SCIENTIFIC AMERICAN

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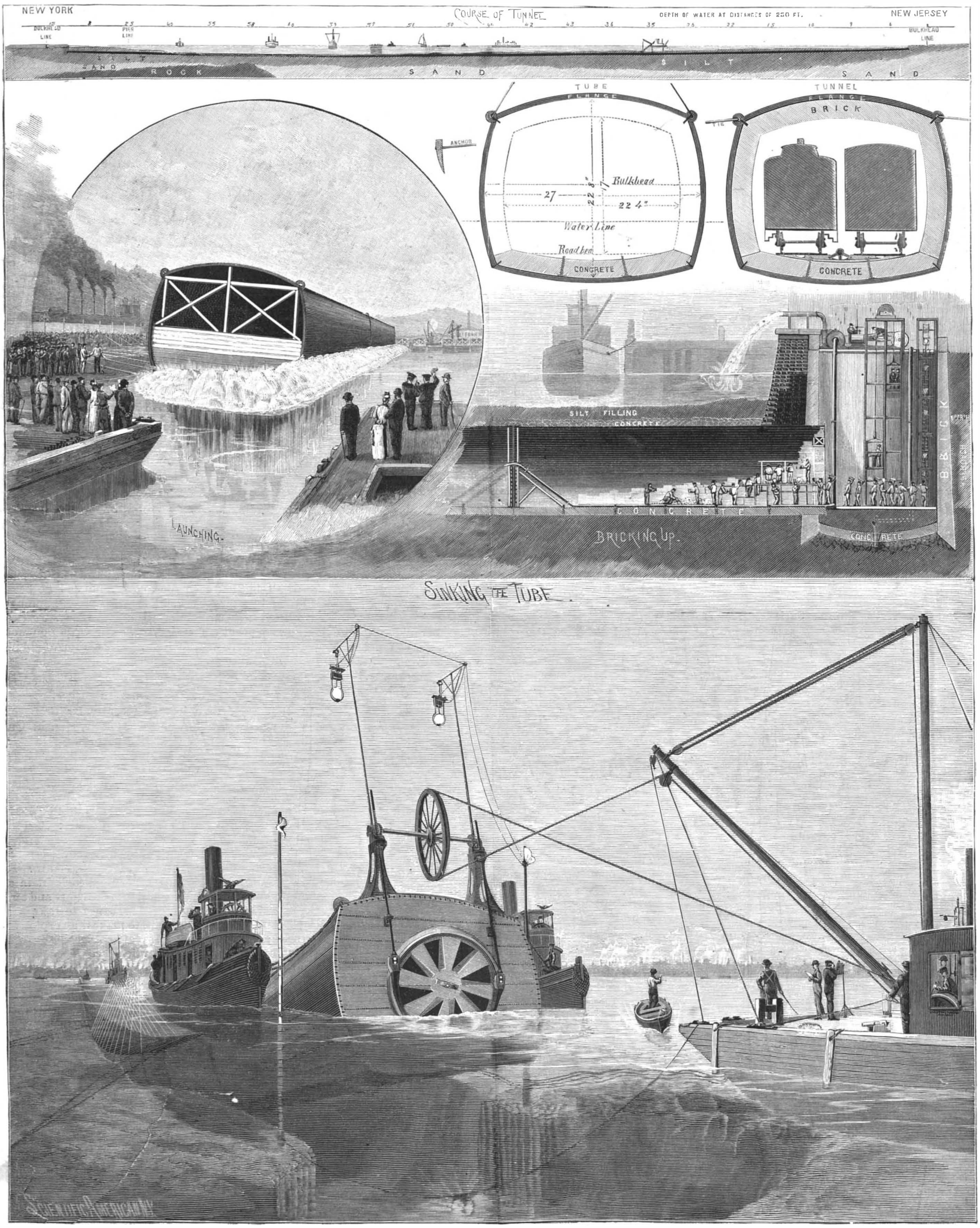
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXVI.—No. 4. Established 1845 | NEW YORK, JANUARY 23, 1892. | $3.00 A YEAR. WEEKLY.



A PROPOSED METHOD OF TUNNELING UNDER THE HUDSON RIVER.—[See page 53.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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One copy, one year, for the U. S., Canada or Mexico................$3 00
One copy, six months, for the U. S., Canada or Mexico............... 1 50
One copy, one year, to any foreign country belonging to Postal Union. 4 00

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NEW YORK, SATURDAY, JANUARY 23, 1892.

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(Illustrated articles are marked with an asterisk.)

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For the Week Ending January 23, 1892.

Price 10 cents. For sale by all newsdealers

IMPROVEMENTS NEEDED IN THE NEW NAVY.

It is probable that the United States Congress and administration have carried out recently no more popular movement than the creation of a new navy. The efforts of American engineers and inventors have alike contributed to the result seen in the production of our "white squadron." But a few weeks have passed since a further triumph for American skill was chronicled in the success of American armor plate when subjected to the competitive trial. The new navy is small but highly efficient, and is kept in constant service, thereby insuring its readiness for service when needed. A few years only are required to bring this country well to the front as a naval power. At the present day the efficiency in all senses of a single ship may outweigh the value of a number of slower and more vulnerable vessels of an older type.

While the navy is satisfactorily progressing, it has become very evident that the new type of fighting vessel requires a higher grade of skill on the part of the crew. The breech-loading guns served by electric or mechanical elevators, the rapid-fire guns, the machine guns with their breech mechanism, the perpetual change in the direction of improvement of charge, gun, carriage, and training mechanism exact more skill on the part of the actual manipulators of the pieces than was formerly looked for. The actual working of the ship, instead of depending upon the handling of her canvas under the control of a single officer, is a complicated affair. Even the stokers play an important part in the attainment of the highest speed, while in the engineering department each man has comparatively delicate interests intrusted to his care.

It is so throughout. The war ship is now a composite mechanism, under control of two great divisions, the captain's and the engineer's department; while in fighting, the gunnery department needs a distinct recognition.

The navy of to-day is unquestionably deficient in properly trained men. The traditions of an extinct phase of the service, that of sailing ships, pervade the new regime. The men who actually work and control the whole of the complicated mechanism are still considered subordinates, not only for the time, but forever. The road to promotion from the ranks to the grade of officer is so hard to travel that a sailor rarely graduates as an officer. The latter is generally a graduate of Annapolis, who has had but a slight experience of the work of the crew of a modern ship, but he is unhesitatingly put in command of these very elements, whose nature is known to him chiefly by tradition.

A feature of the new service as affecting the crew is the comparative idleness of their existence. The constant handling of the sails and overhauling of the rigging and attention to the multifarious work of the old sailing ship are no longer required. Idleness is unquestionably bad for the *morale* of any body of men. It is an evil which extends to the officers, but it has a cure within reach.

By legislation, the step from the ranks into the higher grades of service leading to the commander's higher ranks should be made not only possible, but should be encouraged. The inducement of certain promotion for merit should be held out to every recruit, and the service afloat should be organized to facilitate such advancement. Each ship should, in a certain sense, be made a school ship, where the men would acquire knowledge of steam and electrical engineering as well as of navigation, and the science of modern gunnery should be practiced and carefully studied. The carrying out of this plan, with designated examinations for promotion, and with mandatory laws to fulfill such ends, would revolutionize the service. The enlistment of native Americans would become no longer a rarity, and the old-time much-abused Jack Tar would become a relic of the past. The college-bred man would enter the ranks with every confidence that his past work would insure rapid advancement. The intelligent mechanic would find nothing too abstruse in problems of navigation for him to overcome, and his mechanical knowledge would be of the greatest value to the service as well as to himself, in securing his promotion.

The distinction between officer and man, the relation of subordinates to those commanding them, so necessary to organization, would not suffer. It is an old theory that to know how to command one must know how to obey. It is hard to believe that better material for war commanders could be found than in those who, by sheer industry and force of character, had worked their way up from the ranks.

The officers of a modern ship would be obliged to have more intimate relations with their crews in the way of organizing the statutory study and examinations which such a system would exact. They would be given far better material to command, and the presence in their ships of a progressive body of actual workers as crews would in every way prove a tonic for the entire service.

Our navy, as regards material, ships, armor and ordnance, to-day is in the first rank among nations. All that is now needed is more ships and proper crews. The ships are being rapidly built. Congress might supplement the work so well in progress by providing for the improvement of the status of recruits, and thereby securing intelligent and superior men for the naval service.

An Auger Patent Case.

In the Queen's Bench Division, recently, before Mr. Justice Mathew, sitting to take chancery business for Mr. Justice Stirling, the case of Whitehouse *vs.* W. Gilpin & Co. (limited), came on for hearing. Mr. Moulton said this was an action brought by Mr. Cornelius Whitehouse, Cannock, Staffordshire, against William Gilpin & Co. (limited), also of Cannock, for an infringement of a patent for making a certain kind of auger, known as the solid-winged double thread auger, an exceedingly effective tool, and one which was now very largely in demand. In 1868 Mr. Whitehouse invented an auger and took out a patent for it, proposing to make it by means of casting it very nearly in shape untwisted, and then finishing it by boring it, twisting it, casehardening, and finally sharpening it. But that manufacture was a total failure. The metal which could be got by casting was not hard enough for the purpose unless it was casehardened, and if it was casehardened it became too hard to bore or sharpen. Between these two difficulties the whole thing was a failure, and it never was put in the market. There was another way of making an auger which was also tried. The tool was made of steel, the wings were forged first, and open, and then they were bent down and welded to the edge of the thread. That plan was also a failure, and the tool was not placed in the market. In 1886 the plaintiff hit upon a totally different way of making this same auger, and this was the subject of this patent. He took a piece of tool steel and drew it into a blank with a lump of metal at the ends. He then stamped the steel, in its half finished form, between two dies; then the usual process of twisting was followed, and finally, after drilling, the polished auger was produced. A patent for this plan was taken out by the plaintiff in 1886, and so great was the success of the invention that in 1887 he sold in round numbers 14,000 augers; in 1888, 19,000; in 1889, 32,000; and in 1890, 37,000. In 1891, 28,000 were sold, but there had been a falling off, because, as plaintiff alleged, defendants, who used to buy augers of him, took to making them themselves, and undersold him in the market, thus causing him damage. Mr. Justice Mathew: What is the point here? Mr. Bousfield: We say this is an old process, which could not be patented. Mr. Justice Mathew: And I suppose Mr. Moulton says there is nothing to prevent what seems to be old from being new. Mr. Moulton: Yes; that is what I say. Mr. John Willcox, die manufacturer, said he had made the dies for plaintiff. In cross examination, he admitted that if he had never made a die of the description at all, but had seen the auger, and had he been told to make a die for a blank for that auger, he would have known what shape to make it. Mr. Justice Mathew said that ended the case. The invention was ingenious, but it was not new. The action would be dismissed with costs.

Explosions of Coal Dust in Mines.

In the course of a lecture recently by Professor Harold B. Dixon, at the Owens College, Manchester, on "Coal and Coal Mining," he directed attention to the evidence which has been accumulated regarding the action of finely divided coal dust either in promoting or aggravating the intensity of explosions produced by fire, or, on the other hand, by igniting itself, and causing an explosion in mines. He said the question which was being considered was this: Is dust capable of creating a flame when it comes in contact with a large flame such as may be produced by a blown-out shot or by an explosion of gas and air? It was not supposed that an ordinary naked light in a mine would suffice for an explosion of coal dust and air. There must be first a great disturbance to raise the dust, and mingle it with the air, to make it an explosive mixture; and there must be a great heat locally applied to initiate the explosion. But when once this had been set up, a flame might extend so far as there was the coal dust lying on the floor or sides; and the damage done by it was comparable, at all events, with that caused by an explosion of fire-damp and air. This was a view frequently urged; and, in support of it, the lecturer tried a few experiments. He showed that fine dust falling on a flame will give off flame and sparks, and that when mixed with oxygen an intense flame is produced. The difficulty he added, was to obtain the requisite proportions of coal dust and air to make an explosive mixture.

The Keynote of an Auditorium.

In rooms of poor hearing qualities Dr. Ephraim Cutter says: Every hall or church has its keynote, and the audience will hear better if the speaker's voice is pitched and held to the keynote of the room. To find the key note, sing the natural scale slowly evenly, and smoothly, or play this scale on piano or organ. The which is most prominent is the keynote.

Scientific Digger Indian Surgery.

The poor Digger Indians, of California, are among the lowest tribes of America, who, prior to emigration there, in 1849, lived upon spontaneous production, such as they could kill with bow and arrow, and grasshoppers, which I have seen there, which they captured by hundreds of bushels at a single capture. During my travels there from saw mill to saw mill, when I fitted and inserted my saw teeth in circular saws at the mills, I met with gentlemen who related curious incidents of these Diggers, as they are called, and among them this exceedingly interesting and curious method they had of dealing with a compound fracture:

I was inserting teeth in a saw for a Mr. Wilcox, in a mining town then called Fiddletown, in Sierra County. Most of the yellow metal was obtained by running tunnels under a steep bluff and washing it in a brook. At the head of the town was their saw mill, and about five or six miles from there was an Indian *campudia* (a camp), where several hundreds of these diggers lived.

A saw mill, to them, was a great curiosity then, and nearly every day some of this tribe would visit this mill.

One day, about twenty of them were there, and, it being chilly, most of them stood in front of the fire under the double flue boiler, when a very sad accident occurred, by the collapse of the flues, scalding Mr. Hoxey, one of the owners, so that the poor man died about four days after the accident, and it burned several of the Indians, and blew one poor old *mohalie* (squaw) some twenty feet into an old miner's prospect hole, and broke one of her legs below the knee, it being what surgeons call a compound fracture. The Diggers shouldered her, and went to their *campudia*, the only physician there being kept to take care of poor Mr. Hoxey. About four days after the misfortune several hundred Diggers appeared on the high bluff overlooking the town, with bows and arrows and in war paint. Soon down came a tall chief, who walked up in front of the small hotel, and said: "*Whar saw mill men?*" Some men at the hotel pointed to Mr. Wilcox, then coming over a small bridge. The chief walked up to him, saying: "You saw mill man?" Mr. Wilcox said: "Yes." "Well, Indian came down to see saw mill, do no hurt, then white men shoot off saw mill, burn Indian, break *mohalie* leg; Indian want to fight saw mill men."

Mr. Wilcox was puzzled to know just what to do; but there was a gentleman in town who had been an Indian agent, and they sent to him, who came at once. The agent asked how Mr. Hoxey was, and was told that he was very low and not expected to live through the day.

So they went to the sufferer's room with the Indian chief, and showed the poor man's wounds, and explained, in Indian language: "*No intendi acidenti.*" When the old chief replied: "Me safe. No fite all wano." Which is: "I understand it was not intended; it was accidental; we don't fight." And the Indians soon disappeared.

Now comes the interesting and scientific part of this story. In a day or so after Mr. Hoxey's burial, the surgeon went to the *campudia*, and there sat the poor broken-legged *mohalie*. The physician told me that the Diggers measured around the leg in several places, then cut a piece out of a slippery elm tree, near the size and shape of the leg, took the bark off, shaved off the outside, and made as fine a splint as he ever saw, and fitted it around the broken limb, leaving the space open about one-quarter of an inch on the top, and were pouring in a little water to keep down the fever heat, and that in a few weeks the squaw was limping around town again. J. E. EMERSON.

A Wonderful Cave.

A cave was discovered a short time ago on White River, some thirty miles above Meeker, which seems to be as important a discovery of that kind as any ever made in Colorado. It was found by a prospector and hunter named Hooper, who reported it to the citizens of Meeker. But no one seemed particularly interested in the new find, as that portion of the country surrounding the headwaters of White River is full of curious things, and the settlers in that locality have become accustomed to them, and their curiosity is not easily aroused. Two gentlemen recently made an exploration of the cave, and found it located in a limestone formation and extending into the mountain for half a mile or more.

The opening has the appearance of a railroad tunnel, twelve or fourteen feet wide. The cave continues at this width for considerable distance, when it grows narrower, and in one or two instances the explorers were obliged to stoop in following the passage. The opening is about sixteen feet above the river, and has the form of an incline.

When the party had reach ... nce of a quarter
of a mile, the floor sloped ... wo hun-
dred or three hundred ...
abrupt drop. Rocks w...
ence of water asc...
was lowered, the ...
only twelve fe...
water was f...

The air was good, and they found that the passageway continued, and was followed some three hundred yards further, when another drop of seven or eight feet was encountered. Here was a dry, sandy bottom in this cave, and the passageway was found to continue still further, and was pursued thirty or forty yards further, when they came to what was apparently the end of the tunnel. A stream of water two feet or more in diameter was rushing out of the wall at one side, cutting across the foot of the breast of the passageway, and to all appearances was lost in the wall on the other side. The stream was swift and came out with great force, and, stranger yet, the water was quite hot, and when tasted was very much like the water found in the springs at Glenwood.

Where the water comes from and where it goes is a mystery that the explorers could not solve. Aside from the lime formation, the formation surrounding it is lava, and the supposition has been advanced that there is a crater in the vicinity filled up by crumbled walls of rock, which constantly discharges hot water, and during the course of ages has eaten its way down through a seam or crevice in the limestone to the river below. A few miles above Glenwood there are springs of a similar nature, which are situated almost in the bed of the Grand River. It is quite probable that further investigations will be made.—*Great Divide.*

Royal Society Medals.

The anniversary of the Royal Society, London, was lately celebrated with the usual *eclat.* The medal awards were as follows:

PROF. STANISLAO CANNIZZARO (COPLEY MEDAL).

Stanislao Cannizzaro, Senator of Italy, and Professor of Chemistry in the University of Rome, has rendered invaluable service to the philosophy of modern chemical science. The work of Avogadro, in 1811, and afterward that of Ampere, had already thrown much light on the relative weights of the molecules of elementary bodies, and on the proportion in which those weights enter into chemical combination. But it is to Cannizzaro that we owe the completion of what they had left unfinished. He pointed out the all-important difference, hitherto overlooked, between molecular and atomic weights, and showed (1) how the atomic weights of the elements contained in a volatile compound can be deduced from the molecular weights of such compounds; (2) how the atomic weights of the elements the vapor densities of whose compounds were unknown can be ascertained by help of their specific heats. By these investigations the series of atomic weights of the elements, the most important of all chemical constants, and the relation which these weights bear to the molecular weights of the elements, have been placed on the firm basis on which they have ever since rested. It is to Cannizzaro that science is indebted for this fundamental discovery, and it is this which it is proposed to recognize by the award of the Copley Medal.

