so also would the length of the bowsprit, or the hight of the mast, be a measure of resistance, and for just the same reason. But it is an utter mistake to suppose that any part of a ship's resistance is a direct effect of the inertia of the water which has to be displaced from the area of the ship's way. Indirectly the inertia causes resistance to a ship at the surface, because the pressure due to it makes waves. But to a submerged body, or to the submerged portion of a ship traveling beneath rigid ice, no resistance whatever will be caused by the inertia of the water which is pushed aside. And this means that, if we compare two such submerged bodies, or two such submerged portions of ships traveling beneath the ice, as long as they are both of sufficiently easy shape not to cause eddies, the one which will make the least resistance is the one which has the least skin surface, though it has twice or thrice the area of midship section of the other. The resistance of a ship, then, practically consists of three items—namely, surface friction, eddy resistance, and wave resistance. Of these the first named is, at least in the case of large ships, much the largest item. In the Grayhound, a bluff ship of 1,100 tuns, only 170 feet long, and having a thick stem and sternposts, thus making considerable eddy resistance, and at 10 knots visibly making large waves, the surface friction was 58 per cent of the whole resistance at the speed; and there can be no doubt that, with the long iron ships now built, it must be a far greater proportion than that. Moreover, the Grayhound was a coppered ship; and most of the work of our iron ships has to be done when they are rather foul, which necessarily increases the surface friction item. The second item of resistance—namely, the formation of eddies—is, I believe, imperceptible to ships as finely formed as most modern iron steamships. Thick square shaped stems and sternposts are the most fruitful source of this kind of resistance. The third item is wave resistance. On this point, the stream line theory rather suggests tendencies than supplies quantitative results, because, though it indicates the nature of the forces in which the waves originate, the laws of such wave combinations are so very intricate that they do not enable us to predict what waves will actually be formed under any given condition. In order to reduce wave resistance, we should make the ships very long. On the other hand, to reduce the surface friction we should make her comparatively short, so as to diminish the surface of wetted skin. Thus, as commonly happens in such problems, we are endeavoring to reconcile conflicting methods of improvements; and to work out the problem in any given case, we require to know actual quantities.

We have sufficient general data from which the skin resistance can be determined by simple calculation; but the data for determining wave resistance must be obtained from direct experiments upon different forms to ascertain its value for each form. Such experiments should be directed to determine the wave resistance of all varieties of water line, cross section, and proportion of length, breadth, and depth, so as to give the comparative result for each. An exhaustive series of such experiments could not be tried with full sized ships; but I trust that the experiments I am now carrying out with models for the Admiralty are gradually accumulating the data required on this branch of the subject. I wish, in conclusion, to insist again, with the greatest urgency, on the hopeless futility of any attempt to theorize on goodness of form in ships, except under the strong and entirely new light which the doctrine of stream lines throws on it. It is, I repeat, a simple fact that the whole framework of thought, by which the search for improved forms is commonly directed, consist of ideas which, if the doctrine of stream lines is true, are absolutely delusive and misleading. And real improvements are not seldom attributed to the guidance of those very ideas which I am characterizing as delusive, while in reality they are the fruit of painstaking, but incorrectly rationalized, experience. I am but insisting on views which the highest mathematicians of the day have established irrefutably; and my work has been to appreciate and adopt these views when presented to me. No one is more alive than myself to the plausibility of the unsound views against which I am contending; but it is for the very reason that they are so plausible that it is necessary to protest against them so earnestly; and I hope that, in protesting thus, I shall not be regarded as dogmatic. In truth, it is a process of scepticism, not of dogmatism; for I do not profess to direct any one how to find his way straight to the form of least resistance. For the present we can but feel our way cautiously towards it by careful trials, using only the improved idea which the stream line theory supplies, as safeguards against attributing this or that result to irrelevant or, rather, non-existing causes."

Remarkable Shower of Ice---Perils of Rocky Mountain Railway Traveling.

At Potter station, on the Union Pacific Railroad, recently, a train was just pulling out from the station when a storm commenced, and in ten seconds there was such a fury of hail and wind that the engineer deemed it best to stop the locomotive. The hailstones were simply great chunks of ice, many of them three and four inches in diameter, and of all shapes—squares, cones, cubes, etc. The first stone that struck the train broke a window, and the flying glass severely injured a lady on the face, making a deep cut. Five minutes afterward there was not a whole light of glass on the south side of the train, the whole length of it. The windows in the Pullman cars were of French plate, three eighths of an inch thick, and double. The hail broke both thicknesses, and tore the curtains into shreds. The wooden shutters, too, were smashed, and many of the mirrors were broken. The decklights on the top of the cars were also demolished. The dome of the engine was dented as if it had been pounded with a heavy weight, and the woodwork on the south side of the cars was plowed as if some one had struck it all over with sliding blows from a hammer. During the continuance of this terrific fusillade, which lasted fully twenty minutes, the excitement and fear among the passengers ran very high. Several ladies fainted, and one lady, Mrs. Earle, wife of the superintendent of the Mountain division of the road, went into spasms, from which she did not recover for over an hour after the cessation of the storm. Several persons sitting on the south side of the cars were more or less injured about the head and face.

As soon as the storm abated a little, the matting in the cars was hung up in front of the windows, and the train moved ahead, the drifted hailstones proving an obstacle for some miles. At the next station, strips of tin were procured and fasted over the windows the entire length of thd train. The cars have been run into shop for repairs, ane the damage will amount, it is estimated, to several thousand dollars.—*Denver News.*

DECISIONS OF THE COURTS.

United States Circuit Court.---Northern District of New York.

PATENT PRESS.—GEORGE B. BOOMER AND RUFUS E. BOSCHERT *vs* UNITED POWER PRESS COMPANY *et al.*

Shipman, J.

This is a bill in equity filed February 5, 1874, praying for an account and an injunction, for infringement of letters patent for an improvement in cheese presses, granted to the complainants and to Thomas G. Morse, on November 1, 1870. A reissue was granted to the complainants on January 28, 1873, Morse having previously assigned his interest in the invention to Boomer.

The alleged invention of the patentees consisted in constructing sliding standards, the lower ends of which are attached to the platen, and the upper ends extend through a socket in the head block. When one end of the platen is depressed, these standards tend to incline towards the side of least resistance, and in an opposite direction from that towards which the screw shaft tends to move. In order that these opposing tendencies may be made to counteract each other, a central hub is attached to the screw shaft between the standards; when the standards incline to the side of greatest depression, this central hub or bearing attached to the screw shaft comes in contact with the standard, prevents its further movement, and at the same time, by its pressure upon the standard, prevents the movement of the screw shaft to the side of greatest resistance.

The two styles of machines which the defendants' corporation manufactured and sold, in the city of New York, prior to April 10, 1874, differ only in immaterial details from the press of the complainants.

The defendants contend first that the reissued patent is void because it is not for the same invention as the one which was claimed in the original patent.

But the court held that the claim of the reissued patent embraces, in comprehensive terms, the actual invention, and describes what is claimed to be new, and it was not necessary to mention in that part of the specification that toggle levers and a platen were also used in the press. The only ingredients which entered into the invention for which the original patent was granted are those which are specified in the claim of the reissued patent.