PROF. CHARLES LAPWORTH, F.R.S. (ROYAL MEDAL).

Prof. Lapworth is the author of some of the most original and suggestive papers which have appeared in the geological literature of this country for the last twenty years. Special reference may be made to his researches ou graptolites, and to his patient investigation by these means of the exceedingly complicated structure of the Silurian uplands of the south of Scotland. He has been able not only to supply the key which has given the solution of the stratigraphical difficulties of that region, but also furnish theoretical geology with an array of new facts from which to philosophize as to the mechanism of mountain making. Of not less importance are his detailed studies of the structure of the Northwest Highlands, and his demonstration of the true order of stratigraphical sequence in that region of complex disturbance. As a stratigraphist he has attained the highest rank, and he has likewise made himself a chief paleontological authority on the structure and distribution of the Graptolitidæ. For some years past he has been engaged in a laborious study of the Silurian and Cambrian rocks of the middle of England, the detailed publication of which is awaited with much interest by geologists.

PROF. RUCKER, F.R.S. (ROYAL MEDAL).

In conjunction with Prof. Reinold, Prof. Rucker carried out an important series of researches (extending over ten years) on the electric resistance and other physical properties of liquid films, in the course of which the fact was established that the black part of a soap film in equilibrium has a uniform, or nearly uniform, thickness of 11 or 12 micromillimeters, and that there is an abrupt augmentation across its border to a thickness of about 30 or 40 micromillimeters in passing to the colored portions. This, considered in connection with the well-known sudden opening out of the little black areas in an ordinary soap bubble, proves a minimum of surface tension for some thickness between 10 and 50 micromillimeters, which in the ordinary soap bubble,
...odified by Reinold and Rucker's electric current, is
...ily balanced in virtue of the abrupt change of
...proposition of fundamental importance in
...eory, implying the existence of molecu-
...ss.

In theoretical calculations connected with the compounding of dynamos and motors to produce constant potential difference, constant current, or constant speed, electricians did not see their way to obtain results of a sufficiently simple character to be of use in practice, if they employed a function of the current which fairly represented the magnetism. They were, therefore, compelled to assume in such calculations that the magnetism was a linear function of the current, although it was well known that this was very far from being true when the current was large. Prof. Rucker, however, developed a simple method of attacking such problems, and showed how the magnetic saturation of the iron might be taken into account, and a comprehensive solution of the general problem of compounding dynamos and motors obtained in a workable form. Prof. Rucker's paper containing his investigation, and which will be found in the "Proceedings of the Physical Society," is a most valuable contribution to the theory of direct-current dynamos and motors.

Prof. Rucker has, with the co-operation of Prof. Thorpe, completed a magnetic survey of the British Isles (1884–89), which, independently of its great value in investigations of the distribution of the earth's magnetism, and the changes to which it is subject, is specially remarkable for the exhaustive discussion of the observations in reference to regions of local magnetic disturbance, and their relation to the geological constitution of the earth's crust in the neighborhood. Prof. Rucker has followed up this discussion by a paper on "The Relation between the Magnetic Permeability of Rocks and Regional Magnetic Disturbances," read before the Royal Society. The high estimate that has been formed of the value of this magnetic survey is perhaps most easily appreciated from the very large sums that the Government Grant Committee have recommended should be contributed to aid in the completion of this work of international importance.

PROF. VICTOR MEYER (DAVY MEDAL).

Prof. Victor Meyer, formerly the successor of Wohler at Gottingen, and who now occupies the chair of Bunsen at Heidelberg, is eminent as an original worker and discoverer in almost every branch of chemical science. His methods of determining the vapor densities of substances have been of the greatest service to chemists, not only as convenient and generally applicable modes of ascertaining atomic and molecular weights, but also as serving to throw light on the molecular constitution of elements and compounds under varying conditions of temperature and pressure. A striking example of the value of these methods is seen in their application by their author to the study of the molecular dissociation of the element iodine—one of the most masterly investigations of recent years, and which is universally recognized as of the very highest significance and importance. Not less noteworthy are Victor Meyer's services to organic chemistry. His work on the nitroso bodies, and his brilliant discovery of thiophene, the initial member of a class of substances hitherto unknown, his subsequent synthetical formation of it, and the remarkable series of researches on its derivatives, in part carried out with the aid of his pupils, stamp him as an investigator of exceptional power and distinction.

Cheap Shoes for Europe.

A prominent English manufacturer of boots and shoes arrived in New York recently, and the sole object of his trip is, he says, to learn how to make footwear more cheaply. "The English people are just beginning to admit that America can beat the world at making shoes," he continued, "and what with your high rate of wages and other heavy expenses, we wish to know how you can possibly do it." The solution of the problem is not difficult to find—machinery and harder and quicker work. The American workman is undoubtedly smarter than his English brother, and can turn out a great deal more work in a given time, and any one who has visited factories on both sides of the Atlantic will unhesitatingly confirm this statement. Then, the English manufacturer who buys American machinery is fond of hiring boys to run it, under the delusion that this is economy, in addition to which the English workmen are opposed to machinery, as they think that it means less employment for themselves. The American system is the system arrived at through evolution, and represents ideas, science, hard work, and never-ceasing enterprise, and it is plain that any country, in order to successfully compete with us, must adopt methods which have proved so entirely satisfactory.—*Boots and Shoes.*

FOR some years past foreign travel has been very large. The Secretary of the Treasury estimates that our people spend $60,000,000 in gold every year in foreign countries. Other good authority estimates the amount as high as $100,000,000. One hundred thousand people go to Europe annually, and spend $1,000 each on an average. The great World's Fair approaching will turn travel this way. A contemporary estimates that 100,000 Europeans will come here and spend $1,500 each of foreign gold.

History of the Electrical Utilization of Water Power.

The utilization of water power through the medium of electricity forms the subject matter of a patent granted in Italy, on the 30th day of June, 1866, to Felice Marco, of Florence. In the description accompanying the patent it is stated that "it is known that with a magneto-electric machine we can obtain electric currents of any desired strength. These are used for various purposes, but the movement of the shaft which carries the magnets is produced by steam, necessitating a cost of fuel. But if this machine is placed in a locality where the gratuitous mechanical force of water can be utilized, electricity is produced without cost by means of said machine. It can be conveyed by means of metal wires to points where it is needed for producing the electric light, and for operating electro-magnetic machines; these machines have up to the present time not been used, solely on account of the expense of the acids and metals required to produce the electric current, which far exceeds the cost of fuel used in steam engines. The application which I propose is to produce the electric light gratuitously and to permit the transportation of the mechanical force of waterfalls and streams of mountains and plains into a city by means of the magneto-electric machine. This is undoubtedly the most simple and rational solution of the problem of the production of electricity and of its application for the production of light, heat, and force."

It will be seen that Marco clearly foresaw what is *a fait accompli* to-day, and according to the decisions of the United States courts, his obtaining a patent was "a constructive reduction to practice of the method set forth in the patent, because he who makes the disclosure to the public in a patent benefits the public in this regard equally with him who makes the disclosure by actual reduction to practice."

The principle of the reversibility of dynamo-electric machines was practically demonstrated at the Vienna Universal Exposition of 1873. A Gramme machine used as a motor to work a pump was run by the current produced by a similar machine connected by cable conductors, and put in motion by a gas engine. This was an illustration of the electrical transmission of mechanical energy to a distance; but, obviously, fuel was required to operate the prime motor. It does not appear that Gramme or Fontaine was aware at that time of the published descriptions of Bessolo in 1855, Cazal in 1864, and Marco in 1866, concerning the driving of magneto-electric machines by water power and the utilization of the currents produced for working distant electric motors. Whether the utilization of natural forces by Gramme machines is an invention or not, need not be considered in the historical treatment of the subject.

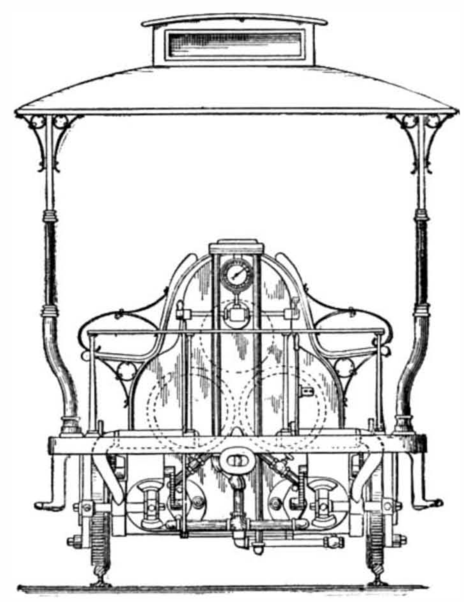
An Italian patent granted September 30, 1874, to Francesco Ferrara-Bracco, of Palermo, has for its subject matter the electrical utilization of water and other natural forces by means of Gramme dynamo machines. After describing the Vienna experiments, the patentee states that his invention consists in the electrical transmission of energy over long distances and the utilization of all kinds of natural forces. He specially describes the operation of a Gramme generator by means of the power derived from a waterfall and the conveyance of the electric current to distant points for operating other Gramme machines as motors. The description states that "to obtain a practical and useful application of the reversibility of the Gramme machine, it is necessary to dispense with combustibles. Natural forces, such as streams and torrents, can be electrically transmitted by means of the Gramme machine, and the current produced by the same subdivided, in large and small industrial establishments, for the production of motive power." It is also stated that "the electric current goes through wires suspended like telegraph wires, and is subdivided and transmitted to the Gramme machines (motors) in many ways."

A. M. TANNER.

THE cost of railroads in the United States has been nine billion dollars.

THE AMMONIA MOTOR.

There has been operated for some time past, in an experimental way, on a section of street railway on the Exposition grounds, between Fifty-seventh and Sixty-seventh Streets, Chicago, a fireless, steamless, and comparatively noiseless motor, designed to supersede horse, electric, and cable cars, on street railways, while also being applicable for many other purposes. The accompanying illustrations afford a perspective and a sectional view of a motor car, to the propulsion of which this motive power is adapted, and a representative of the SCIENTIFIC AMERICAN recently rode on the car to observe its practical operation. The car is being run daily, as an object lesson which attracts a good deal of public interest, and its working seems to be very satisfactory. The preliminary demonstrations or tests are being made primarily for determining its utility for passenger service on the Exposition grounds during the World's Fair, and also for general street railway service.



AMMONIA MOTOR CAR—SECTIONAL VIEW.

Anhydrous ammonia affords the power in this new motor. Ammonia gas, as is well known, condenses to a liquid at a temperature of 38½° F. below zero, or it may be condensed to a liquid by a pressure of 150 to 185 lb. at a temperature of about 70° F. On the removal of the pressure, allowing full expansion of the gas, a reduction of temperature is obtained corresponding to that which would have been required to liquefy the ammonia without pressure, and it is this fact which is taken advantage of in the operation of all the ammonia ice and refrigerating machines.

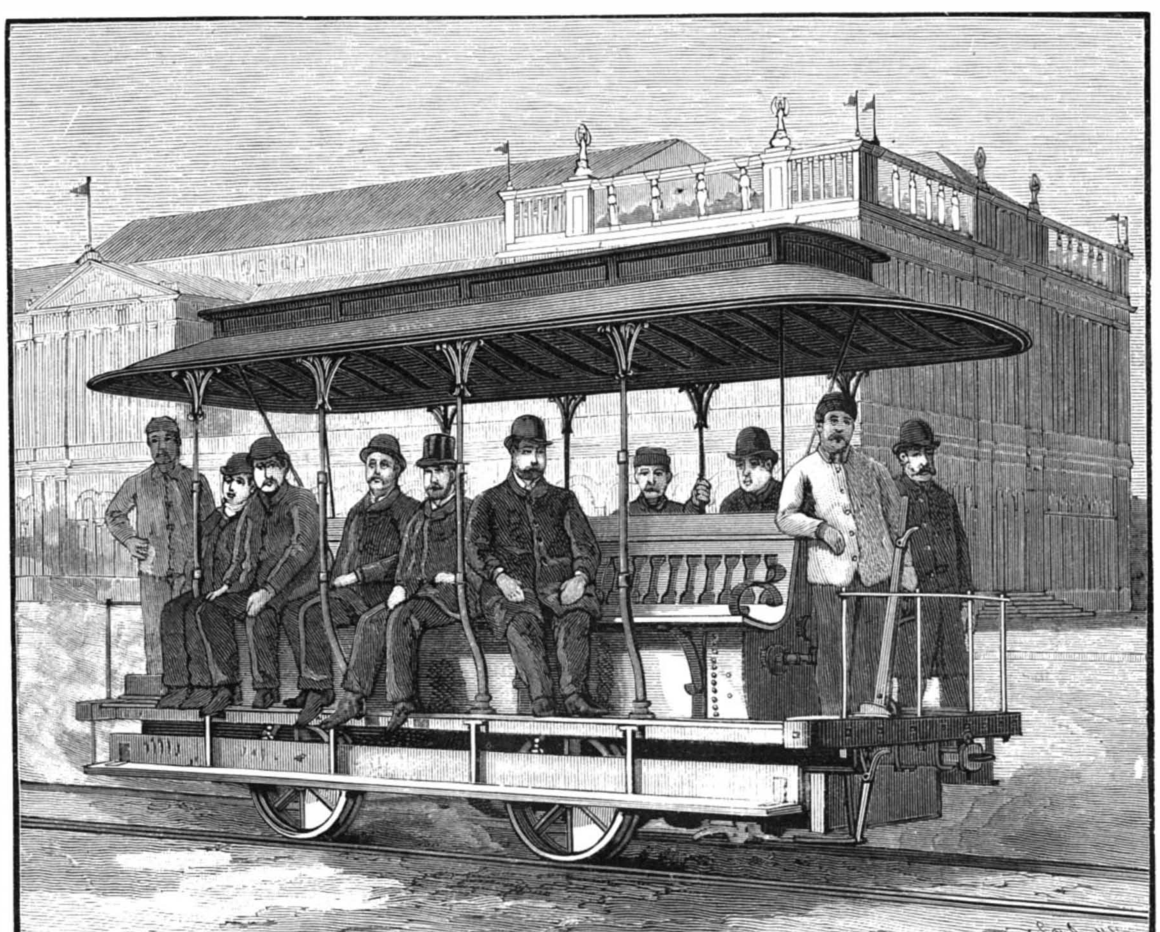
In this motor, the pressure of the gas from the surface of the liquefied ammonia, as it is evaporat... made to move the piston of the engine, the... the gas being regulated by an ordinary t... This operation, under ordinary condit... duce great cold, but in the constr...ment of the several parts of the engine, this is provided for. A sheet iron cylinder or tank, provided with tubes like a locomotive boiler, is incased in a larger and somewhat longer cylinder, with plenty of space between the two cylinders for the reception of water or a weak solution of ammonia, which can freely circulate around the tubes and all around the inner cylinder. When the inner cylinder is two-thirds filled with liquid anhydrous ammonia, and the temperature of the water, ammonia, and all, is 80° F., the ammonia will boil, and will exert a pressure of 147½ lb. to the square inch, to be used against the piston of the engine. The working cylinder is inclosed in a water-tight jacket, in communication with the large outer absorption tank, so that the exhaust gas, on each stroke of the piston, is taken up by the water, which has great affinity for the ammonia gas. As the water in the outer tank absorbs the exhaust gas, the latent heat of the gas is given out, thus increasing its temperature, but most of this increase is transmitted through the metallic surfaces of the tubes to the anhydrous ammonia, and thus keeps up the evaporation of the gas.

At starting, the pressure may fall to 130 lb., but, after running some time, it will go up to 160 or 170 lb., showing that there was an actual gain of heat. The liquid anhydrous ammonia used has, however, passed from the central tank as a gas, in which form it has exerted its pressure upon the piston, being taken up, as exhausted, by the water in the outer tank, the capacity of water to take up ammonia gas being seven hundred times its own volume.

When the quantity of ammonia in the central tank is so reduced as no longer to give sufficient pressure, the motor is run into the generating station, when the solution of ammonia is withdrawn from the outer tank, and the inner tank is again charged with the liquid anhydrous ammonia. The amount of each charge is designed to be sufficient to enable the car ordinarily to run eighteen miles. At the station the gas is separated from the solution by heat, passing thence to a condenser, when it is reduced to a liquid before passing to supply the tank. The same ammonia is used over and over again, and the working of the apparatus is simple and continuous. The charging and discharging is accomplished in about two minutes, and the motor will hold the charge for any length of time, as there is no leakage, and the pressure does not become reduced.

The manner of ascertaining the cost of running this motor is simple. The fuel consumed at the stationary plant for separating a given quantity of anhydrous ammonia is carefully weighed. Then a certain quantity of the ammonia is charged into the motor and the distance made ascertained. On the test with the plant while pumping and blowing, under conditions of actual practice and during extremely cold weather, 1·2 lb. of coal produced one gallon of anhydrous ammonia, and in running the five-ton motor at the rate of fifteen miles per hour, five gallons of ammonia was evaporated per mile run. The coal cost, delivered at the works, $6 per ton of 2,000 lb., which equals 3⅓ lb. for one cent. The five gallons of anhydrous ammonia, requiring only 6 lb. of coal to produce, thus costs only 1·8 cents, and furnishes the power for a mile run of the motor.

This motor is the invention of P. J. McMahon, of Louisiana, who was formerly chief engineer of a United States naval vessel. A company has been formed to manufacture motors of this kind for the various purposes for which they may be adapted. The offices of the company are at room No. 433 Manhattan Building, Chicago.



THE WORLD'S FAIR—AMMONIA MOTOR CAR NOW RUNNING.

Columbian Exhibitions in Spain.

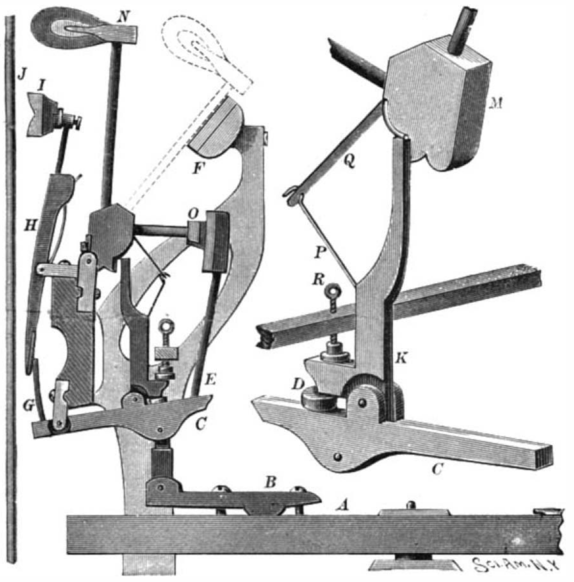
The Spanish government is to give two exhibitions in September, 1892, in celebration of the fourth centenary of the discovery of America by Columbus. One of these will be held at Huelva ... Exposition Historique Euro... held at Madrid. It will ...s, etc., illustrating the ...eoples at the time ...be an interesting ...World.

Inductive Lights.

At the meeting of the American Institute of Electrical Engineers Mr. Tesla employed a machine having 400 poles, which, when run at full speed, enabled him to obtain 20,000 alternations per second. He believes that electro-magnetic waves cannot produce luminous effects unless they have the frequency of true light waves; but this is not the case with electro-static waves or thrusts, as these can excite luminous radiation, no matter what their frequency may be. He made many experiments with Geissler tubes, and also with lamps, in which only one terminal was used. The filament consisted of a single rod which was in a non-striking vacuum. The energy was transferred entirely by condenser action through the coatings in the base of the lamp. He also showed how exhausted tubes could be made to glow in an electro-static field, so that if such tubes were merely hung up in a room in which such a field was produced, they would be lighted up, and could be moved about at will. These experiments created the most intense interest, and point to methods of producing light which may be used in the future.

AN IMPROVED PIANO ACTION.

The illustration represents an action in which the usual spiral spring employed beneath the fly is dispensed with, while the fly is held at all times in position to quickly engage with the hammer butt, thus making the action a very fine repeating one. An improved bridle connection is also provided between the butt and the fly, and the whip is made from one piece of moulding. The improvement has been patented by Mr. Henry Bescher, Jr., No. 228 Suydam Street, Brooklyn, N. Y. To the key, A, pivoted on the base of the instrument frame, is bolted a jack, B, which is pivotally connected by a link with the whip, C, having ears on its upper face, while forward of the ears is a cushion, D, and a rod, E, extending from the upper surface of the whip, holds in position a check. The whip near



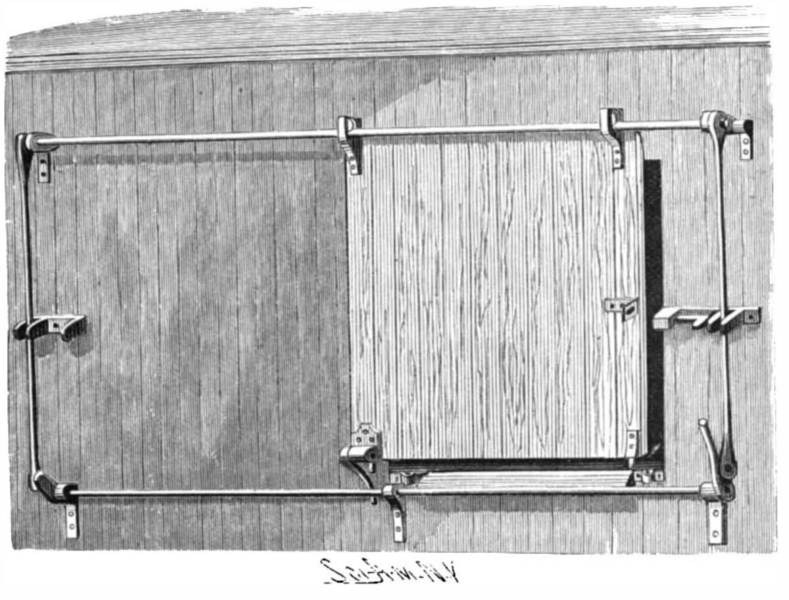
BESCHER'S PIANO ACTION.

its other end is fulcrumed upon an extension of the main action rail, attached to brackets, at the other end of which the hammer rest, F, is secured. The end of the whip has a pin, G, engaging the cushioned lower surface of the damper lever, H, which is spring-pressed and fulcrumed in the usual way on the main action rail, the damper, I, being of any approved form for engagement with the string, J. The lower end of the fly, K, pivoted between the ears of the whip, has a forward extension to engage with the cushion, D, and its upper end is curved to engage with the butt, M, of the hammer, N, the hammer butt having the usual catcher, O, to engage with the check. The bridle connection between the hammer butt and fly consists of a spring hook, P, and a strap, Q. The release of the fly is regulated by a set screw, R, in the regulating rail. With this construction the complicated bridle strap and bridle connection ordinarily employed are dispensed with, and the butt may be readily and conveniently disengaged from the fly, or as speedily connected again with it.

THE first steamboat on Western waters, said the late Mr. J. B. H. Latrobe before the Maryland Historical Society, was the New Orleans, which was built at and started from Pittsburg, Pa., in September, 1811, and reached the city of New Orleans in October of the same year. This boat was built from the designs of Robert Fulton by Nicholas J. Roosevelt, who was associated in this enterprise with Fulton and Chancellor Livingston. The New Orleans was 116 feet long, 20 feet beam, and had an engine with a 34 inch cylinder. The second and third steamboats built for this service were the Vesuvius and the Ætna, and the fourth boat, the Buffalo, was built under the direction of Mr. B. H. Latrobe, Sr., the architect of the first capitol at Washington, who became interested with Fulton and Livingston in the navigation of Western waters about 1813.

AN IMPROVED FREIGHT CAR DOOR.

The illustration represents an improved car door, more especially designed for use on freight cars, which can be readily moved backward and forward to open and close the car. It has been patented by Mr. Andrew G. Gray, of No. 20 Orange Street, St. John, N. B., Canada. The door has at its upper end two hangers, in which are grooved pulleys traveling on a shaft secured at its ends to crank arms, held on short shafts turning in suitable bearings attached to the outside of the car. The crank arms are also pivotally connected by links with crank arms on a lower shaft turning in suitable bearings, one of the lower crank arms also having a handle to be taken hold of by the operator to swing the crank arms upward, the links then likewise operating the upper crank arms to swing outwardly the upper shaft, from which the pulleys support the car door, which is thus disengaged from the door opening, as shown in the illustration. From a pin near one corner of the door at the bottom depends a curved arm, extending behind the bottom shaft, and adapted to prevent the swinging of the door too far out, or this may be effected by a pin on the arm passing in front of the car door, the arm being then hung higher up. Pins in the bottom of the door are adapted to engage apertures at the base of the door opening to hold the door closed, in connection with a suitable catch at the side. The vertical links move in keepers, and the keepers are also provided with stops to limit the movement of the door. When the upper shaft is in the outermost position, as shown, the door may be readily moved to one side, and, when moved back in front of the opening, it is swung down and inward to close the door by simply turning down the lower crank-arm handle.



GRAY'S CAR DOOR.

The Senate Chamber New Decorations.

The *Carpet and Upholsterer's Record* reports the way a gushing correspondent describes the new decorations of the Senate chamber: "A carpet, which is a combination of terra cotta, old gold and crushed strawberry, beautiful to look at and soft under foot, has replaced the garish green affair which covered the floor in the last Congress. The niches above the galleries have been painted a delicate terra cotta to harmonize with the carpet. They now offer a better background to the busts within them. The diplomatic gallery no longer offends the eye with its bright blue upholstery, which has given way to a lining of a salmon tint, which is effective. The seats of the other galleries are now finished in gray. The mahogany desks of the senators contrast handsomely with the carpet and mural adornments."

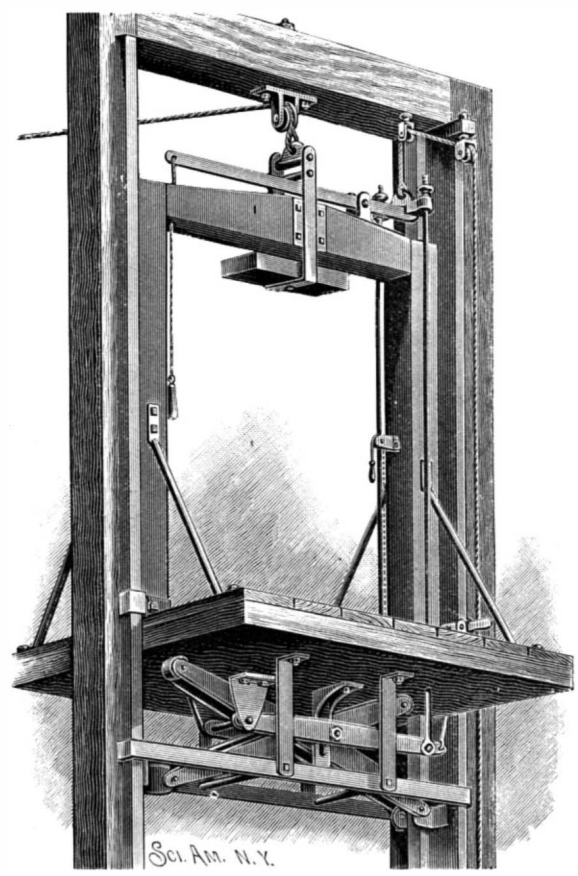
IMPROVED SAFETY DEVICES FOR ELEVATORS.

The elevator construction shown in the accompanying illustration forms the subject of a second patent issued to Mr. Philipp Schmidt, of La Crosse, Wis., and the elevator is thereby rendered safer and stronger, as well as more convenient to control. A heavy weight is suspended from the hoisting rope by means of two plates which loosely embrace the crossbar at the top of the elevator platform, so that a draught on the rope will first lift the weight to the lower side of the cross bar before the platform is raised, the plates having their upper ends spaced apart by two transverse bolts, to one of which the hoisting rope is attached. At the center below the platform is a bracket frame with two parallel depending limbs vertically slotted to receive a transverse bolt, which forms the fulcrum and connection of two composite locking bars, each consisting of two metal plates, spaced apart at one end by the pivot bolt of a loose anti-friction roller, and at the other end by a presser foot composed of two angle plates, held in position by transverse bolts or rivets. One member of each locking bar passes between the pair composing the other bar, and when they are pivoted upon the fulcrum bolt in the vertical slots of the depending bracket limbs, the rollers bear on the lower surface of the platform. The locking bars are sustained in position by two parallel bars, pivoted at one end of each to hanger brackets, and centrally connected with the locking bars by the fulcrum bolt, the opposite ends of the parallel bars being connected by a spacing bolt from which suspension rods extend upward through the platform and are connected to a transverse yoke resting upon a tripping lever pivoted upon the top cross bar. From the opposite end of the lever a pendent cord to which is attached a weight extends within the elevator frame, and the top edge of the lever is in contact with the lower transverse bolt connecting the plates by which the weight is hung from the hoisting rope, so that this weight will rock the lever and elevate the parallel bars at the ends where the two suspension rods are attached to the spacing bolt. The presser feet ends of the locking bars are heavy enough to cause their depression by gravity when the hoisting rope is drawn upon, the inclination of the bars removing the presser feet from contact with the surfaces of the side stanchions, whereon they bear strongly when the weight is in the position shown in the illustration.

Near the free end of one of the parallel bars is attached an upwardly extending link hooking fast to a brake lever pivoted on an arm on the edge of the platform, so that a depression of the end of the brake lever with the foot will vibrate the parallel bars and cause the locking bars to engage their presser feet with the side stanchions. Also attached to one of the parallel bars is a cord passing over a pulley in the elevator car, and by pulling on the cord the platform may be similarly stopped. Attached to the center of the yoke resting upon one end of the tripping lever is a rope extending over a sheave at the top of the elevator frame, thence over a pulley on a side stanchion, and downwardly, this rope affording means for arresting the platform from the exterior.

To strengthen and prevent the spreading of the side stanchions, side strips are oppositely affixed upon their inner faces, which afford locking ribs loosely engaged by the hooked ends of safety clamps, the clamps being normally free to slide on the ribs, but engaging them if the stanchions are inclined to spread apart. These safety clamps are supplemented by others hung from the platform by hanger bars, their ends having lateral hooks loosely bearing upon the outer edges of the ribs.

In operation, the breaking of the hoisting rope releases the weight held under the top cross bar of the elevator, when the tripping lever is vibrated and the locking bars are spread apart to engage with the stanchions. This improvement has been for some time in practical use, applied to an elevator in the inventor's factory at La Crosse, and not long since prevented what would otherwise doubtless have been a serious accident. Two pins broke in the upper wheels while a man with a heavy load was upon the platform, but the safety device prevented the falling of the car.



SCHMIDT'S IMPROVED ELEVATOR.

Correspondence.

The 100 Puzzle.

To the Editor of the Scientific American:

Here is another answer to the 100 puzzle, the solution of which was asked for in a recent issue.

In what way can the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 be arranged so when added together they will make 100?

Answer—

$$59\tfrac{1}{2}$$
$$40\tfrac{38}{76}$$

$$100$$

H.

Gilding for Small Gold Baths.

To the Editor of the Scientific American:

Dissolve 1 pennyweight of fine gold in 2 tablespoons of nitric-muriatic acid. After it is evaporated nearly dry add 1 quart of water, 8 pennyweights of cyanide potash, and 4 pennyweights of caustic alkali. Let the whole solution boil for about four to five minutes and filter it. This solution is now ready for use, and in order to gild, take a piece of zinc and place the things you want plated on the zinc and put it down in the bath, and in a few seconds you will have a color just as bright yellow as if it was solid gold pickled in acid. I have used this receipt for over eleven years, and I never found one equal, because it not alone is simple, but saves battery and is easy to follow. By adding blue vitriol and a little more cyanide potash, I used the same bath for red color, like polished solid gold.

Many people do not like the steam arising from the evaporation of the acid; but this can be avoided as follows:

Put your nitric-muriatic acid in a cup, together with the gold, and set it outside for about two hours, then the gold generally is dissolved. Add about 4 to 6 ounces of liquid ammonia and filter it. You will then find a yellow mass on your filtering paper, while the ammonia and the acid have gone down in your bottle below. After all the liquid has left the bulk, put the paper and all into the water and cyanide potash, as spoken of above. Boil it until the paper has gone to pieces, and filter. There is need in this process to be careful that all the acid and ammonia has left the gold, otherwise it will spoil the result, and for that reason it is better to let it stand in the funnel half an hour longer than necessary for filtering. AUG. LARSEN.

Syracuse, N. Y.

How to Succeed in Making Storage Batteries.

To the Editor of the Scientific American:

I see questions sometimes asked in your paper about storage batteries. One, in the issue of December 26, 1891, "Notes and Queries" (No. 3791), "M. P.," wants to know how the red lead of storage batteries is made to stay in its place until it can be formed. (I am using storage batteries to light my house. They have been in use two years. I made them myself, and have attended to them myself, and they are in excellent shape to-day. They are of the Julien pattern.) I can answer this question, I think, so that any one wishing to make anything in this line will have no very great trouble; any way, I do not have. And if you think it will be of any interest to the readers of the SCIENTIFIC AMERICAN, I am willing to give it. Fill the lead grids with a paste made of red lead and water, let them dry about 15 hours (or, more properly speaking, until they are almost dry, but not quite; the exact point can be determined with a little practice), then brush them over with a common paint brush, dipped in oil of vitriol, on one side only to begin with, and let them stand long enough to become perfectly cool, as the action will heat them a little. When cool, the same treatment can be applied to the other side, and if successful, they are or will be ready to put into the electrolyte, and be firm after 15 minutes, and the paste will not come out, but will be hard and nice. I have made a good many in this way. It is something of a fine point, where success is sure. If the acid is applied before the plates are dry enough, they will fry and become rough, and will be almost worthless. (The heat from the acid, combining with so much water, generates so much steam within the pores of the paste that its tenacity is destroyed.) If much acid be used, the plate will appear too dry at first; but in a few minutes will become soft from the acid absorbing atmospheric moisture, and take weeks to dry, and be worth very little then. If the plate will stand the acid treatment without frying, go ahead; if not, let them dry a little more. Better try a small part of the plate first, and see if it will stand it before going all over it; and be sure and not use too much acid, as too much is sure to spoil it. Only use just enough to act on the surface and turn it a little darker shade. Do not think you must put enough acid on to drive away every appearance of red lead, for this is not necessary.

If these directions are carefully carried out, you will be sure to have a plate (positive plate) filled with red lead that will stand with the best of them. I have undertaken to answer this one question in reference to storage batteries the best I can, using nothing but the plainest of language. NEWELL F. WIGHTMAN.

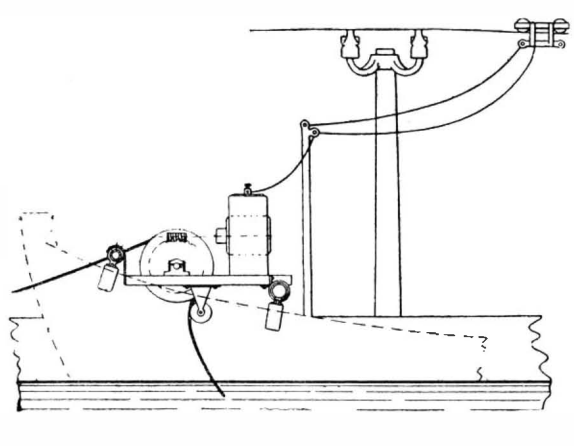
South Meriden, Conn., Dec. 28, 1891.

Flexible Glass.

Herr Eckstein, an Austrian engineer, claims to have discovered a strong and flexible substance, as transparent as the ordinary brittle glass. His process is as follows: From 4 to 8 parts collodion wool are dissolved in about 1 per cent in weight of ether or alcohol. This solution is intimately mixed with from 2 per cent to 4 per cent of castor oil or other non-resinous oil and from 4 per cent to 10 per cent of resin or Canada balsam. This mixture is spread on a glass plate and dried under the influence of a current of hot air of about 50° C., by which it is transformed in a comparatively short space of time into a transparent, hard, vitreous plate, the thickness of which can be regulated as desired. The material thus obtained is said to resist the action of salts, alkalies, and acids, and besides being transparent is odorless. It is flexible, and almost unbreakable. Its inflammability is much inferior to that of other collodion combinations, and it can be further reduced by the addition of magnesium chloride, while an admixture of zinc white produces an ivory appearance. Any color or shade may be imparted to the new glass.

TOWING CANAL BOATS BY ELECTRICITY.

The fact that a vast amount of freight is still transported by canal boats, and that these boats are still drawn by horses or mules, as in the days of Rameses or Tiglathpileser, lends especial interest to a recent invention of a German engineer, Mr. Otto Busser, which is well illustrated in the accompanying drawing. As will be seen, a stationary cable is laid at the bottom of the canal and is grasped by a set of sheaves on the deck of the boat, actuated by an electric motor. The current is supplied to the latter by means of trolley wires strung along the bank, the trolley making



contact on the upper side of the wires and being towed along by the flexible conductors.