The defendants insist, in the next place, that the complainants' patent is invalid, because the elements which are specified in the claim, as forming in combination the invention, do not of themselves perform or accomplish anything.

But the Court held that the claim is properly confined to the invention, and specifies only the improvement which the patentees invented. The elements of the invention are operative in connection with the mechanism of the press, which is accurately described in the specifications.

The defendants contend, thirdly, that the complainants' patent is void, in view of the previous state of the art, as shown in the presses which are described in the patent of Robert Harding, of September 3, 1842, in the patent of P. G. Gardner, of February 28, 1845, in the patent of Nathan Chapman of January 12, 1858, in the patent of Pickens B. Weaver, of August 21, 1860, and in the French press of P. Samin.

But the court held that no one of these presses contained the combination of sliding standards with the central hub of the complainants' press and no one was constructed upon the principle of keeping the platen level by means of the active resistance which standard and hub make to the tendency of the screw shaft to move towards the side of greater resistance when the platen commences to tilt. The point upon which the defendants most strongly relied in this part of the case was that the sliding standard of the Harding press and the central hub or wheel of the Gardner press could have been combined, and thus the complainants' press could have been constructed without the exercise of invention. This theory is not supported by the facts, and it is manifest that an operative machine could not, prior to the date of the complainants' invention, have been constructed from a combination of the two machines of Gardner and Harding without inventive skill of more than ordinary character.

Let there be a decree for the complainants declaring the infringement, and directing an account of profits and an ascertainment of damages until April 10, 1874, with costs.

[*W. B. Smith* and *A. J. Todd* for complainants.
J. Van Santvoord for defendants.]

Recent American and Foreign Patents.

Improved Screw-Pegging Machine.

A. C. McKnight, Philadelphia, Pa.—This invention consists of several novel devices in a screw-pegging machine, by which the fastening together of sole and upper of boot or shoe may be greatly facilitated. These new features, both separately and in the aggregate, will materially contribute to the cheaper manufacture of boots and shoes, while the pegging is done thoroughly and in a workmanlike manner.

Improved Machine for Stiffening Hats.

Granville B. Fuller, Middletown, N. Y.—The hats are dipped into stiffening in a tank, and are placed upon blocks, to which a rapid rotary motion is then given to throw off the surplus stiffening. The hats are given a heavy or a light stiffening by varying the gravity of the stiffening solution contained in the tank.

Improved Knock-Down Bedstead.

William S. Moses, Lebanon, N.H.—This consists of a method of detachably locking the end boards and standards of the head and foot portions of a bedstead by hooks on the lower end board and screws at the top, by which the parts may be readily separated for packing and be put together without the aid of skilled labor.

Improved Wrench.

Peter Samuel, New York city.—A movable jaw is first adjusted relatively to the stationary jaw, to embrace the nut between them. The effect of pressure applied to the handle is to cause it to advance the movable jaw and clamp the nut tightly. The increase of pressure increases the closeness of such contact, so that abrasion of the nut is impossible. When the handle is turned, a cam will act on an arm, and thus on the movable jaw; and when turned in the opposite direction, another cam acts similarly, so that the wrench may be operated to screw nuts on or off the bolts. A spring moves the jaw away from the side of the nut; at once the action of the handle ceases, so that the wrench may be readily removed from the nut.

Combined Spark Arrester and Stove Register.

Thomas R. Freeman and Perine Y. Jones, Ripon, Wis.—The body of the stove has a register frame, to which is attached a frame in which is formed a groove to receive a plate of wire gauze, by which the escape of any sparks through the openings of the register is wholly prevented. The plate can be readily removed when worn and replaced with a new one, and does not interfere with the operation of the register.

Improved Beer Refrigerator.

John N. Bohart, Denison, Texas.—This consists of a skid for supporting the barrel, an ice box arranged above the latter, and an outer case or cover. It was illustrated and described on page 150, current volume of the SCIENTIFIC AMERICAN.

Improved Brush.

Moritz Leiner, New York city.—This consists of a brush having the twisted wire which secures the bristles fastened over the block of the brush, the invention applying only to brushes which have blocks of wood or metal or other suitable material, and of sections of twisted or braided wire and bristles.

Improved Toy Store.

Elias Durlach, New York city.—This consists in a toy grocery store, made of sheet metal, and provided with the detachable sign and ornament, shelves, drawers, boxes, or canisters, a movable counter, and pivoted detachable chandeliers.

Improved Grain Drill Tooth.

George L. Ives, Galesburg, Mich., assignor to himself and Henry L. Keith, same place.—This is a tooth for grain drill tubes, consisting of a front wedge-shaped furrow opener and shank, and having a rear cavity running through both, and passing out on a rearward curve near the bottom.

Improved Animal Trap.

Ebenezer Oliver, New York city.—The body of the trap is made with an offset, formed by bending back the upper part of the front wire of the frame. A wire is secured to the frame of the body and carries a spring, one end of which is secured to the body, and its other end is secured to the door. The door is provided with upright wires at a little distance from the side wires of its frame. The door is made a little narrower than the opening, and in the space thus left is placed a wire, secured to the bottom and to the front wire of the body of the trap. Rings pass around the side wires of the door frame and around the wires last mentioned. When the trap is sprung, the rings slide down upon the wires and fasten the door securely, so that no effort of the animal can open it.

Improved Car Coupling.

Peter Harper, Marshall, Texas.—The drawbar has an upwardly extending hook part, and a coupling link, which is passed through a slot of the bar, and raised for coupling with the approaching drawbar by a forked lever, operated by an intermediate lever rod connection from the platform. The link is retained, raised by a hook arm of the buffer rod engaging the connecting lever mechanism, and is released by the concussion of the cars, dropping forward over the drawbar of the adjoining car. A fulcrumed lever with forked lower part engages the hook arm of the buffer rod, and admits the direct lowering of the link independently of the buffer rod.

Improved Windmill.

Chesley Gates, Locust Grove, Mo.—A small wind wheel for regulating the speed of the large one is arranged where it is subject to the varying wind, and has a cord attached to its hub and connected to a brake lever, so as to pull it against the wheel with more or less force, according to the action of the wind on it. Its effect is varied by an adjustable weight.

Improved Grain Drill.

John T. Lynam, Louisville, Ky.—Around the bearings for the wheel shaft are formed circular projections, upon which rest the edges of a curved plate, the outer part of which projects outward, is bent upward, and is attached to a cross bar. To the cross bar are attached arms, which control and regulate the equal movement of the circular plate. A cross bar is moved to adjust the plate to regulate the amount of seed dropped. An arm is provided with an index that points to division marks upon the side of the bar to indicate the amount of seed the machine will drop to an acre when the plate is adjusted in any particular position.

Improved Screw-Cutting Die.

George R. Stetson, New Bedford, Mass.—In this improvement the chasers are fitted in sockets of a solid die, tapered so that they are held by a binding screw at one side of each. Two of the chasers are provided with an adjusting screw to set them up toward the others as they become worn away.

Improved Crown Bar for Steam Boilers.