A peculiar feature of this arrangement is that the whole installation is portable, and is readily fixed to the gunwales of the boat as it enters the canal, and removed at the further end. This is accomplished by fastening the motor upon a bed plate resting upon adjustable cross rods at whose ends are pivoted vertically clamps which fit over the gunwales and are firmly held by set screws.

What it Costs to Learn Engineering.

A correspondent asks the *Weekly Stationary Engineer* how much it will cost to learn engineering, and says he would like to learn the business. The question is a very hard one, indeed, to answer, for all men are not adapted to learning the business; for although it may appear easy to the observer, the practice of engineering means hard work, close attention, considerable bother, frequent discouragements, and a great deal of study, and at the last the business is not thoroughly learned, for life is too short for a man to learn all there is to be learned in practical steam engineering. A man or boy who has an aptitude for learning and a desire for the business can learn enough to make himself quite practical at it in a length of time depending on the attention he gives to the subject and his facilities for learning.

The principles of steam engineering do not include such a vast array of facts that it should deter any one from an effort to master them, but the degree of success with which they attain the knowledge depends a great deal on the way they go at it. The practical part of steam engineering must be learned in the engine room, and we do not know of any better method of obtaining a good practical knowledge of the business than by going to work in the fire room for a good engineer. Here a man or boy can make himself useful and note the operation of things, and will have a chance to learn the principles involved; but the practical knowledge of them can be obtained only through long practice with the apparatus. While in such a position, if the young man will procure some good work on steam engineering and study the principles from that, he will gain a better insight into the business in the same length of time than he would be able to obtain in any other manner that we are familiar with. The engine itself is generally the point of interest to the would-be engineer; but it by no means comprises all that is of interest or all that is necessary to be learned in order to be an engineer.

Most works on engineering give descriptions of different kinds of boilers, and the boiler is that part of the machinery that requires considerable attention and frequent investigation to know that it is in safe condition, and not only this, but a great deal of fuel can be wasted in producing the steam necessary for driving the machinery, and the engineer must reduce such waste to the lowest point. There are books on steam engineering that will show clearly the construction and operation of the different parts. When these are mastered, one essential part of the business is gained, and such knowledge will enable him to talk with some degree of satisfaction with those who are better posted on the subject, and in this way he will be able to pick up many valuable points in the business, as well as having his attention called to such points as he has overlooked. He will always find that there are a large number of these. If the student will refer to his books for the rules that apply to each part of the business that he becomes acquainted with, he will find his progress quite rapid, and it is usually considered that a good work on steam engineering is one of the best things that a young engineer can have in his possession, and the more frequent use he makes of it and the more attentively he studies what is laid down therein, the greater will be his progress in the business; but he must not consider that because he has an idea of practice he is capable of putting that idea into practice with the same success that he can after he has had a few opportunities to try his hand at it and learn those points that he has most certainly overlooked. The greater number of rules pertaining to steam engineering are commonly laid down in the shape of formulas, and for this reason the student in practical engineering must study his arithmetic pretty closely, if he has not already become proficient in figures, as he will find that those who are most capable in practical engineering are those who have the ability to figure out and calculate the different problems that may present themselves, and one or more is quite likely to come up in practice every day.

The practical part of steam engineering consists in taking care of the machinery and keeping it in the best of order, and not simply, as some suppose, starting and stopping the engine and keeping the water in the boiler at the right height; these things come in in the daily routine and form a part of the picnic. The care of the boiler is quite important; too much cannot be learned in regard to this piece of apparatus. Boilers differ greatly in type as well as in construction, and the man who keeps himself posted on the different styles, studying out their strong points as well as their weak ones, will be the better able to get the best results out of the apparatus he may have in charge, as well as being able to take hold of a new plant containing quite different apparatus.

The economical use of steam is of itself a problem requiring considerable study, attention and investigation, and from the fact that improvements are being made every day, it is reasonable to suppose that a person must keep studying in order to keep up with the times. If the student in practical engineering, when reading on such subjects, comes across something that he cannot understand, it should be sufficient to indicate to him that he does not possess sufficient knowledge of the subject to make these things comprehensible, and for this reason he should give greater study to that particular subject until it is thoroughly comprehended. The principles of engineering, as put down in the books, are for the purpose of assisting those who are struggling to acquire a knowledge of the subject, and it is not well to overlook or pass by any of these without making a strong effort to understand them. While the student is studying the subject, it will be well for him, if he can find the time and opportunity, to converse with engineers who are well posted; but he will find that his time is not put in to best advantage if he uses it in discussing such subjects with those who are no better posted than himself. The more opportunities a young man has for assisting the engineer about the work, making adjustments, lining shafting, doing such pipe work as he has to do about the boiler, grinding valves, and doing the work on the engine, the more he will be able to learn of such things, for such knowledge as this is gained only through the practice, and seems to be that part of the business that the majority of writers skip when making their books. A person that gives the subject sufficient attention and study will, in the course of a few months, be able to take a position as second engineer, but the greatest trouble with young engineers is that they are apt to consider their ability much greater than it really is, and this leads them to take hold of plants that they are not able to handle in a satisfactory manner. As to the cost of learning all of this, that depends more on the man than anything else, for it is not a question of money, only so far as the money serves to produce the books, etc., required to teach the principles. The principal part of it the man must learn by study and experience. It cannot be bought.

A METHOD OF TUNNELING.

BY HAROLD AVERY.

A method of constructing tunnels under rivers whose beds are of mud, clay, silt or sand is shown in the first page illustration. A sectional iron tube is sunk in a cut dredged for it, leveled, topped with clay or concrete in bags, the cut filled in and working shafts built around the ends. The tunnel tube is then pumped out and bricked up by sections, a roadbed made and junction effected with approaches, in detail as follows:

The course of the tunnel is determined by the contour of the river bed, and the curve is preferably a circular arc whose chord is the distance between the most favorably situated points for termini, and whose versed sine is the depth of water necessary to avoid interference with navigation. Upon the length and radius of this arc depends the number of sections that compose the tube, for sufficient flexibility must be secured to allow it to follow the curve. For this reason a circular is preferable to an elliptic arc, as it permits of uniformity in length of sections, and it may be advantageous to have the termini at different levels to use it.

The course is dredged deep enough to accommodate the tube and its topping, and where the depth of water permits, some of the excavated material may be used to form a bedding and surcharged bank with natural slope.

The cut is widened at the ends for shafts, and piles driven on the sides at the points where the ends of the tube are to rest.

The cross section of the tube is of such shape as to provide for the greatest useful space with least displacement, a quadrilateral bounded by arcs whose chords form a rectangle.

A flange at each end and angle, inwardly projecting studs from the bottom, and eyes at upper angles for anchor rods complete the iron work.

In the invert of each section a concrete bed is set, to give stability while floating and as a furtherance of the work. The studs hold this in position.

In each end a wooden bulkhead is built of sufficient height to retain a volume of water greater than the difference between the displacement of the section submerged and the displacement due to its weight.

Several sections may be built, bolted, and launched together.

After launching, the divisions are floated, end to end, and bolted together above the water line. A leaf dock is used to complete the work below. At each end of the tube an iron bulkhead fitted with a valve is built.

These valves control the submersion of the tube, and, with the sectional bulkheads, prevent strain from violent change of gravity.

When the tube is in position for submersion, the water admitted through the valve fills that section to the level of the top of the nearest bulkhead, then, flowing over into the next section, fills that in a like manner, repeating the process, the one end sinking and the other rising until its valve is above the water.

At this juncture the air is allowed to escape and the tube gradually sinks into place, its motion being regulated by the valve.

When in place both valves are opened. As the tube sinks, the anchors are joined to the tie rods and swung loose.

Where there is a current or tide, the buoyed ends of heavy ship's anchor cables are passed through a catch block, uniting the ends of a number of guys, and the slack taken up. Leveling, where necessary, is now effected by sand pumps, and the topping and side filling completed.

The top longitudinal flanges hold the clay or concrete topping, making it part of the tube.

A crib bulkhead filled with rock and clay is now built over each end of the tube and around the extended cut and pumped out, the water falling in the tube to the level of the top of the first wooden bulkhead.

The shaft is built, the iron head removed, the first section bricked up, the next section pumped out and bricked, and so on, progressing by sections from both ends until finished with a roadbed, rails, lights, etc.

The main operations of dredging, building the tube, and cutting approaches can be carried on simultaneously, thereby facilitating the completion of the tunnel.

An application of this method to a tunnel under the Hudson River, between New York and Jersey City, six hundred feet south of and nearly parallel with that under construction, is illustrated on the front page. A profile of the river bed at this line shows the depth at mean low water, the strata of the bed, the curve and length of tunnel, the pier and bulkhead lines, etc.

As the greatest depth is near the New York shore, the course is laid so that the roadbed will leave that side at a depth of 34 feet, sink to 60 feet, and rise toward the Jersey City end until it terminates at a point 26 feet below mean low water.

The curve is a circular arc of 86,000 feet radius and 5250·662 feet in length, embracing an angle of 3° 6′ 10″. The chord is 5,250 feet, vers. sin. 40 feet, and angular extension 1·585 seconds = 7·944 inches. Allowing a little less than one-eighth inch for extension of each tubular joint, we have 7·944 ÷ 0·115 = 69 = No. joints = 70 sections, and 5,250 ÷ 70 = 75 = length of section. The form adopted for a double track tunnel is a rectangle, 20 feet wide by 14 feet 7 inches high, bounded by arcs of 27 feet radius for top and sides and 42 feet 4 inches for invert.

Each section is built of wrought iron 1 inch in thickness; the plates 36 inches wide, 9 in arch, 7 in each side, and 9 in invert. There are four longitudinal flanges, 12 inches wide, one at each angle, a vertical flange at each end 6 inches wide, and studs 5 inches diameter and 30 inches long projecting inwardly from the bottom, ten in number and set in pairs, 15 feet apart.

Eyes are set at terminals of upper longitudinal flanges, into which are let ties to whose ends broad-faced anchors of narrow section are joined, when the completed tube sinks. The bed of concrete is then laid, the wooden bulkheads constructed, and the section is ready to join to the next. The form and dimensions of the tube may be explained by reference to the engraving and the following table:

Section.

Perimeter	1,029·122	inches.
Area vertical section	538·122	sq. ft.
" plane of flotation	1,950	" "
Displacement	13,713	cu. "
" submerged	40,359·159	
Draught	7	feet.

Weight in Position and Finished.

Iron	141·131	Total weight,
Concrete	250·68	1,400·211 tons.
Brick	603·9	Displacement,
Roadbed	4·5	1,156·371 tons.
Clay in bags	400	

This topping is held in place by the upper longitudinal flanges, and does not include the filling of silt. Concrete might be substituted.

In the view that shows the launching, two sections have been built and joined, and are being launched together. The method of construction and the bulkheads and draught, as well as their general relations, are here represented.

After launching, two divisions of two sections each are placed end to end and bolted together above the water line. A leaf dock accurately fitting the immersed part is employed to complete the junction. Two divisions of four sections each are then joined, then two of eight, and so on until the limit of length desirable for towing from place of construction is reached.

In the extreme ends iron bulkheads are built and fitted with radially apertured valves actuated by a rack and pinion movement. Set axially with the wheel that gears with the pinions is a large wheel operated by a rope passing through a snatch block on the end of a derrick boom (so as to keep an even tension at different levels) and around the drum of a hoisting engine. The action of this arrangement is shown in the engraving. The cut has been dredged and the guys anchored to counteract the swing of the tide. The valve on the New York end has been opened, the water has filled the greater part of the tube, flowing over bulkhead after bulkhead and gently submerging the tube until the operation is nearly complete. The anchors are being joined to the ties and the valve closed. The telephone and telegraph have kept those in charge at the opposite ends in constant communication, while the electric lights have enabled the greater part of the work to be done before the traffic of the day has commenced. When the tube is sunk, both valves are opened and the water allowed to fill the tube. Leveling is now attended to by sand pumps, clay or concrete two feet deep is thrown upon the top in bags and the filling finished after the tube has had time to settle firmly in position.

The sectional view of a terminus explains the position of the crib bulkhead, behind which the water has been pumped out to the first wooden bulkhead, a brick working shaft constructed, the iron head and valve removed and the process of completing the bricking up the first section begun. Radially pressed bricks allowed by arches of the same radius are used. The brick and concrete are 28 inches thick. The bricking is completed section by section as previously described.

The dimensions of this tunnel call for

Iron	10,600 tons	Total weight,
Concrete	18,750 "	104,650 tons.
Brick	45,300 "	" displacement,
Clay	30,000 "	86,728

Ballast per linear foot 3⅓ tons.

Among the advantages claimed for this method are the increased safety, rapidity, and simplicity of construction, the lessened cost of operation, applicability to nearly every place whose business warrants a tunnel, and adaptability to single or double track, trade or travel.

THE Whitinsville (Mass.) Machine Company have lately put into successful use a 100 horse power electrical locomotive, made by the Thomson-Houston Co. It takes the current from an overhead wire by trolley. The machine is used for drawing freight cars from the W. Co.'s works to the main line, 1¼ miles.

Ornamenting Fabrics and Garments.

The main object of this invention is to obtain, in a more economical manner than heretofore, the effect of embroidered appliqué, by means of the brush, and to insure advantages not hitherto secured in such ornamentation. In attaining this, a woolen or a silken fabric is taken, and stretched on a table, and the design is traced upon it which is to be applied in colors. Suppose a Japanese design is required, having, as a leading feature, a dragon, a ground color is applied within the outlines of the figure, of a tint somewhat darker than that of the fabric. The tint will consist of an aniline or other dye, brought to a suitable consistency to prevent its running when applied with a brush. When the tinted portion of the fabric is dry, it will be ready to receive the detailed markings, which are made in appropriate colors with oil paints, prepared as described below, so as to render the same flexible when dry. In some cases, bronze powders of various shades may be employed to heighten the effect; these are mixed with a medium that prevents them from tarnishing. The ornament thus produced may have any desired degree of artistic finish, the result being obtained without showing any indication of overweighted ornamentation, such as is observable in sacerdotal robes decorated with moulded patterns. In applying the invention to silk robes or curtains, the appliqué ground, by leaving unobscured the luster of the silk, presents a good contrast to the oil color, which represents the embroidery. In carrying out a floral decoration after the conventional type, the ground may be tinted for the leaves, buds, and flowers, according to the appropriate colors, taking care, however, to retain the style peculiar to embroidery, or brocade, and distinct from that of painting. By this mode of procedure, ornamentation is quickly produced, which will give less stiffness to a garment than embroidered appliqué would impart, and will have no tendency to crack or peel off; and, in preparing hangings in place of tapestry, artistic effects are produced in one-tenth of the time required for working tapestry. The proper thickening of the dye liquor used for the ground color is obtained by mixing a gelatinous compound, prepared in the manner described, and using it in about the following proportions: One quart of the dye liquor, brought to the required tint, and mixed therewith 1½ pints of a thick solution of gum ghatti, 1½ pints of a thick solution of Iceland moss, ¼ pint of liquid ox gall, and 1 ounce of glycerine. In case it is desired to store this mixture in stock bottles, to preserve the mixture from deterioration, ⅛ pint of methylated spirit and ¾ of an ounce of nitro-benzole are added. The softening of the oil colors for bringing out the details of the drawing is obtained by mixing with the colors on the palette a small proportion of a composition which is prepared as follows: To 1 ounce of hard German paraffin, melted with heat in 1 quart of spirits of turpentine, 2 ounces of terebine drier is added. The bronze powders are mixed with a medium composed of equal parts of copal varnish, crystal varnish, and turpentine, with the addition of terebine drier, equal in quantity to about one-twelfth of the mixed medium, sufficient to bring them to the consistency of oil paint, and thus the firm adhesion of the bronze powder to the fabric to be decorated is insured, and also the bronze powder is protected from the tarnishing action of the atmosphere. Decorations effected by the means above described will stand ordinary careful washing. The process is, therefore, applicable not merely to silks, but to linen and other washing materials.

Resorcin as a Dermatic.

Dr. A. Ravogli, of Cincinnati, says:

"I have found resorcin a valuable remedy in the treatment of skin diseases, either in children or in adults. In children those cases of eczema which were called *Melitagra fluorescens*, where the surface is covered with yellow, greasy crusts, a salve with resorcin has, in a few days, removed the eruption. I usually prescribe in these cases:

Resorcin	ʒ ss.
Salicylic acid	gr. vj.
Vaselin	℥ j.

Rub on twice a day.

"Not long ago I had several children living in the same neighborhood affected with *Impetigo contagiosa.* Several remedies had been prescribed by other physicians, but in spite of them the eruption was gaining larger proportions. I prescribed the same formula, raising the dose of resorcin to ʒ j in 1 ounce of vaselin. After a few applications the crusts came off, showing the pustules dry, and in a few days nothing remained but a red discoloration in the place of the pustules.

"In cases of *Seborrhea capitis* and *Seborrhea nasi*, the best results were obtained from this remedy. It dried up the greasy contents of the glands, which appear as dark points. The inflammation of the sebaceous glands subsides, and the redness which accompanies the seborrhea disappears.

"In cases of *Trichophyties*, the use of resorcin gave some improvement, but not fully satisfactory results.

"In cases of *Psoriasis*, resorcin did not prove so beneficial as pyrogallol, although resorcin has the advantage of *not staining* so much."—*Lancet-Clinic.*

Cleaning Rubber Blankets.

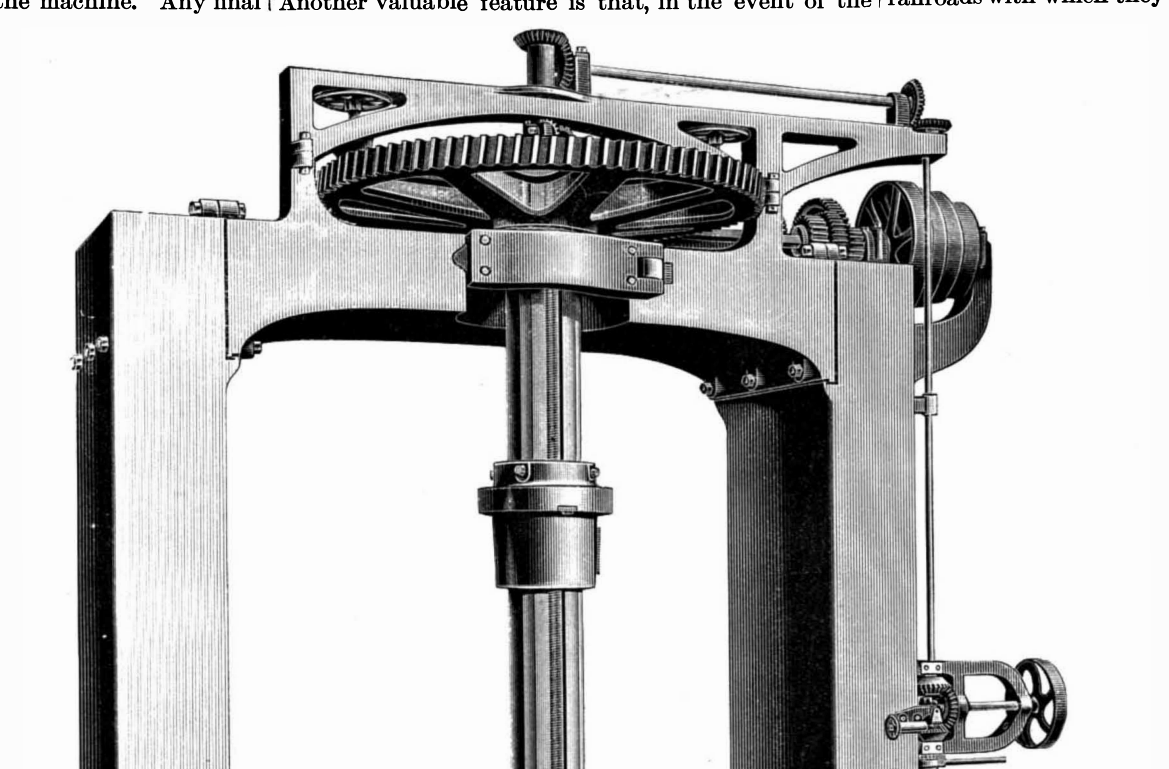
The use of turpentine for removing ink, fat, oil, and colors from the rubber blankets has spread of late to such an extent that a few remarks on the subject may not be amiss. As little turpentine as possible should be employed when its use seems advisable, and it is necessary to be careful that the cleaned blankets are thoroughly dry before they are used again. This is a very important point, as otherwise the surface of the rubber would be softened and the impression of the cylinder would spoil the blanket by cracking or corrugating the surface. The best way is to clean the blankets in the evening, after the day's work is over; this will allow plenty of time for the drying of the turpentine and the return of the blankets to their natural condition, which would not be the case if the cleaning were done during the day, when the blankets may be required any moment.

As a very effective substitute for turpentine, spirits of hartshorn is highly recommended. It cleans more quickly and thoroughly, and offers less danger of spoiling the blankets. The spirits of hartshorn should be diluted until it has a strength of about 6 or 9 degrees; it can easily be obtained of a strength of 18 degrees, and be diluted by adding one or two equal parts of water. After cleaning the blankets they should be dried with the use of pulverized magnesia or chalk. If treated in this way, the spirits of hartshorn dries very quick—much quicker than turpentine—and nothing prevents its use without the slightest danger of deterioration.—*Lithographic Art Jour.*

VERTICAL CYLINDER BORING MACHINE.

We illustrate a vertical cylinder boring machine made by Messrs. Thomas Shanks & Co., Union Iron Works, Johnstone. *Engineering* says: We believe it is the largest machine of this class ever made; it has three interchangeable boring bars of 18 in., 12 in., and 10 in. in diameter respectively. The width of framing for the work is over 13 ft., and the height 12½ ft. The traveling table for holding the work is 8 ft. wide and 14 ft. long. It will be seen from the illustration that no head room is required for lifting the boring bar to clear the work, because when the table is traversed to the front the crane can drop the cylinder upon it clear of the machine. The boring bar, with the worm wheel attached to it, is then placed inside the cylinder, and both are traversed back into position on the machine. Any final adjustment which may be required is then performed. No alteration of the upper structure with regard to the feed is required, as the connection is at once made when the bar is fixed. Any feed and any driving power is obtained by a simple change, not occupying more than a minute of time, and the boring blocks can be elevated or lowered quickly by power through friction clutches or slowly by hand; the attendant having full control from the work table, whether the bar is rotating or is at rest.

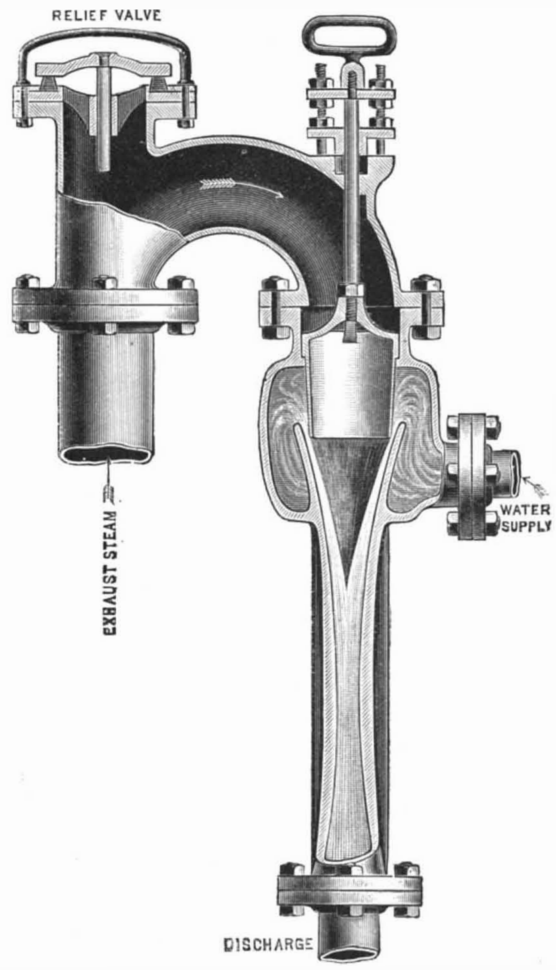
The changes of gear allow of work to be bored varying from 11 in. in diameter up to 130 in. in diameter, while the surfacing range extends to 144 in. in diameter. The illustration shows only a conical socket with heavy collar fitted on four scraped surfaces upon the bar, and kept tight by gun metal wedge strips, but the machine is fitted with a complete series of boring blocks, each bored to fit the taper socket, and with four tool holders arranged to vary the diameter of cut up to 12 in. These blocks are further fitted with two interchangeable surfacing compound slide rests, which are readily detached after the cylinder is faced and recessed. The weight of the machine with the 18 in. bar is 52 tons. The two interchangeable smaller bars weigh 8 tons, the boring and surfacing apparatus weigh 10 tons, so that the complete weight of the machine is 70 tons.



LARGE VERTICAL CYLINDER BORING MACHINE.

IMPROVED SIPHON CONDENSER.

The cut herewith represents the latest and most improved form of siphon condensers, and is manufactured



SIPHON CONDENSER.

by the Chicago Water Jacket Condenser Co., 47 W. Washington Street, Chicago.

The novel features are the water jacket that entirely surrounds the condensing chamber with a current of cold water, and the adjustable nozzle, whereby the amount of water admitted can be closely regulated. Another valuable feature is that, in the event of the annular water passage becoming clogged, it can be promptly flushed out without any stoppage or disconnection. A vacuum of 24 to 28 inches is attained, and is produced by the weight of the column of condensing water itself, no air pump being necessary. The apparatus is extremely simple and durable, and the vacuum obtained is the very highest.

Deep Water to Duluth.

Briefly stated, the object of the deep waterways convention, which met in Detroit recently, was to secure a channel with a uniform depth of not less than twenty feet of water all the way from Duluth to Buffalo. This is the first thing demanded by the already immense and rapidly increasing commerce of the lakes. It can be secured by dredging out about half a dozen shallow spots between the links of the magnificent chain of lakes which form a magnificent highway along our northern frontier, and the cost would not be excessive—between three and four million dollars is the estimate. Next, the sentiment of the convention was in favor of "a waterway of sufficient capacity to allow the free passage of vessels drawing twenty feet of water, through our own territory, from the great lakes to the Atlantic Ocean;" and it requested Congress to authorize the Secretary of War to have surveys and estimates made for such a canal. No particular route was specified, but the limitation of the work to "our own territory" cuts out the St. Lawrence route and makes it necessary for the canal to run from either Buffalo or Oswego to the Hudson River, entering that stream at Albany —a route which has been under consideration for some time.

If the proposition be carried out in its grand entirety, an immense amount of grain will be loaded on vessels at Duluth, Superior, and Chicago, and be water-borne directly to Europe, or else to New York and Atlantic ports, without touching any of the railroads which would bring it to Philadelphia, while corresponding amount of imports for the West would be carried back over the same cheap and convenient route. It looks as if the proposed waterway would "side-track" this city more than any other enterprise has done since the Erie Canal was built, and while this city would not seek to hinder such a great national improvement on that account, it naturally feels some apprehension over it. But perhaps the danger is more apparent than real. Canals do not always hurt the railroads with which they compete. The operations of the Erie Canal have not injured the business of the New York Central road, nor has the Susquehanna Canal, in our own State, proved a formidable rival to the Northern Central Railway. There is freight enough for both, and the canals take a great deal of bulky, unprofitable material which the railroads do not want if they can get anything better.—*Philadelphia Inquirer.*

PROFESSOR Pettenkofer, of Munich, has recently reported upon the contamination of the River Isar, into which the city of Munich drains. Munich has 280,000 inhabitants, and about 40,000 lb. weight of sewage are discharged into the river daily. Nevertheless, at Ismanig, three and a half miles below the sewer outfall, no trace of sewage could be found in the water by analysis. At the mouth of the sewer the bacteria numbered 198,000 per cubic centimeter; but at Ismanig this had been reduced to 15,230 and to 3,602 per cubic centimeter at Freisling, nineteen miles below. Professor Pettenkofer holds that there is no danger of sewage pollution in the river if the volume of sewage discharged does not exceed one-fifteenth the volume of the flow of the river, and if the sewage enters at a greater velocity, so as to prevent banking up.

THE longest mileage operated by a single system is that of the Union Pacific—10,928 miles.

THE WORLD'S FAIR FRANKLIN STATUE.

In a conspicuous positon, mounted on a pedestal before the south entrance of the Electrical Exhibits Building, at the Columbian Fair, will be the statue of Franklin shown in our illustration. The statue is 21 feet high, and is the work of Carl Rohl Smith, a Dane. Representing Franklin, as it does, actually conducting the lightning to the earth in his well known experiment with the kite in Philadelphia, there could not well be found a subject more strikingly appropriate for the place it is to occupy, in front of the spacious edifice to be devoted to the display of electrical appliances.

The names of forty-one eminent electricians now dead will be placed over the entrance to Electricity Building, as follows: Franklin, Galvani, Ampere, Faraday, Ohm, Sturgeon, Morse, Siemens, Davy, Volta, Henry, Oersted, Coulomb, Ronald, Page, Weber, Gilbert, Davenport, Soemmering, Don Silva, Arago, Damill, Jacobi, Wheatstone, Gauss, Vail, Bain, De la Rive, Joule, Saussure, Cooke, Varley, Steinheil, Guericke, La Place, Channing, Priestley, Maxwell, Coxe, Thales, and Cavendish.

THE WORLD'S FAIR—FRANKLIN STATUE IN FRONT OF THE ELECTRICAL BUILDING.

Revival of Sailing Ships.

A marked revival in the use and construction of sailing vessels is now in progress both in this country and abroad, the distinctive characteristics of the new vessels being great size and use of steel. In Great Britain the sailing ship Maria Rickmers, which was recently launched by Messrs. Russell & Co., Port Glasgow, is, by 14 feet, the largest sailing ship in the world. Besides having five masts, she is provided with auxiliary steam power, which will enable her to make progress, even when there is not sufficient wind to fill her vast sails. The vessel has been built for Messrs. Rickmers, of Bremen, and is of steel. Her dimensions are: Length 375 feet, breadth 48 feet, depth 28 feet 4½ inches. Her tonnage is 3,813 tons gross, and she will carry 5,700 tons deadweight on Lloyd's freeboard. She will be supplied by Messrs. Kincaid & Co., Greenock, with triple expansion engines of 650 indicated horse power, with 160 pounds working pressure, cylinders to be of 16 inches, 26 inches, and 42 inches by 27 inches stroke. The propeller will be of "Bevis" patent feathering type, and it is calculated that a speed of from six to seven knots an hour will be attained in calm weather with the vessel fully loaded. Her spread of canvas will be enormous. The vessel will have several special features of construction to distinguish her from the ordinary type of first-class sailing ships. She will be fitted to carry a large quantity of water ballast in a suitably subdivided double bottom. For facilitating loading and discharge of cargo she will have three steam winches, steam donkey boiler, and steam windlass, besides a fan engine. She will be employed in the East India rice trade.

The Pass of Melfort, one of the newest type of sailing vessels, and intended for carrying chiefly large deadweight cargoes, was recently launched by the Fairfield Shipbuilding and Engineering Company for Messrs. Gibson & Clark, Glasgow. Her dimensions are: Between perpendiculars, 298 feet; beam, 44 feet; depth of hold, 24 feet 6 inches. She has four masts the entire length of steel. Her lower masts and top masts are in one, and topgallant and royal masts are steel, having a small pole about two feet long of wood on top. The jigger or fourth mast is a pole mast entirely of steel, with a jackstay riveted on back so as to run the gaff up and down on the mast. All the yards are of steel except the royal yards, which with the spanker boom are the only parts constructed of wood. The bowsprit and jibboom are in one, also built of steel. Wherever steel could be employed it has been used to replace wood. The deck from stem to stern is of steel, sheathed with wood; the topgallant rail is of steel—the very hatch beams and fore and afters are all of steel. On the forecastle the old catheads are no longer in use, but a crane and a novel method of shipping and letting go the anchors has been substituted. The rigging is all set up with screws—even the fore and aft stays are set up with screws—so that if in the working of the vessel there is any slacking of the wire rigging, it can be instantly tightened up by the crew. The old fashioned ratlines of ropes on the shrouds have given place to round iron bars. The vessel has double topgallant yards, and the patent halyard winches of Messrs. Shaw & Hastie are applied to the topsail yards, so that the sails on these can be rapidly set in about a seventh of the time that it would take under the old method. The Pass of Melfort is 2,355 tons gross, and carries for her net register 2,195 tons, an exceptionally large cargo, having upward of 3,950 tons deadweight on board.

Occupation for Old People.

When people get old, the question as to what shall be their occupations may be more important than it has been at any previous period of their lives. They may only stay out their existence, with the consciousness that they are superannuated members of society, who have fallen out of the procession which is marching along with the progress of the world and have been left behind to die as beasts and some savage tribes of men abandon the exhausted of their members. Such old people, pitiable in their decay, may be sustained by appropriate regard, but they do not represent the true dignity of age. They have dropped behind when they might have gone ahead. They have accounted themselves supernumeraries in society when really they might be among its most important and useful factors, if they would only forget their age as measured by years alone. They have put themselves on the retired list when they are still fitted for active service. Their faculties fall into decay simply because they do not exercise them. No matter how young a man may be in years, he can produce for himself the same result in the same way. Physicians can report many cases wherein are manifested all the symptoms of age at the very beginning of manhood, and so also they can point out examples of physical and intellectual youth even at a period exceeding the psalmist's limit of life. Run through history yourself, and more especially the history of our own time, and you can make out a long list of men distinguished in statesmanship, science, literature and the church, whose intellectual prowess has been displayed up to fourscore years and beyond. They would not grow old; they would not allow themselves to be counted out of the world of thought and accomplishment. They remained in the competition to the last. Life was not mere animal existence for them after they had passed the limit where conventional age begins. Longevity did not bring rest, for they kept the intellectual machine bright with the friction of continued use. It simply gave them time to learn more and to do more with the advantage of a training and an experience so much prolonged. Consciousness of decay brings depression, but discovery of the ability for growth gives youthful exhilaration. Nothing is so delightful as finding out that the machine has not worn out after all, but is ready for use to good purpose even to the end. What men want in both youth and age is the recreation which is afforded by a keen interest in occupations that make them forget themselves. It prolongs their lives, for the foundation of youth is not exhausted. A variety of occupations furnishes far better recreation than the mere pursuit of pleasure for itself. Even a hobby serves the purpose more effectually than any direct chase of happiness, so elusive is the prize when you go hunting for it instead of waiting for it to come to you while you are seeking only to make the best use of your life.—*Chautauquan.*

A Permanent Magnetic Field.

At the meeting of the Physical Society, of London, on December 4, a paper was read on "A Permanent Magnetic Field," by Mr. W. Hibbert. The author had noticed the approximate constancy of an "aged" bar magnet, and he obtained still greater constancy by attaching pole pieces to a bar magnet of such a shape as to give a nearly closed circuit of small "magnetic resistance." The pattern now described consists of a steel rod 1 inch in diameter and about 2½ inches long, with a cast iron disk, 4 inches in diameter and five-eighths of an inch thick, fixed at one end. The other end is fitted in a hemispherical iron shell, which surrounds the bar and comes flush with the upper surface of the disk. An annular air space, less than one-sixteenth of an inch wide, is left between the cylindrical surface of the disk and the inside of the shell, and when the bar is magnetized a strong magnetic field exists in this space. To use this field for producing electro-magnetic impulses, a coil of wire is wound in a shallow groove on a brass tube, which can slide easily through the annular space, thus cutting all the lines. The tube is allowed to fall by its own weight, a neat trigger arrangement being provided for effecting its release.

The instrument exhibited had 90 turns of wire in the coil, and the total magnetic flux across the air space was about 30 C. G. S. lines. A large electro-magnetic impulse is therefore obtainable, even through resistances as great as 10,000 ohms. Tests of three instruments show that there has been practically no magnetic decay in seven months. The author, therefore, considers them satisfactory, and is prepared to supply them as magnetic standards. To facilitate calculation, the number of lines will be adjusted to a convenient number, say 20,000 or 25,000.

Several uses to which the instruments are well suited are mentioned in the paper, and a simple way of determing permeability by the magnetometer is described.

Aconite as an Antidote to Insect Venom.