James McPhail, Ellis, Kan.—This invention is an improvement upon that covered by letters patent No. 129,634, and consists in the employment of a detachable lock bar, having lugs on its ends, in connection with a crown bar composed of two parallel parts. The lock bar aids in preserving the parallelism of the bars, and strengthens and braces the same. It also prevents the bolts being thrown out of vertical parallelism with the bars by reason of the warping of the crown sheet.

Improved Wrench.

John H. Morrissey, Indianapolis, Ind.—The invention consists of a wheel wrench having a central socket part, with diametrically extending arms that are securely locked by fastening springs to the hub hand, to be applied to the nut for unscrewing the same, and in reversed position for being stored away without engaging the nut

Improved Picture Nail.

Owen W. Taft, 221 Pearl Street, New York city.—This consists of an ornamental head made of two cups of sheet metal, one being permanently attached, and the other detachable. The cups are ornamented with spiral ribs, which also form screw threads, by which the detachable part is connected to the permanently attached part. The cup, which is permanently attached to the nail, is fastened by filling it around the shank by solder.

Improved Combined Harrow and Cultivator.

William McCray, Black Oak, Mo.—Wings are used upon each side of the central bar. The forward ends of the wings are connected by bars. The rear ends of the wings are connected by bars secured to their upper sides. To and between the rear ends of the bars and the rear braces are secured the outer ends of the two bars, in which several holes are formed to receive the bolts by which they are secured to the plate, so that the wings may be expanded or contracted to make a wider or narrower cut, as may be desired. The wing teeth, which are curved outward and rearward, are made thin upon their forward edge.

Improved Hose Spanner and Key.

Andrew J. Barnard, Camden, N. J.—By this implement, a hose may be quickly and tightly connected to the water pipe, and the stopcock of the same opened. The handle is made of a double curved or S-shaped form. At one end, and cast in one piece therewith, are arranged recessed prongs, which fit in a semicircle around and, by their recessed parts, on the lug of the hose coupling. The coupling is first screwed on by hand, and then drawn tightly by applying the prongs. A key at the other ends of the handle serves to turn the water on or off by being applied to the stopcock of the water pipe. A tapering lug, forming an extension of the key, serves for lifting the lid of the box, so that the hose may be coupled and the water turned on.

Improved Car Wheel Lubricator.

John Woodville, Washington, Ind.—The car wheel has an oil chamber arranged between its spokes or arms. As the wheel revolves, oil will slide down the back wall and turn into the passage; but if more falls than is required, the superfluity falls back, the collar and washer in the hub preventing its escape.

Improved Rotary Engine.

Jacob W. Vanarder and George F. Savage, Utsaladdy, Wash. Ter.—This invention is an improvement in the class of rotary engines whose pistons are caused to reciprocate as they rotate, by means of a fixed cam; and it relates to cutting out the middle portion of the pistons and fitting them together in such a manner that space is economized within the wheel case.

Improved Device for Hanging Pictures, Mirrors, etc.

Harvey D. Pope, Dayton, Ohio.—The object of this invention is to provide a device for adjustably hanging pictures, mirrors, etc., so as to vary them in their inclination to the wall, according to the hights at which they are hung, and the different quarters whence the light proceeds. It consists of a frame to be attached to the wall, to which the picture or mirror is fastened upon both sides by links which are long enough to give the desired adjustment. The lower part of the picture is hinged to a hollow bar which slides inside a hollow pendent bar or case attached at the top to the frame, and provided upon one of its inner sides with ratchet teeth or notches. Inside the inner bar is a rod or wire attached to a spring pawl at the top, and a thumb latch below, by pressing upon which latter the pawl is disengaged from the ratchet teeth and the picture raised or lowered, the links serving to control the different inclinations to the wall.

Improved Dovetailing Machine.

Charles P. Baile, New Windsor, Md.—This invention relates to certain improvements in that class of dovetailing machines in which a revolving cutter is moved against the boards to be cut so as to produce, by a single movement, the reciprocally fitting tenons and mortises. It consists in a vertical cutter revolving in a sliding carriage moving in horizontal guides, the said carriage being actuated by a treadle, cord, and spring, and the guides in which it is contained being supported upon a vertically adjustable bed.

Improved Insole for Boots and Shoes.

Charles F. Hill, Baltimore, Md.—The object of this invention is to increase the flexibility of the soles of boots and shoes, and it consists in cutting in the insole or lasting sole, or both, slits transversely to the same at the bend of the sole.

Patent Heating and Ventilating Stove.

Marius C. C. Church, Parkersburg, W. Va.—This invention relates to certain improvements in heating stoves, and it consists in a detachable fire pot back, having flanged sides that slide vertically into guide ways in the outer casing. It also consists in the particular construction of the smoke flue ascending vertically from the stove and having partition plates attached thereto, in combination with a detachable cover above the heating chamber, so constructed as to leave an annular outlet for the heated air, which, passing up in columns adjacent to said pipe, heats the room better by affording a more perfect convection. This invention is claimed to be a valuable improvement; but our readers can form their own opinions on obtaining further information from the inventor, as above.

Improved Plow.

J. Freeman, Corpus Christi, Texas.—This invention contemplates an improvement in the present mode of securing the share and moldboard of a plow to a skeleton frame, so as to enable a single bolt both to serve as a fastening of the parts and a brace to the whole structure.

Improved Signal Lantern.

George J. Cave, Elizabeth, N. J.—Two glass tubes, made of different colors and of the same diameter, are placed end to end, and are connected together and kept in place upon each other. The lower tube is secured to a base ring, to which is rigidly attached a handle, so that the glasses can be conveniently raised by grasping and raising the said handle. A spring catch receives the base ring when the glass tubes have been raised sufficiently to display the upper tube above the case. Another spring catch receives the base ring when the glass tubes have been raised sufficiently to display the lower tube. By this construction, by operating a handle, the upper or the lower catch may be drawn out, or both catches may be drawn out at the same time. To the base ring are attached three spring rods, which pass up along the sides of the colored glass tubes, and which, when the said glass tubes are fully raised, rest against the upper part of the globe, and prevent the said glass tubes from shaking about. A shade, made in telescopic parts, is secured to the cap of the lantern, and extends downward so far as to cover the upper glass tube when the tubes are fully raised, so as to prevent any light from shining through said upper tube.

Improved Method of Scouring and Polishing Rice.

Philip R. Lachicotte, Waccamaw (Georgetown P. O.), S. C., assignor to P. R. Lachicotte and Sons, of same place.—This is a method of scouring and polishing rice by applying friction surfaces to the previously hulled article commixed with the ash of rice chaff.

Improved Railroad Rail Joint.

Joseph C. Wright, Monocacy Station, Pa.—This invention consists of an inside spring plate for the flange, and an outside spring for the tread of the wheel, to take off the weight of the wheel, or a portion of it, from the ends of the rails, and thus prevent the pounding and hammering due to the springing down of the rails when the wheel passes over the ends. It also consists in the form of the plates, and arrangements for fastening them in position, whereby they are secured without bolts or screws.

Improved Oil Can.

John Askwith, Chicago, Ill.—This is an attachment to the bottom of the can, so contrived that the drip escaping from the nozzle or any leak will be caught and retained while pouring from the nozzle. It also consists of a nozzle for pouring out the drip, so contrived with the attachment that it serves for a handle to use in pouring, and of a nozzle so combined with the drip attachment and the nozzle for pouring out of the can that the drip may be poured out together with the contents of the can or through the same nozzle.