A correspondent from Durango says that formerly about one-half of the children in the city died from the sting of the scorpion; but now nearly all the lives are saved, if taken in time, by the use of a strong tincture of aconite, of which five or six drops are put in a tumbler half full of water and a teaspoonful given at frequent intervals.—*Merck's Bulletin.*

Evolution in the Flower.*

The flower has a special importance to us in studying the life history of the plant. It is the indication of its endeavor to discharge the second of the duties of the organism, the preservation of the species or the propagation of the race. It consists of parts whose meaning is only evident when regarded from this point of view. On a stalk there are superposed successive whorls of modified leaves; a conspicuous outer ring, often composed of two sets of leaves, known as sepals and petals, and within this two other whorls, the stamens and pistil. Of these the stamens develop in their club-shaped heads, or anthers, a number of grains of various forms known as pollen, which give rise to what is the male element in reproduction. The pistil or collection of carpels develops the ovules, in which we have the female cell ultimately produced. The problem of reproduction involves the transference of pollen from stamen to carpel in an organism which itself is passive and motionless. The pollen must reach a particular portion of the carpel known as the stigma, which is usually its uppermost part, and here the changes leading to fertilization are initiated.

It has been found by Darwin and others in long-continued experiments that the best offspring is produced when pollen from one flower in applied to the stigma of another flower, either on the same plant or on another plant of the same species. This cross fertilization, as it is called, has given rise to various curious and interesting mechanisms to secure it.

The original flower was probably one of a very humble type, such a one indeed as we now find on our forest trees. It had no particular color and was not conspicuous among the foliage. It produced large quantities of pollen and was often provided only with stamens or with pistil.

It was fertilized by natural agencies, of which the wind was the most usual.

From such a type the various highly colored, scented, and curiously shaped flowers we now know have been developed.

In the order of such development the aid of the insect world has been prominent. To effect the change from wind fertilization to insect fertilization is the initial difficulty. That once effected, various modifications would soon ensue, and those that were advantageous to the plant would be preserved by natural selection.

Now, insects are largely feeders on pollen, and it is easy to see how the vast amount of pollen produced by such a flower would attract an insect to visit it. The successive visits of the insect to various flowers would result in the deposition of pollen from one on the stigmas of others, so that the first insect-fertilized or entomophilous flower would arise. It would be in character such as would be due to the influence of quite a short-lipped insect, with a feebly developed sense of color. We find instances of these still existing, quite simple in structure, wide open, regular in shape, and offering only pollen to the insect, and either white or yellow in color.

But many flowers offer another attraction than pollen, in the shape of honey. It is not uncommon to find honey secreted by other parts of the plant than the flower. If we suppose that this secretion of honey at some time came to be poured out on the flower, such a flower would have an increased attraction for an insect, and this property, possibly arising accidentally at first, would be perpetuated, and so the nectary come to be a regular part of the flower.

A further development would follow in the shape of various mechanisms for the shelter of the honey from rain, and so lead to its being hidden in tubes or spurs, and accessible only to particular insects.

This development, so briefly sketched out, has not proceeded along one line. Many visitors have been attracted by flowers, and each has led to particular modifications. I shall consider only two of these, the fly and the bee.

The fly is an insect of a low order of intelligence, shy and lazy. It is attracted both by pollen and by honey, and the structure of its mouth enables it to eat both of these.

Its peculiar characteristics have led to the development of flowers which secure it in a kind of prison and retain it for a few days, ultimately releasing it. Such are the flowers of Aristolochia and Arum. In both these the fly enters by pushing past a fringe of hairs, which are set at an angle inclined forward. The insect is by these prevented from going out. The stigmas of the flowers are ready to receive pollen on its entrance, and if it has emerged from another flower it is dusted with pollen, which, as it crawls over the stigmas, it leaves behind it. After a day or two the stigmas in the prison fade, and the anthers ripen and discharge their pollen, with which the visitor becomes coated. At this time the hairs wither and the fly is enabled to escape and to visit other flowers, where the same programme is repeated.

The low intelligence of the fly is taken advantage of by the so-called grass of Parnassus. In this a number of shining knobs are developed in part of the flower near the stamens, and from a distance these look as if coated with honey, and the fly, deceived thereby, visits flower after flower and effects fertilization.

A higher type of flower visited by flies is seen in Veronica, where honey is hidden in a small tube in the center of the flower. To reach it the fly is obliged to hold on by the stamens, and in so doing it dusts its body with pollen, which on a visit to another flower is deposited in the stigma, this being so placed as to touch the insect before the stamens do.

The conspicuousness, however, which first attracted the fly also attracted other insects, whose visits did not always lead to the desired end. Even highly organized flowers still suffer from this disadvantage. The flowers of the Columbine, Oxlip, and Bean are still visited by short-tongued bees, which cannot reach their honey in the legitimate fashion. These bite holes in the petals and steal it without benefiting the flower.

We have to look to this fact for the explanation of arrangements to protect the flower from these depredators. We have these seen best in the so-called bee flowers.

Bees, as a class of insects, are characterized by more intelligence and greater industry than flies. They have a higher color sense and a more complex mouth. With these endowments we co-relate the fact that, unlike flies, they store up food for their young. Some of the more interesting types of bee flower are seen in the Leguminosæ, where elaborate mechanisms lead to the dusting of the visitor with pollen on the part of his body to which the stigma of the next flower must be applied. In Lotus the pollen is forced out of the flower by a sort of piston, made of the dilated ends of some of the stamens. This is made to work by the weight of the bee when it alights upon the flower. In the Broom the same effect is secured by a sort of explosion, which takes place when the bee commences its search for the honey of the flower.

In the Violet a curious cup-like hinged projection has been developed, which opens as the tongue of the bee, coated with foreign pollen, passes down the tube of the flower, but closes and covers up the stigma, when it is withdrawn carrying pollen from the flower's own stamens.

In the Barberry and in the Cornflower the stamens have become endowed with a peculiar irritability, which subserves the same purpose of dusting the visitor with pollen.

In Salvia, the sage, a curious modification of part of the stamen into a lever leads to the pollen falling on to the back of the bee, where the stigma of the next flower visited finds it.

The various forms of orchids introduce us to still more elaborate mechanism, rendering fertilization without insect aid impossible.

The development of color in flowers and the explanation of the various markings on the petals must be studied also in connection with insect life.

Probably white and yellow flowers were the earliest, the first distinction being drawn thereby between flower and foliage. These were visited probably by lowly forms of insects, as they are to-day. When honey began to be secreted and hidden, more distinctiveness was needed, and the insects with a high color sense became the agents of further modification. The markings on the petals, usually straight lines or rows of dots, pointed the insect to the part where the treasure lay. So the development of blues and reds accompanied the evolution of the elaborate mechanisms already described.

Of lowly forms, with easily accessible honey, Muller has shown 60 per cent are visited by flies, as against 3 per cent by bees, while of reds and blues it can be noted that the reverse obtains. Flies visit yellow or white flowers more than twice as frequently as red or blue ones.

*Notes of a lecture delivered at an evening meeting of the Pharmaceutical Society, Wednesday, November 11, by Professor J. R. Green.—*The Pharmaceutical Journal* (London).

A New Puddling Furnace.

At a recent meeting of the Cleveland Institute of Engineers, Middlesbrough, Eng., the secretary read a paper by Mr. James Van Langer, of Leeds, "On the Pietzka Patent Puddling and Heating Furnace." The inventor of the furnace is Mr. Gottfried Pietzka, manager of the puddling and rolling mill departments at the Witkowitz Works, in Austria, where altogether about 10,000 men are employed. The novel features of the furnace are a reversible hearth, or rather a double hearth mounted on a platform turning on a hydraulic ram. The pig iron is charged on to one division of the hearth, and when melted the double hearth is raised about four meters by the hydraulic ram and turned right round, so that the other division of the hearth receives a fresh charge of pig iron, while that already melted in the first division is being puddled. The heating too is done by gas fuel instead of by coal as in the ordinary puddling furnace, a recuperator being erected in close contiguity to the furnace. At the Witkowitz Works the furnaces have been in operation for about twelve months, and the average saving there during the past half year has been 10s. per ton, the loss of iron also being 2 to 3 per cent less than in an ordinary furnace. Mr. Howson said they had heard of the flint age, the bronze age, and the iron age, but now they had got to the steel age, and Mr. Langer was wanting them to go back to the iron age. He feared it would be very costly in comparison with the ordinary puddling furnace. Mr. J. E. Stead said this was certainly the greatest advance toward economy, so far as gas producers were concerned, which he had seen, and that advance was produced by having the gas producers close to the puddling furnace. To his mind the furnace was a tremendous improvement on anything else they had seen, and if it did allow an economy of 60 per cent it was a very great advance indeed. In answer to questions by one or two gentlemen, Mr. Langer said there were more men to a furnace in Austria than in England, but the rate per ton was much about the same. The cost of the new furnace was about four times that of the old type, but the output was seven tons per day, as against two tons in the old furnace.

Sodium.

According to Rosenfeld, when sodium which has been kept under mineral oil and is covered with a crust is immersed in a mixture of petroleum three parts and amyl alcohol one part, or rubbed with a cloth soaked with this mixture, it acquires at once a silvery luster. If now it be put into petroleum containing 5 per cent amyl alcohol, then washed with pure petroleum and kept in petroleum containing one-half to one per cent of amyl alcohol, it preserves this luster for a long time; becoming covered very slowly, however, with a film of sodium-amyl oxide, which is easily removed with filter paper. Potassium and lithium can be purified similarly. Sodium thus cleaned combines at once with mercury, evolving light. By pressing clean sodium and potassium together, under a mixture of one part amyl alcohol and nine parts petroleum, the liquid alloy of these metals is easily obtained. By mixing one gramme of the clean sodium rubbed to a fine powder with three grammes of salt, with 0·7 gramme of sulphur, avoiding pressure, combination takes place with the evolution of light and sodium sulphide is formed. Selenium and tellurium behave similarly.—*Ber. Berl. Chem. Ges.; J. Chem. Soc.*

Slag Paint.

Among the papers presented at the recent Glen Summit meeting of the American Institute of Mining Engineers was one by Mr. A. Sahlin, of New York City, describing the utilization of puddle and reheating slags for paint stock. According to Mr. Sahlin, these slags are being used with much success, and command as high as $30 to $40 a ton for this purpose. The slag is ground down to an almost impalpable dust by means of a crusher and a disintegrating machine or pulverizer. Samples of the slags used at the works at Boonton, N. J., have shown the following chemical composition:

	Puddle slag.	Heating cinder.
FeO	52·430	71·290
Fe_2O_3	19·620	
MnO	6·410	0·210
CaO	0·810	—
Al_2O_3	0·380	7·780
SiO_2	16·390	20·060
P_2O_5	3·840	0·270
S		trace.

The cinder gives best results, but both the slags are said to make good paint stock. Mr. Sahlin described at length the machinery used, and stated that the dust produced is so fine that it cannot be measured by screens, and is good enough for any high grade paints. When mixed with linseed oil and ground on an ordinary burr mill it makes up into a dark olive-green color, so neutral in its tint that an addition of from 3 to 15 per cent of coloring matter will change it into a bright blue, yellow, drab, or glossy black. About 40 per cent of the slag is thus directly available. The remaining 60 per cent is collected in the settling chamber, ground to a fineness of about 225 mesh, and used for producing durable shades of dark red for railway and other purposes. The chemical reactions of the process were fully described by Mr. Sahlin, who wound up his paper by stating:

"The slag paints are remarkable for their durability, body, gloss, and covering capacity, and for the stubbornness with which they resist all chemical reaction. They are cheap in price and uniform in fineness as in composition. The raw material is available in great abundance and at a nominal cost; and, as their superiority and the simple methods of preparing them become better understood, there is no reason to doubt that they might be universally used, and might form a most valuable by-product of the iron industry."

A STRANGE death is reported from New Orleans. It is said that while playing a hose upon a fire a telephone wire and an electric light wire got crossed, the stream of water from the nozzle struck the wires, a heavy current followed down the water and killed the fireman who was holding the nozzle.

Results of Extirpation of the Liver.

In a preliminary note Dr. Von Meister confirms, from his own experimental observations, some of the results previously obtained by Ponfick of the remarkable degree of reparative power exhibited by the liver, and applicable, doubtless, to other glands in greater or less degree. Thus he finds that in the dog and cat, as well as in the rabbit, the removal of more than three-fourths of that organ is not followed by any serious consequences, and that within the space of thirty-six days repair has advanced to such an extent that the weight of the organ is regained. This regeneration is effected partly by hypertrophy of the hepatic cells, but mainly by their hyperplasia; but new lobules are not formed, and biliary ducts, as well as blood vessels, share in the new formation.

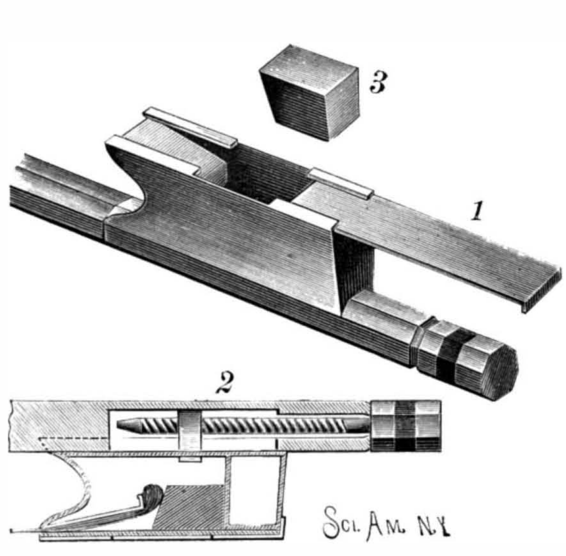
Observations were also made upon the effect of extirpation of such large portions of the liver upon the excretion of urea. It was found that the total quantity of nitrogen notably diminishes, but not in proportion to the nitrogen of the urea, so that the proportion of the latter to the whole nitrogenous excretion is decreased. On the other hand, the amount of extractive matters is increased, and their nitrogenous constituents appear in greater proportion than normal to the total nitrogen. The diminution in urea is proportionate to the amount of liver substance removed, total extirpation of the organ leading to a very marked decrease in urea. It was further found that after partial extirpation—within a period of from eleven to fifteen days—the quantity of urea rises until it once more attains the normal degree.—*Lancet.*

Magneto Heat Motor.

A curious scientific toy was recently exhibited at a meeting of the Royal Society in London. It is a heat engine, based upon the principle that nickel, magnetic at ordinary temperatures, promptly becomes non-magnetic at a temperature of 572° F. The construction of the engine is as follows: A disk of copper is suspended by two strings so that it can swing like a pendulum. Mounted on the copper disk is a magnet which holds up a piece of nickel. An alcohol lamp placed below the disk heats the nickel until it becomes demagnetized and drops away, when the copper pendulum makes an oscillation. During this oscillation the nickel cools sufficiently to regain its magnetic character and is caught up by the swinging magnet only to be passed again over the lamp, which causes it again to drop, and so on, the pendulum being thus kept in motion.

A BOW FOR STRINGED MUSICAL INSTRUMENTS.

The improvement represented in the accompanying illustration is designed to facilitate the ready insertion and secure fastening of the ends of the hair in the frog in rehairing the bows of violins, violas, violoncellos, bass viols, etc. It has been patented by Mr. William H. Ayres and Henry Schroeder. Fig. 1 is an inverted perspective view of the end of a bow provided with the improvement, with the hair removed and the cover partly open, and Fig. 2 is a side section, the hair being secured in place. The screw rod turning in the end of the staff engages a nut held on the frog, sliding as usual on the end of the staff. The frog is preferably of sheet metal, and into its under side projects a vertical



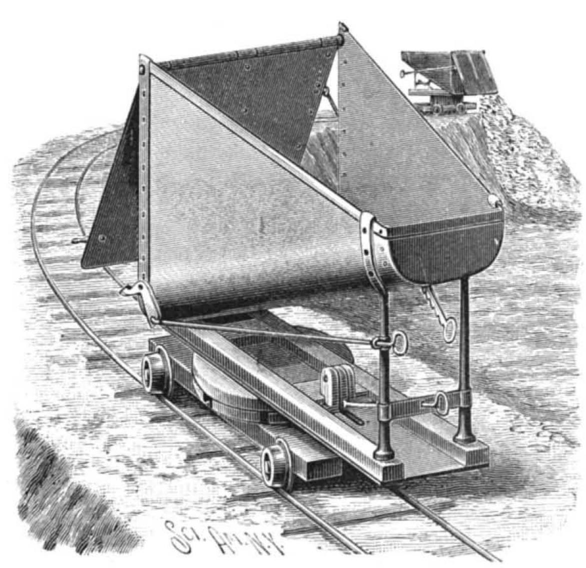
AYRES & SCHROEDER'S BOW FOR VIOLINS, ETC.

extension of the inclined bottom over which passes the hair, the ends of which are tied in the usual manner, and pressed securely in contact with the extension by a wedge-shaped block (Fig. 3), the rear end of the block abutting against a slightly inclined interior wall of the frog. The under side of the frog is closed by a longitudinally sliding cover, so that the block is held in place and the several parts are locked together.

Further information relative to this improvement may be obtained of Mr. W. H. Ayres, box 294, Madison Barracks, Sackett's Harbor, N. Y.

AN IMPROVED DUMPING CAR.

The car shown in the illustration is designed to be simple and durable in construction, and is arranged to dump automatically when the door is unlocked, discharging the load in any desired direction. It is the invention of Mr. P. Emerson Glafcke, of Sixteenth Street and Warren Avenue, Cheyenne, Wyoming. On the wheeled truck is a circular plate in which lies a friction plate, and upon the latter rests a turntable supporting a frame turning on a central pivot in the circular plate. This frame supports the car body,



GLAFCKE'S DUMPING CAR.

which widens toward the front and has a large open lower end, preventing the wedging of the load in the car. The large end is closed by a door hinged upon a rod at the top, and at one side of the door is a pin adapted to engage a notch in a pivoted latch, the rear end of the latch being pivotally connected with a rearwardly extending handle rod. To hold the door in open position, a rod pivoted to its other side has teeth adapted to engage a loop on the side of the car, whereby, when the door swings open, one of the teeth on the rod engages the loop to hold the door open, the end of the rod having also a handle, by pulling upon which the door is released and allowed to close automatically. In the frame carrying the car body is a vertically pivoted locking arm whose free end passes into a notch in the turntable and into one of a series of notches in the circular plate upon the truck, this arm being also connected with a rearwardly extending handle rod having a notch adapted to engage a transverse brace of the rear standard, to hold the rod in a locked position. Before the dumping of the load, if the car body is to be turned in any particular direction, the locking arm is disengaged by means of the handle rod, when the frame can be turned as desired to bring the front end of the car body to the point of dumping, and the locking arm is then engaged with a notch in the lower circular plate, holding the frame in locked position. The load is dumped automatically by the operator pulling the handle rod to disengage the catch by which the door is held closed, the pressure of the load on the door causing the latter to swing outward, when the load slides down the inclined bottom of the car body. A car of two tons capacity embodying these improvements has been in successful operation on the Comstock Lode, owned by the Silver Crown Milling, Mining and Smelting Company, for several months past, and it is said that the owners, engineers and miners all pronounce it superior to the old style, all the catches working by gravity, so that it can be operated by a boy, while it is said to cost no more than the common cars to build.