Improved Cultivator Teeth.

John Flynn, Monches, Wis.—The invention consists in the combination of the spring and its wheel with the tooth, having a concavity formed in its rear side contiguous to a lug, through which passes a set screw, whereby the wheel can be adjusted in such manner as to cause the tooth to yield more or less readily, as required in different soils.

Machine for Making Crimping Tacks, Awls, Etc.

Henry A. Williams, West Medway, Mass.—This invention relates to roller die machinery for shaping shoemakers' awls, also crimping tacks; and it consists, first, of notches in the surface of the rollers surrounding the dies, and between the dies, and the cavities outside of the dies, for clearance, the object being to utilize the holding-back tendency of the notches on the metal expelled from the sides in the form of fins, to counteract the longitudinal strain which the metal is subject to by the drawing action of the rollers. Second, the invention consists of feed mechanism, in combination with die rollers contrived to automatically feed a long rod forward between the die rollers, hold it until the dies gripe it, and, after the blank is formed, draw the rod back to the cutters, and then leave it and slide back to take hold for feeding again. Third, it consists of gripers contrived to seize the rod as soon as the dies have performed their office, and hold it while the carrier continues to go back for a new hold, and while the cutters detach the rolled piece; and, fourth it consists of the rollers contrived for shifting laterally along the feed mechanism, and provided with mechanism for so shifting them to utilize one feed for all the different dies of a set of rolls having different sizes or forms for different articles.

Improved Automatic Gate.

William W. McKay, Ossian, Iowa.—This gate is so constructed that it may be readily opened by a person in a vehicle or upon horseback, and again closed after the said vehicle or horse has passed through. The only operation is slightly pushing upon levers before and after passage, which, through the medium of counterpoises, cause the gate to shut into compact form, or to extend.

Improved Hat.

Charles Sinclair, New York city.—The invention consists of a crown plate, which is adjusted on radial supporting wires into higher or lower position, the wire ends being attached in suitable manner to the sweat band of the hat. The head is thereby kept cool and comfortable, as no pressure of the hat is exerted on the forehead or back of the head.

Improved Stamp-Mill Feeder.

John Walker, Sonora, Cal.—This invention relates to an improved feeder for stamp mills, which is operated in combination with the stamp, and so constructed that a uniform and continuous feed of ore is secured. The invention consists of a feeding disk, with stationary hopper, directing gage piece, and discharge apron, the disk being rotated by pulley, rope, and weight connection of its shaft with a pivoted lever and conical collar of the stamp shaft.

Improved Vehicle Top.

Jerome B. Relyea, Hicksville, assignor to himself and Lewis E. Brewster, Bryan, Ohio.—The case of the device is concaved upon its inner side to fit upon the rear bow of a buggy top. In the middle part of the concaved plate is formed a slot to receive the rubber block, the inner edge of which is designed to rest against the bow to which the device is attached. Upon the outer sides of the concaved plate are formed two caps, the inner ends of which form shoulders for the rubber block to rest against, to prevent the said rubber block from falling out.

Improved Cloth Measure Register.

James Brown, Jr., Matteawan, N. Y.—This is an improved machine for attachment to a store counter, to register the number of yards, of cloth or any other flexible material sold by the yard, measured off, so that the clerk can always know exactly how many yards he has measured, and "will not be under the necessity of remeasuring the goods one or more times, should the purchaser persist in talking to him."

Improved Farm Fence.

Andrew Miller, Guntersville, Ala.—This improvement in fence consists of one of the upper boards of the panel extended a little longer than the others, to drop into a slot in the top of the post, while at the lower part the corners drop alongside of stop cleats nailed on the posts. Cleats are on the middle portion, which, at the same time, drop down on the top of a stake on the opposite side to the stop block, which effectually holds the panel upright, and at the same time allows it to be lifted off the posts readily. The posts are driven into the ground, and are not as high as the panels, being small and light.

Improved Champagne Freezer.

Charles H. Ludwig, New York city.—A frame is applied to the cooler in a fixed or detachable manner, as desired. A central vertical rod is revolved in cross bearings at the top part of a frame by gearing operated by a crank handle, the rod being provided at the lower end with a fixed cross piece, to which jaws, that are fitted to the necks of champagne or other bottles, are hinged. A clamp bolt and screw nut connects the hinged jaws, and admits their rigid attachment to the bottle for being revolved by the rod, and thereby quickly acted upon by the ice in the ice receptacle. Any beverage may thus be cooled in a very short time, and the champagne *frappé* be made in quick and convenient manner. Information regarding territorial or shop rights, purchase of machines, etc., may be had by addressing Ludwig and Battin, No. 50 East 26th street, New York city.

Improved Spring Power.

Valentine Moeslein, Waterloo, Ill.—This invention is a contrivance of double but independent springs in a spring power apparatus, so that both work together to drive one and the same train, and each can be wound up independent of the other, whereby one may be wound up when the other is partly run out, and *vice versâ*, making a regular and uniform continuous power.

Improved Folding School-Desk.

David I. Stagg, New York city.—This folding school-desk is so constructed that when the desk board is folded down, its upper edge will not project above the desk back. Bars are arranged to serve both as handles to the leaf and as a brace to the shelf.

Improved Manufacture of Horseshoes.

Alfred B. Seymour, Jersey City, N. J.—This is a process of making horseshoes by rolling steel bars with a V-shaped flange, then notching said flange transversely, and finally bending the blank into horseshoe shape, whereby the calks are brought closer together at the toe.

Improved Chuck.

Edward S. Perot and Harry C. Beitenman, Philadelphia, Pa.—There is a ring under the wheel, having inclines to ride up and down studs in the bottom of the groove for the wheel, and a shank extending out through the shell of the chuck, for turning it. The slot for the shank is inclined, to correspond with the inclines, so that by shifting the stud to one end of the slot, the ring will push the wheel into gear with the pinions; and shifting it the other way, it will allow the wheel to move back out of gear, thereby causing the jaws to work in the manner of a universal chuck. A stop lug locks the ring when raised up the inclines, to hold the wheel in gear by filling the slot out of which the shank projects.

Improved Center Board.

Joseph L. Dickenson, Hempstead, N. Y.—This is an improved method of hanging center boards, which will enable the center board to be shipped and unshipped while the vessel is floating in the water and loaded, and which will prevent leakage around the center board bolt. The center board trunk has a hole bored into but not through its timbers. There is a bolt, shorter than said hole, and a superimposed plug of wood to be driven into the aperture.