Progress of the Pan-American Railway.

The executive committee of the Inter-Continental Railway has recently been in session in Washington reviewing reports received from engineer officers and others concerning the project. The first surveying corps, under the leadership of Captain M. M. Macomb, of the Fourth United States Artillery, has surveyed three lines through Guatemala from the Mexican boundary to Guatemala City. The most popular route runs through the coffee country, the second follows the coast, and the third is across the highlands in the interior.

Wm. F. Shunk has charge of the second party, which left Quito, in Ecuador, last June, to survey northward. They had reached the city of Pappegan, at the head of the Cauco River, when last heard from, and are working down the river toward Panama. The third party started southward from Quito last fall, under the leadership of J. M. Miller; but Mr. Miller's health was broken by the climate and he was obliged to return to the United States, leaving Mr. Kelly in charge. The corps has surveyed a distance of 450 miles, and reached the boundary of Peru. They will stretch their chains along the Maranon River to Cero de Pasto, the terminus of the New Orola Railroad, and expect to complete their work in eighteen months. The engineers report that their work has not proved nearly so difficult as was expected. No insurmountable difficulties have been encountered.

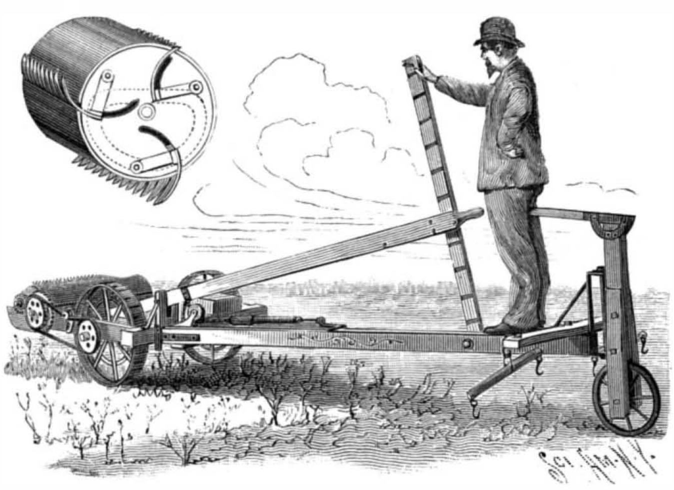
Colima again in Eruption.

A dispatch from the city of Mexico says: Thursday, December 3, was a day of terror in Colima. Between 4 and 5:30 P. M. on that day the volcano of Colima was in a state of violent eruption, and at 8 o'clock that night a heavy shower of ashes began falling upon the city. It lasted over an hour, covering the streets and roofs of buildings and greatly terrifying the inhabitants.

The volcano of Colima, which is in the State of Jalisco, Mexico, is 12,000 feet high, and forms the southwestern extremity of the chain which traverses Mexico from east to west. For forty years it had been inactive, and was supposed to be extinct; but on July 12, 1869, it began to smoke, and a few weeks later to pour forth pumice stone intensely heated, which spread for miles and covered hundreds of acres.

AN IMPROVED WEED PULLER.

A machine designed to pull weeds entirely out of the ground, or to kill them, in case they are well rooted, by stripping off their seeds and leaves, is shown in the illustration, and has been patented by Messrs. John F. F. Gatgens and Robert C. Dowdin, of Central House, Butte County, Cal. It is adapted to be pushed forward by horses attached as indicated in the picture, and a sprocket wheel on the drive wheel is connected to rotate a forward shaft turning in suitable bearings, this shaft having a gear wheel by which is rotated a drum on a shaft turning in bearings on the front end of the main frame. A shifting lever, operating a clutch turning and sliding on the drum shaft, affords the means of readily connecting it with or disconnecting it from the drive wheel. The drum, shown in the small figure, has longitudinal slots in its rim, in each of which moves a comb, the teeth of which are secured to a bar whose ends are formed with trunnions passing through segmental slots in the heads of the drum. The teeth are curved and so pointed that two adjacent teeth form a V-shaped opening into which the stems of the weeds readily pass and are firmly gripped. The outer ends of the trunnions of the teeth-carrying bars have friction rollers traveling in cam grooves of cams bolted to bearings on the front ends of the side beams, and the bars are guided by attached arms pivoted to the inside of the heads at the centers of the segmental slots of the respective trunnions, so that when the drum is revolved the teeth of the several combs are made to project through and be withdrawn into the longitudinal slots in the face of the drum. Each comb is moved to its outermost limit previous to reaching its lowest position, so that the teeth come in contact with the weeds from the rear, but as soon as the comb with the weeds or leaves has reached about a horizontal position, the comb, owing to the action of the cam, commences to recede within the drum, whereby the weeds, seeds, and leaves are pushed off and drop to the ground, the comb again moving outward in the same manner in the further revolution of the drum. Pivoted disks prevent the entry of dust, dirt, etc., to the drum through the segmental slots, and a lever fulcrumed to one of the longitudinal beams facilitates the raising or lowering of the front end of the machine, this lever being held in



GATGENS & DOWDIN'S WEED PULLER.

adjusted position in a suitable vertical rack bar. This machine is said to have given great satisfaction in practical work, being well adapted to pull up or kill weeds in cultivated ground in which the grain has appeared without injury to the grain.

THE self-pouring tea pot, of which we gave an illustration in the SCIENTIFIC AMERICAN, of October 17, 1891, is now made in several elegant forms by Messrs. Paine, Diehl & Co., 1430 South Penn Square, Philadelphia, Pa.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — Frank Vaughan, Elizabeth City, N. C. According to this invention the drawhead is supported to turn on an axis, and has a link and link mortise arranged on different radii, the draw-head being arranged to turn to adjust either the link or the mortise to position to face the meeting drawhead, to receive its own link or to set its link to enter the other mortise. The link may be a hook bar, arrow-head rod, or other suitable construction, and the link-securing pin is pivoted and arranged to close at its opposite end against a shoulder forming a fixed part of the drawhead, or consisting of a spring plate secured to the drawhead, when by depressing the plate the pin is released.

Mechanical Appliances.

BRICK KILN. —John B. Griswold, Zanesville, Ohio. This invention provides for the novel arrangement and connection of kilns in a series, and connecting them to a single stack, in such a manner that the waste heat from a kiln just burned off will be utilized in a green kiln. The improved kiln is also designed to burn brick, tile and similar articles uniformly and of even hardness, by a perfect combustion of the gases and fuel at all times, a large part of the ware being burned by radiated heat before the fire touches it, the ware being protected from direct contact with the fire at its hottest points, thereby preventing it from being blackened or fire-marked.

PRINTERS' SIDE STICK AND QUOIN.— Albert A. Bogen and Robert Nix, New Ulm, Minn. This device consists mainly of two bars having parallel outer sides and connected together by a central casing, the outer bar having its inner side formed with inclines or bevels adapted to be engaged by blocks or wedges mounted to slide between the bars, the wedges being engaged by screw rods revolving in suitable bearings in the casing. The screw rods are revolved through gears by means of a key, whereby the wedges are moved against the bevels of the outer bar to force its outer side in contact with the form, the outer side of the other bar resting against the inside of the chase, or *vice versa*. The device is designed to be simple and durable in construction, and readily manipulated to lock the form firmly in the chase.

COUNTERBALANCE FOR JOURNALS. — William H. Wood, New York City. The journal box fitted to the shaft has a groove for receiving packing, an adjustable packing being fitted to the groove and the shaft, while ducts connected with the groove are supplied with a fluid under pressure, and a duct leads to the space in the journal box within the packing containing fluid under pressure. The invention provides means for opposing the weight or pressure of a shaft on its bearing, or the thrust or pressure of any moving body revolving or sliding in frictional contact with any body, so as to reduce friction between the surfaces to a minimum.

MULTIPLE BUTTON DRILLING MACHINE.—John W. Lewerth, New York City. This is a compact and durable machine by means of which several holes may be drilled simultaneously. A frame having parallel arms is movable to and from a table on which is a button-clamping device, a stud on one of the arms affording a bearing for drill spindles on which are pinions meshing with the teeth of a revoluble sleeve. The frame is raised and lowered to raise and lower the drills in the progress of the work, and motion is given to the sleeve by a belt from any convenient power.

Agricultural.

HAND PLANTER. — Herman Seppmann, South Bend, Minn. This invention provides means whereby two hand planters may be connected, held at a suitable distance apart, and operated to simultaneously plant two hills. A lever is fulcrumed at each side of the center of a horizontal frame connecting the two planters, a spring normally forcing the levers apart, while connecting bars unite them with the operating mechanism of the planters. The operator carries the two levers toward each other, and when they are released they return automatically to their normal position, at one movement the seed being planted in the ground and at the next movement the shoes being charged, so that they may be again operated to plant their respective hills.

WAGON.—Paul H. Munroe, Plainfield, Ill. This is a vehicle especially adapted for farm work, riding and hauling easily and turning in a small space, while it is also provided with adjustable cutters for cutting corn or other produce, the cutters being mounted on the under side of the body near the middle. The wagon also a variety of other novel details.

Miscellaneous.

WELL CASINGS.—Charles C. Chamberlin, Washington, Pa. This invention relates to an apparatus for tightening the joints of casings for oil, gas or water wells after the casing has been jointed and arranged in the well. To the tube is secured a horizontal bearing collar, upon which rests a wheel with upwardly and outwardly inclined periphery, and the wheel and tube are connected by a rope, so that as the wheel revolves the tube is also revolved, tightening the casing. A flange on the lower side of the wheel prevents the rope dropping off, and several coils of rope being passed around the wheel, the rope is passed over and receives power from the power wheel of the derrick.

ELECTRIC METER.—Charles K. Huguet, New Orleans, La. A closed receptacle, to which is attached a pressure gauge, is filled with a suitable electrolytic liquid, and from its bottom projects two stems of a fixed and an adjustable electrode, through which a portion, preferably about one thousandth part, of the whole current may be passed, the solution being thus decomposed and the gas created causing a pressure which is indicated on the pressure gauge, the total pressure, taken in connection with the temperature, showing the proportion of the total current which passes through the shunts on which the meter is placed. A table for measuring ampere hours is also designed for use with the meter.

HOT WATER HEATER. — John Q. A. Gantt and John D. Bloomhardt, Altoona, Pa. This heater has a double-walled fire box with vertical end projections, from which extend upward circulation pipes arranged in a zigzag manner, and connected with a hollow head piece. The coils or circulation pipes are inexpensively made, and the number may be readily added to, to increase the capacity of the heater, which is designed to utilize the heat of the fuel to its fullest extent. The coils, fire box and head piece are all adapted to be inclosed in any common form of casing.

SASH RAIL FASTENER. — George W. Galbreath, Sedalia, Mo. This is a fastener for the meeting rails of sashes, designed to be simple, inexpensive, and of durable construction, in which the locking pawls are gravity pawls, and the fastener may be operated to release the two sashes by the use of one hand, which hand may also be employed for raising the sash. The keeper section consists of a casing having an opening in one side, gravity pawls being eccentrically fulcrumed in the casing, while the bolt section consists of a casing in which a spring-controlled bolt is held to slide, being moved within the casing and out of engagement with the keeper section by a shifting lever.

KNOB ATTACHMENT. — George E. Hamlin, New York City. This invention is an improvement in that class of knob spindles which are made of two parts, in the form of flat bars secured together by a screw. The spindle sections have shoulders adapted to fill cavities in the knob shanks, and the sections are connected by a pin or fastening key, when washers are dropped over the spindle, and roses are attached in the usual manner, concealing the washers and the ends of the door openings. By means of this improvement a quick and effective adjustment is readily obtained of knobs for doors of different thicknesses, the knobs being readily removable as may be desired.

POISE FOR SCALE BEAMS. — Gustav Wilkening, Houston, Texas. This is an improvement for scale beams made smooth on their upper surface for the poise to move on when being adjusted to weigh, the hook carrying the poise having at its upper or nose end an intervening roller supported by pointed screws forming the running bearing, below which projects a front pointer or indicator, while combined with the poise and its suspension hook is a spring arranged to carry the weight. The easy sliding of the poise and hook-carrying roller on the beam are designed to save much time in weighing, and prevent the cutting and marking of the beam.

ALARM GONG. — Vernon T. Lynch, Chicago, Ill. This is a device for use on different types of vehicles, and is also designed for use in connection with cable motor cars, the gong being suspended below the end platform. A bent standard is held within the gong to support a ball in a keeper box in such position that the ball will be repeatedly struck by radial striking arms to sound the gong, on a sleeve being revolved to which the arms are attached, there being on the sleeve a pinion meshing with a toothed sector bar, with which is connected a foot block at the upper end of a radius bar. By placing the foot upon the block and rocking it quickly, the arms strike the block in rapid succession, throwing it against the rim of the gong.

CAKE BAKING PAN. — Mary E. McDaniel, Mineola, Texas. This pan has a lower main section, with flaring side walls and a center tube, and an upper detachable extension chamber having a flat top in which are openings, while above this is a pivoted upwardly dished lid. The circulation of hot air currents within the oven is thus afforded free access to the cake material on its upper surface while lateral draught is cut off, the cake rising within the extension chamber and around the central tube.

MELON CARRIER. — John K. Fler, Leavenworth, Kansas. This device consists of flexible side strands connected by cross plates or bars, with cross handles at the ends, one of the handles being arranged to serve as a hand hold, making a simple and inexpensive carrier, designed especially for carrying watermelons.

DRAUGHT EQUALIZER. — Walter B. Lawrence, Traer, and Frank W. Reisinger, La Porte, Iowa. According to this invention several different whiffletrees are so arranged and connected with levers that an unequal number of horses may be worked on different sides of the pole and still have an equal forward pull upon it. The adjustment of the levers may be made at different points, according to the number and strength of the horses pulling on different sides of the pole, and means are provided for remedying any side draught.

VEHICLE SPRING BRACE.—Sidney J. Graham, Colville, Washington. This invention provides an equalizer block turning upon a stud projecting downward from the seat, and having bores in which turn pins pivotally connected with brackets, which are connected by links with the lower ends of the springs. The improvement is designed to prevent the springs from swaying out of perpendicular, causing the springs to settle in a straight line, and avoiding all side stain, no matter what weight or load is placed on one side of the wagon or one side of the seat.

PAD SCREW FOR HARNESS. — Charles B. Waterhouse, Rising City, Neb. According to this invention the pad screw has a longitudinal perforation which extends through the screw head, then turns outward and vanishes on the threaded shank. A soft metal rod or key is inserted in this perforation, and its inner end engages and locks a nut concealed within the harness pad, the locking key being withdrawn to remove the pad screw.

PHYSICIANS' OPERATING TABLE. — Grant B. Nichols, Wapakoneta, Ohio. The table frame has a horizontal middle part and downwardly inclined end parts, and the table top is made in three sections, of which the middle one is secured to the horizontal part of the frame and the two other parts are hinged on its inclined ends. The table is designed to be readily changed into the desired position to make the patient as comfortable as possible while permitting the surgeon to conveniently perform an operation.

BURIAL APPARATUS. — Murray L. Smith, Smyrna, Ohio. This is a compact and easily handled apparatus to enable undertakers to safely lower a coffin into the grave with but little assistance and without allowing the coffin to slip or fall. The invention provides a novel construction and arrangement of the parts of a folding derrick with cords and windlasses, very light and foldable into small compass to be easily carried upon the hearse.

SUSPENDERS. — Elias H. Lieberthal, Bay City, Mich. According to this invention a slotted metal plate or clamp is concealed within or made to lie flush with the junction piece of the bifurcated end straps, the slot of the plate, through which the main web passes, having teeth to catch but not penetrate the web, whereby the suspenders may be readily lengthened or shortened and a secure hold established, all buckles and projecting parts being dispensed with.

WATCH CHARM DESIGN.—Fayette W. Roe, Omaha, Neb. This design simulates an acorn, at the lower end of the cap of which is a band in which appear abbreviations of the days of the week, while below are vertical panels containing columns of figures, the whole presenting the appearance of an acorn calendar.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

NEW BOOKS AND PUBLICATIONS.

MACHINERY PATTERN MAKING. By P. S. Dingey. 12mo. Pp. 90. 22 plates, cloth. John Wiley & Sons: New York. 1891. Price $2.

This work, which is freely illustrated with 376 figures and many full size profiles of gear wheels, will prove of value to all pattern makers. The processes of making important typical patterns and core boxes are fully described. Great attention is given to the making of patterns for gear wheels, which has always been a stumbling block to pattern makers. For a work of its size it contains a large amount of useful information.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(3916) F. M. A. C. asks: How much smaller than a hair can German silver wire be made? A. Something depends on the size of the hair. We think German silver cannot be drawn finer than the finest hair.

(3917) W. W. P. asks: What is the cause of a telephone magnet producing severe shocks when the wires are touched together and separated, and will continue when the insulated connection or wire is touched to the armature, which also produces a spark? A. The magneto used for signaling on telephone lines produces an alternating current which is capable of giving a strong shock. If the strong current is not traceable to the magneto, your line is probably crossed by a telegraph line or electric light wire.

(3918) R. F. asks what to apply to prints to render them transferable to paper. A. Try either of the following—benzine, alcohol and ammonia, or a strong lather of shaving soap.

(3919) G. H. P. asks: Does the throwing off and on of the current in an incandescent lamp have a tendency to injure it beyond the extent of the burning? If so, why? For instance: Would the burning of a lamp ten times, ten minutes each time, be any more injurious than the burning of the same lamp for one hundred consecutive minutes? A. With reference to the above query, Mr. Edison says that he tested by automatic means the effect upon an incandescent lamp of throwing off and on the current fifty thousand times, and found that it made no difference in the life of the lamp.

(3920) W. O. P. asks how to render drawing paper transparent? A. Use purified benzine for temporary purposes.

(3921) J. S. J. asks how to put a bright polish on a cow horn? A. Scrape the horn with a steel scraper, smooth with very fine emery paper, then with powdered finely pumice stone and water, and finish with rotten stone and oil or water.