Notes & Queries

G. J. E. will find directions for making rubber hand stamps on p. 156, vol. 21.—H. F. G. (size of boiler), H. P. T. (cut-off of engine), and S. M. R. (horse power of a water wheel) do not send sufficient data.—I. H. can cement meerschaum by the process described on p. 202, vol. 47.—W. L. S. will find that his queries as to magnetic variation are answered on p. 164, vol. 33.—T. J. W. will find a description of the polyspherical ship on p. 100, vol. 31.—W. F. R. will find a recipe for paste that will not sour on p. 219, vol. 30.—B. J. B. will find an answer to the cannon and car question on p. 273, vol. 32.—F. H. will find a recipe for bronzing on iron castings on p. 283, vol. 30.—M. A. will find a recipe for black paint for iron fencing on p. 379, vol. 31.—C. will find a recipe for paste on p. 315, vol. 30, and on p. 11, vol. 31.—B. W. D. will find directions for constructing a windmill on p. 241, vol. 32.—M.H.K. is referred to p. 319, vol. 32, for a means of getting rid of ants. Constructing a sundial is described on p. 409, vol. 29.—W. P. K. will find directions for freeing sulphuric acid from water on p. 111, vol. 29.—E. T. can bleach beeswax by the method described on p. 299, vol 31.—S. A. R. will find directions for making a filter on p. 251, vol. 31.—G. V. can temper springs by the process described on p. 363, vol. 32.—S. L. will find directions for waterproofing cloth on p. 347, vol. 31. For a book on the lathe, try "The Lathe and its Uses."—A. D., D. McG., A. C. D., and R. F. H. will find a full explanation of the mystery of an ice boat traveling faster than the wind on p. 176, vol. 28.—H. S. S. will find a method of ascertaining the amount of water carried over in steam on p. 257, vol. 31.—A. K. will find a recipe for a cement for filling burr stones on p. 251, vol. 31.—J. A. will find directions for making malleable iron castings on p. 138, vol. 29.—D. I. S. can drive away cockroaches by the method described on p. 315, vol. 32.—W. M. H. will find a recipe for yellow lacquer on tin on p. 139, vol. 32.—T. C. P. will find directions for preserving eggs on p. 219, vol. 31.—H. L. S. will find directions for manufacturing aluminum on pp. 99, 116, vol. 32.—H. G. S. will find an answer to his query as to the growth of the beard on p. 362, vol. 32.—A. K. will find the desired information as to the phylloxera on p. 48, vol. 33.—S. A. T. will find directions for extracting glycerin on p. 202, vol. 31. Consult a physician as to the feet troubles.—T. B. will find directions for making bleaching salts (chloride of lime) on p. 91, vol. 32.—V. L. Jr. and A. J. P. will find directions for silvering without a battery on p. 299, vol. 31.—F. M. E. will find an answer to all his queries as to lightning rods on p. 145, vol. 31.—A. E. G. will find a recipe for paraffin varnish on p. 91, vol. 31. Ants may be destroyed by the method described on p. 319, vol. 32.—J. B. M. can prevent rust on iron by the method given on p. 283, vol. 31.

(1) J. N. Jr. asks: In regard to the fireproof qualities of a safe, do the walls require to be any thicker for a large sized safe, or does 5 inch filling offer the same protection in a large as well as in a small size? A. The same thickness for both sizes will do.

(2) I. L. asks: What is the name of the fastest steamboat in the world, and what is her best time? A. We think about 25 miles an hour has been made on the North river, and this is the fastest time. Perhaps some of our readers may have notes that will be of interest.

(3) T. H. W. says: Please give me through your valuable paper a rule by which I can exactly calculate the departure of a curve from a tangent, the radius and tangent being given, at right angles to each other. A. You want the equation of the curve, which you can obtain from a treatise on analytical geometry, for any of the common curves. In case you do not know the nature of the curve, it must be determined by experiment. The equation of the circle, referred to its center, R being the radius, and x, y, the co-ordinates, is $x^2 + y^2 = R^2$

(4) G. L. B. asks: Have I a right to make any patented article for myself? A. No.

1. Does a rifle ball leave the gun before one feels the recoil? A. No. 2. Will the recoil make any difference with the shooting? A. Yes.

(5) D. C. asks: Why does iron not always shrink alike? A. Because it is not homogeneous, being harder and closer in fiber in some places than in others.

(6) C. P. A. says: 1. I have in mind to build a small boat, 40 feet long and 13 feet wide. What size of engine would it take to run it? A. Use an engine of 12 or 15 horse power. 2. Does boiler iron have to be stamped on every plate with the breaking strain and the maker's name? A. The law in regard to stamping boiler plates is as follows: "And be it further enacted: That every such plate of boiler iron or steel, made for use in the construction of steamboat boilers, shall be distinctly and permanently stamped by the manufacturer thereof, and, if practicable, in such places that the marks shall be left visible when such plate shall be worked into boilers, with the name of the manufacturer, the place where manufactured, and the number of pounds tensile strain it will bear to the square inch." This refers to plate subject to a tensile strain.

How are rubber stamps made? A. See p. 156, vol. 31.

(7) R. B. asks: Can water be pumped from an airtight tank, having no vent? A. No.

(8) H. D. M. asks: Can you give us a first class recipe for making Babbitt metal for lining journal boxes? A. It would be better to buy the metal from a reliable manufacturer. We can recommend the use of cast iron boxes, from personal experience and observation.

What is the best style of clutch now known for connecting two lines of shafting, to throw them in and out of gear? A. You will probably find a friction clutch the most satisfactory.

(9) J. O. asks: Can I own and run a steam yacht for my own pleasure upon the Connecticut river and on Long Island Sound, without getting a license? I do not wish to carry passengers for hire. A. You must obtain a license. Apply to the inspector in your district. The fees are: Vessel, $25; captain, $10; engineer, $5.

(10) H. H. says: 1. Following the subjoined directions, I attempted some electro-plating: "Take a $2.50 piece of gold and put in a mixture of 1 oz. nitric and 4 ozs. muriatic acid (in glass vessel only); when it is all cut, dissolve ½ oz. sulphate of potash in 1 pint pure rain water, and mix with the gold solution, stirring well; then let it stand, and the gold will be thrown down; then pour off the acid fluid, and wash the gold with two or three waters, or until no acid is tasted on touching the tongue to the gold. Now dissolve 1 oz. cyanuret of potassium in 1 pint pure rain water, to which add the gold, and it is ready for use. Clean the article to be plated from all grease and dirt with whiting and a brush; if there are cracks, it may be necessary to put the article in a solution of caustic potash; suspend it in the cyanuret of gold solution with a small strip of zinc about the width of a common knitting needle." With the exception of using some fully 18 carat gold for the $2.50 gold piece, I followed directions, but the result was not satisfactory. The deposit was about the color of and very similar in appearance and feel to German silver. What was the cause? How can I, in some simple manner, touch up by electro-plating with gold such things as parts of watch movements, etc.? A. A defective colored gilding may be improved by the help of the following mixture: 3 parts nitrate of potash, 1½ alum, 1½ sulphate of zinc, 1½ common salt. These ingredients are put into a small quantity of water, to form a sort of paste, which is put on the articles to be colored; they are then placed upon an iron plate over a clear fire, so that they will attain nearly a black heat, when they are suddenly plunged into cold water; this gives them a beautiful high color.

(11) W. B. H. asks: How can I find the relative conductivity of different substances? A. You can find them tabulated in De la Rive's work on electricity, and in several others. The process of working them out is somewhat complicated, and requires a great deal of experience to do it accurately.