(3922) A. D. S. asks: 1. I inclose a sample of powder which is used to make a depolarizing solution for batteries. Will you please inform me what it is, so I can obtain it through our druggists? A. It is potassium nitrate, or saltpeter. 2. How is the proper way to charge and discharge the Leyden jar? I have induction coil that will make 1¼ in. spark, but cannot do anything with the jar? A. To charge a Leyden jar with an induction coil, connect the knob of the jar with one terminal and the outer coating with the other terminal and pass the current until it is charged, and remove while the current is still passing. To discharge, put the knob and outer coating in electrical connection. 3. Why is the change in dates of Easter Sunday? A. Easter corresponds with the Jewish Passover. 4. There is a dead wire here on poles where there are several telegraph wires; one terminal ends outside the office, the other is brought into the office and terminates at the switch board with the free end loose about 8 in.; that wire becomes charged at times so a spark will leap through the insulation if you approach it with the hand. Is it an induced current set up in the wire? A. As regards the wire, it may be in imperfect electric connection with some high tension system, or it may be excited inductively. We should advise its removal unless you are certain that it does not touch any live electric light wire. Do not take sparks from it if there is any danger of such contact existing.

(3923) M. D. writes: May I trouble you to name any literature that may have been published on poisonous decoration of houses, or decorations containing poison, with sources whence it may be obtained? A. See SUPPLEMENT, Nos. 219, 220, 283.

(3924) B. W. A. writes: I have about 30 dwt. of gold filings and clippings in which there is a certain per cent of iron and platinum as well as other dirt. I want to convert this into pure gold. Please give the process and the best way for me to go about it? I have been in the habit of giving my scraps to a refiner, but am not satisfied with my share of metal, as I use nothing less than 18 K. A. By fusion of the metal with borax and sodium nitrate you can get rid of the iron, etc., and have nothing but the precious metals left. It is quite possible that treatment with hot nitric acid will do the same, but if any chloride is present, some of the gold or platinum will be lost. To separate the gold from the platinum, heat for several hours with mercury, and pass the amalgam through a cloth. The gold will go through and the platinum will remain behind. Any adhering amalgam can be removed with more mercury. Distill the mercury from the gold in a retort. Or you may dissolve the precious metals in aqua regia, evaporate almost to dryness, and precipitate the platinum with absolute alcohol and ammonium chloride. The resulting precipitate of ammonio-platinum chloride is filtered out, washed and ignited. The gold is precipitated with solution of ferrous sulphate.

(3925) D. H. writes: I am doubtful about simple electric motor described in Hopkins' "Experimental Science" having power enough to run 16 ft. boat where I want to run it, in Jamaica Bay; the tide in some places runs five miles an hour. Please answer the following questions through Notes and Queries: 1. What power would motor have if made as large again? A. If made double the size linear measurement, it would have eight times the power. If all the parts had double the sectional area, it would have twice the power. 2. How can it be reversed? A. By reversing the current in the field magnet or the armature, but not in both. 3. Will same size wire do for winding field and armature? A. Yes; if used as a series machine. 4. How should it be geared for boat? A. So that the armature will make from four to six revolutions to one of the screw. 5. What kind of storage batteries would be best, and what would they weigh? A. For the machine in its present size, two cells in parallel. The cells weigh about 15 lb. each. 6. How many gravity cells would it take to recharge them, if boat is used two or three times a week and not more than two hours at a time? A. Four cells of gravity to one of storage battery. 7. How many amperes and volts are there to a horse power? A. 746 watts constitute an electrical horse power. A watt is a volt multiplied into an ampere. D. H. adds: I am delighted with Cyclopedia of Notes and Queries; there is more information in it for the money than any book I ever saw.

(3926) E. M. asks how to find the speed of a motor that is too small to run a common speed indicator without reducing its speed to a large extent? A. On the armature shaft place a cardboard disk provided with a circular row of equidistant holes numbering say 10 or 20. Start the motor, blow through the holes with a pipe having a diameter equal to that of the holes. Compare the sound with a sound of the same pitch made by some correctly tuned musical instrument. The number of air puffs per revolution and the number of vibrations required to produce the musical sound will furnish a basis for a tolerably correct estimate of the speed.

(3927) R. E. P. gives the following method of cutting off glass bottles: A fine wire is adjusted by means of a block around the bottle. By passing a current of electricity through the fine wire, it becomes very hot, heating the bottle where separation is desired. If it does not break at once, pour a little water over it.

(3928) J. B.—The two specimens sent are nodules of brown oxide of iron of no commercial value.

(3929) K. J. D. writes: 1. I wish to make a battery such as described in SCIENTIFIC AMERICAN, No. 15, April 11, 1885, page 230, and wish to know if the porous cups used in the Leclanche battery will do for this? A. Yes. 2. If so, should the tin cells be made larger in proportion to the porous cups? A. Yes; it would be better to have them proportionately larger.

(3930) D M. asks: 1. Have you any book or SCIENTIFIC AMERICAN SUPPLEMENT giving directions for making a 4 in. equatorial telescope, similar to the one described in SCIENTIFIC AMERICAN of November 28, 1891? I have an engine screw-cutting lathe, and by buying a compound achromatic lens, I think I can construct a good one. A. We have no instructions for making a 4 in. equatorial telescope. Special instructions are hardly necessary; all that is needed for the equatorial mechanism is the three axes, the ones in altitude and azimuth being at right angles to each other; the one for latitude adjustment being, of course, adjustable. 2. In making the plunge battery described in "Experimental Science," Fig. 394, can I use any other cell than the one described, either glass or porcelain? Would glass fruit jars do, by making plates circular? A. Glass cells can be used to advantage. 3. How much solution would it take for each filling? A. About one gallon per cell. 4. Can I run my lathe with the same swing, 13 in., 8 in. over tool carriage, 43 in. between centers? A. Yes; but you will find it an expensive and troublesome power. Better use a gas or steam engine. 5. In winding field magnet for small Edison dynamo, is the winding all in one piece like a spool, or is it wound like the one in SUPPLEMENT, No. 600? A. All in one piece. 6. Is there, or have any engines been made with a endless cylinder, so that there is not any dead center, like an overshot wheel with a jet of steam on the paddles? A. Yes; but they are not much used.

(3931) D. H. says: I about to build a trunk from my dam to my mill, a distance of about half a mile; the trunk is to be of wood, and will lie about one foot under ground. Can you give me any information as to a method to preserve this trunk. The wood being underground, and filled with water all the time, will naturally decay, and I thought you might be able to tell me some way to prevent this rapid decay to a certain extent. I know you are authority on all such matters, and if you will tell me where I can find something that will give me information in this regard, or if you can help me, it will oblige me greatly. I omitted to state that the trunk will be built of hemlock. A. So long as the trunk is kept filled with water, there will be but little decay. Wooden water pipes buried in the earth and kept filled with water are very enduring—last fifty years and more.

(3932) A. W. asks: Is there any chemical sensitive to the action of gaslight, that is, is there any chemical, perfectly invisible in yellow or red light, which will darken on exposure to the light of a gas jet? I want to prepare the surface of a blank sheet of white paper by tracing or drawing thereon some drawing or picture which will burn and char the surface of the paper, leaving a black design on the paper. I have tried saturating with saltpeter, but it burns the paper through, and is too slow, and have tried a preparation of sugar and chlorate of potash, ¼ chlorate of potash to 1 pint sugar, both pulverized; it will burn a few inches, then go out. I prepared the paper by going over it with mucilage with a camel's hair brush, and carefully dusting over the powder, and have tried making a paste out of the sugar and potash, and painting it on, but it would not work. How can this be done? The powder must be white. I want a chemical, colorless, that will turn black on application of another; for instance, if I draw a design on a sheet of paper with a colorless solution of some chemical I would like to bring it out with another one, and would like to know what will destroy the color then produced. I have a few good receipts on that subject which work very well, but would like to improve. I use chloride of iron and gallic acid, using the acid as the base and the iron as a developer, and can destroy the color with oxalic acid in solution. Now is there any color that oxalic acid will bring out, which chloride of iron will not? The effect I wish to produce is to go over the paper with a colorless solution of two different chemicals, and having two designs or pictures on the paper already prepared, and by going over it with one developer one of the pictures will appear, and then by going over the same paper again with a second developer to bring out the second picture, which has remained invisible, and at the same time destroy the first picture produced. I have come very near accomplishing the above, and can do it with solutions in glasses, but they won't work on paper. A. Perhaps some of our readers can answer the above. Or it may be answers will be found among the twelve thousand receipts given in the "Scientific American Cyclopedia."

(3933) J. M. McC. asks: Can you give me the different processes of testing glass tubes for vacuum? In testing with an induction coil, how can you tell when there is a good vacuum, and when a poor one? What kind of an induction coil should be used? And how many volts should be used? Is there such a thing as a vacuum meter? A. The discharge of an induction coil will not pass through an air-filled tube when the distance between the points is greater than the striking distance of the coil. On exhausting the air, the discharge takes place irregularly and presents a bluish color. As the exhaustion proceeds, the discharge becomes more regular and the color becomes purple. This is about the degree of exhaustion of Geissler tubes. On exhausting still further the tube becomes more luminous and the color is apple green. By carrying the exhaustion as far as possible, the conductivity of the tube is destroyed, and the discharge of the coil will not take place even over a very short distance. Tubes exhausted to this degree are sold as "perfect vacuum" tube. Such tubes are sometimes connected with electric lamp exhausting apparatus to indicate when a high vacuum has been reached. A coil like that described in SUPPLEMENT, No. 160, answers well for vacuum tube work. Vacuum gauges are in common use. They consist simply of an inverted glass siphon of small caliber partly filled with mercury.

(3934) B. J. says: In casting zinc rods 1¼ inches diameter, they in cooling settle down in the center, leaving a hole; how can I avoid this? A. You can make full castings by tipping the moulds at an angle of about 60° and pouring at the top or by a gate running down the side, if you make two rods in a mould. Clamp the moulds with back boards to prevent bursting of the mould by pressure. 2. How to make a saturated solution, as copper sulphate solution; when is it said to be completely saturated? A. The solution will be saturated when no more of the salts can be dissolved. You can keep it saturated by keeping an excess of crystals in the solution.

(3935) I. J. M., Syracuse, says: In one of the streets in this city is laid a water pipe 6 inches in diameter, with a pressure of 25 pounds; there are fire plugs 400 feet apart with 2½ inch discharge gates. Engine No. 1 takes one takes one plug and goes pumping water. Engine No. 2 takes the plug 400 feet nearer the fountain head and also goes to pumping water. There is but water enough for one engine when the pipe is open. There is an elevation of 10 feet between each engine. A claims that engine No. 2 will get the most water if the couplings from engine to plug are tight and don't draw air. B claims that engine No. 1, which is 10 feet lower, will get the most water. Which is right? The water pipe is 5½ feet in the ground. A. Both engines will get water according to their ability to produce a vacuum in their suction pipe. The flow of water will also increase in the main equal to the additional head produced by the suction of both engines. The probability is, with the ordinary hydrant connection at the side of the main, that engine No. 2, next the source of supply, will get the most water.

(3936) L. B. A. asks: Which takes the most fuel, the high speed or slow speed engine, and why? Can a dynamo be run with a slow speed engine by using larger pulley on engine with same efficiency? If not, why? A. The speed is not essential to the economy of steam engines, although some strong claims are made for high speed engines of the automatic class. The best showing of all-round economy comes from speeds of 75 to 120 revolutions for medium size engines. High or low speeds for driving dynamos are both used with special reference to engineering preference, but for large plants the moderate speed engines belted to the dynamos are the most approved for efficiency and economy.

(3937) A. M. asks for the method of making celery totally white by some bleaching process, not blanching. A. There is no method of bleaching green celery. Celery is prevented from turning green by covering the stems with earth as the growth advances.

(3938) F. A. R. asks whether carbons and porous cells of old Leclanche batteries could be used for making Bunsen batteries. A. Yes, after soaking for a few hours in hot water.

(3939) G. C. K. asks: Can a man get more power out of a dynamo than it takes to run it, say supposing it would take 20 horse power to run a dynamo, how much power would I get out of the dynamo? A. Out of 20 horse power put into a dynamo you could get from 75 per cent to 90 per cent.

[Pitman's "Teacher" of Shorthand or Phonography is furnished at 15 cents, *not* 10 cents, as stated in our reply 3858, Jan. 9.—ED.]

Replies to Enquiries.

The following replies relate to enquiries recently published in SCIENTIFIC AMERICAN, and to the number therein given:

(3713) Lime Concrete.—Referring to query 3713, Wm. H. Bond, of Greensboro, Ind., says: I have a story and a half house which was built eight years ago, entirely of gravel and lime, not a particle of cement in it, and seems to-day almost as solid as stone, outside walls 12 inches, and inside 10 inches thick. I used one bushel of lime to fourteen of gravel.

(3715) J. S. J.—Referring to query and answer, No. 3715, about lining butter tubs, would say that some of the best shippers of the finest grades of butter use a paraffine of low melting point on the inside of tub and then cover the top of the butter with a thin coating of the same. This makes an air tight package; melt wax in pail, set in boiling water, and brush on to tub.

W. O. P. asks (1) how to mount drawings. (2) For the composition of pattern maker's varnish.—C. F. C. asks for compounds for boiler incrustation. Also for waterproof glue.—G. D. M. asks how to make transparent soaps.—D. K. T. asks how to make blue prints.—K. L. S. asks how to remove comedones.—J. M. S. asks for an ink eraser.—J. H. T. asks how to make printer's ink.—E. S. asks how to make chewing gum.—H. M. asks how to make a hektograph.—W. H. E. asks how to get rid of red ants.—R. N. S. asks how to make a hektograph, and also how to make hektograph ink.—M. W. C. asks how to make and apply ink to type writer ribbons.—P. P. C. asks for a metal polish.—R. N. S. asks how to make a hektograph and for hektograph ink.—H. W. Z. asks for an elastic cement to cement powdered cork.—G. W. asks how to preserve a bouquet.—E. D. asks how to make glycerine soap.—B. E. H. asks how to make artificial diamonds.—E. B. asks how baking powder is made.—J. C. M. asks for a receipt for making artificial meerschaum.—W. M. asks how to make the hair grow.—W. W. asks for formulas for making good rubber cements.

Answers to all of the above queries will be found in the "Scientific American Cyclopedia of Receipts, Notes and Queries," to which our correspondents are referred. The advertisement of this book is printed in another column.

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January 12, 1892,

AND EACH BEARING THAT DATE.

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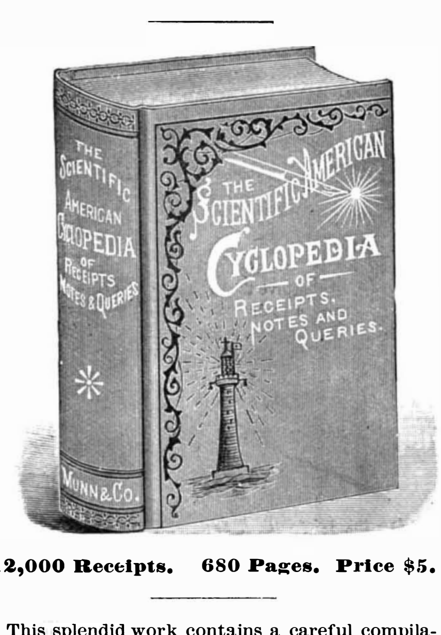

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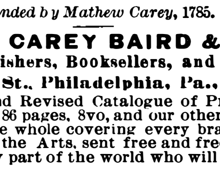

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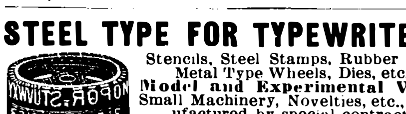

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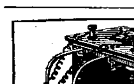

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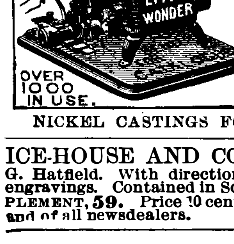

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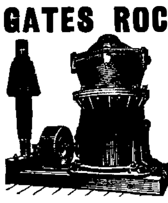

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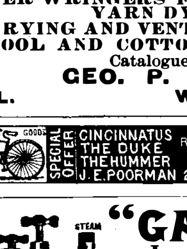

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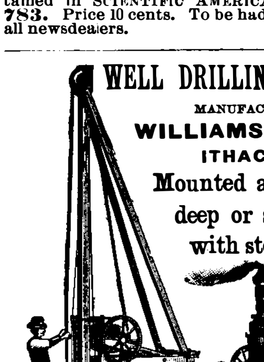

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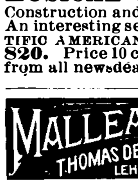

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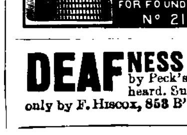

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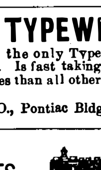

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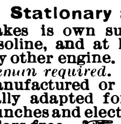

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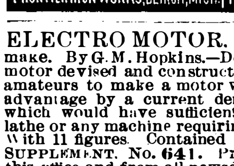

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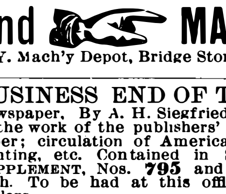

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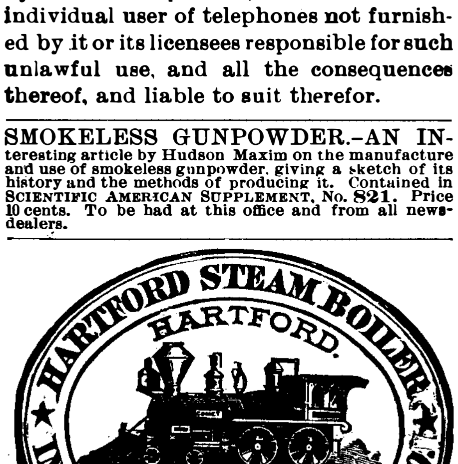

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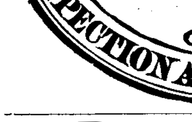

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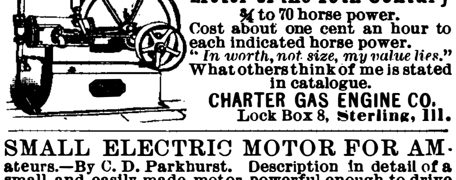

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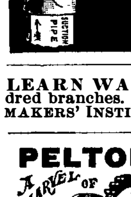

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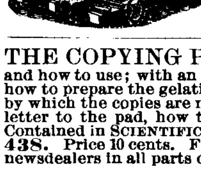

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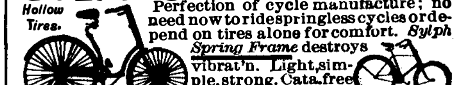

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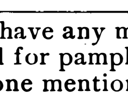

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