(12) L. J. W. says: I have tried to electroplate with a battery of 2 zincs and a carbon in dilute sulphuric acid, but I cannot get a good deposit either on metal or a wax mold, the wax mold being well rubbed with pure graphite. The zincs are 3 inches x 6 x ½, and the carbon is of the same size. The deposit on the metal is in spots, and brittle, altogether unlike the nature of copper. Please tell me what is the matter. A. Your trouble might arise from several causes. Perhaps your solution is too strong. The best solution is made of 3 parts saturated solution of sulphate of copper and 1 part of sulphuric acid with 10 of water. Perhaps your anode is too large. Try a smaller one. Perhaps your cathode and anode are too near together; try them farther apart; that is, separate your metals farther from the copper plate.

(13) L. S. Y. asks: What chemicals and metals are used in the Hill battery? A. Sulphate of copper and sulphate of zinc are the chemicals, and zinc and copper the metals.

(14) A. B. C. asks: 1. How will I proceed to finish up ash doors and frames in oil polish, after filling with two coats of filling? What material is used, and how many coats are necessary to produce a good job? A. The fineness of the polish depends in a great measure upon the care with which the filling may be rubbed down; the rubbing is indispensable, in fact, to a good finish. For the best work, put on three coats of shellac; after the first coat is hard, rub it down with No. 1 sandpaper; after the second coat is hard, rub down with No. ½ sandpaper, and after the third coat, the same. Then put on one or two coats of beeswax dissolved in spirits of turpentine and oil, in some cases three coats. For polished panels, put on three coats of hard flowing varnish, each of the first two coats to stand two or three days until hard, and then be rubbed with rotten stone, the third coat to be rubbed with cotton batting and flour. 2. I have a brick foundation, penciled, and it is ruined from mold. How can I prevent the mold from affecting the paint? A. The mold is caused from dampness, and this arises either from a close confined position of the wall, or from water rising in the body of the wall from the ground. The only remedy is to remove the cause of the dampness.

(15) M. H. T. & Co. say: In our business we have orders for hooks, etc., that are to withstand the draft of an ordinary locomotive. Will you please give us your idea of the amount an engine with four drive wheels can lift, dead weight, with single purchase? A. About 8,000 lbs. on an average, taking the adhesion at $\frac{1}{4}$ of the weight on the driving wheels.

(16) C. F. asks: 1. What is the percentage of phosphorus in phosphorus oil? A. Twelve grains phosphorus are put into 1 oz. almond oil. About 4 grains phosphorus are taken up by the oil. 2. What medical action has it? A. Solutions of phosphorus have been used in small quantities to allay excessive oxidation of the animal tissues. Vitreous phosphorus, taken internally, acts as a powerful irritant poison.

Can corrosive sublimate be made by precipitation of mercurial nitrate by muriate of soda? A. No; the precipitate consists of the subchloride of mercury (calomel).

(17) G. says: 1. I have a boiler carrying 70 lbs. to the square inch with a ¾ safety valve attached. What would be the pressure on said valve? Will I have any greater pressure on a 3 inch safety valve with the same pressure of steam? A. Pressure on ¾ valve $= 70 \times (\frac{3}{4})^2 \times 0{\cdot}7854$; pressure on 3 inch $= 70 \times (3)^2 \times 0{\cdot}7854$, hence the pressure in the second valve is 16 times as great as that on the first. 2. Please give me a rule for finding horse powers of boilers. A. We do not know of any standard for the horse power of a boiler.

(18) P. asks: 1. Can gold leaf be applied to glass without the use of oils? A. Gold size is used for this purpose. 2. How can I transfer a wood cut or steel engraving to glass, so that I can apply colors to the back, and let them strike through? A. See p. 123, vol. 30.

(19) G. F. K. asks: 1. I have built an engine 1¼ bore x 3 inches stroke, with a fly wheel weighing 12 lbs. Would a copper boiler 20 inches high x 15 inches diameter, with 4 flues two inches in diameter, heated with 4 lamps, making 60 lbs. steam, run said engine at the rate of 600 revolutions per minute? A. If the lamps are very powerful, we think it may answer. It will have to be forced, however. 2. Please state the thickness the boiler shell should be. A. Make it ⅛ of an inch thick.

(20) C. H. says: I have a 1 inch iron pipe, 480 feet long, to bring water from a spring. The fall is 8 or 10 feet, and the water runs out 3 feet above the ground. I cannot get the pipe to run full of water; it will not run more than half full, though there is water enough to fill it. What is the remedy? A. Probably the pipe has high points, where air collects.

(21) H. N. B. says: I am running a circular saw, with an idle pulley in a horizontal frame, hinged, and working a few inches from the saw pulley. The belt is quite slack, increasing the lap six inches. I apply just sufficient weight on the frame to keep the belt from slipping; it works smoothly and well and almost noiselessly. One lacing has lasted three months on heavy work. The proprietor contends that I am wearing the belt on the outer surface and otherwise injuring it by applying the weight. Is he right? A. The plan you have adopted is a very good manner of applying a tightener. It would probably be somewhat more efficient if you stretched the belt a little tighter; but from your account of the manner in which it operates, there seems to be little reason for making any change.

(22) L. M. says: I say that, if a train of cars runs on a circular track or a curve, the road must be inclined outward if the locomotive draws, and inward if it pushes from behind. My friend says in both cases the road must incline inward. Who is right? A. Your friend.

(23) I. D. C. asks: 1. Will a balloon made in the form of a sphere or a spheroid carry as much weight and ascend with as much ease as if made pear-shaped, the gas and all other things being equal? A. Yes. 2. Is gas of a high illuminating power the best for balloons? A. The lightest gas is the best, hence that having the best illuminating qualities is by no means the best for a balloon. 3. How can I determine the weight which a balloon of a given size will ascend with when filled with coal gas? A. See p. 64, vol. 32.

(24) L. B. S. asks: How can I make a small battery for plating and other purposes? A. Put a copper plate in a glass vessel 8 inches deep, and cover it with crystals of sulphate of copper. Suspend a piece of zinc near the top. Connect insulated copper wire to copper plate and another to zinc. Fill the vessel with water.

(25) I. O. T. asks: 1. Please give me a rule for finding how much and what size of wire I must use on relays, in putting up a short or long telegraphic line. A. Use the purest copper obtainable, and make the sum of the resistances of all the relays equal to the resistance of the rest of the circuit, including that of the battery; this gives the best result when the line is well insulated. There is no simple formula for fixing upon the size of wire that would serve for any and every case whatever; but for local and short circuits, Nos. 18 to 23 are convenient sizes, and Nos. 28 to 32 are generally used for main lines. A current of 0·02 of a weber is a very fair working strength for main line circuits. All the necessary data for ascertaining the resistance of the various sizes of copper and iron wire will be found in J. T. Sprague's work on "Electricity, its Theory, Sources, and Applications," under "Conductivity and Resistance." 2. I have been making an induction coil, 7x3 inches, center bundle of wires is 1 inch in diameter; primary coil is of No. 14 wire, about 90 feet long; sec-

ondary coil is of No. 36 silk covered wire, 5,000 feet of it being used. I can detect a very slight residue of magnetism in the iron wires when the current is not passing; should this be? The shock is far from strong. What is wrong? What ought I to expect from such a coil if I add 5,000 feet more to the secondary coil, and a good condenser? A. It would be difficult to tell exactly what is wrong with your coil without inspecting it; properly constructed, however, one of that size should give a very severe shock. From ¾ to 1 inch per mile of secondary wire is a fair average for ordinary coils, but this varies with the manner of winding and the degree of insulation. 3. My condenser is made of tissue tinfoil and paper of a thickness of 400 leaves to the inch; it is made like an interleaved book. It contains 45 square feet, and is well connected with the primary coil: but I get no additional effect. What is wrong? A. Your condenser is properly made, and should add materially to the effect if rightly connected to the primary circuit. Sprague's book, above referred to, gives much useful information in regard to the construction of coils.

(26) L. W. asks: Which is the best book on qualitative analysis? A. Fresenius is a standard work on the subject.

(27) F. B. asks: How can I make a silver bath, for electro-plating? A. Dissolve 123 ozs. cyanide of potassium in 100 gallons of water; get one or two flat porous vessels, and place them in this solution to within half an inch of the mouth, and fill them to the same hight with the solution; in these porous vessels place small plates or sheets of iron or copper, and connect them with the zinc terminal of a battery; in the large solution place a sheet of silver connected with the copper terminal of the battery. This arrangement being made at night, and the power employed being two of Bunsen's batteries or four Daniell's, the solution will be ready for use in the morning. A small quantity of solution for silvering may be made up from this description. A half ounce of silver to the gallon will do very well. A small quantity may be prepared in an hour.

(28) A. A. H. asks: 1. How can I plate silver without a battery? A. For silver plating on copper, use nitrate of silver and common salt, each 20 grains; cream of tartar, 3½ drachms. Mix. Moisten with cold water and rub on the article to be plated. 2. Can I make a solution by cutting silver in acid? A. Silver dissolves in dilute nitric acid.

(29) N. S. W. asks: 1. What is the office of the core of wires in an induction coil, as shown in p. 115, vol. 33? A. The object of the core of iron wires is to increase the inductive effect. 2. Where is the connection with the conductors? A. The primary wires are attached to the binding screws at the right of the instrument. 3. What is the necessity of insulated wire if the coil is divided by insulators? A. The wire must be insulated, otherwise the current would leap across from one turn to another. If you will read the article carefully, you will see the object of the secondary coil. 4. If a battery current is connected with the coil, what is the necessity of the current breaker? A. It is by alternately breaking and making contact with the battery that the secondary effects are produced. A constant current through the primary coil would produce no static effect upon the secondary. 5. If the copper wire be immersed in a solution of shellac, is that insulation sufficient for a coil? A. A shellac covering might answer, but silk would be better.

(30) F. C. says: How can I deodorize a swordfish's sword? A. Try washing it with a little benzole or carbolic acid.

(31) L. P. S. says: In your issue of August 28 (in answer to M. V. O., who asks: Does a fan blower require more power to drive it when the discharge pipe is open than when it is closed?) You answer: "The action is the same as in partially closing the discharge valve of a pump. If the same speed is maintained, the resistance is increased." This is contrary to experimental results. If M. V. O. will make his fan belt sufficiently slack to reduce the speed of his fan one quarter or one third, by slipping, when the valve is open, he will find, on shutting the value, the fan will immediately resume its full speed. This, I think, is due to the changing of the course of the air as it rushes through the fan, from a straightforward to a rotary motion, which takes considerable power; but when no air passes through the fan, that which is inclosed within it, after having received its initial momentum, keeps it up without any additional power except to overcome the friction on the inside of the air jacket. I have often tried this, and always found it to take more power when the blast is taken from the fan. A. We think you are quite right, when the gate is entirely closed. As to the effect when partially closed, we would like to hear from readers who have made experiments. We are glad you have called attention to the matter, for we always desire to give correct information, and in our answer to M. V. O. we had in mind the action of blowers producing positive blast.

(32) K. asks: Is there a more speedy method of reducing a leaf to its skeleton (without destroying the fiber) than by steeping in pure water for months: a method, by the way, tried by me without success? A. Steep the leaf in a little strong lime water for a short time; spraying the leaf with water will then remove all but the fibers.

(33) J. G. E. asks: Is there any way of making cloth impervious to dust? A. Cloths that have been rendered impervious to moisture are likewise impervious to dust. Pass the cloth through a weak solution of glue and alum; and after passing it between the rollers of an ordinary wringer to remove the superfluous moisture, dry it, first in the air and then in a warm room.

(34) V. L. C. asks: How can I make plaster casts for stereotyping, so that they will not crack when put into heated metal? A. After the plaster cast has hardened, it should be placed in a hot oven in order to drive off all the superfluous moisture. Plates prepared in this way do not crack.

(35) G. C. says: 1. My counter is badly corroded by the action of soda water, and fountains have to be tinned every 3 years. Is there any remedy for this common annoyance? A. You fail to state of what material your counter is composed. If of wood or marble, we would suggest the use of a glass plate. Porcelain or slate topped counters are best where there is a liability of their frequent contact with carbonic acid water. 2. Would a small quantity of soda put in the water before charging prevent the mischief? A. No.

(36) Z. asks: Please explain the electric action in the automatic railway signal in use upon the Boston and Albany Railways. A. The action is produced by the opening and closing of an electric circuit by the movements of the cars upon the rails, and causes the movement of an armature attached to an electromagnet, which strikes a bell.

(37) F. M. W. asks: What is the process for clarifying and purifying lard, grease, and tallow? A. They are subjected to the action of steam at a high pressure in large cylindrical iron vessels. The steam is made to enter the vessel from below in such a manner as to cause a constant agitation of the melted contents. The condensed steam, being heavier than the grease, falls to the bottom of the cylinder, carrying with it the greater part of the impurities, and is drawn off by suitable taps.

(38) W. H. B. says: In your last issue you recommend a correspondent to use iodine in olive oil to prevent the hair from falling out. Will it not discolor the hair and skin? A. Yes; but almost inappreciably, and for a short time only. The color is not permanent.

(39) J. T. asks: Is any portion of the human tooth ivory? A. No.

(40) G. W. S. asks: 1. What is soluble or water glass? A. Water glass is a variety of glass containing a large proportion of alkaline flux. It is quite soluble in boiling water. 2. Would it answer for making a smooth hard finish on wooden handles, and give a polished surface? A. Water glass might answer the purpose; but it is an efflorrescent substance, and would finally become converted into a white powder, if exposed to the air.

What is put in glue size to give it body? A. A little flour and litharge are sometimes used.

(41) C. A. B. asks: What can soft sandstone be saturated with to make it impervious (or nearly so) to water? Coal tar would do but for the color. A. A solution of alum, glue, and litharge has been used for this purpose.

(42) S. A. T. asks: What will prevent the beard from splitting, so that it will grow long? A. Clip the ends frequently.

What makes Limburger cheese have such a very strong and offensive odor? A. It's putrescence.

(43) L. I. asks: Please give me an analysis of crude petroleum. A. Crude petroleum varies in density from 0·820 to 0·782, or 40° Baumé to 48° Baumé. It is a mixture of a great number of hydrocarbons, compounds of carbon and hydrogen, the average proportion of the two elements being: Carbon 85, hydrogen 15. These hydrocarbons differ from each other in volatility. Some are so volatile as to evaporate rapidly at ordinary temperatures, others require a temperature of 700° to 800° Fah. to vaporize them.

(44) G. B. asks: What is a good alloy, resembling silver in weight and appearance? A. Try the following: Tin 4½ lbs., bismuth, antimony, and lead, each ½ lb.

(45) C. H. S. asks: How can I cover twine thread, etc., with metallic lead, so that on bending it will keep its shape? A. The process employed in manufacturing long lengths of lead pipe might advantageously be used for this purpose. In this the lead, in a molten condition, is forced by hydraulic pressure through a die, through the center of which a steel mandril, of the required size for the bore, passes. By a little alteration of the mechanism you might substitute twine or thread for the mandril, and decrease the size of the die.

(46) F. C. W. says: G. G. F. can remove glossy spots in black goods by rubbing them with a piece of cloth.

(47) M. W. W. says, in reply to numerous queries as to the size of axle spindles: The almost universal testimony is in favor, within certain ranges, of the large spindles, especially in common freight and farm wagons. This may not arise from the difference in the spindles, and probably does not, but from other causes. In practice, the small sized spindles are usually solid iron, and the spindles are turned, and the boxes bored to fit. The larger spindle is about twice the diameter for the same grade of wagon, that is, a 1½ inch solid iron spindle corresponds to a 3 inch thimble skein, as it is termed, which is usually a cast iron thimble fitted on to a wooden axle, not turned and with the boxes not turned, the fit being much looser than in the case of the solid iron spindle. This may have some effect, but I think the real cause is the greater stability of the wooden axle, retaining its set without springing, generally as long as it lasts; while it is probably rare to find solid iron axles that are not more or less sprung, when of course they run hard. This seems still more reasonable when it is considered that solid iron spindles (when the load is carried on springs, thus reducing the liability to spring the axle) seldom give any trouble. There is also some difference in weight in favor of the wooden axle, though hardly enough to justify the decided preference manifested for it.

(48) E. D. R. says, in answer to J. A. B., who asks if there is a seed called bird pepper: The pods thus called are the capsules and seeds of *capsicum annuum*, or cayenne pepper, and can be procured in almost any drug store under the name of bird pepper; mocking birds are extremely fond of them when fresh, and eat of them freely, hence the vulgar name. The best are the African bird peppers, and are the same as used for making pepper sauce.

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

D. D. W.—No gold or silver is present. There is a trace of arsenic. The specimen is shale inclosing a yellow powder consisting principally of silica, iron, lime, alumina, and potash.—M. C. S.—It is smoky quartz, of little or no value.—C. C. P.—It is marcasite.—W. W. J.—It is a variety of soft white clay.—A. J. H.—Your specimens have not been received. Forward other specimens, and we will examine them.—R. L.'s specimen has not been received.—No name.—A fine specimen of variegated red jasper or shale.

COMMUNICATIONS RECEIVED.

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

On Squaring the Circle. By E. C.
On Rapid Transit. By J. H. McH.
On the Extraction of Gold from Ores. By J. T.
On the Weather. By W. B.

Also inquiries and answers from the following:
A. A. A.—L. H. D.—W. M. R.—J. D. D.—J. J. M.—R. K.—A. G.—F. J. S.—G. B.—G. W.—F. K.—C. D.—F. D. C.—W. M. T.—A. T.—R. B.—E. B. B.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of inquiries analogous to the following are sent: "Who sells an efficient rice-hulling machine? Whose is the best firebrick press? Whose is the best dog power, for churning and other light work? Whose is the best rack press for expressing seed oil?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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DESIGNS PATENTED.

8,583.—INKSTAND.—B. Brower, New York city.
8,584.—SILK FABRIC.—J. Colgnet, New York city.
8,585.—GLASS DISH.—G. E. Hatch, East Cambridge, Ms.
8,586 to 8,589.—CARPETS.—A. Heald, Philadelphia, Pa.
8,590.—CARPET.—W. Kerr, Philadelphia, Pa.
8,591.—BADGE.—J. S. Littell, Newark, N. J.
8,592.—CASSIMERES.—W. B. Weeden, Providence, R. I.
8,593.—FLAG.—J. C. Deming, Norfolk, Va.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA
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5,123.—H. S. Pomeroy, New Haven, Conn., U. S. Automatic lid prop. Sept. 4, 1875.
5,124.—W. E. Andrew, New York city, U. S. Separating oleomargarin and stearin from fat. Sept. 4, 1875.
5,125.—A. W. Richards, Indianola, Iowa, U. S. Perambulating cot. Sept. 4, 1875.
5,126.—G. Campbell *et al.*, Toronto, Ont. Fireproof shutter. Sept. 4, 1875.
5,127.—A. Weir, Wellesley, Ont. Spinning wheel. Sept 4, 1875.
5,128.—G. S. Walker, Erie, Pa., U. S. Washing machine. Sept. 4, 1875.
5,129.—W. Ball, New Vienna, Ohio, U. S. Canal boat. Sept. 4, 1875.
5,130.—J. H. Myers, Montreal, P. Q. Shirt. Sept. 4, 1875.
5,131.—J. Buechner, St. Paul, Minn., U. S. Picture exhibitor. Sept. 4, 1875.
5,132.—J. W. H. Doubler, Philadelphia, Pa., U. S. Mechanical motor. Sept. 4, 1874.
5,133.—O. Noack, Baltimore, Md., U. S. Crimping machine. Sept. 4, 1875.
5,134.—G. J. Shimer, Milton, Pa., U. S. Cutter head. Sept. 4, 1875.
5,135.—J. Armor, Hamilton City, Ont. Hose coupling. Sept. 4, 1875.
5,136.—G. H. Steadman, Hopwell Cape, N. B. Railway snow shoveller. Sept. 7, 1875.
5,137.—E. May, Montreal, P. Q. Elastic motor. Sept. 7, 1875.
5,138.—J. S. Wetherell, New Market, Ont. Combined luggage box. Sept. 7, 1875.
5,139.—G. R. Eager, Boston, Mass., U. S. Blouse, overall, or pantaloon garment. Sept. 7, 1875.
5,140.—C. J. Addy *et al.*, Boston, Mass., U. S. Sole edge trimming machine. Sept. 7, 1875.
5,141.—J. Dildine, Limestoneville, Pa., U. S. Animal trap. Sept. 7, 1875.
5,142.—S. Strunz, Pittsburgh, Pa., U. S. Soap. Sept. 7, 1875.
5,143.—J. Russell, New York city, U. S. Horse shoe machine. Sept. 7, 1875.
5,144.—P. K. Dealy, St. John, N. B. Locomotive ash pan cleaner and heater. Sept. 7, 1875.
5,145.—L. C. Whiting, East Saginaw, Mich., U. S. Pianoforte pedal attachment. Sept. 7, 1875.
5,146.—J. D. Smedley, Syracuse, N. Y., U. S. Chamber attachment to cooking stoves. Sept. 7, 1875.

Advertisements.

Back Page - - - - - - $1.00 a line.
Inside Page - - - - - - 75 cents a line.
Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Friday morning to appear in next issue.